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THE

ENCYCLOPÆDIA BRITANNICA

A

DICTIONARY

OF

ARTS, SCIENCES AND GENERAL LITERATURE

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ENCYCLOPÆDIA BRITANNICA.

T

T is the twentieth symbol in our alphabet. It has varied but little in form since the earliest days when it appeared in Greece and Italy, though some of the Italic alphabets exhibit variants: *e.g.*, in Umbrian and Etruscan inscriptions we find the horizontal stroke sometimes on one side only, and slanting; sometimes the form is nearly that of our ordinary small *t* without the ornamental turn at the bottom. In value it has been in all languages a surd or voiceless dental, corresponding to *d*, which is voiced. But the term "dental" includes some varieties of position, of which the most definite are—(1) where the point of the tongue touches the teeth (true "dental"), as in French; (2) where the tongue touches the gum behind the teeth, and not the teeth at all, as in English; (3) where the point of the tongue is slightly bent back against the palate, producing the sound much heard in south India (often called "cerebral"). T when followed by *i* or *y* is liable to pass into the *s*-sound; this happened in the local dialects of Italy before the Christian era; at Rome the transition was later. This changed sound passed on into the Romance languages, *e.g.*, in French "nation," pronounced "nasion," whence in England it was sounded first as "nasiun" and now as "nashun." Similarly in English *t* followed by *u* undergoes a change of sound; this is due, however, to the old sound of *ū*, viz., long French *u*, or Old English *y*. This long *yy* developed into the *iu* sound heard in "use," "cure," &c.; then the new *i* affected the preceding *t*, and the result is *tsh*, as in "nature" (natshure); similarly *d* in "verdure" is sounded as *dzh* (verdzhure).

English employs the digraph *th* to denote two sounds, differing as voiceless and voiced sounds—the initial sounds of "thin" and "then" respectively. It would be a great convenience if *dh* could be used for the voiced sound, so that "then" should be written "dhen." But it would be even better if the single symbols could be employed to denote these single sounds, as was to some extent the case in the earlier days of our language: in Anglo-Saxon we have the two symbols ð and þ. The first is only a *d* crossed; the second was a rune and was called "thorn." These, however, were not consistently employed one for the voiceless and one for the voiced sound; also *th* is actually found in the oldest texts, and later on it occurs together with ð and þ. It is probable that the voiceless sound was originally the only one in Teutonic. It was eventually differentiated into two sounds; but, as is usually the case, writing remained more archaic than speech. In modern English and Icelandic, and probably in the parent Teutonic also, initial *th* is voiceless, except in English in a small number of pronouns and particles in common use, as "thou," "this," "that," "then," "than," "though," "thus"; and it is regularly voiceless when final. The nature of the two sounds is this: the tongue is pressed against the back of the teeth (sometimes, especially when used by foreigners, against the bottom of the upper teeth) and either the breath for *th* or the voice for *dh* is forced through the interstices of the teeth. This pair of sounds is found in modern Greek, where *th* appears as *θ* and *dh* as δ. In Spanish and in Danish under certain circumstances the sound denoted by *d* is *dh*.

TABARÍ AND EARLY ARAB HISTORIANS. Arabian historians differ from all others in the unique form of their compositions. Each event is related in the words of eye-witnesses or contemporaries transmitted to the final narrator through a chain of intermediate reporters (*ráwís*), each of whom passed on the original report to his successor. Often the same account is given in two or more slightly divergent forms, which have come down through different chains of reporters. Often, too, one event or one important detail is told in several ways on the basis of several contemporary statements transmitted to the final narrator through distinct lines of tradition. The writer therefore exercises no independent criticism except as regards the choice of authorities; for he rejects accounts of which the first author or one of the intermediate links seems to him unworthy of credit, and sometimes he states which of several accounts seems to him the best. Modern judgment does not always confirm this choice; some authorities much esteemed by Moslems are by European scholars deemed untrustworthy, and *vice versa*. Fortunately the various historians did not always give preference to the same account of a transaction, and so one supplies what another omits.

A second type of Arabian historiography is that in which an author combines the different traditions about one occurrence into one continuous narrative, but prefixes a statement as to the lines of authorities used and states which of them he mainly follows. In this case the writer recurs to the first method, already described, only when the different traditions are greatly at variance with one another. In yet a third type of history the old method is entirely forsaken and we have a continuous narrative only occasionally interrupted by citation of the authority for some particular point. But the principle still is that what has been well said once need not be told again in other words. The writer therefore keeps as close as he can to the letter of his sources, so that quite a late writer often reproduces the very words of the first narrator.

From very early times the Arabs had great delight in verses and tales, and the development of their language was certainly much influenced by this fact. In ancient times story-tellers and singers found their subjects in the doughty deeds of the tribe on its forays, in the merits of horse or camel, in hunting adventures and love complaints, and sometimes in contests with foreign powers and in the impression produced by the wealth and might of the sovereigns of Persia and Constantinople. The appearance of the Prophet with the great changes that ensued, the conquests that made the Arabs—till then a despised race—lords of half the civilized world, supplied a vast store of new matter for relations which men were never weary of hearing and recounting. They wished to know everything about the apostle of God, whose influence on his own time was so enormous, who had accomplished all that seemed impossible and had inspired the Arabs with a courage and confidence that made them stronger than the legions of Byzantium and Ctesiphon. Every one who had known or seen him was questioned and was eager to answer. Moreover, the word of God in the Koran left many practical points undecided, and therefore it was of the highest importance to know exactly how the Prophet had spoken and acted in various circumstances. Where could this be better learned than at Medina, where he had lived so long and where the majority of his companions continued to live? So at Medina a school was gradually formed, where the chief part of the traditions about Mohammed and his first successors took a form more or less fixed. Soon divers fathers of Islam began to assist memory by making notes, and their disciples sought to take written jottings of what they had heard from them, which they could carry with them when they returned to their homes. Thus by the close of the 1st century many *dictata* were already in circulation. For example, Ḥasan of Baṣra (d. 110 A.H.; 728 A.D.) had a great mass of such notes, and he was accused of sometimes passing off as oral tradition things he had really drawn from books; for oral tradition was still the one recognized authority, and it is related of more than one old scholar, and even of Ḥasan of Baṣra himself, that he directed his books to be burned at his death. The books were mere helps, and what they knew these scholars had handed on by word of mouth. Long after this date, when all scholars drew mainly from books, the old forms were still kept up. Ṭabarí, for example, when he cites a book expresses himself as if he had heard what he quotes from the master with whom he read the passage or from whose copy he transcribed it. He even expresses himself in this wise; "'Omar b. Shabba has related to me in his book on the history of Baṣra."

Historians before Ṭabarí.

Naturally, then, no independent book of the 1st century from the Flight has come down to us. But in the 2d century real books began to be composed. The materials were supplied in the first place by oral tradition, in the second by the *dictata* of older scholars, and finally by various kinds of documents, such as treaties, letters, collections of poetry, and genealogical lists. Genealogical studies had become necessary through 'Omar's system of assigning state pensions to certain classes of persons according to their kinship with the Prophet, or their deserts during his lifetime. This subject received much attention even in the 1st century, but books about it were first written in the 2d, the most famous being those of Ibn al-Kalbí (d. 146 A.H.), of his son Hishám[1] (d. 204), and of Al-Sharḳí ibn al-Ḳoṭámí. Genealogy, which often called for elucidations, led on to history. Beládhorí's excellent *Ansáb al-Ashráf* (Genealogies of the Nobles) is a history of the Arabs on a genealogical plan.

The oldest extant history is the biography of the Prophet by Ibn Isḥáḳ (d. 150). This work is generally trustworthy. Mohammed's life before he appeared as a prophet and the story of his ancestors are indeed mixed with many fables illustrated by spurious verses. But in Ibn Isḥáḳ's day these fables were generally accepted as history—for many of them had been first related by contemporaries of Mohammed—and no one certainly thought it blameworthy to put pious verses in the mouth of the Prophet's forefathers, though, according to the *Fihrist* (p. 92), Ibn Isḥáḳ was duped by others with regard to the poems he quotes.

The *Life* of the Prophet by Ibn 'Oḳba (d. 141), based on the statements of two very trustworthy men, 'Orwa ibn az-Zobair (d. 94) and Az-Zohrí (d.124), seems to be quite lost, Sprenger having vainly made every effort to find a copy. It was still much read in Syria in the 14th century. But we fortunately possess the *Book of the Campaigns* of the Prophet by Al-Wáḳidí (d. 207) and the important *Book of Classes* of his disciple Ibn Sa'd.[3] Wáḳidí had much more copious materials than Ibn Isḥáḳ, but gives way much more to a popular and sometimes romancing style of treatment. Nevertheless he sometimes helps us to recognize in Ibn Isḥáḳ's narrative modifications of the genuine tradition made for a purpose, and the additional details he supplies set various events before us in a clearer light. Apart from this his chief merits lie in his studies on the subject of the traditional authorities, the results of which are given by Ibn Sa'd, and in his chronology, which is often excellent. A special study of the traditions about the conquest of Syria made by De Goeje in 1864 led to the conclusion that Wáḳidí's chronology is sound as regards the main events, and that later historians have gone astray by forsaking his guidance. This result has been confirmed by certain contemporary notices found by Nöldeke in 1874 in a Syriac MS. of the British Museum. And that Ibn Isḥáḳ agrees with Wáḳidí in certain main dates is important evidence for the trustworthiness of the former also. For the chronology before the year 10 of the Flight Wáḳidí did his best, but here, the material being defective, many of his conclusions are precarious. Yet, though we have good ground for doubts, we are seldom able to construct a better chronology. Wáḳidí had already a great library at his disposal. He is said to have had 600 chests of books, chiefly *dictata* written by or for himself, but in part real books by Abú Mikhnaf (d. 130), Ibn Isḥáḳ (whom he uses but does not name), 'Awána (d. 147), and other authors. Abú Mikhnaf left a great number of monographs on the chief events from the death of the Prophet to the caliphate of Walíd II. These were much used by later writers, and we have many extracts from them, but none of the works themselves, except a sort of romance based on his account of the death of Ḥosain, of which Wüstenfeld has given a translation. With regard to the history of ‘Irák in particular he was deemed to have the best lights, and for this subject he is Ṭabarí's chief source, just as Madáiní, a younger contemporary of Wáḳidí, is followed by preference in all that relates to Khorásán. Madáiní's *History of the Caliphs* is the best if not the oldest published before Ṭabarí; but this book has quite disappeared and is known only by the excerpts given by later writers, particularly Beládhorí and Ṭabarí. From these we judge that he had great narrative power with much clear and exact learning, and must be placed high as a critical historian. His plan was to record the various traditions about an event, choosing them with critical skill; sometimes, however, he fused the several traditions into a continuous narrative. A just estimate of the relative value of the historians can only be reached by careful comparison in detail. This has been essayed by Brünnow in his study on the Khárijites (Leyden, 1884), in which the narrative of Mobarrad in the Kámil is compared with the excerpts of Madáiní given by Beládhorí and those of Abú Mikhnaf given by Ṭabarí. The conclusion reached is that Abú Mikhnaf and Madáiní are both well informed and impartial.

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[1] Of Hishám b. al-Kalbí's book there are copies in the British Museum and in the Escorial.

[2] Ibn Isháḳ's original work seems to be still extant in the Köprülü library at Constantinople; the edition of it by Ibn Hishám has been edited by Wustenfeld (Göttingen, 1858-60) and translated into German by Weil (Stuttgart, 1864).

[3] Wákidí has been edited from an imperfect MS. by Kremer (Calcutta, 1856). A condensed translation by Wellhausen appeared in 1882. The great book of Ibn Sa'd is unpublished, but there are some useful papers on it by Loth.

Among the contemporaries of Wáḳidí and Madáiní were Ibn Khidásh (d. 223), the historian of the family Mohallab, whose work was one of Mobarrad's sources for the *History of the Khárijites*; Haitham ibn ‘Adí (d. 207), whose works, though now lost, are often cited; and Saif ibn ‘Omar at-Tamímí, whose book on the revolt of the tribes under Abúbekr and on the Mohammedan conquests was much used by Ṭabarí. Saif, however, seems to have been little esteemed; Beládhorí very seldom cites him, and nothing can be found in Arabic literature about his life and those of his authorities. He is barely mentioned in the *Fihrist*, the writer plainly having nothing to tell of him, and blundering in the one thing he does say by representing his disciple Sho‘aib as his master. Hájji Khalífa knows nothing but his name. His narratives are detailed and often tinged with romance, and he is certainly much inferior to Wáḳidí in accuracy. Besides these are to be mentioned Abú ‘Obaida (d. 209), who was celebrated as a philologist and wrote several historical monographs that are often cited, and Azraḳí, whose excellent *History of Mecca* was published after his death by his grandson (d. 244). With these writers we pass into the 3d century of Islam. But we have still an important point to notice in the 2d century; for in it learned Persians began to take part in the creation of Arabic historical literature. Ibn Moḳaffa‘ translated the great *Book of Persian Kings*, and others followed his example. Ṭabarí and his contemporaries, senior and junior, such as Ibn Ḳotaiba, Ya‘ḳúbí, Dínawarí, preserve to us a good part of the information about Persian history made known through such translations.[1] But even more important than the knowledge conveyed by these works was their influence on literary style and composition. Half a century later began versions from the Greek either direct or through the Syriac. The pieces translated were mostly philosophical; but the Arabs also learned something, however superficially, of ancient history.

The 3d century was far more productive than the 2d. Abú ‘Obaida was presently succeeded by Ibn al-A‘rábí (d. 231), who in like manner was chiefly famous as a philologist, and who wrote about ancient poems and battles. Much that he wrote is quoted in Tabrízí's commentary on the *Ḥamása*, which is still richer in extracts from the historical elucidations of early poems given by Ar-Riyáshí (d. 257). Of special fame as a genealogist was Ibn Ḥabíb (d. 245), of whom we have a booklet on Arabian tribal names published by Wüstenfeld (1850). Azraḳí again was followed by Fákihí, who wrote a *History of Mecca* in 272,[2] and ‘Omar b. Shabba (d. 262), who composed an excellent history of Baṣra, known to us only by excerpts. Of the works of Zobair b. Bakkár (d. 256), one of Ṭabarí's teachers, a learned historian and genealogist much consulted by later writers, there is a fragment in the Köprülü library at Constantinople, and another in Göttingen, part of which has been made known by Wüstenfeld (*Die Familie Al-Zobair*, Göttingen, 1878). Ya‘ḳúbí or Ibn Wáḍiḥ wrote a short general history of much value, published by Houtsma (Leyden, 1883). About India he knows more than his predecessors and more than his successors down to Bérúní. Ibn Khordádbeh's historical works are lost. Ibn ‘Abdalḥakam (d. 257) wrote of the conquest of Egypt and the West. Extracts from this book are given by De Slane in his *Histoire des Berbères*, and others by Karle and Jones, from which we gather that it was a medley of true tradition and romance, and must be reckoned, with the book of his slightly senior contemporary, the Spaniard Ibn Ḥabíb, to the class of historical romances (see below, p. 5). A high place must be assigned to the historian Ibn Ḳotaiba (d. 276), who as Rosen has well shown, wrote a series of books with a view to raising the scholarship of the large class of *kátibs* or official scribes. To this series belong his very useful *Handbook of History* (ed. Wüstenfeld, Göttingen, 1850) and his *‘Oyún al-Akhbár*, though the latter book according to the arrangement falls rather under the class of *litteræ humaniores*. Much more eminent is Beládhorí (d. 279), whose book on the Arab conquest (ed. De Goeje, Leyden, 1865-66) merits the special praise given to it by Mas‘údí. Of his great *Ansáb al-Ashráf* a large part exists at Paris in the valuable collection of M. Schefer and another part was published by Ahlwardt in 1884. A contemporary, Ibn abí Ṭáhir Taifúr (d. 280), wrote on the ‘Abbásid caliphs and was drawn on by Ṭabarí. The sixth part of his work is in the British Museum. Of the universal history of Dínawarí (d. 282), entitled *The Long Narratives*, an edition by Girgas is now (1887) in the press.

Ṭabarí.

All these histories are more or less thrown into the shade by the great work of Ṭabarí, whose fame has never faded from his own day to ours, and who well deserves to have this article on early Arabic histories placed under his name. Abú Ja‘far Mohammed b. Jarír aṭ-Ṭabarí (so his full name runs) is described as a tall lean figure, with large eyes, brown complexion, and hair which remained black till his death. His learning was astounding and few could speak so well. Born 224 A.H. (838-9 A.D.) at Amol in Ṭabaristán, he came to Baghdad as a young man and heard there the most famous teachers of the age. He travelled through Syria and Egypt (where he was in 263), and finally settled down in Baghdad, where he remained till his death in 310 (922 A.D.), always active and surrounded by pupils. He is said to have written forty pages daily for forty years. This no doubt is an exaggeration, but certainly he must have been a man of most persistent industry. His two chief works are a great *Commentary on the Koran* and his *Annals*. There is an anecdote to the effect that each originally filled 30,000 leaves, but that his pupils found them too extensive to be written to his dictation, and that he then resolved to condense them to a tenth of their original size, exclaiming, "God help us! Ambition is extinct." One cannot say how far this story is true, but it is probable enough that his materials, at least for the *Annals*, were many times greater than the book itself.

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[1] For details see the introduction to Noldeke's excellent translation of Tabari's *History of the Persians and Arabs in the Sasanian Period*, Leyden, 1879.

[2] Published in excerpt by Wüstenfeld along with Azraḳí, Leipsic, 1857-59.

Where the same topic comes up in the *Annals* and in the *Commentary* we often find different traditions quoted, or the same tradition derived through different channels, and this shows the copious variety of his sources. Various parts of the *Annals* give the impression of being condensed. The *Commentary* was published before the *Annals*, and is better composed. It is the head corner-stone of Koran exegesis, as the *Annals* are of historiography. It came into general use mainly through the abridgment of Baghawí in the beginning of the 6th century of the Flight, being itself too large to be much read. The great book exists complete in the viceregal library at Cairo, and ought to be published at once.[1]

The *Annals* are a general history from the creation to 302 A.H., and are in the course of publication at Leyden. They will fill some 7000 to 7500 pages, one and a half printed pages corresponding roughly to one leaf of Ṭabarí's original MS. Tabarí added a supplement about his authorities, an abridgment of which is to follow the Leyden edition. It contains biographical notices of traditionalists, contemporaries of Mohammed, and their successors to the second half of the 2d century.[2] Other works by Ṭabarí will be spoken of in detail in the preface to the Leyden edition.

The success of the *Annals* and *Commentary* was due above all to the author's personality. The respect paid to him by his contemporaries appears in various anecdotes preserved in his biography. His pupils had an unbounded admiration for his extraordinary knowledge, and what he said seemed to them the best that could be said. In truth, both his great works were the best of their kind, especially the *Commentary*, which, in the judgment of all impartial critics, has not been equalled, before or since, in completeness, learning, and independent judgment. A contemporary says that "it would be worth a journey to China to procure the book." So general was this view that the opinion of Ṭabarí was quoted as a legal authority.

The inferiority of the *Annals* as a literary composition may be due partly to the author's years, partly to the inequality of his sources, sometimes superabundant, sometimes defective, partly perhaps to the somewhat hasty condensation of his original draft. Nevertheless the value of the book is very great: the author's selection of traditions is usually happy, and the episodes of most importance are treated with most fulness of detail, so that it deserves the high reputation it has enjoyed from the first. This reputation rose steadily; there were twenty copies (one of them written by Tabarí's own hand) in the library of the Fátimite caliph 'Azíz (latter half of the 4th century), whereas, when Saladin became lord of Egypt, the princely library contained 1200 copies (Makrízí, i. 408 *sq.*). Only princes and rich men could own a book which in the time of 'Azíz cost one hundred dinars. We know that it had a place in most great libraries in other countries, for we find that it was used in all lands. Thus the fact that no complete copy can now be found anywhere, and that the Leyden edition rests on odd volumes lying in various places, gives a striking image of what the East has suffered from barbarism.

The *Annals* soon came to be dealt with in various ways. They were published in shorter form with the omission of the names of authorities and of most of the poems cited; some passages quoted by later writers are not found even in the Leyden edition. On the other hand, some interpolations took place, one in the author's lifetime and perhaps by his own hand. Then many supplements were written, *e.g.*, by Ferghání (not extant) and by Hamadhání (partly preserved in Paris). 'Aríb of Cordova made an abridgment, adding the history of the West and continuing the story to about 365.[3] Ibn Mashkawaih wrote a history from the creation to 369 A.H., with the purpose of drawing the lessons of the story, following Ṭabarí closely, as far as his book is known, and seldom recurring to other sources before the reign of Moktadir; what follows is his own composition, and shows him to be a writer of talent.[4] In 352 an abridgment of the *Annals* was translated into Persian by Bal'amí, who, however, interwove many fables.[5] Ibn al-Athír (d. 630) abridged the whole work, usually with judgment, but sometimes too hastily. Though he sometimes glided lightly over difficulties, his work is of service in fixing the text of Tabarí. He also furnished a continuation to the year 620. Later writers took Ṭabarí as their main authority, but fortunately sometimes consulted other sources, and so add to our knowledge,—especially Ibn al-Jauzí (d. 597), who adds many important details. These later historians had valuable help from the biographies of famous men and special histories of countries and cities, dynasties and princes, on which much labour was spent from the 4th century onwards.

Historians after Ṭabarí.

The chief historians after Tabarí may be briefly mentioned in chronological order. Rází (d. 325) wrote a *History of Spain*; Eutychius (d. 328) wrote *Annals* (published by Pocock, Oxford, 1656), which are very important because he gives the Christian tradition; Ibn 'Abd Rabbihi (d. 328) has very valuable historical passages in his famous miscellany called *Al-'Iḳd al-Faríd* (3 vols., Cairo, 1293 A.H.); Ṣúlí (d. 335) wrote on the 'Abbásid caliphs, their viziers and court poets; Mas'údí (see MAS'ÚDY) composed various historical and geographical works (d. 345). Of Tabarí's contemporary Hamza Ispahání we have the *Annals* (published by Gottwaldt, St. Petersburg, 1844); Abu 'l-Faraj al-Ispahání (d. 356) in his *Book of Songs* (*Kitáb al-Aghání*, 20 vols., Cairo, 1285) gave the lives of poets whose songs were sung; Ibn al-Ḳútiya (d. 367) wrote a *History of Spain*; Ibn Zúlák (d. 387) a *History of Egypt*; 'Otbi wrote the *History of Mahmúd of Ghazna* (d. 421), at whose court he lived (printed on the margin of the Egyptian edition of Ibn al-Athír); Tha'labí (d. 427) wrote a well-known *History of the Old Prophets*; Abú No'aim al-Ispahání (d. 430) wrote a *History of Ispahan*, chiefly of the scholars of that city; Tha'alibí (d. 429 or 430) wrote, *inter alia*, a well-known *History of the Poets of his Time*, now (1887) in course of publication at Damascus. Bèrúní (d. 440) takes a high place among historians by his *Chronology of Ancient Nations* (ed. Sachau, Leipsic, 1878; Eng. trans., London, 1879) and his contributions to the history of India and Khwárizm; Koḍá'í (d. 454) wrote a *Description of Egypt* and also various historical pieces, of which some are extant; Ibn Ṣá'id of Cordova (d. 462) wrote a *View of the History of the Various Nations*. Baghdad and its learned men found an excellent historian in Al-Khatíb al-Baghdádí (d. 463), and Spain in Ibn Hayán (d. 469), and half a century later in Ibn Khakán (d. 529) and Ibn Bassám (d. 542). Sam'ání (d. 562) wrote an excellent book on genealogies; Ibn 'Asákir (d. 571) a *History of Damascus and her Scholars*, which is of great value, and exists in whole or in part in several libraries. The *Biographical Dictionary* of the Spaniard Ibn Pascual (d. 578) and that of Dabbí, a somewhat junior contemporary, are edited in Codera's *Bibliotheca Arab. Hisp.* (1883-1885); Saladin found his historian in the famous 'Imád addín (d. 597). Ibn al-Jauzí, who died in the same year, has been already mentioned. Abdalwáhid's *History of the Almohades*, written in 621, was published by Dozy (2d ed., 1881). The geographer Yákút (d. 626) wrote also some historical works, now lost. Abdallatíf (d. 629) is known by his writings about Egypt (trans. De Sacy, 1810); Ibn al-Athír (d. 630) wrote, in addition to the *Chronicle* already mentioned, a *Biographical Dictionary of Contemporaries of the Prophet*. Kiftí (d. 646) is especially known by his *History of Arabic Philologists*. Sibt ibn al-Jauzí (d. 654), grandson of the Ibn al-Jauzí already mentioned, wrote a great *Chronicle*, of which much the larger part still exists. Codera has edited (Madrid, 1886) Ibn al-'Abbár's (d. 658) *Biographical Lexicon*, already known by Dozy's excerpts from it. Ibn al-'Adím (d. 660) is famed for his *History of Aleppo*, and Abú Sháma (d. 665) wrote a well-known *History of Saladin and Nureddin*, taking a great deal from 'Imád addin. A. Muller has recently published (1885) Ibn abi Osaibia's (d. 668) *History of Physicians*. The *History* of Ibn al-'Amid (d. 675), better known as ELMACIN (*q.v.*), was printed by Erpenius in 1625. Ibn Sa'id al-Maghribí (d. 673 or 685) is famous for his histories, but still more for his geographical writings. The noted theologian **NAWAWÍ** (*q.v.*; d. 676) wrote a *Biographical Dictionary of the Worthies of the First Ages of Islam*. Pre-eminent as a biographer is Ibn Khallikán (d. 681), whose much-used work was partly edited by De Slane and completely by Wüstenfeld (1835-40), and translated into English by the former scholar (4 vols., 1843-71).

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[1] See the excellent article by Loth in *Z.D.M.G.*, xxxv. 588 *sq.*

[2] The MS. containing this abridgment is described by Loth in *Z.D.M.G.*, xxxii. 581 *sq.* It is now in the British Museum.

[3] Of this work the Gotha library has a portion containing 290-320 A.H., of which the part about the West has been printed by Dozy in the *Bayán*, and the rest is to be published at Leyden.

[4] A fragment (198-251 A.H.) is printed in De Goeje, *Fragm. Hist. Ar.*, vol. ii., Leyden, 1871. Schefer possesses an excellent MS. of the years 249-316; Oxford has another fragment, 345-360 A.H.; the second part is in the Escorial.

[5] The first part was rendered into French by Dubeux in 1836. We have now an excellent French translation by Zotenberg, 1874.

Abu 'l-Faraj, better known as Bar-Hebræus (d. 685), wrote besides his Syriac *Chronicle* an Arabic *History of Dynasties* (ed. Pocock, Oxford, 1663). Ibn 'Adhárí's *History of Africa and Spain* has been published by Dozy (2 vols., Leyden, 1848-51), and the *Kartás* of Ibn abí Zar' by Tornberg (1843). One of the best known of Arab writers is Abulfeda (d. 732), whose *Annales Muslemici* were published with a Latin version by Reiske (Copenhagen, 5 vols. 4to, 1789-94). The *History of the Time before Mohammed* has been published by Fleischer (1831). Not less famous is the great *Encyclopædia* of his contemporary Nowairí (d. 732), but only some extracts are as yet in print. Ibn Sayyid an-Nás (d. 734) wrote a full biography of the Prophet; Mizzí (d. 742) an extensive work on the men from whom traditions have been derived. We still possess, nearly complete, the great *Chronicle* of Dhahabí (d. 748), a very learned biographer and historian. A complete edition of the geographical and historical *Masálik al-Abṣár* of Ibn Faḍlalláh (d. 749) is much to be desired. It is known at present by extracts given by Quatremère and Amari. Ibn al-Wardí (d. 749 or 750), best known by his *Cosmography*, wrote a *Chronicle* which has been printed in Egypt. Safadí (d. 764) got a great name as a biographer. Yáfi'í (d. 768) wrote a *Chronicle of Islam* and *Lives of Saints*. Sobkí (d. 771) published *Lives of the Theologians of the Sháfi'ite School*. Of Ibn Kathír's *History* the greatest part is extant. For the history of Spain and the Maghrib the writings of Ibn al-Khatíb (d. 776) are of acknowledged value. Another history, of which we possess the greater part, is the large work of Ibn al-Forát (d. 807). Far superior to all these, however, is the famous Ibn Khaldún (d. 808), who proves himself a great thinker in the *Prolegomena to his Universal History*. Of the *Prolegomena* there are an edition by Quatremère (1858) and a French version by De Slane (1863). The latter scholar also published text and version of the *History of the Berbers*, and there is a poor Egyptian edition of the whole work. Of the historical works of the famous lexicographer Fírúzábádí (d. 817) only a *Life of the Prophet* remains. MAKRIZI (d. 845) is spoken of in a separate article; Ibn Hajar (d. 852) is best known by his *Biographical Dictionary of Contemporaries of the Prophet*, now in course of publication in the *Bibliotheca Indica*. Ibn 'Arabsháh (d. 854) is known by his *History of Timúr* (Leeuwarden, 1767). 'Ainí (d. 855) wrote a *General History*, still extant. Abu 'l-Mahásin (d. 874) wrote at length on the history of Egypt; the first two parts have been published by Juynboll. Flugel has published Ibn Kotlubogha's *Biographies of the Ḥanafite Jurists*. Ibn Shihna (d. 890) wrote a *History of Aleppo*. Of Sakhawí we possess a bibliographical work on the historians. The polymath Soyúṭí (d. 911) contributed a *History of the Caliphs* and many biographical pieces. Samhúdí's *History of Medina* is known through the excerpts of Wüstenfeld (1861). Ibn Iyás (d. 930) wrote a *History of Egypt*, and Diyárbekrí (d. 966) a *Life of Mohammed*. To these names must be added MAKKARI (*q.v.*) and Hajji Khalífa, the famous Turkish bibliographer (d. 1068), who, besides his *Bibliographical Lexicon* and his well-known geography, the *Jihán-numa*, wrote histories, mostly in Turkish. He made use of European sources, and with him Arabic historiography may be said to cease, though he had some unimportant successors.

A word must be said of the historical romances, the beginnings of which go back to the first centuries of Islam. The interest in all that concerned Mohammed and in the allusions of the Koran to old prophets and races led many professional narrators to choose these subjects in place of the doughty deeds of the Bedouins. The increasing veneration paid to the Prophet and love for the marvellous soon gave rise to fables about his childhood, his visit to heaven, &c., which have found their way even into sober histories, just as many Jewish legends told by the converted Jew Ka'b al-Aḥbár and by Wahb ibn Monabbih, and many fables about the old princes of Yemen told by 'Abíd, are taken as genuine history (see, however, Mas'údí, iv. 88 *sq.*). A fresh field for romantic legend was found in the history of the victories of Islam, the exploits of the first heroes of the faith, the fortunes of 'Alí and his house. Even under the first Omayyads there were in the mosques of most great cities preachers who edified the people by stories about Islam and its victories, and there is ample evidence that these men did not stick to actual fact. Sho'ba said of them "they get from us a handbreadth of tradition and make it an ell." Then, too, history was often expressly forged for party ends. The people swallowed all this, and so a romantic tradition sprang up side by side with the historical, and had a literature of its own, the beginnings of which must be placed as early as the second century of the Flight. The oldest samples still extant are the fables about the conquest of Spain ascribed to Ibn Habíb (d. 238), and those about the conquest of Egypt and the West by Ibn 'Abdalhakam (d. 257). In these truth and falsehood are mingled, as Dozy has shown in his *Recherches*. But most of the extant literature of this kind is, in its present form, much more recent; *e.g.*, the *Story of the Death of Hosain* by the Pseudo-Abú Mikhnaf (translated by Wüstenfeld); the *Conquest of Syria* by Abú Ismá'íl al-Baçri (edited by Nassau Lees, Calcutta, 1854, and discussed by De Goeje, 1864); the Pseudo-Wákidí (see Hamaker, *De Expugnatione Memphidis et Alexandriæ*, Leyden, 1835); the Pseudo-Ibn Kotaiba (see Dozy, *Recherches*); the book ascribed to A'sam Kúfí, &c. Further inquiry into the origin of these works is called for, but some of them were plainly directed to stir up fresh zeal against the Christians. In the 6th century some of these books had gained so much authority that they were used as sources, and thus many untruths crept into accepted history. (M. J. DE G.)

TABERNACLE, the portable sanctuary of Israel in the wilderness wanderings. Critical analysis of the PENTATEUCH (*q.v.*) teaches us to draw a sharp line between the old notices of the tabernacle contained in the pre-Deuteronomic history book (JE) and the account given by the post-exilic priestly narrator. The latter throws back into the time of Moses the whole scheme of worship and ritual of which the second temple was the centre, and, as this scheme necessarily implies the existence of an elaborate sanctuary on the pattern of the temple, he describes a tabernacle of extraordinary splendour pitched in the middle of the camp, with an outer and inner chamber and a court-yard, and all the apparatus of sacrificial and atoning ritual, just as in the temple, only constructed of boards, posts, and curtains so that it could be taken down and moved from place to place. The whole description is ideal, as appears not only from the details but from the fact that the old history knows nothing of such a structure. The Chronicler indeed, who had before him the Pentateuch in its present shape, assumes that after the Israelites entered Canaan the tabernacle continued to be the one legitimate place of sacrifice until it was superseded by Solomon's temple, and represents it as standing at Gibeon in the days of David and his son (1 Chron. xxi. 29 *sq.*; 2 Chron. i. 3). But the book of Kings knows Gibeon only as "the greatest high place" (1 Kings iii. 4).[1]

Again, the tabernacle of the Priestly Code is pre-eminently the sanctuary of the ark, bearing the name *mishkan ha eduth*, "the tabernacle of the testimony," *i.e.*, the habitation in which lay "the ark of the testimony" or chest containing the stones on which the decalogue was inscribed. But between Joshua's days and the building of the temple the ark migrated from one tent or habitation to another (2 Sam. vii. 6; 1 Chron. xvii. 5), and at Shiloh it was housed not in a tent but in a temple (1 Sam. iii. 3, 15). And, while in the Priestly Code the tabernacle is the only legitimate sanctuary and its priests are the only legitimate priests, the whole history shows that no such restriction was even thought of till after the time of the prophet Isaiah.

With all this it agrees that the oldest parts of the Pentateuch speak indeed of a tabernacle, but one of a quite different kind. The tabernacle of the Elohist (for of the two narratives—Elohistic and Jahvistic—which are combined in the so-called Jehovistic history only the former seems to mention it) is a tent which Moses pitched outside the camp (Exod. xxxiii. 7 *sq.*), and where Jehovah was wont to reveal Himself to him in the pillar of cloud, which descended for the purpose and stood at the door (Num. xi. 25; xii. 5; xiv. 10); it is therefore called *ōhel mō'ēd*, "the tent of tryst." No description of it is given, nor is its origin spoken of but something of the old narrative has obviously been lost before Exod. xxxiii. 7, and here what is lacking was probably explained. It appears, however, that it was very different from the tabernacle described by the priestly narrator. It was not in the centre of the camp but stood some distance outside it,[1] and it was not the seat of an elaborate organization of priests and guarded by a host of Levites, but had a single minister and custodian, viz., Joshua, who was not a Levite at all but Moses' attendant (Exod. xxxiii. 11).

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[1] Two passages in the old history, which comprises the books of Judges, Samuel, and Kings, speak of the tabernacle (*ōhel mō'ēd*); but external and internal evidence show them to be interpolated (1 Sam. ii. 22; 1 Kings viii. 4).

The existence of such a simple tent sanctuary presents none of the difficulties that beset the priestly narrative. Portable shrines were familiar to Semitic antiquity, and tents as sanctuaries were known to the Israelites in much later times at the high places and in connexion with irregular worships (Ezek. xvi. 16, "thou didst take of thy garments and madest for thyself sewn high places," *i.e.*, shrines of curtains sewn together; 2 Kings xxiii. 7, where for "hangings for the grove" read "tents for the Ashera": comp. Hos. ix. 6 and Syriac *prakk*, Assyrian *parakku*, a small chapel or shrine, from the same root as Hebrew *pārōketh*, the vail of the Holy of Holies). Such idolatrous tabernacles were probably relics of the usages of the nomadic Semites, and it is only natural that Israel in its wanderings should have had the like. And it is noteworthy that the portable chapels of the heathen Semites were mainly used for divination (comp. *Journ. of Philol.*, xiii. 283 *sq.*), just as the Mosaic tabernacle is described by the Elohist not as a place of sacrifice (such as the tabernacle of the Priestly Code is) but as a place of oracle.

The heathen shrines of this sort contained portable idols or baetylia (see Selden, *De Diis Syriis*, i. 6); but what the Mosaic tabernacle contained is not expressly told. The ordinary and seemingly the easiest assumption is that the ark stood in it, and Deut. x. 1 *sq.*, which must be drawn from the lost part of the older narrative already alluded to, certainly places the construction of the ark, to contain the tables of stone, just before the time when the tabernacle is first mentioned by the Elohist. But neither in Deuteronomy nor before it are the ark and the tabernacle ever mentioned together, and of the two old narrators it is not clear that the Jahvist ever mentions the tabernacle or the Elohist the ark. The relation between the two calls for further investigation, especially as the ark retains its importance after the occupation of Canaan, while the "tent of tryst" is not mentioned after the time of Moses, who, according to the Elohist (Exod. xii.), enjoyed at it a privilege of direct access to the Deity not accorded to later prophets.

TABERNACLES, Feast of. The original character of this Hebrew feast, celebrated at the close of the agricultural year as a thanksgiving for the produce of the seasons, but especially for the vintage and olive harvest, has been explained in Pentateuch, vol. xviii. p. 511. As such it is described in the old law of Exod. xxiii. 16, under the name of "the feast of ingathering, at the end of the year" (which, in the old Hebrew calendar, ran from autumn to autumn), "when thou hast gathered in thy labours out of the field" (comp. Exod. xxxiv. 22). The same feast is spoken of in Deut. xvi. 13 as "the feast of booths" (E.V. "tabernacles," whence the current name of the feast), when "thou hast gathered in thy corn and wine" from the corn-floor and the wine-press. No explanation is here given of the name "feast of booths"; but after the exile it was understood that during this feast the people assembled at Jerusalem were to live in booths constructed of branches of trees (Lev. xxiii. 39 *sq.*; Neh. viii. 14 *sq.*). The passage in Nehemiah, describing the celebration of the feast in 444 B.C., serves as a commentary on the post-exilic law in Leviticus, and from it we learn that the use of booths on that occasion had no foundation in traditional usage, but was based directly on the law, which then for the first time became generally known.[2] According to the law in question, the booths were to be a memorial of the wilderness wandering (Lev. xxiii. 43), but of this there is no hint in Deuteronomy; and, while it is quite in the style of the later law to attach a new historical reference to an old name like "feast of booths," it is certain from Exodus that the feast had originally agricultural and not historical significance. As such it is exactly parallel to the vintage feasts of other ancient nations, *e.g.*, to the Athenian Oschophoria. And, in particular, it is noteworthy that in Judges ix. 27 we find a vintage feast at Shechem among the Canaanites, from whom the Israelites first learned the ways of agricultural life, and from whom so much of the popular religion was copied. To acts of worship nominally addressed to Jehovah, but really to the Canaanite Baalim, Hosea expressly reckons rites celebrated "on all cornfloors" (ix. 1), expressing thanks for divine gifts of corn, wine, and oil (ii. 8 *sq.*), and in their context these allusions leave no doubt that the prophet refers, in part at least, to autumn feasts, in which Jehovah worship was mingled with Canaanite elements (comp. Wellhausen, *Prol. zur Gesch. Isr.*, cap. 3, ii.; Eng. trans., p. 92 *sq.*). These feasts were local in character, but in northern Israel there was a great autumn feast at the royal sanctuary at Bethel (1 Kings xii. 33), as even in the days of Solomon there was such a feast at Jerusalem (1 Kings viii. 2). In the nature of things the local feasts were the older, and it was the fame of great shrines that gradually tended to draw worshippers from a distance to temples like those of Jerusalem and Bethel. Finally, the Deuteronomic law of the one sanctuary and the course of events which made that law the practical rule of the remnant of Israel put an end to all local religious feasts, but at the same time obscured the old significance of the festal cycle, and made room for the historical interpretation of the celebrations, now concentrated at the temple, which prevailed among the later Jews (comp. Passover and Pentecost). In their later form all the yearly feasts have exact times and rules. In Deuteronomy the autumn feast is not yet tied to a day—it could hardly be so while it was still essentially a harvest thanksgiving—but in the priestly legislation it is fixed to commence on the fifteenth day of the seventh month (Lev. xxiii. 34). In Deuteronomy the feast lasts seven days; Lev. xxiii. 36 adds an eighth, and this day ultimately became the most important (John vii. 37).

* If we accept the conclusion that the autumn festival was originally a vintage feast celebrated in local sanctuaries, the name "feast of booths" admits of a natural explanation. The Canaanite feast at Shechem and the Hebrew feast at Shiloh (Judges xxi. 21) were partly celebrated abroad in the vineyards, and Hosea also knows such feasts on the open corn-floors. That it was usual to go forth and live in booths during the vintage may be concluded from Isa. i. 8; the same practice still prevails at Hebron (Robinson, *Bibl. Res.*, ii. 81). If it was these booths erected among the vineyards that originally gave their name to the feast, we can understand how the book of Nehemiah recognizes the erection of booths within the city of Jerusalem as an innovation. No doubt at all feasts where there was a great concourse of visitors many would be compelled to live in tents; this seems to have been the case even in old Israel (Hos. xii. 9). But that is quite a different thing from the later observance, in which booths or bowers had to be made and used even by those who had houses of their own.

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[1] In old Israel the sanctuary, after the people had settled down in cities, usually stood outside the town, and this was the case even with the temple at Jerusalem when it was first built.

[2] The expression that the Israelites had not done so since the days of Joshua means that there was no recollection of their having ever done so; for of course it is assumed that Joshua carried out every direction of the law.

TABLES, MATHEMATICAL. In any table the results tabulated are termed the "tabular results" or "respondents," and the corresponding numbers by which the table is entered are termed the "arguments." A table is said to be of single or double entry according as there are one or two arguments. For example, a table of logarithms is a table of single entry, the numbers being the arguments and the logarithms the tabular results; an ordinary multiplication table is a table of double entry, giving *xy* as tabular result for *x* and *y* as arguments. The intrinsic value of a table may be estimated by the actual amount of time saved by consulting it; for example, a table of square roots to ten decimals is more valuable than a table of squares, as the extraction of the root would occupy more time than the multiplication of the number by itself. The value of a table does not depend upon the difficulty of calculating it; for, once made, it is made for ever, and as far as the user is concerned the amount of labour devoted to its original construction is immaterial. In some tables the labour required in the construction is the same as if all the tabular results had been calculated separately; but in the majority of instances a table can be formed by expeditious methods which are inapplicable to the calculation of an individual result. This is the case with tables of a continuous quantity, which may frequently be constructed by differences. The most striking instance perhaps is afforded by a factor table or a table of primes; for, if it is required to determine whether a given number is prime or not, the only available method (in the absence of tables) is to divide it by every prime less than its square root or until one is found that divides it without remainder. But to form a table of prime numbers the process is theoretically simple and rapid, for we have only to range all the numbers in a line and strike out every second beginning from two, every third beginning from three, and so on, those that remain being primes. Even when the tabular results are constructed separately, the method of differences or other methods connecting together different tabular results may afford valuable verifications. By having recourse to tables not only does the computer save time and labour but he also obtains the certainty of accuracy; in fact, even when the tabular results are so easy to calculate that no time or mental effort would be saved by the use of a table, the certainty of accuracy might make it advantageous to employ it.

The invention of logarithms in 1614, followed immediately by the calculation of logarithmic tables, revolutionized all the methods of calculation; and the original work performed by Briggs and Vlacq in calculating logarithms 260 years ago has in effect formed a portion of every arithmetical operation that has since been carried out by means of logarithms. And not only has an incredible amount of labour been saved [1] but a vast number of calculations and researches have been rendered practicable which otherwise would have been quite beyond human reach. The mathematical process that underlies the tabular method of obtaining a result may be indirect and complicated; for example, the logarithmic method would be quite unsuitable for the multiplication of two numbers if the logarithms had to be calculated specially for the purpose and were not already tabulated for use. The arrangement of a table on the page and all typographical details—such as the shape of the figures, their spacing, the thickness and placing of the rules, the colour and quality of the paper, &c.—are of the highest importance, as the computer has to spend hours with his eyes fixed upon the book; and the efforts of eye and brain required in finding the right numbers amidst a mass of figures on a page and in taking them out accurately, when the computer is tired as well as when he is fresh, are far more trying than the mechanical action of simple reading. Moreover, the trouble required by the computer to *learn* the use of a table need scarcely be considered; the important matter is the time and labour saved by it after he has learned its use. Tables are, as a rule, intended for professional and not amateur use; and it is of little moment whether the user who is unfamiliar with a table has to spend ten seconds or a minute in obtaining an isolated result, provided it can be used rapidly and without risk of error by a skilled computer.

In the following descriptions of tables an attempt is made to give an account of all those that a computer of the present day is likely to use in carrying out arithmetical calculations. Tables of merely bibliographical or historical interest are not regarded as coming within the scope of this article, although for special reasons such tables are briefly noticed in some cases. Tables relating to ordinary arithmetical operations are first described, and afterwards an account is given of the most useful and least technical of the more strictly mathematical tables, such as factorials, gamma functions, integrals, Bessel's functions, &c. It is difficult to classify the tables described in a perfectly satisfactory manner without prolixity, as many collections contain valuable sets belonging to a variety of classes. Nearly all modern tables are stereotyped, and in giving their titles the accompanying date is either that of the original stereotyping or of the *tirage* in question. In tables that have passed through many editions the date given is that of the edition described. A much fuller account of general tables published previously to 1872, by the present writer, is contained in the British Association *Report* for 1873, pp. 1-175: and to this the reader is referred.

Divisors and primes.

Tables of Divisors (*Factor Tables*) *and Tables of Primes.*—The existing factor tables extend to 9,000,000. In 1811 Chernac published at Deventer his *Cribrum Arithmeticum*, which gives all the prime divisors of every number not divisible by 2, 3, or 5 up to 1,020,000. In 1814-17 Burckhardt published at Paris his *Tables des Diviseurs*, giving the least divisor of every number not divisible by 2, 3, or 5 up to 3,036,000. The second million was issued in 1814, the third in 1816, and the first in 1817. The corresponding tables for the seventh (in 1862), eighth (1863), and ninth (1865) millions were calculated by Dase and issued at Hamburg. Dase died suddenly during the progress of the work, and it was completed by Rosenberg. Dase's calculation was performed at the instigation of Gauss, and he began at 6,000,000 because the Berlin Academy was in possession of a manuscript presented by Crelle extending Burckhardt's tables from 3,000,000 to 6,000,000. This manuscript, not having been published by 1877, was found on examination to be so inaccurate that the publication was not desirable, and accordingly the three intervening millions were calculated and published by James Glaisher, the *Factor Table for the Fourth Million* appearing at London in 1879, and those for the fifth and sixth millions in 1880 and 1883 respectively (all three millions stereotyped). The tenth million, though calculated by Dase and Rosenberg, has not been published. It is in the possession of the Berlin Academy, having been presented in 1878. The nine quarto volumes (*Tables des Diviseurs*, Paris, 1814-17; *Factor Tables*, London, 1879-83; *Factoren-Tafeln*, Hamburg, 1862-65) thus form one uniform table, giving the least divisor of every number not divisible by 2, 3, or 5, from unity to nine millions. The arrangement of the results on the page, which is due to Burckhardt, is admirable for its clearness and condensation, the least factors for 9000 numbers being given on each page. The tabular portion of each million occupies 112 pages. The first three millions were issued separately, and also bound in one volume, but the other six millions are all separate. Burckhardt began with the second million instead of the first, as Chernac's factor table for the first million was already in existence. Burckhardt's first million does not supersede Chernac's, as the latter gives all the prime divisors of numbers not divisible by 2, 3, or 5 up to 1,020,000. It occupies 1020 pages, and Burckhardt found it very accurate; he detected only thirty-eight errors, of which nine were due to the author, the remaining twenty-nine having been caused by the slipping of type in the printing. The errata thus discovered are given in the first million. Burckhardt gives but a very brief account of the method by which he constructed his table; and the introduction to Dase's millions merely consists of Gauss's letter suggesting their construction. The Introduction to the *Fourth Million* (pp. 52) contains a full account of the method of construction and a history of factor tables, with a bibliography of writings on the subject. The Introduction (pp. 103) to the *Sixth Million* contains an enumeration of primes and a great number of tables relating to the distribution of primes in the whole nine millions, portions of which had been published in the *Cambridge Philosophical Proceedings* and elsewhere. The factor tables which have been described greatly exceed in both extent and accuracy any others of the same kind, the largest of which only reaches 408,000. This is the limit of Felkel's *Tafel aller einfachen Factoren* (Vienna, 1776), a remarkable and extremely rare book,[1] nearly all the copies having been destroyed. Vega (*Tabulæ*, 1797) gave a table showing all the divisors of numbers not divisible by 2, 3, or 5 up to 102,000, followed by a list of primes from 102,000 to 400,313. In the earlier editions of this work there are several errors in the list, but these are no doubt corrected in Hülsse's edition (1840). These are the largest and most convenient tables after those of Chernac. Salomon (1827) gives a factor table to 102,011, Kohler (*Handbuch*, 1818) all divisors up to 21,524, and Houël (*Tables de Logarithmes*, 1871) least divisors up to 10,841. Barlow (*Tables*, 1814) gives the complete resolution of every number up to 10,000 into its factors; for example, corresponding to 4932 we have given $2^2.3^2.137$. This table is unique so far as we know. The work also contains a list of primes up to 100,103. Both these tables are omitted in the stereotyped reprint of 1840. In *Rees's Cyclopædia* (1819), article "Prime Numbers," there is a list of primes to 217,219 arranged in decades. The *Fourth Million* (1879) contains a list of primes up to 30,341. On the first page of the *Second Million* Burckhardt gives the first nine multiples of the primes to 1423; and a smaller table of the same kind, extending only to 313, occurs in Lambert's *Supplementa*.

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[1] Referring to factor tables, Lambert wrote (*Supplementa Tabularum*, 1798, p. xv.): "Universalis finis talium tabularum est ut semel pro semper computetur quod sæpius de novo computandum foret, et ut pro omni casu computetur quod in futurum pro quovis casu computatum desiderabitur." This applies to all tables.

Multiplication.

Multiplication Tables.—A multiplication table is usually of double entry, the two arguments being the two factors; when so arranged it is frequently called a Pythagorean table. The largest and most useful work is Crelle's *Rechentafeln* (stereotyped, Bremiker's edition, 1864), which gives in one volume all the products up to 1000 × 1000, so arranged that all the multiples of any one number appear on the same page. The original edition was published in 1820 and consisted of two thick octavo volumes. The second (stereotyped) edition is a convenient folio volume of 450 pages. Only one other multiplication table of the same extent has appeared, viz., Herwart von Hohenburg's *Tabulæ Arithmeticæ Προσθαφαιρέσεως Universales*[2] (Munich, 1610), on which see NAPIER, vol. xvii. p. 183. The invention of logarithms four years later afforded another means of performing multiplications, and Von Hohenburg's work never became generally known. The three following tables are for the multiplication of a number by a single digit. (1) Crelle, *Erleichterungs-Tafel für jeden, der zu rechnen hat* (Berlin, 1836), a work extending to 1000 pages, gives the product of a number of seven figures by a single digit, by means of a double operation of entry. Each page is divided into two tables: for example, to multiply 9382477 by 7 we turn to page 825, and enter the right-hand table at line 77, column 7, where we find 77339; we then enter the left-hand table on the same page at line 93, column 7, and find 656, so that the product required is 65677339. (2) Bretschneider, *Produktentafel* (Hamburg and Gotha, 1841), is somewhat similar to Crelle's table, but smaller, the number of figures in the multiplicand being five instead of seven. (3) In Laundy, *A Table of Products* (London, 1865), the product of any five-figure number by a single digit is given by a double arrangement. The extent of the table is the same as that of Bretschneider's, as also is the principle, but the arrangement is different, Laundy's table occupying only 10 pages and Bretschneider's 99 pages. Among earlier works may be noticed Gruson, *Grosses Einmaleins von Eins bis Hunderttausend* (Berlin, 1799),—a table of products up to 9 × 10,000. The author's intention was to extend it to 100,000, but we believe only the first part was published. In this book there is no condensation or double arrangement; the pages are very large, each containing 125 lines.

Quarter-squares.

Quarter-Squares.—Multiplication may be performed by means of a table of single entry in the manner indicated by the formula—

$$ab=\frac{1}{4}(a+b)^2-\frac{1}{4}(a-b)^2.$$

Thus with a table of quarter-squares we can multiply together any two numbers by subtracting the quarter-square of their difference from the quarter-square of their sum. The largest table of quarter-squares is Laundy, *Table of Quarter-Squares of all Numbers up to 100,000* (London, 1856). Smaller works are Centnerschwer, *Neuerfundene Multiplications- und Quadrat-Tafeln* (Berlin, 1825), which extends to 20,000, and Merpaut, *Tables Arithmonomiques* (Vannes, 1832), which extends to 40,000. In Merpaut's work the quarter-square is termed the "arithmone." Ludolf, who published in 1690 a table of squares to 100,000 (see next paragraph), explains in his introduction how his table may be used to effect multiplications by means of the above formula; but the earliest book on quarter-squares is Voisin, *Tables des Multiplications, ou logarithmes des nombres entiers depuis 1 jusqu'à 20,000* (Paris, 1817). By a logarithm Voison means a quarter-square, *i.e.*, he calls a a root and $\frac{1}{4}a^2$ its logarithm. On the subject of quarter-squares, &c., see the paper (already referred to) in *Phil. Mag.*, November 1878.

Squares, cubes, &c

Squares, Cubes, &c.—The most convenient table for general use, as well as the most extensive, is Barlow's *Tables* (Useful Knowledge Society, London, from the stereotyped plates of 1840), which gives squares, cubes, square roots, cube roots, and reciprocals to 10,000. The largest table of squares and cubes is Kulik, *Tafeln der Quadrat- und Kubik-Zahlen* (Leipsic, 1848), which gives both as far as 100,000. Two early tables also give squares as far as 100,000, viz., Maginus, *Tabula Tetragonica* (Venice, 1592), and Ludolf, *Tetragonometria Tabularia* (Amsterdam, 1690). Hutton, *Tables of Products and Powers of Numbers* (London, 1781), gives squares up to 25,400, cubes to 10,000, and the first ten powers of the first hundred numbers. Barlow, *Mathematical Tables* (original edition, London, 1814), gives the first ten powers of the first hundred numbers. The first nine or ten powers are given in Vega, *Tabulæ* (1797), and in Hülsse's edition of the same (1840), in Kohler, *Handbuch* (1848), and in other collections. Faà de Bruno, *Calcul des Erreurs* (Paris, 1869), and Müller, *Vierstellige Logarithmen* (1844), give squares for use in connexion with the method of least squares. Small tables occur frequently in books intended for engineers and practical men. Drach (*Messenger of Math.*, vol. vii., 1878, p. 87) has given to 33 places the cube roots (and the cube roots of the squares) of primes up to 127. Small tables of powers of 2, 3, 5, 7 occur in various collections. In Vega's *Tabulæ* (1797, and the subsequent editions, including Hülsse's) the powers of 2, 3, 5 as far as the 45th, 36th, and 27th respectively are given; they also occur in Köhler's *Handbuch* (1848). The first 25 powers of 2, 3, 5, 7 are given in Salomon, *Logarithmische Tafeln* (1827). Shanks, *Rectification of the Circle* (1853), gives powers of 2 up to 2^{721}.

Triangular numbe

Triangular Numbers.—E. de Joncourt, *De Natura et Præclaro Usu Simplicissimæ Speciei Numerorum Trigonalium* (The Hague, 1762), contains a table of triangular numbers up to 20,000: viz., $\frac{1}{2}n(n+1)$ is given for all numbers from $n=1$ to 20,000. The table occupies 224 pages.

Reciprocals.

Reciprocals.—Barlow's *Tables* give reciprocals up to 10,000 to 9 or 10 places; and they have been carried to ten times this extent by Oakes, *Table of the Reciprocals of Numbers from 1 to 100,000* (London, 1865). This gives seven figures of the reciprocal, and is arranged like a table of seven-figure logarithms, differences being added at the side of the page. The reciprocal of a number of five figures is therefore taken out at once, and two more figures may be interpolated for as in logarithms. Picarte, *La Division réduite à une Addition* (Paris, 1861), gives to ten significant figures the reciprocals of the numbers from 10,000 to 100,000, and also the first nine multiples of these reciprocals. Small tables of reciprocals are not common.

Vulgar fractio as decima

Tables for the Expression of Vulgar Fractions as Decimals.—Tables of this kind have been given by Wucherer, Goodwyn, and Gauss. Wucherer, *Beyträge zum allgemeinern Gebrauch der Decimalbrüche* (Carlsruhe, 1796), gives the decimal fractions (to 5 places) for all vulgar fractions whose numerator and denominator are each less than 50 and prime to one another, arranged according to denominators. The most extensive and elaborate tables that have been published are contained in Henry Goodwyn's *First Centenary of Tables of all Decimal Quotients* (London, 1816), *A Tabular Series of Decimal Quotients* (1823), and *A Table of the Circles arising from the Division of a Unit or any other Whole Number by all the Integers from 1 to 1024* (1823). The *Tabular Series* (1823), running to 153 pages, gives to 8 places the decimal corresponding to every vulgar fraction less than $\frac{99}{991}$ whose numerator and denominator do not surpass 1000. The arguments are not arranged according to their numerators or denominators, but according to their magnitude, so that the tabular results exhibit a steady increase from ·001 ($=\frac{1}{1000}$) to ·09989909 ($=\frac{99}{991}$). The author intended the table to include all fractions whose numerator and denominator were each less than 1000, but no more was ever published. The *Table of Circles* (1823) gives all the periods of the circulating decimals that can arise from the division of any integer by another integer less than 1024. Thus for 13 we find $\cdot\dot{0}7692\dot{3}$ and $\cdot\dot{1}5384\dot{6}$, which are the only periods in which the fraction $\frac{x}{13}$ can circulate. The table occupies 107 pages, some of the periods being of course very long (*e.g.*, for 1021 the period contains 1020 figures). The *First Centenary* (1816) gives the complete periods of the reciprocals of the numbers from 1 to 100. Goodwyn's tables are very scarce, but as they are nearly unique of their kind they deserve special notice. A second edition of the *First Centenary* was issued in 1818 with the addition of some of the *Tabular Series*, the numerator not exceeding 50 and the denominator not exceeding 100. A posthumous table of Gauss's, entitled "Tafel zur Verwandlung gemeiner Bruche mit Nennern aus dem ersten Tausend in Decimalbruche," occurs in vol. ii. pp. 412-434 of his *Gesammelte Werke* (Gottingen, 1863), and resembles Goodwyn's *Table of Circles*. On this subject see a paper "On Circulating Decimals, with special reference to Henry Goodwyn's *Table of Circles* and *Tabular Series of Decimal Quotients*," in *Camb. Phil. Proc.*, vol. iii. (1878), pp. 185-206, where is also given a table of the periods of fractions corresponding to denominators prime to 10 from 1 to 1024 obtained by counting from Goodwyn's table. See also the section on "Circulating Decimals," p. 13 below.

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[1] For information about it, see a paper on "Factor Tables," in *Camb. Phil. Proc.*, vol. iii. (1878) pp. 99-136, or the Introduction to the *Fourth Million*.

[2] See a paper "On Multiplication by a Table of Single Entry," in *Phil. Mag.*, November 1878, for a notice of this book.

Sexagesimal and sexcentenary.

Sexagesimal and Sexcentenary Tables.—Originally all calculations were sexagesimal; and the relics of the system still exist in the division of the degree into 60 minutes and the minute into 60 seconds. To facilitate interpolation, therefore, in trigonometrical and other tables the following large sexagesimal tables were constructed. John Bernoulli, *A Sexcentenary Table* (London, 1779), gives at once the fourth term of any proportion of which the first term is 600″ and each of the other two is less than 600″; the table is of double entry, and may be more fully described as giving the value of $\frac{xy}{600}$ correct to tenths of a second, x and y each containing a number of seconds less than 600. Michael Taylor, *A Sexagesimal Table* (London, 1780), exhibits at sight the fourth term of any proportion where the first term is 60 minutes, the second any number of minutes less than 60, and the third any number of minutes and seconds under 60 minutes; there is also another table in which the third term is any absolute number under 1000. Not much use seems to have been made of these tables, both of which were published by the Commissioners of Longitude. Small tables for the conversion of sexagesimals into centesimals and *vice versa* are given in a few collections, such as Hulsse's edition of Vega.

Trigonometrical.

Trigonometrical Tables (Natural).—Peter Apian published in 1533 a table of sines with the radius divided decimally. The first complete canon giving all the six ratios of the sides of a right-angled triangle is due to Rheticus (1551), who also introduced the semiquadrantal arrangement. Rheticus's canon was calculated for every ten minutes to 7 places, and Vieta extended it to every minute (1579). In 1554 Reinhold published a table of tangents to every minute. The first complete canon published in England was by Blunedvile (1594), although a table of sines had appeared four years earlier. Regiomontanus called his table of tangents (or rather cotangents) *tabula fœcunda* on account of its great use; and till the introduction of the word "tangent" by Finck (*Geometriæ Rotundi Libri XIV.*, Basel, 1583) a table of tangents was called a *tabula fœcunda* or *canon fœcundus*. Besides "tangent," Finck also introduced the word "secant," the table of secants having previously been called *tabula benefica* by Maurolycus (1558) and *tabula fœcundissima* by Vieta.

By far the greatest computer of pure trigonometrical tables is George Joachim Rheticus, whose work has never been superseded. His celebrated ten-decimal canon, the *Opus Palatinum*, was published by Valentine Otho at Neustadt in 1596, and in 1613 his fifteen-decimal table of sines by Pitiscus at Frankfort under the title *Thesaurus Mathematicus*. The *Opus Palatinum* contains a complete ten-decimal trigonometrical canon for every ten seconds of the quadrant, semiquadrantally arranged, with differences for all the tabular results throughout. Sines, cosines, and secants are given on the left-hand pages in columns headed respectively "Perpendiculum," "Basis," "Hypotenusa," and on the right-hand appear tangents, cosecants, and cotangents in columns headed respectively "Perpendiculum," "Hypotenusa," "Basis." At his death Rheticus left the canon nearly complete, and the trigonometry was finished and the whole edited by Valentine Otho; it was named in honour of the elector palatine Frederick IV., who bore the expense of publication. The *Thesaurus* of 1613 gives natural sines for every ten seconds throughout the quadrant, to 15 places, semiquadrantally arranged, with first, second, and third differences. Natural sines are also given for every second from 0° to 1° and from 89° to 90°, to 15 places, with first and second differences. The rescue of the manuscript of this work by Pitiscus forms a striking episode in the history of mathematical tables. The alterations and emendations in the earlier part of the corrected edition of the *Opus Palatinum* were made by Pitiscus, who had his suspicions that Rheticus had himself calculated a ten-second table of sines to 15 decimal places; but it could not be found. Eventually the lost canon was discovered amongst the papers of Rheticus, which had passed from Otho to James Christmann on the death of the former. Amongst these Pitiscus found (1) the ten-second table of sines to 15 places, with first, second, and third differences (printed in the *Thesaurus*); (2) sines for every second of the first and last degrees of the quadrant, also to 15 places, with first and second differences; (3) the commencement of a canon of tangents and secants, to the same number of decimal places, for every ten seconds, with first and second differences; (4) a complete minute canon of sines, tangents, and secants, also to 15 decimal places. These tables taken in connexion with the *Opus Palatinum* give an idea of the enormous labours undertaken by Rheticus: his tables not only remain to this day the ultimate authorities but formed the data whereby Vlacq calculated his logarithmic canon. Pitiscus says that for twelve years Rheticus constantly had computers at work.

A history of trigonometrical tables by Hutton was prefixed to all the early editions of his *Tables of Logarithms*, and forms Tract xix. of his *Mathematical Tracts*, vol. i. pp. 278-306, 1812. A good deal of bibliographical information about the *Opus Palatinum* and earlier trigonometrical tables is given in De Morgan's article "Tables" in the *English Cyclopædia*. The invention of logarithms the year after the publication of Rheticus's volume by Pitiscus changed all the methods of calculation; and it is worthy of note that Napier's original table of 1614 was a logarithmic canon of sines and not a table of the logarithms of numbers. The logarithmic canon at once superseded the natural canon; and since Pitiscus's time no really extensive table of pure trigonometrical functions has appeared. In recent years the employment of the arithmometer of Thomas de Colmar has revived the use of tables of natural trigonometrical functions, it being found convenient for some purposes to employ an arithmometer and a natural canon instead of a logarithmic canon. Junge's *Tafel der wirklichen Länge der Sinus und Cosinus* (Leipsic, 1864) was published with this object. It gives natural sines and cosines for every ten seconds of the quadrant to 6 places. F. M. Clouth, *Tables pour le Calcul des Coordonnées Goniométriques* (Mainz, n.d.), gives natural sines and cosines (to 6 places) and their first nine multiples (to 4 places) for every centesimal minute of the quadrant. Tables of natural functions occur in many collections, the natural and logarithmic values being sometimes given on opposite pages, sometimes side by side on the same page.

The following works contain tables of trigonometrical functions other than sines, cosines, and tangents. Pasquich, *Tabulæ Logarithmico-Trigonometricæ* (Leipsic, 1817), contains a table of $\sin^2 x$, $\cos^2 x$, $\tan^2 x$, $\cot^2 x$ from $x=1°$ to 45° at intervals of 1′ to 5 places. Andrew, *Astronomical and Nautical Tables* (London, 1805), contains a table of "squares of natural semichords," *i.e.*, of $\sin^2 \frac{1}{2}x$ from $x=0°$ to 120° at intervals of 10″ to 7 places. This table has recently been greatly extended by Major-General Hannyngton in his *Haversines, Natural and Logarithmic, used in computing Lunar Distances for the Nautical Almanac* (London, 1876). The name "haversine," now frequently used in works upon navigation, is an abbreviation of "half versed sine"; viz., the haversine of x is equal to $\frac{1}{2}(1-\cos x)$, that is, to $\sin^2 \frac{1}{2}x$. The table gives logarithmic haversines for every 15″ from 0° to 180°, and natural haversines for every 10″ from 0° to 180°, to 7 places, except near the beginning, where the logarithms are given to only 5 or 6 places. The work itself occupies 327 folio pages, and was suggested by Andrew's, a copy of which by chance fell into Hannyngton's hands. Hannyngton recomputed the whole of it by a partly mechanical method, a combination of two arithmometers being employed. A table of haversines is useful for the solution of spherical triangles when two sides and the included angle are given, and in many other problems in spherical trigonometry. Andrew's original table seems to have attracted very little notice. Hannyngton's was printed, on the recommendation of the superintendent of the *Nautical Almanac* office, at the public cost. Before the calculation of Hannyngton's table Farley's *Natural Versed Sines* (London, 1856) was used in the *Nautical Almanac* office in computing lunar distances. This fine table contains natural versed sines from 0° to 125° at intervals of 10″ to 7 places, with proportional parts, and log versed sines from 0° to 135° at intervals of 15″ to 7 places. The arguments are also given in time. The manuscript was used in the office for twenty-five years before it was printed. Traverse tables, which occur in most collections of navigation tables, contain multiples of sines and cosines.

Common or Briggian logarithms.

Common or Briggian Logarithms of Numbers and Trigonometrical Ratios.—For an account of the invention and history of logarithms, see LOGARITHMS (vol. xiv. p. 773) and NAPIER. The following are the fundamental works which contain the results of the original calculations of logarithms of numbers and trigonometrical ratios:—Briggs, *Arithmetica Logarithmica* (London, 1624), logarithms of numbers from 1 to 20,000 and from 90,000 to 100,000 to 14 places, with interscript differences; Vlacq, *Arithmetica Logarithmica* (Gouda, 1628, also an English edition, London, 1631, the tables being the same), ten-figure logarithms of numbers from 1 to 100,000, with differences, also log sines, tangents, and secants for every minute of the quadrant to 10 places, with interscript differences; Vlacq, *Trigonometria Artificialis* (Gouda, 1633), log sines and tangents to every ten seconds of the quadrant to 10 places, with differences, and ten-figure logarithms of numbers up to 20,000, with differences; Briggs, *Trigonometria Britannica* (London, 1633), natural sines to 15 places, tangents and secants to 10 places, log sines to 14 places, and tangents to 10 places, at intervals of a hundredth of a degree from 0° to 45° with interscript differences for all the functions. In 1794 Vega reprinted at Leipsic Vlacq's two works in a single folio volume, *Thesaurus Logarithmorum Completus*. The arrangement of the table of logarithms of numbers is more compendious than in Vlacq, being similar to that of an ordinary seven-figure table, but it is not so convenient, as mistakes in taking out the differences are more liable to occur. The trigonometrical canon gives log sines, cosines, tangents, and cotangents, from 0° to 2° at intervals of one second, to 10 places, without differences, and for the rest of the quadrant at intervals of ten seconds. The trigonometrical canon is not wholly reprinted from the *Trigonometria Artificialis*, as the logarithms for every second of the first two degrees, which do not occur in Vlacq, were calculated for the work by Lieutenant Dorfmund. Vega devoted great attention to the detection of errors in Vlacq's logarithms of numbers, and has given several important errata lists. M. Lefort (*Annales de l'Observatoire de Paris*, vol. iv.) has given a full errata list in Vlacq's and Vega's logarithms of numbers, obtained by comparison with the great French manuscript *Tables du Cadastre* (see LOGARITHMS, p. 776; comp. also *Monthly Notices of Roy. Ast. Soc.* for May 1872, June 1872, March 1873, and 1874, suppl. number). Vega seems not to have bestowed on the trigonometrical canon anything like the care that he devoted to the logarithms of numbers, as Gauss[1] estimates the total of last-figure errors at from 31,983 to 47,746, most of them only amounting to a unit, but some to as much as 3 or 4. As these errors in the *Trigonometria Artificialis* still remain uncorrected, it cannot be said that a reliable ten-place logarithmic trigonometrical canon exists. The calculator who has occasion to perform work requiring ten-figure logarithms of numbers should use Vlacq's *Arithmetica Logarithmica* of 1628, after carefully correcting the errors pointed out by Vega and Lefort. After Vlacq, Vega's *Thesaurus* is the next best table; and Pineto's *Tables de Logarithmes Vulgaires à Dix Décimales, construites d'après un nouveau mode* (St Petersburg, 1871), though a tract of only 80 pages, may be usefully employed when Vlacq and Vega are unprocurable. Pineto's work consists of three tables: the first, or auxiliary table, contains a series of factors by which the numbers whose logarithms are required are to be multiplied to bring them within the range of table 2; it also gives the logarithms of the reciprocals of these factors to 12 places. Table 1 merely gives logarithms to 1000 to 10 places. Table 2 gives logarithms from 1,000,000 to 1,011,000, with proportional parts to hundredths. The mode of using these tables is as follows. If the logarithm cannot be taken out directly from table 2, a factor M is found from the auxiliary table by which the number must be multiplied to bring it within the range of table 2. Then the logarithm can be taken out, and, to neutralize the effect of the multiplication, so far as the result is concerned, $\log\left(\frac{1}{M}\right)$ must be added; this quantity is therefore given in an adjoining column to M in the auxiliary table. A similar procedure gives the number answering to any logarithm, another factor (approximately the reciprocal of M) being given, so that in both cases multiplication is used. The laborious part of the work is the multiplication by M; but this is somewhat compensated for by the ease with which, by means of the proportional parts, the logarithm is taken out. The factors are 300 in number, and are chosen so as to minimize the labour, only 25 of the 300 consisting of three figures all different and not involving 0 or 1. The principle of multiplying by a factor which is subsequently cancelled by subtracting its logarithm is used also in a tract, containing only ten pages, published by MM. Namur and Mansion at Brussels in 1877 under the title *Tables de Logarithmes à 12 décimales jusqu'à 434 milliards*. Here a table is given of logarithms of numbers near to 434,294, and other numbers are brought within the range of the table by multiplication by one or two factors. The logarithms of the numbers near to 434,294 are selected for tabulation because their differences commence with the figures 100 ... and the presence of the zeros in the difference renders the interpolation easy.

If seven-figure logarithms do not give sufficiently accurate results, it is usual to have recourse to ten-figure tables: with one exception, there exist no tables giving 8 or 9 figures. The exception is John Newton's *Trigonometria Britannica* (London, 1658), which gives logarithms of numbers to 100,000 to 8 places, and also log sines and tangents for every centesimal minute (*i.e.*, the nine-thousandth part of a right angle), and also log sines and tangents for the first three degrees of the quadrant to 5 places, the interval being the one-thousandth part of a degree. This table is also unique in that it gives the logarithms of the differences instead of the actual differences. The arrangement of the page now universal in seven-figure tables—with the fifth figures running horizontally along the top line of the page—is due to John Newton.

As a rule seven-figure logarithms of numbers are not published separately, most tables of logarithms containing both the logarithms of numbers and a trigonometrical canon. Babbage's and Sang's logarithms are exceptional and give logarithms of numbers only. Babbage, *Table of the Logarithms of the Natural Numbers from 1 to 108,000* (London, stereotyped in 1827; there are several tirages of later dates), is the best for ordinary use. Great pains were taken to get the maximum of clearness. The change of figure in the middle of the block of numbers is marked by a change of type in the fourth figure, which (with the sole exception of the asterisk) is the best method that has been used. Copies of the book were printed on paper of different colours—yellow, brown, green, &c.—as it was considered that black on a white ground was a fatiguing combination for the eye. The tables were also issued with title-pages and introductions in other languages. The book is not very easy to procure now. In 1871 Mr Sang published *A New Table of Seven-place Logarithms of all Numbers from 20 000 to 200 000* (London). In an ordinary table extending from 10,000 to 100,000 the differences near the beginning are so numerous that the proportional parts are either very crowded or some of them omitted; by making the table extend from 20,000 to 200,000 instead of from 10,000 to 100,000 the differences are halved in magnitude, while there are only one-fourth as many in a page. There is also greater accuracy. A further peculiarity of this table is that multiples of the differences, instead of proportional parts, are given at the side of the page. Typographically the table is exceptional, as there are no rules, the numbers being separated from the logarithms by reversed commas. This work was to a great extent the result of an original calculation; see *Edinburgh Transactions*, vol. xxvi. (1871). Mr Sang proposed to publish a nine-figure table from 1 to 1,000,000, but the requisite support was not obtained. Various papers of Mr Sang's relating to his logarithmic calculations will be found in the *Edinburgh Proceedings* subsequent to 1872. In this connexion reference should be made to Abraham Sharp's table of logarithms of numbers from 1 to 100 and of primes from 100 to 1100 to 61 places, also of numbers from 999,990 to 1,000,010 to 63 places. These first appeared in *Geometry Improv'd . . . by A. S. Philomath* (London, 1717). They have been republished in Sherwin's, Callet's, and the earlier editions of Hutton's tables. Parkhurst, *Astronomical Tables* (New York, 1871), gives logarithms of numbers from 1 to 109 to 102 places.[2]

In many seven-figure tables of logarithms of numbers the values of S and T are given at the top of the page, with V, the variation of each, for the purpose of deducing log sines and tangents. S and T denote $\log\frac{\sin x}{x}$ and $\log\frac{\tan x}{x}$ respectively, the arguments being the number of seconds denoted by certain numbers (sometimes only the first, sometimes every tenth) in the number column on each page. Thus, in Callet's tables, on the page on which the first number is 67200, $S = \log\frac{\sin 6720''}{6720}$ and $T = \log\frac{\tan 6720''}{6720}$, while the V's are the variations of each for 10″. To find, for example, log 1° 52′ 12″·7, or log sin 6732″·7, we have $S = 4{\cdot}6854980$ and $\log 6732{\cdot}7 = 3{\cdot}8281893$, whence, by addition, we obtain 8·5136873; but V for 10″ is −2·29, whence the variation for 12″·7 is −3, and the log sine required is 8·5136870. Tables of S and T are frequently called, after their inventor, "Delambre's tables." Some seven-figure tables extend to 100,000, and others to 108,000, the last 8000 logarithms, to 8 places, being given to ensure greater accuracy, as near the beginning of the numbers the differences are large and the interpolations more laborious and less exact than in the rest of the table. The eight-figure logarithms, however, at the end of a seven-figure table are liable to occasion error; for the computer who is accustomed to three leading figures, common to the block of figures, may fail to notice that in this part of the table there are four, and so a figure (the fourth) is sometimes omitted in taking out the logarithm. In the ordinary method of arranging a seven-figure table the change in the fourth figure, when it occurs in the course of the line, is a source of frequent error unless it is very clearly indicated. In the earlier tables the change was not marked at all, and the computer had to decide for himself, each time he took out a logarithm, whether the third figure had to be increased. In some tables the line is broken where the change occurs; but the dislocation of the figures and the corresponding irregularity in the lines are very awkward. Babbage printed the fourth figure in small type after a change. The best method seems to be that of prefixing an asterisk to the fourth figure of each logarithm after the change, as is done in Schrön's and many other modern tables. This is beautifully clear and the asterisk at once catches the eye. Shortrede and Sang replace 0 after a change by a *nokta* (resembling a diamond in a pack of cards). This is very clear in the case of the 0's, but leaves unmarked the cases in which the fourth figure is 1 or 2. Babbage printed a subscript point under the last figure of each logarithm that had been increased. Schrön used a bar subscript, which, being more obtrusive, is not so satisfactory. In some tables the increase of the last figure is only marked when the figure is increased to a 5, and then a Roman five (v) is used in place of the Arabic figure. Hereditary errors in logarithmic tables are considered in two papers "On the Progress to Accuracy of Logarithmic Tables" and "On Logarithmic Tables," in *Monthly Notices of Roy. Ast. Soc.* for 1873. See also the *Monthly Notices* for 1874, p. 248; and a paper by Gernerth, *Ztsch. f. d. österr. Gymn.*, Heft vi. p. 407.

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[1] See his "Einige Bemerkungen zu Vega's *Thesaurus Logarithmorum*," in *Astronomische Nachrichten* for 1851 (reprinted in his *Werke*, vol. iii. pp. 257-264); also *Monthly Notices Roy. Ast. Soc.* for May 1873.

[2] Legendre (*Traité des Fonctions Elliptiques*, vol. ii., 1826) gives a table of natural sines to 15 places, and of log sines to 14 places, for every 15″ of the quadrant, and also a table of logarithms of uneven numbers from 1163 to 1501, and of primes from 1501 to 10,000 to 19 places. The latter, which was extracted from the *Tables du Cadastre*, is a continuation of a table in Gardiner's *Tables of Logarithms* (London, 1742; reprinted at Avignon, 1770), which gives logarithms of all numbers to 1000, and of uneven numbers from 1000 to 1163. Legendre's tables also appeared in his *Exercices de Calcul Intégral*, vol. iii. (1816).

Passing now to the logarithmic trigonometrical canon, the first great advance after the publication of the *Trigonometria Artificialis* in 1633 was made by Michael Taylor, *Tables of Logarithms* (London, 1792), which gives log sines and tangents to every second of the quadrant to 7 places. This table contains about 450 pages with an average number of 7750 figures to the page, so that there are altogether nearly three millions and a half of figures. The change in the leading figures, when it occurs in a column, is not marked at all; and the table must be used with very great caution. In fact it is advisable to go through the whole of it, and fill in with ink the first 0 after the change, as well as make some mark that will catch the eye at the head of every column containing a change. The table was calculated by interpolation from the *Trigonometria Artificialis* to 10 places and then reduced to 7, so that the last figure should always be correct. Partly on account of the absence of a mark to denote the change of figure in the column and partly on account of the size of the table and a somewhat inconvenient arrangement, the work seems never to have come into very general use. Computers have always preferred Bagay's *Nouvelles Tables Astronomiques et Hydrographiques* (Paris, 1829), which also contains a complete logarithmic canon to every second. The change in the column is very clearly marked by a large black nucleus, surrounded by a circle, printed instead of zero. Bagay's work has now become very rare. The only other canon to every second that has been published is contained in Shortrede's *Logarithmic Tables* (Edinburgh). This work was originally issued in 1844 in one volume, but being dissatisfied with it Shortrede issued a new edition in 1849 in two volumes. The first volume contains logarithms of numbers, antilogarithms, &c., and the second the trigonometrical canon to every second. The volumes are sold separately, and may be regarded as independent works; they are not even described on their title-pages as vol. i. and vol. ii. The trigonometrical canon is very complete in every respect, the arguments being given in time as well as in arc, full proportional parts being added, &c. The change of figure in the column is denoted by a nokta, printed instead of 0 where the change occurs.

Of tables in which the quadrant is divided centesimally, the principal are Hobert and Ideler, *Nouvelles Tables Trigonométriques* (Berlin, 1799), and Borda and Delambre, *Tables Trigonométriques Décimales* (Paris, 1801). The former give, among other tables, natural and log sines, cosines, tangents, and cotangents, to 7 places, the arguments proceeding to 3° at intervals of 10″ and thence to 50° at intervals of 1′ (centesimal), and also natural sines and tangents for the first hundred ten-thousandths of a right angle to 10 places. The latter gives log sines, cosines, tangents, cotangents, secants, and cosecants from 0° to 3° at intervals of 10″ (with full proportional parts for every second), and thence to 50° at intervals of 1′ (centesimal) to 7 places. There is also a table of log sines, cosines, tangents, and cotangents from 0′ to 10′ at intervals of 10″ and from 0° to 50° at intervals of 10′ (centesimal) to 11 places. Hobert and Ideler give a natural as well as a logarithmic canon; but Borda and Delambre give only the latter. Borda and Delambre give seven-figure logarithms of numbers to 10,000, the line being broken when a change of figure takes place in it.

In Briggs's *Trigonometria Britannica* of 1633 the degree is divided centesimally, and but for the appearance in the same year of Vlacq's *Trigonometria Artificialis*, in which the degree is divided sexagesimally, this reform might have been effected. It is clear that the most suitable time for effecting such a change was when the natural canon was replaced by the logarithmic canon, and Briggs took advantage of this opportunity. He left the degree unaltered, but divided it centesimally instead of sexagesimally, thus ensuring the advantages of decimal division (a saving of work in interpolations, multiplications, &c.) with the minimum of change. The French mathematicians at the end of the 18th century divided the right angle centesimally, completely changing the whole system, with no appreciable advantages over Briggs's system. In fact the centesimal degree is as arbitrary a unit as the nonagesimal, and it is only the non-centesimal subdivision of the degree that gives rise to inconvenience. Briggs's example was followed by Roe, Oughtred, and other 17th-century writers; but the centesimal division of the degree seems to have entirely passed out of use, till it was recently revived by Bremiker in his *Logarithmisch-trigonometrische Tafeln mit fünf Decimalstellen* (Berlin, 1872). This little book of 158 pages gives a five-figure canon to every hundredth of a degree with proportional parts, besides logarithms of numbers, addition and subtraction logarithms, &c.

Collections.

Collections of Tables.—For a computer who requires in one volume logarithms of numbers and a ten-second logarithmic canon, perhaps the two best books are Schrön, *Seven-Figure Logarithms* (London, 1865, stereotyped, an English edition of the German work published at Brunswick), and Bruhns, *A New Manual of Logarithms to Seven Places of Decimals* (Leipsic, 1870). Both give logarithms of numbers and a complete ten-second canon to 7 places; Bruhns also gives log sines, cosines, tangents, and cotangents to every second up to 6° with proportional parts. Schrön contains an interpolation table, of 75 pages, giving the first 100 multiples of all numbers from 40 to 420. The logarithms of numbers extend to 108,000 in Schron and to 100.000 in Bruhns. Almost equally convenient is Bremiker's edition of Vega's *Logarithmic Tables* (Berlin, stereotyped; the English edition was translated from the fortieth edition of Dr Bremiker's by W. L. F. Fischer). This book gives a canon to every ten seconds, and for the first five degrees to every second, with logarithms of numbers to 100,000. All these works give the proportional parts for all the differences in the logarithms of numbers. In Babbage's, Callet's, and many other tables only every other table of proportional parts is given near the beginning for want of space. Schron, Bruhns, and most modern tables published in Germany have title-pages and introductions in different languages. Dupuis, *Tables de Logarithmes à sept Décimales* (stereotyped, third tirage, 1868, Paris), is also very convenient, containing a ten-second canon, besides logarithms of numbers to 100,000, hyperbolic logarithms of numbers to 1000, to 7 places, &c. In this work negative characteristics are printed throughout in the tables of circular functions, the minus sign being placed above the figure; these are preferable to the ordinary characteristics that are increased by 10. This is the only work we know in which negative characteristics are used. The edges of the pages containing the circular functions are red, the rest being grey. Dupuis also edited Callet's logarithms in 1862, with which this work must not be confounded. Salomon, *Logarithmische Tafeln* (Vienna, 1827), contains a ten-second canon (the intervals being one second for the first two degrees), logarithms of numbers to 108,000, squares, cubes, square roots, and cube roots to 1000, a factor table to 102,011, ten-place Briggian and hyperbolic logarithms of numbers to 1000 and of primes to 10,333, and many other useful tables. The work, which is scarce, is a well-printed small quarto volume.

Of collections of general tables the most useful and accessible are Hutton, Callet, Vega, and Kohler. Hutton's well-known *Mathematical Tables* (London) was first issued in 1785, but considerable additions were made in the fifth edition (1811). The tables contain seven-figure logarithms to 108,000, and to 1200 to 20 places, some antilogarithms to 20 places, hyperbolic logarithms from 1 to 10 at intervals of ·01 and to 1200 at intervals of unity to 7 places, logistic logarithms, log sines and tangents to every second of the first two degrees, and natural and log sines, tangents, secants, and versed sines for every minute of the quadrant to 7 places. The natural functions occupy the left-hand pages and the logarithmic the right-hand. The first six editions, published in Hutton's lifetime (d. 1823), contain Abraham Sharp's 61-figure logarithms of numbers. Olinthus Gregory, who brought out the 1830 and succeeding editions, omitted these tables and Hutton's introduction, which contains a history of logarithms, the methods of constructing them, &c. Callet's *Tables Portatives de Logarithmes* (stereotyped, Paris) seems to have been first issued in 1783, and has since passed through a great many editions. In that of 1853 the contents are seven-figure logarithms to 108,000, Briggian and hyperbolic logarithms to 48 places of numbers to 100 and of primes to 1097, log sines and tangents for minutes (centesimal) throughout the quadrant to 7 places, natural and log sines to 15 places for every ten minutes (centesimal) of the quadrant, log sines and tangents for every second of the first five degrees (sexagesimal) and for every ten seconds of the quadrant (sexagesimal) to 7 places, besides logistic logarithms, the first hundred multiples of the modulus to 24 places and the first ten to 70 places, and other tables. This is one of the most complete and practically useful collections of logarithms that have been published, and it is peculiar in giving a centesimally divided canon. The size of the page in the editions published in the 19th century is larger than that of the earlier editions, the type having been reset. Vega's *Tabulæ Logarithmo-trigonometricæ* was first published in 1797 in two volumes. The first contains seven-figure logarithms to 101,000, log sines, &c., for every tenth of a second to 1′, for every second to 1° 30′, for every 10″ to 6° 3′, and thence at intervals of a minute, also natural sines and tangents to every minute, all to 7 places. The second volume gives simple divisors of all numbers up to 102,000, a list of primes from 102,000 to 400,313, hyperbolic logarithms of numbers to 1000 and of primes to 10,000, to 8 places, e^x and $\log_{10}e^x$ to $x=10$ at intervals of ·01 to 7 figures and 7 places respectively, the first nine powers of the numbers from 1 to 100, squares and cubes to 1000, logistic logarithms, binomial theorem coefficients, &c. Vega also published *Manuale Logarithmico-trigonometricum* (Leipsic, 1800), the tables in which are identical with a portion of those contained in the first volume of the *Tabulæ*. The *Tabulæ* went through many editions, a stereotyped issue being brought out by J. A. Hulsse (*Sammlung mathematischer Tafeln*, Leipsic) in one volume in 1840. The contents are nearly the same as those of the original work, the chief difference being that a large table of Gaussian logarithms is added. Vega differs from Hutton and Callet in giving so many useful non-logarithmic tables, and his collection is in many respects complementary to theirs. Schulze, *Neue und erweiterte Sammlung logarithmischer, trigonometrischer, und anderer Tafeln* (Berlin, 1778, 2 vols.), is a valuable collection, and contains seven-figure logarithms to 101,000, log sines and tangents to 2° at intervals of a second, and natural sines, tangents, and secants to 7 places, log sines and tangents and Napierian log sines and tangents to 8 places, all for every ten seconds to 4° and thence for every minute to 45°, besides squares, cubes, square roots, and cube roots to 1000, binomial theorem coefficients, powers of *e*, and other small tables. Wolfram's hyperbolic logarithms of numbers below 10,000 to 48 places first appeared in this work. Lambert, *Supplementa Tabularum Logarithmicarum et Trigonometricarum* (Lisbon, 1798), contains a number of useful and curious non-logarithmic tables; it bears a general resemblance to the second volume of Vega, but contains numerous other small tables of a more strictly mathematical character. A very useful collection of non-logarithmic tables is printed in Barlow's *New Mathematical Tables* (London, 1814). It gives squares, cubes, square roots, and cube roots (to 7 places), reciprocals to 9 or 10 places, and resolutions into their prime factors of all numbers from 1 to 10,000, the first ten powers of numbers to 100, fourth and fifth powers of numbers from 100 to 1000, prime numbers from 1 to 100,103, eight-place hyperbolic logarithms to 10,000, tables for the solution of the irreducible case in cubic equations, &c. In the stereotyped reprint of 1840 only the squares, cubes, square roots, cube roots, and reciprocals are retained. The first volume of Shortrede's tables, in addition to the trigonometrical canon to every second, contains antilogarithms and Gaussian logarithms. Hassler, *Tabulæ Logarithmicæ et Trigonometricæ* (New York, 1830, stereotyped), gives seven-figure logarithms to 100,000, log sines and tangents for every second to 1°, and log sines, cosines, tangents, and cotangents from 1° to 3° at intervals of 10″ and thence to 45° at intervals of 30″. Every effort has been made to reduce the size of the tables without loss of distinctness, the page being only about 3 by 5 inches. Copies of the work were published with the introduction and title-page in different languages. Stanley, *Tables of Logarithms* (New Haven, U.S., 1860), gives seven-figure logarithms to 100,000, and log sines, cosines, tangents, cotangents, secants, and cosecants at intervals of ten seconds to 15° and thence at intervals of a minute to 45° to 7 places, besides natural sines and cosines, antilogarithms, and other tables. This collection owed its origin to the fact that Hassler's tables were found to be inconvenient owing to the smallness of the type. Luvini, *Tables of Logarithms* (London, 1866, stereotyped, printed at Turin), gives seven-figure logarithms to 20,040, Briggian and hyperbolic logarithms of primes to 1200 to 20 places, log sines and tangents for each second to 9′, at intervals of 10″ to 2°, of 30″ to 9°, of 1′ to 45° to 7 places, besides square and cube roots up to 625. The book, which is intended for schools, engineers, &c., has a peculiar arrangement of the logarithms and proportional parts on the pages. Chambers's *Mathematical Tables* (Edinburgh), containing logarithms of numbers to 100,000, and a canon to every minute of log sines, tangents, and secants and of natural sines to 7 places, besides proportional logarithms and other small tables, is cheap and suitable for schools, though not to be compared as regards matter or typography to the best tables described above. Of six-figure tables Bremiker's *Logarithmorum VI. Decimalium Nova Tabula Berolinensis* (Berlin, 1852) is probably one of the best. It gives logarithms of numbers to 100,000, with proportional parts, and log sines and tangents for every second to 5°, and beyond this point for every ten seconds, with proportional parts. Hantschl, *Logarithmisch-trigonometrisches Handbuch* (Vienna, 1827), gives five-figure logarithms to 10,000, log sines and tangents for every ten seconds to 6 places, natural sines, tangents, secants, and versed sines for every minute to 7 places, logarithms of primes to 15,391, hyperbolic logarithms of numbers to 11,273 to 8 places, least divisors of numbers to 18,277, binomial theorem coefficients, &c. Farley's *Six-Figure Logarithms* (London, stereotyped, 1840) gives six-figure logarithms to 10,000 and log sines and tangents for every minute to 6 places. Of five-figure tables the most convenient is *Tables of Logarithms* (Useful Knowledge Society, London, from the stereotyped plates of 1839), which were prepared by De Morgan, though they have no name on the title-page. They contain five-figure logarithms to 10,000, log sines and tangents to every minute to 5 places, besides a few smaller tables. Lalande's *Tables de Logarithmes* is a five-figure table with nearly the same contents as De Morgan's, first published in 1805. It has since passed through many editions, and, after being extended from 5 to 7 places, passed through several more. Galbraith and Haughton, *Manual of Mathematical Tables* (London, 1860), give five-figure logarithms to 10,000 and log sines and tangents for every minute, also a small table of Gaussian logarithms. Houel, *Tables de Logarithmes à Cinq Décimales* (Paris, 1871), is a very convenient collection of five-figure tables; besides logarithms of numbers and circular functions, there are Gaussian logarithms, least divisors of numbers to 10,841, antilogarithms, &c. The work contains 118 pages of tables. The same author's *Recueil de Formules et de Tables Numériques* (Paris, 1868) contains 19 tables, occupying 62 pages, most of them giving results to 4 places; they relate to very varied subjects,—antilogarithms, Gaussian logarithms, logarithms of $\frac{1+x}{1-x}$, elliptic integrals, squares for use in the method of least squares, &c. Bremiker, *Tafel vierstelliger Logarithmen* (Berlin, 1874), gives four-figure logarithms of numbers to 2009, log sines, cosines, tangents, and cotangents to 3° for every hundredth of a degree, and thence to 45° for every tenth of a degree, to 4 places. There are also Gaussian logarithms, squares from 0·000 to 13,500, antilogarithms, &c. The book contains 60 pages. Willich, *Popular Tables* (London, 1853), is a useful book for an amateur; it gives Briggian and hyperbolic logarithms to 1200 to 7 places, squares, &c., to 343, &c.

Napier logarithms.

Hyperbolic or Napierian Logarithms.—The logarithms invented by Napier and explained by him in the *Descriptio* (1614) were not the same as those now called natural or hyperbolic (viz., to base *e*), and very frequently also Napierian, logarithms. Napierian logarithms, strictly so called, have entirely passed out of use and are of purely historic interest; it is therefore sufficient to refer to LOGARITHMS and NAPIER, where a full account is given. Apart from the inventor's own publications, the only Napierian tables of importance are contained in Ursinus's *Trigonometria* (Cologne, 1624-25) and Schulze's *Sammlung* (Berlin, 1778), the former being the largest that has been constructed. Logarithms to the base *e*, where *e* denotes 2·71828, were first published by Speidell, *New Logarithmes* (1619).

Hyperbolic logarithms.

The most copious table of hyperbolic logarithms is Dase, *Tafel der natürlichen Logarithmen* (Vienna, 1850), which extends from 1 to 1000 at intervals of unity and from 1000 to 10,500 at intervals of ·1 to 7 places, with differences and proportional parts, arranged as in an ordinary seven-figure table. By adding log 10 to the results the range is from 10,000 to 105,000 at intervals of unity. The table formed part of the *Annals of the Vienna Observatory* for 1851, but separate copies were printed. The most elaborate table of hyperbolic logarithms is due to Wolfram, who calculated to 48 places the logarithms of all numbers up to 2200, and of all primes (also of a great many composite numbers) between this limit and 10,009 Wolfram's results first appeared in Schulze's *Sammlung* (1778). Six logarithms which Wolfram had been prevented from computing by a serious illness were supplied in the *Berliner Jahrbuch*, 1783, p. 191. The complete table was reproduced in Vega's *Thesaurus* (1794), when several errors were corrected. Tables of hyperbolic logarithms are contained in the following collections:—Callet, all numbers to 100 and primes to 1097 to 48 places; Borda and Delambre (1801), all numbers up to 1200 to 11 places; Salomon (1827), all numbers to 1000 and primes to 10,333 to 10 places; Vega, *Tabulæ* (including Hülsse's edition, 1840), and Köhler (1848), all numbers to 1000 and primes to 10,000 to 8 places; Barlow (1814), all numbers to 10,000; Hutton and Willich (1853), all numbers to 1200 to 7 places; Dupuis (1868), all numbers to 1000 to 7 places. Hutton also gives hyperbolic logarithms from 1 to 10 at intervals of ·01 to 7 places. *Rees's Cyclopædia* (1819), art. "Hyperbolic Logarithms," contains a table of hyperbolic logarithms of all numbers up to 10,000 to 8 places.

Conversion of Briggia and hyperbolic logarithms.

Tables to convert Briggian into Hyperbolic Logarithms, and vice versa.—Such tables merely consist of the first hundred (sometimes only the first ten) multiples of the modulus ·43429 44819... and its reciprocal 2·30258 50929 ... to 5, 6, 8, 10, or more places. They are generally to be found in collections of logarithmic tables, but rarely exceed a page in extent, and are very easy to construct. Schrön and Bruhns both give the first hundred multiples of the modulus and its reciprocal to 10 places, and Bremiker (in his edition of Vega and in his six-figure tables) and Dupuis to 7 places. Degen, *Tabularum Enneas* (Copenhagen, 1824), gives the first hundred multiples of the modulus to 30 places.

Antilogarithms.

Antilogarithms.—In the ordinary tables of logarithms the natural numbers are integers, while the logarithms are incommensurable. In an antilogarithmic canon the logarithms are exact quantities, such as ·00001, ·00002, &c., and the corresponding numbers are incommensurable. The largest and earliest work of this kind is Dodson's *Antilogarithmic Canon* (London, 1742), which gives numbers to 11 places corresponding to logarithms from 0 to 1 at intervals of ·00001, arranged like a seven-figure logarithmic table, with interscript differences and proportional parts at the bottom of the page. This work was the only antilogarithmic canon for more than a century, till in 1844 Shortrede published the first edition of his tables; in 1849 he published the second edition, and in the same year Filipowski's tables appeared. Both these works contain seven-figure antilogarithms: Shortrede gives numbers to logarithms from 0 to 1 at intervals of ·00001, with differences and multiples at the top of the page, and Filipowski, *A Table of Antilogarithms* (London, 1849), contains a table of the same extent, the proportional parts being given to hundredths.

Addition and Subtraction, or Gaussian, Logarithms.—The object

Gaussian logarithms.

of such tables is to give log $(a \pm b)$ by only one entry when log a and log b are given (see LOGARITHMS, vol. xiv. p. 777). Let

$$A = \log x, \qquad B = \log\left(1 + \frac{1}{x}\right), \qquad C = \log(1 + x).$$

Leaving out the specimen table in Leonelli's *Théorie des Logarithmes Additionnels et Deductifs* (Bordeaux, 1803), the principal tables are the following. Gauss, in Zach's *Monatliche Correspondenz* (1812), giving B and C for argument A from 0 to 2 at intervals of ·001, thence to 3·40 at intervals of ·01, and to 5 at intervals of ·1, all to 5 places. This table is reprinted in Gauss's *Werke*, vol. iii. p. 244. Matthiessen, *Tafel zur bequemern Berechnung* (Altona, 1818), giving B and C to 7 places for argument A from 0 to 2 at intervals of ·0001, thence to 3 at intervals of ·001, to 4 at intervals of ·01, and to 5 at intervals of ·1; the table is not conveniently arranged. Peter Gray, *Tables and Formulæ* (London, 1849, and "Addendum," 1870), giving C for argument A from 0 to 2 at intervals of ·0001 to 6 places, with proportional parts to hundredths, and log $(1 - x)$ for argument A from $\bar{3}$ to $\bar{1}$ at intervals of ·001 and from 1 to $\bar{1}$·9 at intervals of ·0001, to 6 places, with proportional parts. Zech, *Tafeln der Additions- und Subtractions-Logarithmen* (Leipsic, 1849), giving B for argument A from 0 to 2 at intervals of ·0001, thence to 4 at intervals of ·001 and to 6 at intervals of ·01; also C for argument A from 0 to ·0003 at intervals of ·0000001, thence to ·05 at intervals of ·000001 and to ·303 at intervals of ·00001, all to 7 places, with proportional parts. These tables are reprinted from Hulsse's edition of Vega (1849); the 1840 edition of Hulsse's Vega contained a reprint of Gauss's original table. Wittstein, *Logarithmes de Gauss à Sept Décimales* (Hanover, 1866), giving B for argument A from 3 to 4 at intervals of ·1, from 4 to 6 at intervals of ·01, from 6 to 8 at intervals of ·001, from 8 to 10 at intervals of ·0001, also from 0 to 4 at the same intervals. In this handsome work the arrangement is similar to that in a seven-figure logarithmic table. Gauss's original five-place table was reprinted in Pasquich, *Tabulæ* (Leipsic, 1817); Köhler, *Jerome de la Lande's Tafeln* (Leipsic, 1832), and *Handbuch* (Leipsic, 1848); and Galbraith and Haughton, *Manual* (London, 1860). Houël, *Tables de Logarithmes* (1871), also gives a small five-place table of Gaussian logarithms, the addition and subtraction logarithms being separated as in Zech. Modified Gaussian logarithms are given by J. H. T. Müller, *Vierstellige Logarithmen* (Gotha, 1844), viz., a four-place table of B and $-\log\left(1 - \frac{1}{x}\right)$ from $A = 0$ to ·03 at intervals of ·0001, thence to ·23 at intervals of ·001, to 2 at intervals of ·01, and to 4 at intervals of ·1; and by Shortrede, *Logarithmic Tables* (vol. i., 1849), viz., a five-place table of B and log $(1 + x)$ from $A = \bar{5}$ to $\bar{3}$ at intervals of ·1, from $A = \bar{3}$ to $\bar{2}$·7 at intervals of ·01, to 1·3 at intervals of ·001, to 3 at intervals of ·01, and to 5 at intervals of ·1. Filipowski's *Antilogarithms* (1849) contains Gaussian logarithms arranged in a new way. The principal table gives log $(x + 1)$ as tabular result for log x as argument from 8 to 14 at intervals of ·001 to 5 places. Weidenbach, *Tafel um den Logarithmen* (Copenhagen, 1829), gives $\log\frac{x+1}{x-1}$ for argument A from ·382 to 2·002 at intervals of ·001, to 3·6 at intervals of ·01, and to 5·5 at intervals of ·1, to 5 places.

Logistic and proportional logarithms.

Logistic and Proportional Logarithms.—In most collections of tables of logarithms a five-place table of logistic logarithms for every second to 1° is given. Logistic tables give log 3600 − log x at intervals of a second, x being expressed in degrees, minutes, and seconds; Schulze (1778) and Vega (1797) have them to $x = 3600''$ and Callet and Hutton to $x = 5280''$. Proportional logarithms for every second to 3° (*i.e.*, log 10,800 − log x) form part of nearly all collections of tables relating to navigation, generally to 4 places, sometimes to 5. Bagay, *Tables* (1829), gives a five-place table, but such are not often to be found in collections of mathematical tables. The same remark applies to tables of proportional logarithms for every minute to 24^h, which give to 4 or 5 places the values of log 1440 − log x. The object of a proportional or logistic table, or a table of log a − log x, is to facilitate the calculation of proportions in which the third term is a.

Interpolation tables.

Interpolation Tables.—All tables of proportional parts may be regarded as interpolation tables. Bremiker, *Tafel der Proportionaltheile* (Berlin, 1843), gives proportional parts to hundredths of all numbers from 70 to 699. Schrön, *Logarithms*, contains an interpolation table giving the first hundred multiples of all numbers from 40 to 410. Tables of the values of binomial theorem coefficients, which are required when second and higher orders of differences are used, are described below. Woolhouse, *On Interpolation, Summation, and the Adjustment of Numerical Tables* (London, 1865), contains nine pages of interpolation tables. The book consists of papers extracted from vols. xi. and xii. of the *Assurance Magazine*.

Dual logarithms.

Dual Logarithms.—This term is used by Mr Oliver Byrne in his *Dual Arithmetic, Young Dual Arithmetician, Tables of Dual Logarithms*, &c. (London, 1863-67). A dual number of the ascending branch is a continued product of powers of 1·1, 1·01, 1·001, &c., taken in order, the powers only being expressed; thus ↓6,9.7,8 denotes $(1{\cdot}1)^6(1{\cdot}01)^9(1{\cdot}001)^7(1{\cdot}0001)^8$, the numbers following the ↓ being called dual digits. A dual number which has all but the last digit zeros is called a dual logarithm; the author uses dual logarithms in which there are seven ciphers between the ↓ and the logarithms. A dual number of the descending branch is a continued product of powers of ·9, ·99, &c.: for instance, $({\cdot}9)^3({\cdot}99)^2$ is denoted by '3 '2↑. The *Tables*, which occupy 112 pages, give dual numbers and logarithms, both of the ascending and descending branches, and the corresponding natural numbers. The author claimed that his tables were superior to those of common logarithms.

Constants.

Constants.—In nearly all tables of logarithms there is a page devoted to certain frequently used constants and their logarithms, such as $\pi, \frac{1}{\pi}, \pi^2, \sqrt{\pi}$. A specially good collection is printed in Templeton's *Millwright's and Engineer's Pocket Companion* (corrected by S. Maynard, London, 1871), which gives 53 constants involving π and their logarithms, generally to 30 places, and 13 others that may be properly called mathematical. A good list of constants involving π is given in Salomon (1827). A paper by Paucker in *Grunert's Archiv* (vol. i. p. 9) has a number of constants involving π given to a great many places, and Gauss's memoir on the lemniscate function (*Werke*, vol. iii.) has $e^{-\pi}, e^{-\frac{1}{2}\pi}, e^{-\frac{1}{4}\pi}$, &c., calculated to about 50 places. The quantity π has been worked out to 707 places (Shanks, *Proc. Roy. Soc.*, vol. xxi. p. 319) and Euler's constant to 263 places (Adams, *Proc. Roy. Soc.*, vol. xxvii. p. 88). The value of the modulus M, calculated by Prof. Adams, is given in LOGARITHMS, vol. xiv. p. 779. This value is correct to 263 places; but the calculation has since been carried to 272 places (see Adams, *Proc. Roy. Soc.*, vol. xlii. p. 22, 1887).

Irreducible cubic equations

Tables for the Solution of the Irreducible Case in Cubic Equations.—Lambert, *Supplementa* (1798), gives $\pm(x - x^3)$ from $x = {\cdot}001$ to 1·155 at intervals of ·001 to 7 places, and Barlow (1814) gives $x^3 - x$ from $x = 1$ to 1·1549 at intervals of ·0001 to 8 places.

Binomial theorem coefficients.

Binomial Theorem Coefficients.—The values of

$$\frac{x(x-1)}{1\,.\,2}, \frac{x(x-1)(x-2)}{1\,.\,2\,.\,3}, \ldots \frac{x(x-1)\ldots(x-5)}{1\,.\,2\ldots 6},$$

from $x = {\cdot}01$ to $x = 1$ at intervals of ·01 to 7 places, are serviceable for use in interpolation by second and higher orders of differences. The table quoted above occurs in Schulze (1778), Barlow (1814), Vega (1797 and succeeding editions), Hantschl (1827), and Kohler (1848). Rouse, *Doctrine of Chances* (London, no date), gives on a folding sheet $(a + b)^n$ for $n = 1, 2, \ldots 20$. Lambert, *Supplementa* (1798), has the coefficients of the first 16 terms in $(1 + x)^{\frac{1}{2}}$ and $(1 - x)^{\frac{1}{2}}$, their accurate values being given as decimals. Vega (1797) has a page of tables giving $\frac{1}{2\,.\,4}, \frac{1\,.\,3}{2\,.\,4\,.\,6}, \ldots \frac{1}{2\,.\,3}, \ldots$ and similar quantities to 10 places, with their logarithms to 7 places, and a page of this kind occurs in other collections. Kohler (1848) gives the values of 40 such quantities.

Figurate numbers

Figurate Numbers.—Lambert, *Supplementa*, gives $x \frac{x(x+1)}{1\,.\,2}, \ldots \frac{x(x+1)\ldots(x+11)}{1\,.\,2\ldots 12}$ from $x = 1$ to 30.

Trigonometrical quadratic surds

Trigonometrical Quadratic Surds.—The surd values of the sines of every third degree of the quadrant are given in some tables of logarithms; *e.g.*, in Hutton's (p. xxxix., ed. 1855), we find $\sin 3^\circ = \frac{1}{8}\{\sqrt{(5+\sqrt{5})} + \sqrt{\tfrac{15}{8}} + \sqrt{\tfrac{3}{8}} - \sqrt{(15+3\sqrt{5})} - \sqrt{\tfrac{5}{8}} - \sqrt{\tfrac{1}{2}}\}$; and the numerical values of the surds $\sqrt{(5+\sqrt{5})}$, $\sqrt{(\tfrac{15}{2})}$, &c., are given to 10 places. These values were extended to 20 places by Peter Gray, *Messenger of Math.*, vol. vi. (1877), p. 105.

Circulating decimals.

Circulating Decimals.—Goodwyn's tables have been described above, p. 8. Several others have been published giving the numbers of digits in the periods of the reciprocals of primes: Burckhardt, *Tables des Diviseurs du Premier Million* (Paris, 1814-17), gave one for all primes up to 2,543 and for 22 primes exceeding that limit. Desmarest, *Théorie des Nombres* (Paris, 1852), included all primes up to 10,000. Reuschle, *Mathematische Abhandlung, enthaltend neue zahlentheoretische Tabellen* (1856), contains a similar table to 15,000. This Shanks extended to 60,000; the portion from 1 to 30,000 is printed in the *Proc. Roy. Soc.*, vol. xxii. p. 200, and the remainder is preserved in the archives of the society (*Id.*, xxiii. p. 260 and xxiv. p. 392). The number of digits in the decimal period of $\frac{1}{p}$ is the same as the exponent to which 10 belongs for modulus p, so that, whenever the period has $p - 1$ digits, 10 is a primitive root of p. Tables of primes having a given number, n, of digits in their periods, *i.e.*, tables of the resolutions of $10^n - 1$ into factors and, as far as known, into prime factors, have been given by Loof (in *Grunert's Archiv*, vol. xvi. p. 54; reprinted in *Nouv. Annales*, vol. xiv. p. 115) and by Shanks (*Proc. Roy. Soc.*, vol. xxii. p. 381). The former extends to $n = 60$ and the latter to $n = 100$, but there are gaps in both. Reuschle's tract also contains resolutions of $10^n - 1$. For further references on circulating decimals, see *Proc. Camb. Phil. Soc.*, vol. iii. p. 185 (1878).

Pythagorean Triangles.—Right-angled triangles in which the

Pythagorean triangles.

sides and hypothenuse are all rational integers are frequently termed Pythagorean triangles, as, for example, the triangles 3, 4, 5 and 5, 12, 13. Schulze, *Sammlung* (1778), contains a table of such triangles subject to the condition $\tan \frac{1}{2}\omega > \frac{1}{3}$ (ω being one of the acute angles). About 100 triangles are given, but some occur twice. Large tables of right-angled rational triangles were given by Bretschneider, in *Grunert's Archiv*, vol. i. p. 96 (1841), and by Sang, *Edinburgh Transactions*, vol. xxiii. p. 727 (1864). In these the triangles are arranged according to hypothenuses and extend to 1201, 1200, 49, and 1105, 1073, 264 respectively. Whitworth, in a paper read before the Lit. and Phil. Society of Liverpool in 1875, carried his list as far as 2465, 2337, 784. See also Rath, "Die rationalen Dreiecke," in *Grunert's Archiv*, vol. lvi. p. 188 (1874). Sang's paper also contains a table of triangles having an angle equal to 120° and their sides integers.

Powers of π.

Powers of π.—Paucker, in *Grunert's Archiv*, vol. i. p. 10, gives π^{-1} and $\pi^{\frac{1}{2}}$ to 140 places, and π^{-2}, $\pi^{-\frac{1}{2}}$, $\pi^{\frac{1}{3}}$, $\pi^{\frac{2}{3}}$ to about 50 places; and in Maynard's list of constants (see "Constants," above) π^2 is given to 31 places. The first twelve powers of π and π^{-1} to 22 or more places were printed by Glaisher, *Proc. Lond. Math. Soc.*, vol. viii. p. 140, and the first hundred multiples of π and π^{-1} to 12 places by Kulik, *Tafel der Quadrat-und Kubik-Zahlen* (Leipsic, 1848).

Series $1^{-n}+2^{-n}$, &c.

The Series $1^{-n}+2^{-n}+3^{-n}+$ &c.—Let S_n, s_n, σ_n denote respectively the sums of the series $1^{-n}+2^{-n}+3^{-n}+$ &c., $1^{-n}-2^{-n}+3^{-n}-$ &c., $1^{-n}+3^{-n}+5^{-n}+$ &c. Legendre (*Traité des Fonctions Elliptiques*, vol. ii. p. 432) has computed S_n to 16 places from $n=1$ to 35, and Glaisher (*Proc. Lond. Math. Soc.*, vol. iv. p. 48) has deduced s_n and σ_n for the same arguments and to the same number of places. The latter has also given S_n, s_n, σ_n for $n=2, 4, 6, \dots$ 12 to 22 or more places (*Proc. Lond. Math. Soc.*, vol. viii. p. 140), and the values of Σ_n, where $\Sigma_n=2^{-n}+3^{-n}+5^{-n}+$ &c. (prime numbers only involved), for $n=2, 4, 6, \dots$ 36 to 15 places (*Compte Rendu de l'Assoc. Française* for 1878, p. 172).

Hyperbolic antilogarithms.

Tables of e^x and e^{-x}, or Hyperbolic Antilogarithms.—The largest tables are the following. Gudermann, *Theorie der potenzial- oder cyklisch-hyperbolischen Functionen* (Berlin, 1833), which consists of papers reprinted from vols. viii. and ix. of *Crelle's Journal*, and gives $\log_{10}\sinh x$, $\log_{10}\cosh x$, and $\log_{10}\tanh x$ from $x=2$ to 5 at intervals of ·001 to 9 places and from $x=5$ to 12 at intervals of ·01 to 10 places. Since $\sinh x=\frac{1}{2}(e^x-e^{-x})$ and $\cosh x=\frac{1}{2}(e^x+e^{-x})$, the values of e^x and e^{-x} are deducible at once by addition and subtraction. Newman, in *Camb. Phil. Trans.*, vol. xiii. pp. 145-241, gives values of e^{-x} from $x=0$ to 15·349 at intervals of ·001 to 12 places, from $x=15·350$ to 17·298 at intervals of ·002, and from $x=17·300$ to 27·635 at intervals of ·005, to 14 places. Glaisher, in *Camb. Phil. Trans.*, vol. xiii. pp. 243-272, gives four tables of e^x, e^{-x}, $\log_{10} e^x$, $\log_{10} e^{-x}$, their ranges being from $x=·001$ to ·1 at intervals of ·001, from ·01 to 2 at intervals of ·01, from ·1 to 10 at intervals of ·1, from 1 to 500 at intervals of unity. Vega, *Tabulæ* (1797 and later edd.), has $\log_{10} e^x$ to 7 places and e^x to 7 figures from $x=·01$ to 10 at intervals of ·01. Kohler's *Handbuch* contains a small table of e^x. In Schulze's *Sammlung* (1778) e^x is given for $x=1, 2, 3, \dots 24$ to 28 or 29 figures and for $x=25$, 30, and 60 to 32 or 33 figures; this table is printed in Glaisher's paper (*loc. cit.*). In Salomon's *Tafeln* (1827) the values of e^{n}, $e^{\cdot n}$, $e^{\cdot 0n}$, $e^{\cdot 00n}$, $\dots e^{\cdot 000000n}$, where n has the values 1, 2, … 9, are given to 12 places. Bretschneider, in *Grunert's Archiv*, iii. p. 33, worked out e^x and e^{-x} and also $\sin x$ and $\cos x$ for $x=1, 2, \dots$ 10 to 20 places.

Factorials.

Factorials.—The values of $\log_{10}(n!)$, where $n!$ denotes $1.2.3\dots n$, from $n=1$ to 1200 to 18 places, are given by Degen, *Tabularum Enneas* (Copenhagen, 1824), and reprinted, to 6 places, at the end of De Morgan's article "Probabilities" in the *Encyclopædia Metropolitana*. Shortrede, *Tables* (1849, vol. i.), gives $\log(n!)$ to $n=1000$ to 5 places, and for the arguments ending in 0 to 8 places. Degen also gives the complements of the logarithms. The first 20 figures of the values of $n\times n!$ and the values of $\log_{10}\dfrac{1}{n\times n!}$ are computed by Glaisher as far as $n=71$ in the *Phil. Trans.* for 1870 (p. 370), and the values of $\dfrac{1}{n!}$ to 28 significant figures as far as $n=50$ in *Camb. Phil. Trans.*, vol. xiii. p. 246.

Bernoullian numbers.

Bernoullian Numbers.—The first fifteen Bernoullian numbers were given by Euler, *Inst. Calc. Diff.*, part ii. ch. v. Sixteen more were calculated by Rothe, and the first thirty-one were published by Ohm in *Crelle's Journal*, vol. xx. p. 11. Prof. J. C. Adams has calculated the next thirty-one, and a table of the first sixty-two was published by him in the *Brit. Assoc. Report* for 1877 and in *Crelle's Journal*, vol. lxxxv. p. 269. The first nine figures of the values of the first 250 Bernoullian numbers, and their Briggian logarithms to 10 places, have been printed by Glaisher, *Camb. Phil. Trans.*, vol. xii. p. 384.

Tables of log tan $(\frac{1}{4}\pi+\frac{1}{2}\phi)$.

Tables of log tan $(\frac{1}{4}\pi+\frac{1}{2}\phi)$.—Gudermann, *Theorie der potenzial- oder cyklisch-hyperbolischen Functionen* (Berlin, 1833), gives (in 100 pages) $\log\tan(\frac{1}{4}\pi+\frac{1}{2}\phi)$ for every centesimal minute of the quadrant to 7 places. Another table contains the values of this function, also at intervals of a minute, from 88° to 100° (centesimal) to 11 places. Legendre, *Traité des Fonctions Elliptiques* (vol. ii. p. 256), gives the same function for every half degree (sexagesimal) of the quadrant to 12 places.

Gamma function.

The Gamma Function.—Legendre's great table appeared in vol. ii. of his *Exercices de Calcul Intégral* (1816), p. 85, and in vol. ii. of his *Traité des Fonctions Elliptiques* (1826), p. 489. $\log_{10}\Gamma(x)$ is given from $x=1$ to 2 at intervals of ·001 to 12 places, with differences to the third order. This table is reprinted in full in Schlömilch, *Analytische Studien* (1848), p. 183; an abridgment in which the arguments differ by ·01 occurs in De Morgan's *Diff. and Int. Calc.*, p. 587. The last figures of the values omitted are also supplied, so that the full table can be reproduced. A seven-place abridgment (without differences) is published in Bertrand, *Calcul Intégral* (1870), p. 285, and a six-figure abridgment in Williamson, *Integral Calculus* (1884), p. 169. In vol. i. of his *Exercices* (1811), Legendre had previously published a seven-place table of $\log_{10}\Gamma(x)$, without differences.

Elliptic functions.

Tables connected with Elliptic Functions.—Legendre calculated elaborate tables of the elliptic integrals in vol. ii. of *Traité des Fonctions Elliptiques* (1826). Denoting the modular angle by θ, the amplitude by ϕ, and the incomplete integral of the second kind by $E_1(\phi)$ the tables are—(1) $\log_{10} E$ and $\log_{10} K$ from $\theta=0°$ to 90° at intervals of 0°·1 to 12 or 14 places, with differences to the third order; (2) $E_1(\phi)$ and $F(\phi)$, the modular angle being 45° from $\phi=0°$ to 90° at intervals of 0°·5 to 12 places, with differences to the fifth order; (3) $E_1(45°)$ and $F(45°)$ from $\theta=0°$ to 90° at intervals of 1°, with differences to the sixth order, also E and K for the same arguments, all to 12 places; (4) $E_1(\phi)$ and $F(\phi)$ for every degree of both the amplitude and the argument to 9 or 10 places. The first three tables had been published previously in vol. iii. of the *Exercices de Calcul Intégral* (1816).

Tables involving q.

Tables involving q.—Verhulst, *Traité des Fonctions Elliptiques* (Brussels, 1841), contains a table of $\log_{10}\log_{10}\left(\dfrac{1}{q}\right)$ for argument θ at intervals of 0°·1 to 12 or 14 places. Jacobi, in *Crelle's Journal*, vol. xxvi. p. 93, gives $\log_{10} q$ from $\theta=0°$ to 90° at intervals of 0°·1 to 5 places. Meissel, *Sammlung mathematischer Tafeln*, i. (Iserlohn, 1860), consists of a table of $\log_{10} q$ at intervals of 1′ from $\theta=0°$ to 90° to 8 places. Glaisher, in *Month. Not. Roy. Ast. Soc.*, vol. xxxvii. p. 372 (1877), gives $\log_{10} q$ to 10 places and q to 9 places for every degree. In Bertrand, *Calcul Intégral* (1870), a table of $\log_{10} q$ from $\theta=0°$ to 90° at intervals of 5′ to 5 places is accompanied by tables of $\log_{10}\sqrt{\dfrac{2K}{\pi}}$ and $\log_{10}\log_{10}\dfrac{1}{q}$ and by abridgments of Legendre's tables of the elliptic integrals. Schlömilch, *Vorlesungen der höheren Analysis* (Brunswick, 1879), p. 448, gives a small table of $\log_{10} q$ for every degree to 5 places.

Legendrian coefficients.

Legendrian Coefficients.—The values of $P^n(x)$ for $n=1, 2, 3, \dots 7$ from $x=0$ to 1 at intervals of ·01 are given by Glaisher, in *Brit. Assoc. Rep.* for 1879, pp. 54-57. The functions tabulated are $P^1(x)=x$, $P^2(x)=\frac{1}{2}(3x^2-1)$, $P^3(x)=\frac{1}{2}(5x^3-3x)$, $P^4(x)=\frac{1}{8}(35x^4-30x^2+3)$, $P^5(x)=\frac{1}{8}(63x^5-70x^3+15x)$, $P^6(x)=\frac{1}{16}(231x^6-315x^4+105x^2-5)$, $P^7(x)=\frac{1}{16}(429x^7-693x^5+315x^3-35x)$. The functions occur in connexion with the theory of interpolation, the attraction of spheroids, and other physical theories.

Bessel's functions.

Bessel's Functions.—Bessel's original table appeared at the end of his memoir "Untersuchung des planetarischen Theils der Störungen, welche aus der Bewegung der Sonne entstehen" (in *Abh. d. Berl. Akad.*, 1824; reprinted in vol. i. of his *Abhandlungen*, p. 84). It gives $J_0(x)$ and $J_1(x)$ from $x=0$ to 3·2 at intervals of ·01. More extensive tables were calculated by Hansen in "Ermittelung der absoluten Storungen in Ellipsen von beliebiger Excentricitat und Neigung" (in *Schriften der Sternwarte Seeberg*, part i., Gotha, 1843). They include an extension of Bessel's original table to $x=20$, besides smaller tables of $J_n(x)$ for certain values of n as far as $n=28$, all to 7 places. Hansen's table was reproduced by Schlomilch, in *Zeitschr. fur Math.*, vol. ii. p. 158, and by Lommel, *Studien über die Bessel'schen Functionen* (Leipsic, 1868), p. 127. Hansen's notation is slightly different from Bessel's; the change amounts to halving each argument. Schlömilch gives the table in Hansen's form; Lommel expresses it in Bessel's.

Sine, &c., integrals.

Sine, Cosine, Exponential, and Logarithm Integrals.—The functions so named are the integrals $\int_0^x \frac{\sin x}{x}dx$, $\int_\infty^x \frac{\cos x}{x}dx$, $\int_{-\infty}^x \frac{e^x}{x}dx$, $\int_0^x \frac{dx}{\log x}$, which are denoted by the functional signs Si x, Ci x, Ei x, li x respectively. Soldner, *Théorie et Tables d'une Nouvelle Fonction Transcendante* (Munich, 1809), gave the values of li x from $x=0$ to 1 at intervals of ·1 to 7 places, and thence at various intervals to 1220 to 5 or more places. This table is reprinted in De Morgan's *Diff. and Int. Calc.*, p. 662. Bretschneider, in *Grunert's Archiv*, vol. iii. p. 33, calculated Ei $(\pm x)$, Si x, Ci x for $x=1, 2, \dots$ 10 to 20 places, and subsequently (in Schlömilch's *Zeitschrift*, vol. vi.) worked out the values of the same functions from $x=0$ to 1 at intervals of ·01 and from 1 to 7·5 at intervals of ·1 to 10 places. Two tracts by L. Stenberg, *Tabulæ Logarithmi Integralis* (Malmö, part i. 1861 and part ii. 1867), give the values of li 10^x from $x=-15$ to 3·5 at intervals of ·01 to 18 places. Glaisher, in *Phil. Trans.*, 1870, p. 367, gives Ei $(\pm x)$, Si x, Ci x from $x=0$ to 1 at intervals of ·01 to 18 places, from $x=1$ to 5 at intervals of ·1 and thence to 15 at intervals of unity, and for $x=20$ to 11 places, besides seven-place tables of Si x and Ci x and tables of their maximum and minimum values. See also Bellavitis, "Tavole Numeriche Logaritmo-Integrale" (a paper in *Memoirs of the Venetian Institute*, 1874). Bessel calculated the values of li 1000, li 10,000, li 100,000, li 200,000, . . . li 600,000, and li 1,000,000 (see *Abhandlungen*, vol. ii. p. 339). In Glaisher, *Factor Table for the Sixth Million* (1883), § iii., the values of li x are given from $x=0$ to 9,000,000 at intervals of 50,000 to the nearest integer.

Values of $\int_0^x e^{-x^2}dx$ *and* $e^{x^2}\int_0^x e^{-x^2}dx$.—These functions are employed in researches connected with refractions, theory of errors, conduction of heat, &c. Let $\int_0^x e^{-x^2}dx$ and $\int_x^\infty e^{-x^2}dx$ be denoted by Erf x and Erfc x respectively, standing for "error function" and "error function complement," so that Erf x + Erfc $x = \frac{1}{2}\sqrt{\pi}$ (*Phil. Mag.*, Dec. 1871; it has since been found convenient to transpose as above the definitions of Erf and Erfc). The tables of the functions, and of the functions multiplied by e^{x^2}, are as follows. Kramp, *Analyse des Réfractions* (Strasburg, 1798), has Erfc x from $x=0$ to 3 at intervals of ·01 to 8 or more places, also $\log_{10}$ (Erfc x) and $\log_{10}(e^{x^2}$Erfc $x)$ for the same values to 7 places. Bessel, *Fundamenta Astronomiæ* (Königsberg, 1818), has $\log_{10}(e^{x^2}$Erfc $x)$ from $x=0$ to 1 at intervals of ·01 to 7 places, likewise for argument $\log_{10} x$, the arguments increasing from 0 to 1 at intervals of ·01. Legendre, *Traité des Fonctions Elliptiques* (1826), vol. ii. p. 520, contains $\Gamma(\frac{1}{2}, e^{-x^2})$, that is, 2 Erfc x from $x=0$ to ·5 at intervals of ·01 to 10 places. Encke, *Berliner Ast. Jahrbuch* for 1834, prints $\frac{2}{\sqrt{\pi}}$ Erf x from $x=0$ to 2 at intervals of ·01 to 7 places and $\frac{2}{\sqrt{\pi}}$ Erf (ρx) from $x=0$ to 3·4 at intervals of ·01 and thence to 5 at intervals of ·1 to 5 places, ρ being ·4769360. Glaisher, in *Phil. Mag.*, December 1871, has calculated Erfc x from $x=3$ to 4·5 at intervals of ·01 to 11, 13, or 14 places. Encke's tables and two of Kramp's were reprinted in the *Encyclopædia Metropolitana*, art. "Probabilities."

Tables of Integrals, not Numerical.—Meyer Hirsch, *Integraltafeln* (1810; Eng. trans., 1823), and Minding, *Integraltafeln* (Berlin, 1849), give values of indefinite integrals and formulæ of reduction; both are useful and valuable works. De Haan, *Nouvelles Tables d'Intégrales Définies* (Leyden, 1867), is a quarto volume of 727 pages containing evaluations of definite integrals, arranged in 485 tables. The first edition appeared in vol. iv. of the *Transactions* of the Amsterdam Academy of Sciences. This, though not so full and accurate as the second edition, gives references to the original memoirs in which the different integrals are considered.

Tables relating to the Theory of Numbers.—These are of so technical a character and so numerous that a full account cannot be attempted here. The reader is referred to Cayley's paper in the *Brit. Assoc. Rep.* for 1875, where a full description with references is given. Three tables may, however, be briefly noticed on account of their importance and because they form separate volumes: (1) Degen, *Canon Pellianus* (Copenhagen, 1817), relates to the indeterminate equation $y^2 - ax^2 = 1$ for values of a from 1 to 1000. It in fact gives the expression for $\sqrt{a}$ as a continued fraction; (2) Jacobi, *Canon Arithmeticus* (Berlin, 1839), is a quarto work containing 240 pages of tables, where we find for each prime up to 1000 the numbers corresponding to given indices and the indices corresponding to given numbers, a certain primitive root (10 is taken whenever it is a primitive root) of the prime being selected as base; (3) Reuschle, *Tafeln complexer Primzahlen, welche aus Wurzeln der Einheit gebildet sind* (Berlin, 1875), includes an enormous mass of results relating to the higher complex theories. A table of $\chi(n)$, where $\chi(n)$ denotes the sum of the complex numbers which have n for their norm for primes up to $n=13,000$ (cf. *Quart. Journ.*, vol. xx. p. 152), has been published since the date of Cayley's report. Some tables that belong to the theory of numbers have been described above under "Factor Tables" (p. 7).

Bibliography.—Full bibliographical and historical information relating to tables is collected in *Brit. Assoc. Rep.* for 1873, p. 6. The principal works are:—Heilbronner, *Historia Matheseos* (Leipsic, 1742), the arithmetical portion being at the end; Scheibel, *Einleitung zur mathematischen Bücherkenntniss* (Breslau, 1771-84); Kaestner, *Geschichte der Mathematik* (Gottingen, 1796-1800), vol. iii.; Murhard, *Bibliotheca Mathematica* (Leipsic, 1797-1804), vol. ii.; Rogg, *Bibliotheca Mathematica* (Tubingen, 1830), and continuation from 1830 to 1854 by Sohnke (Leipsic and London, 1854); Lalande, *Bibliographie Astronomique* (Paris, 1803), a separate index on p. 900. A great deal of accurate information upon early tables is given by Delambre, *Histoire de l'Astronomie Moderne* (Paris, 1821), vol. i.; and Nos. xix. and xx. of Hutton's *Mathematical Tracts* (1812). For a complete list of logarithmic tables of all kinds from 1614 to 1862, see De Haan, "Iets over Logarithmentafels," in *Verslagen en Mededeelingen der Koning. Akad. van Wetenschappen* (Amsterdam, 1862), pt. xiv. De Morgan's article "Tables," which appeared first in the *Penny Cyclopædia*, and afterwards with additions in the *English Cyclopædia*, gives not only a good deal of bibliographical information but also an account of tables relating to life assurance and annuities, astronomical tables, commercial tables, &c. (J. W. L. G.)

TABOO (also written TABU and TAPU) is the name given to a system of religious prohibitions which attained its fullest development in Polynesia (from Hawaii to New Zealand; see vol. xix. p. 426), but of which under different names traces may be discovered in most parts of the world.

Meaning. The word "taboo" is common to the different dialects of Polynesia, and is perhaps derived from *ta*, "to mark," and *pu*, an adverb of intensity. The compound word "taboo" (tapu) would thus originally mean "marked thoroughly." Its ordinary sense is "sacred." It does not, however, imply any moral quality, but only "a connexion with the gods or a separation from ordinary purposes and exclusive appropriation to persons or things considered sacred; sometimes it means devoted as by a vow." Chiefs who trace their lineage to the gods are called *arii tabu*, "chiefs sacred," and a temple is called a *wahi tabu*, "place sacred." The converse of taboo is *noa* (in Tonga *gnofóa*), which means "general" or "common." Thus the rule which forbade women to eat with men, as well as, except on special occasions, to eat any fruits or animals offered in sacrifice to the gods, was called *ai tabu*, "eating sacred"; while the present relaxation of the rule is called *ai noa*, eating generally, or having food in common. Although it was employed for civil as well as religious purposes, the taboo was essentially a religious observance. In Hawaii it could be imposed only by priests; but elsewhere in Polynesia kings and chiefs, and even to a certain extent ordinary individuals, exercised the same power. The strictness with which the taboo was observed depended largely on the influence of the person who imposed it: if he was a great chief it would not be broken; but a powerful man often set at nought the taboo of an inferior.

General and particular taboos. A taboo might be general or particular, permanent or temporary. A general taboo applied, *e.g.*, to a whole class of animals; a particular taboo was confined to one or more individuals of the class. Idols, temples, the persons and names of kings and of members of the royal family, the persons of chiefs and priests, and the property (canoes, houses, clothes, &c.) of all these classes of persons were always taboo or sacred. By a somewhat arbitrary extension of this principle a chief could render taboo to (*i.e.*, in favour of) himself anything which took his fancy by merely calling it by the name of a part of his person. Thus, if he said "That axe is my backbone," or "is my head," the axe was his; if he roared out "That canoe! my skull shall be the baler to bale it out," the canoe was his likewise. The names of chiefs and still more of kings were taboo, and could not be uttered. If the name of a king of Tahiti was a common word or even resembled a common word, that word dropped out of use and a new name was substituted for it. Thus in course of time most of the common words in the language underwent considerable modifications or were entirely changed.

Duration. Certain foods were permanently taboo to (*i.e.*, in favour of or for the use of) gods and men, but were forbidden to women. Thus in Hawaii the flesh of hogs, fowls, turtle, and several kinds of fish, cocoa-nuts, and nearly everything offered in sacrifice were reserved for gods and men, and could not, except in special cases, be consumed by women. In the Marquesas Islands human flesh was tabooed from women. Sometimes certain fruits, animals, and fish were taboo for months together from both men and women. In the Marquesas houses were tabooed against water: nothing was washed in them; no drop of water might be spilled in them. If an island or a district was tabooed, no canoe or person might approach it while the taboo lasted; if a path was tabooed, no one might walk on it. Seasons generally kept taboo were the approach of a great religious ceremony, the time of preparation for war, and the sickness of chiefs. The time during which they lasted varied from years to months or days. In Hawaii there was a tradition of one that lasted thirty years, during which men might not trim their beards, &c. A common period was forty days. A taboo was either common or strict. During a common taboo the men were only required to abstain from their ordinary occupations and to attend morning and evening prayers. But during a strict taboo every fire and light on the island or in the district was extinguished; no canoe was launched; no person bathed; no one, except those who had to attend at the temple, was allowed to be seen out of doors; no dog might bark, no pig grunt, no cock crow. Hence at these seasons they tied up the mouths of dogs and pigs, and put fowls under a calabash or bandaged their eyes. The taboo was imposed either by proclamation or by fixing certain marks (a pole with a bunch of bamboo leaves, a white cloth, &c.) on the places or things tabooed.

Penalty for violation.

The penalty for the violation of a taboo was either religious or civil. The religious penalty inflicted by the offended *atuas* or spirits generally took the form of a disease: the offender swelled up and died, the notion being that the *atua* or his emissary (often an infant spirit) had entered into him and devoured his vitals. Cases are on record in which persons who had unwittingly broken a taboo actually died of terror on discovering their fatal error. Chiefs and priests, however, could in the case of involuntary transgressions perform certain mystical ceremonies which prevented this penalty from taking effect. The civil penalty for breaking a taboo varied in severity. In Hawaii there were police officers appointed by the king to see that the taboo was observed, and every breach of it was punished with death, unless the offender had powerful friends in the persons of priests or chiefs. Elsewhere the punishment was milder; in Fiji (which, however, is Melanesian) death was rarely inflicted, but the delinquent was robbed and his gardens despoiled. In New Zealand this judicial robbery was reduced to a system. No sooner was it known that a man had broken a taboo than all his friends and acquaintances swarmed down on him and carried off whatever they could lay hands on. Under this system (known as *muru*) property circulated with great rapidity. If, *e.g.*, a child fell into the fire, the father was robbed of nearly all he possessed.[1]

Things naturally taboo.

Besides the permanent and the artificially created taboos there were others which arose spontaneously as a result of circumstances. Thus all persons dangerously ill were taboo and were removed from their houses to sheds in the bush; if they remained in the house and died there the house was tabooed and deserted. Mothers after childbirth were taboo, and so were their new-born children. Women before marriage were *noa*, and could have as many lovers as they chose; but after marriage they were strictly tabooed to their husbands and from every one else. One of the strictest taboos was incurred by all persons who handled the body or bones of a dead person or assisted at his funeral. In Tonga a common person who touched a dead chief was tabooed for ten lunar months; a chief who touched a dead chief was tabooed for from three to five months according to the rank of the deceased. Burial grounds were taboo; and in New Zealand a canoe which had carried a corpse was never afterwards used, but was drawn on shore and painted red. Red was the taboo colour in New Zealand; in Hawaii, Tahiti, Tonga, and Samoa it was white. In the Marquesas a man who had slain an enemy was taboo for ten days: he might have no intercourse with his wife and might not meddle with fire; he had to get some one else to cook for him. A woman engaged in the preparation of cocoa-nut oil was taboo for five days or more, during which she might have no intercourse with men. A tabooed person might not eat his food with his hands, but was fed by another person; if he could get no one to feed him, he had to go down on his knees and pick up his food with his mouth, holding his hands behind him. A chief who was permanently taboo never ate in his own house but always in the open air, being fed by one of his wives, or taking his food with the help of a fern stalk so as not to touch his head with his hands; food left by him was kept for him in a sacred place; any other person eating of it was supposed to die immediately. A man of any standing could not carry provisions on his back; if he did so they became taboo and were useless to any one but himself. For the taboo was communicated as it were by infection to whatever a tabooed person or thing touched. This rule applied in its fullest force to the king and queen of Tahiti. The ground they trod on became sacred; if they entered a house, it became taboo to them and had to be abandoned to them by its owner. Hence special houses were set apart for them on their travels, and, except in their hereditary districts, they were always carried on men's shoulders to prevent them touching the ground. Elsewhere, as in New Zealand, this rule was not carried out so strictly. But even in New Zealand the spots on which great chiefs rested during a journey became taboo and were surrounded with a fence of basket-work. The head and hair, especially of a chief, were particularly taboo or sacred; to touch a man's head was a gross insult. If a chief touched his own head with his fingers he had immediately to apply them to his nose and snuff up the sanctity which they had abstracted from his head. The cutting of a chief's hair was a solemn ceremony; the severed locks were collected and buried in a sacred place or hung up on a tree. If a drop of a chief's blood fell upon anything, that thing became taboo to him, *i.e.*, was his property. If he breathed on a fire, it became sacred and could not be used for cooking. In his house no fire could under any circumstances be used for cooking; no woman could enter his house before a certain service had been gone through. Whatever a new-born child touched became taboo to (*i.e.*, in favour of) the child. The law which separated tabooed persons and things from contact with food was especially strict. Hence a tabooed or sacred person ought not to leave his comb or blanket or anything which had touched his head or back (for the back was also particularly taboo) in a place where food had been cooked; and in drinking he was careful not to touch the vessel with his hands or lips (otherwise the vessel became taboo and could not be used by any one else), but to have the liquid shot down his throat from a distance by a second person.

Removal of taboo.

There were various ceremonies by which a taboo could be removed. In Tonga a person who had become taboo by touching a chief or anything belonging to him could not feed himself till he had got rid of the taboo by touching the soles of a superior chief's feet with his hands and then rinsing his hands in water, or (if water was scarce) rubbing them with the juice of the plantain or banana. But, if a man found that he had already (unknowingly) eaten with tabooed hands, he sat down before a chief, took up the foot of the latter, and pressed it against his stomach to counteract the effect of the food inside. In New Zealand a taboo could be taken off by a child or grandchild. The tabooed person touched the child and took drink or food from its hands; the man was then free, but the child was tabooed for the rest of the day. A Maori chief who became taboo by touching the sacred head of his child was disinfected, so to speak, as follows. On the following day (the ceremony could not be performed sooner) he rubbed his hands over with potato or fern root which had been cooked over a sacred fire; this food was then carried to the head of the family *in the female line*, who ate it, whereupon the hands became *noa*. The taboo was removed from a new-born child in a somewhat similar manner. The father took the child in his arms and touched its head, back, &c., with some fern root which had been roasted over a sacred fire; next morning a similar ceremony was performed on the child by its eldest relative in the female line; the child was then *noa*, *i.e.*, free from taboo. Another mode of removing the taboo was to pass a consecrated piece of wood over the right shoulder, round the loins, and back again over the left shoulder, after which the stick was broken in two and either buried, or burned, or cast into the sea.

Private taboos.

Besides the taboos already described there were others which any one could impose. In New Zealand, if a man wished to preserve his house, crop, garden, or anything else, he made it taboo; similarly he could appropriate a forest tree or a piece of drift timber, &c., by tying a mark to it or giving it a chop with his axe. In Samoa for a similar purpose a man would set up a representation of, *e.g.*, a sea pike or a shark, believing that any one who meddled with property thus protected would be killed by a sea pike or shark the next time he bathed. Somewhat similar to this was what may be called the village taboo. In the autumn the *kumera* (sweet potato) fields belonging to the village were taboo till the crop was gathered, so that no stranger could approach them: and all persons engaged in getting in the crop were taboo, and could therefore for the time engage in no other occupation. Similar taboos were laid on woods during the hunting season and on rivers during the fishing season.

Classification.

On looking over the various taboos mentioned above we are tempted to divide them into two general classes,—taboos of privilege and taboos of disability. Thus the taboo of chiefs, priests, and temples might be described as a privilege, while the taboo imposed on the sick and on persons who had come in contact with the dead might be regarded as a disability; and we might say accordingly that the former rendered persons and things sacred or holy, while the latter rendered them unclean or accursed. But that no such distinction ought to be drawn is clear from the fact that the rules to be observed in the one case and in the other were identical. On the other hand, it is true that the opposition of sacred and accursed, clean and unclean, which plays so important a part in the later history of religion, did in fact arise by differentiation from the single root idea of taboo, which includes and reconciles them both and by reference to which alone their history and mutual relation are intelligible.

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[1] The origin of this custom may perhaps be discerned in a custom of the Dieri tribe, South Australia. Among them, if a child meets with an accident, all its relations immediately get their heads broken with sticks or boomerangs till the blood flows down their faces, this surgical operation being supposed to ease the child's pain (*Native Tribes of S. Australia*, p. 260).

Use in sociological evolution.

The original character of the taboo must be looked for not in its civil but in its religious element. It was not the creation of a legislator but the gradual outgrowth of animistic beliefs, to which the ambition and avarice of chiefs and priests afterwards gave an artificial extension. But in serving the cause of avarice and ambition it subserved the progress of civilization, by fostering conceptions of the rights of property and the sanctity of the marriage tie,—conceptions which in time grew strong enough to stand by themselves and to fling away the crutch of superstition which in earlier days had been their sole support. For we shall scarcely err in believing that even in advanced societies the moral sentiments, in so far as they are merely sentiments and are not based on an induction from experience, derive much of their force from an original system of taboo. Thus on the taboo were grafted the golden fruits of law and morality, while the parent stem dwindled slowly into the sour crabs and empty husks of popular superstition on which the swine of modern society are still content to feed.

Diffusion of similar customs.

It remains to indicate briefly some facts which point to a wide diffusion under various names of customs similar to the taboo. As might have been expected, the taboo is found, though in a less marked form, among the Micronesians, Malays, and Dyaks, all of whom are ethnologically connected with the Polynesians. In Micronesia both the name and the institution occur: the inhabitants of certain islands are forbidden to eat certain animals and the fruits of certain trees; temples and great chiefs are tabooed from the people; any one who fishes must previously for twenty-four hours abstain from women;[1] in conversing with women men are not allowed to use certain words, &c. Again, the Malays have the custom, though apparently not the name. In Timor and the neighbouring islands the word for taboo is *pamali* (or *pomali*); and during the long festival which celebrates a successful head-hunt the man who has secured the most heads is *pamali*; he must not sleep with his wife nor eat from his own hand, but is fed by women. *Pamali* is a Javanese word, and had originally in Java and Sumatra the same meaning that it now bears in Timor. In Celebes a mother after childbirth was *pamali*. Amongst the Dyaks of Borneo the *pamali* (called by the Land Dyaks *porikh*) is regularly practised at the planting of rice, harvest home, when the cry of the gazelle is heard behind, in times of sickness, after a death, &c. At the harvest home it is observed by the whole tribe, no one being allowed to enter or leave the village. The house where a death has taken place is *pamali* for twelve days, during which no one may enter it and nothing may be taken out of it. A tabooed Dyak may not bathe, meddle with fire, follow his ordinary occupation, or leave his house. Certain families are forbidden to eat the flesh of particular animals, as cattle, goats, and snakes. The taboo is often indicated by a bundle of spears or a rattan. The Motu of New Guinea also have the taboo: a man is tabooed after handling a corpse. He then keeps apart from his wife; his food is cooked for him by his sister; and he may not touch it with his hands. After three days he bathes and is free.[2] But the Motu appear to be Malayo-Polynesians, not Melanesians proper. However, in Melanesia also we find the taboo. It flourished in Fiji. It is observed in New Caledonia in cases of death, to preserve a crop, &c. According to the Rev. R. H. Codrington, there is this distinction between the Melanesian and the Polynesian taboo, that for the former there is no supernatural sanction: the man who breaks a taboo simply pays compensation to the person on whose tabooed property he has transgressed. But Mr R. Parkinson states that in New Britain (now New Pomerania) a person who violates a taboo-mark set on a plantation, tree, &c., is supposed to be "attacked by sickness and misfortune." To go through the similar customs observed by savages all over the world would be endless; we may, however, note that a regular system of taboo is said to exist among some of the wild tribes of the Naga Hills in India,[3] and that the rules not to touch food with the hands or the head with the hands are observed by tabooed women among one of the Fraser Lake tribes in North America.[4] In fact some of the most characteristic features of taboo—the prohibition to eat certain foods and the disabilities entailed by childbirth and by contact with the dead, together with a variety of ceremonies for removing these disabilities—have been found more or less amongst all primitive races. It is more interesting to mark the traces of such customs among civilized peoples, *e.g.*, Jews, Greeks, and Romans.

Amongst the Jews.

Amongst the Jews—(1) the vow of the Nazarite (Num. vi. 1-21) presents the closest resemblance to the Polynesian taboo. The meaning of the word Nazarite is "one separated or consecrated," and this, as we saw (p. 15), is precisely the meaning of taboo. It is the head of the Nazarite that is especially consecrated (v. 7, "his separation unto God is upon his head"; v. 9, "defile the head of his separation"; v. 11, "shall hallow his head"), and so it was in the taboo. The Nazarite might not partake of certain meats and drinks, nor shave his head, nor touch a dead body,—all rules of taboo. If a person died suddenly beside him, this was said to "defile the head of his separation," and the same effect, expressed in the same language, would apply to a tabooed Polynesian in similar circumstances. Again, the mode of terminating the vow of the Nazarite corresponds with the mode of breaking a taboo. He shaved his head at the door of the sanctuary and the priest placed food in his hands, either of which acts would have been a flagrant violation of a Polynesian taboo. (2) Some of the rules for the observance of the Sabbath are identical with rules of strict taboo; such are the prohibitions to do any work, to kindle a fire in the house, to cook food, and to go out of doors (Exod. xxxv. 2, 3; xvi. 23, 29). The Essenes strictly observed the rules to cook no food and light no fire on the Sabbath (Josephus, *Bell. Jud.*, ii. 8, 9). (3) Any one who touched a dead body was "unclean" for seven days; what he touched became unclean, and could communicate its uncleanness to any other person who touched it. At the end of seven days the unclean person washed his clothes, bathed himself, and was clean (Num. xix. 11, 14, 19, 22). In Polynesia, as we have seen, any one who touched a dead body was taboo; what he touched became taboo, and could communicate the infection to any one who touched it; and one of the ceremonies for getting rid of the taboo was washing. (4) A Jewish mother after childbirth was unclean (Lev. xii.); a Polynesian mother was taboo. (5) A great many animals were unclean, and could infect with their uncleanness whatever they touched; earthen vessels touched by certain of them were broken. Certain animals were taboo in Polynesia, and utensils which had contracted a taint of taboo were in some cases broken.

Amongst the Greeks.

Amongst the Greeks a survival, or at least a reminiscence, of a system of taboo is perhaps to be found in certain applications of the epithets "sacred" and "divine" in

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[1] For other examples of taboos (especially injunctions to continence) among various peoples in connexion with fishing, hunting, and trading, see Turner, *Samoa*, p. 349; Aymonier, *Notes sur les Laos*, pp. 21 *sq.*, 25, 26, 113, 141; W. Powell, *Wanderings in a Wild Country*, p. 207; *Report of International Expedition to Point Barrow, Alaska*, p. 39, Washington, 1885.

[2] *Journ. Anthrop. Inst.*, viii. p. 370.

[3] *Journ. Anthrop. Inst.*, xi. p. 71; Dalton, *Descriptive Ethnology of Bengal*, p. 43.

[4] *Journ. Anthrop. Inst.*, vii. p. 206.

Homer. Thus a king or a chief is sacred (*ἱερὴ ἲς Τηλεμάχοιο*, *Od.*, ii. 409, xviii. 405, &c.; *ἱερὸν μένος Ἀλκινόοιο*, *Od.*, vii. 167, viii. 2, &c.) or divine (δῖος Ὀδυσσεύς, &c.; Ὀδυσσῆος *θείοιο*, *Il.*, ii. 335, &c.; *θείων βασιλήων*, *Od.*, iv. 691); his chariot is sacred (*Il.*, xvii. 464), and his house is divine (*Od.*, iv. 43). An army is sacred (*Od.*, xxiv. 81), and so are sentinels on duty (*Il.*, x. 56; xxiv. 681). This resembles the war-taboo of the Polynesians; on a warlike expedition all Maori warriors are taboo, and the permanent personal taboo of the chiefs is increased twofold: they are "tabooed an inch thick." The Jews also seem to have had a war-taboo, for when out on the war-path they abstained from women (1 Sam. xxi. 4, 5),—a rule strictly observed by Maori warriors on a dangerous expedition. The Dards, who with the kindred Siah Posh Káfirs on the southern slopes of the Hindu Kush—tribes which probably of all Aryan peoples retain a social state most nearly approximating to that of the primitive Aryans—abstain from sexual intercourse during the whole of the fighting season, from May to September; and "victory to the chastest" is said to be a maxim of all the fighting tribes from the Hindu Kush to Albania.[1] The same rule of continence in war is observed by some Indian tribes of North America.[2] In Homer a fish is sacred (*Il.*, xvi. 407), and Plato points out that during a campaign the Homeric warriors never ate fish (*Rep.*, 404 B). Even in time of peace the men of Homer's day only ate fish when reduced to the verge of starvation (*Od.*, iv. 363 *sq.*; xii. 329 *sq.*). The Siah Posh Káfirs refuse to eat fish, although their rivers abound in it.[3] The Hindus of Vedic times appear not to have eaten fish.[4] It is probable, therefore, that among the early Aryans, as among primitive peoples in various parts of the world, the eating of fish was tabooed. Again, the threshing-floor, the winnowing-fan, and meal are all sacred (*Il.*, v. 499; H. Merc., 21, 63; *Il.*, xi. 631). Similarly in New Zealand a taboo was commonly laid on places where farming operations were going on; and among the Basutos, before the corn on the threshing-floor can be touched, a religious ceremony has to be performed, and all "defiled" persons are carefully kept from seeing it.[5] Although the Homeric folk ate swine, the epithet "divine" commonly applied to a swineherd in Homer may point to a time when pigs were sacred or tabooed. In Crete pigs were certainly sacred and not eaten (Athenæus, 376a), and apparently at Pessinus also (Pausanias, vii. 17, 10). Amongst the Jews and Syrians, of course, pigs were tabooed; and it was a moot question with the Greeks whether the Jews abhorred or worshipped pigs (Plut., *Quæst. Conv.*, iv. 5). The pigs kept in the great temple at Hierapolis were neither sacrificed nor eaten; some people thought that they were sacred, others that they were unclean, *ἐναγέας* (Lucian, *De Dea Syria*, 54). Here we have an exact taboo, the ideas of sacredness and uncleanness being indistinguishable. Similarly by the Ojibways the dog is regarded as "unclean and yet as in some respects holy."[6] The divergence of the two conceptions is illustrated by the history of the cow among different branches of the Aryan race: the Hindus regard this animal as sacred; the Shin caste among the Dards hold it in abhorrence.[7] The general word for taboo in Greek is *ἄγος*, which occurs in the sense both of "sacredness" and of "pollution"; and the same is true of the adjective *ἅγιος* and of the rare adjective *ἀναγής*, "tabooed" (Bekker's *Anecdota Græca*, 212, 32; Harpocration, *s.v.* *ἀναγεῖς*). Usually, however, the Greeks discriminated the two senses, *ἁγνός* being devoted to the sense of "sacred" and *ἐναγής* to that of "unclean" or "accursed." "To taboo" is *ἁγίζειν*; "to observe a taboo" is *ἁγνεύειν*; and the state or season of taboo is *ἁγνεία* or *ἁγιστεία*. The rules of the Greek *ἁγνεία* correspond closely to those of the Polynesian taboo, consisting in "purifications, washings, and sprinklings, and in abstaining from mourning for the dead, child-bed, and all pollutions, and in refraining from certain foods," &c.[8]

Amongst the Romans.

Amongst the Romans, who preserved more traces of primitive barbarism than the Greeks, the flamen dialis was hedged in by a perfect network of taboos. He was not allowed to ride or even touch a horse, nor to look at an army under arms, nor to wear a ring which was not broken, nor to have a knot on any part of his garments; no fire, except a sacred fire, could be taken out of his house; he might not touch or even name a goat, a dog, raw meat, beans, and ivy; he might not walk under a vine; the feet of his bed had to be daubed with mud; his hair could be cut only by a freeman, and his hair and nails when cut had to be buried under a lucky tree; he might not touch a corpse, &c. His wife, the flaminica, was also subject to taboos: at certain festivals she might not comb her hair; if she heard thunder, she was taboo (*feriata*) till she had offered an expiatory sacrifice. The similarity of some of these rules to the Polynesian taboo is obvious. The Roman *feriæ* were periods of taboo; no work might be done during them except works of necessity: *e.g.*, an ox might be pulled out of a pit or a tottering roof supported. Any person who mentioned Salus, Semonia, Seia, Segetia, or Tutilina was tabooed (*ferias observabat*).[9] The Latin *sacer* is exactly "taboo"; for it means either "sacred" or "accursed."

Literature.—On the Polynesian taboo, see Cook, *Voyages*, vol. v. p. 427 *sq.*, vol. vii. p. 146 *sq.* (ed. 1809); G. F. Angas, *Savage Scenes in Australia and New Zealand*, passim; W. Yate, *New Zealand*, p. 84 *sq.*; Ellis, *Polynesian Researches*, 2d ed., vol. iv. p. 385 *sq.*; Langsdorff, *Reise um die Welt*, i. p. 114 *sq.*; Mariner, *Tonga Islands*, i. p. 141 note, ii. pp. 82, 220 *sq.*; Turner, *Nineteen Years in Polynesia*, p. 294 *sq.*; Id., *Samoa*, p. 185 *sq.*; Klemm, *Culturgeschichte*, iv. p. 372 *sq.*; Waitz-Gerland, *Anthropologie der Natur-Völker*, vi. pp. 343-363; Shortland, *Traditions and Superstitions of the New Zealanders*, p. 101 *sq.*; Id., *Maori Religion and Mythology*, p. 25 *sq.*; *Old New Zealand*, by a Pakeha Maori, chapters vii.-xii.; Polack, *Manners and Customs of the New Zealanders*, i. p. 275 *sq.*; Dieffenbach, *Travels in New Zealand*, ii. p. 100 *sq.*; R. Taylor, *New Zealand*, p. 163 *sq.* On the taboo in Micronesia, see Waitz-Gerland, *op. cit.*, v. pt. ii. p. 147 *sq.*; among the Dyaks and Malays, see Id., vi. p. 354 *sq.*; Low, *Sarawak*, pp. 260-262; Bock, *Head-Hunters of Borneo*, pp. 214-230; Spencer St John, *Life in the Forests of the Far East*, i. p. 184 *sq.*; A. R. Wallace, *The Malay Archipelago*, p. 196; in Melanesia, Williams, *Fiji and the Fijians*, i. p. 234 *sq.* (ed. 1860); J. E. Erskine, *The Western Pacific*, p. 254; Vincendon-Dumoulin and Desgraz, *Iles Marquises*, p. 259 *sq.*; *Journ. Anthrop. Inst.*, x. pp. 279, 290; Ch. Lemire, *Nouvelle Calédonie*, Paris, 1884, p. 117; R. Parkinson, *Im Bismarck-Archipel*, Leipsic, 1887, p. 144. (J. G. FR.)

TABRÍZ, Tavris, or Tavriz, a town of Persia, capital of the province of Adarbaiján (Azerbijan, ancient Atropatene), is situated in 38° 4′ N. lat. and 46° 18′ E. long., more than 4000 feet above the sea, at the eastern end of a wide valley, through which runs a river whose waters irrigate the gardens that encircle the town. In 1812 the walls had a circumference of 3¼ miles. Overlooking the valley on the north-east and east are bold bare rocks, while to the south rises the more regular peak of Sahand. The town possesses few buildings of note, and of the extensive ruins but few merit attention. Mounsey in 1866 mentioned the blue mosque; the *ark* or citadel, containing the palace of the heir-apparent,—a large frowning building near the centre of the town; the Great Maidan, an open square;

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[1] Reclus, *Nouv. Géog. Univ.*, viii. p. 126.

[2] Schoolcraft, *Indian Tribes*, iv. p. 63; Adair, *Hist. of American Indians*, p. 163. Cp. Morse, *Report on Indian Affairs*, p. 130 *sq.*, and Bancroft, *Native Races of the Pacific States*, i. p. 189.

[3] Elphinstone, *Kingdom of Caubul*, ii. 379, ed. 1839; *Journ. Ethnol. Soc.*, i. p. 192.

[4] Zimmer, *Altindisches Leben*, p. 271.

[5] Casalis, *The Basutos*, p. 251 *sq.*

[6] Kohl, *Kitchi-Gami*, p. 38, Eng. trans.

[7] F. Drew, *The Jummoo and Kashmir Territories*, p. 428; Biddulph, *Tribes of the Hindoo Koosh*, p. 51.

[8] Diogenes Laertius, viii. 1, 33: cp. Plut., *Quæst. Conv.*, v. 10.

[9] Macrobius, *Sat.*, i. 16, 8

and the bazaars. The mosque, which he ascribes to Sháh Abbas, is that of the Turcoman Jahan Sháh (1410–1468): Abbas Mirza converted the citadel into an arsenal. Among the ruins of old Tauris the sepulchre of the Mogul sultan, Ghazan Khán, is no longer to be distinguished, except as part of a huge tumulus. It is situated about 2 miles south-west from the modern town, but far within the original boundaries. The "spacious arches of stone and other vestiges of departed majesty" with which Porter found it surrounded in 1818 were possibly remains of the college (*madrasa*) and monastery (*záwiya*) where Ibn Batuta found shelter during his visit to the locality. In spite of the cholera visitation of 1822 and other occasional ravages of sickness, and the severe cold of winter, the climate of Tabríz is proverbially healthy. Its orchards and fruit gardens have a high reputation, and its running streams make amends for ill-paved and narrow streets and sorely defective municipal arrangements. General Schindler estimated the population in 1886 at about 170,000,—a number agreeing with the latest local census. The same authority states that the city contains 8 tombs of imámzádehs, 318 mosques, 100 public baths, 166 caravanserais, 3922 shops, 28 guard-houses, and 5 Christian (Armenian) churches; but this account must comprise in some of its items more buildings than are actually in use. There are said to be nearly 3000 Armenians in the place.

Tabríz is a city of extensive commerce, a great emporium for the trade of Persia on the west, and the special mart between Turkey, Russia, and Persia. It possesses an international telegraph station, and the line passes hence to Tiflis and Europe on one side and to Teheran on the other. Subsidiary lines have been constructed to near Astara on the Caspian (136 miles long) and to Sanjbulak on the Kurdish frontier (125 miles long). Eastwick in 1860 estimated the value of the exports to Turkey at about £600,000 and to Russia at about £400,000, exclusive of smuggling. The chief imports were British, and some Swiss—coloured cotton goods, grey calicoes, and broadcloth,—with miscellaneous goods from Germany. In 1881 there was a marked improvement in the trade of Tabríz, mainly in increased imports from Constantinople. In 1885 the imports amounted to £721,730 and the exports to £306,687. The principal items of the former were cottons (from England), woollen cloth (from Austria and Germany), sugar (from France), and tea (from Holland); of the latter dried fruits (to Russia) and silk (to France, Austria, and Switzerland). There are lead mines near Tabríz, and cobalt and copper are obtainable from the Sahand.

There is perhaps no city in Persia on which so much has been recorded by native and foreign writers as Tabríz. Among the former Ibn Batuta, the Arab, and Hamd Ullah, the Persian, are notable. Of the latter may be mentioned Chardin, Porter, Ouseley, Tancoigne, Morier, Du Pré, Malcolm, Lady Sheil, Eastwick, Mounsey, Schindler, and Madame Dieulafoy (in *Tour du Monde*, 1883). The name *Tabríz* has been a subject of much comment and conjecture, but there is no doubt that it is taken from the ancient name of Tauris. The history of Tabríz is a long and painful record of sieges and conflicts, of earthquakes and destruction by natural causes. Of late years it has recovered to some extent its former high position, and is in many respects a worthy rival to the capital.

TACITUS. The famous Roman historian Tacitus, who ranks beyond dispute in the highest place among men of letters of all ages, lived in the latter half of the first and in the early part of the 2d century of our era, through the reigns of the emperors Nero, Galba, Otho, Vitellius, Vespasian, Titus, Domitian, Nerva, Trajan. All we know of his personal history is from allusions to himself in his own works, and from eleven letters addressed to him by his very intimate friend the younger Pliny. The exact year of his birth is a matter of inference, but it may be approximately fixed near the close of the reign of Claudius, from 52 to 54 A.D. Pliny indeed speaks of Tacitus and himself as being "much of an age"[1] (*propemodum æquales*), though himself born in 61 or 62, but he must have been some years junior to his friend, who began, he tells us,[2] his official life with a quæstorship under Vespasian in 78 or 79, at which time he must have been twenty-five years of age at least. Of his family and birthplace we know nothing certain; we can infer nothing from his name Cornelius, which was then very widely extended; but the fact of his early promotion seems to point to respectable antecedents, and it may be that his father was one Cornelius Tacitus, who had been a procurator in one of the divisions of Gaul, to whom allusion is made by the elder Pliny in his *Natural History* (vii. 76). But it is all matter of pure conjecture, as it also is whether his "prænomen" was Publius or Caius. He has come down to us simply as Cornelius Tacitus. The most interesting facts about him to us are that he was an eminent pleader at the Roman bar, that he was an eye-witness of the "reign of terror" during the last three years of Domitian, and that he was the son-in-law of the great and good Julius Agricola, the humane and enlightened governor of Britain. This honourable connexion, which testifies to his high moral character, may very possibly have accelerated his promotion, which he says[3] was begun by Vespasian, augmented by Titus, and still further advanced by Domitian, under whom we find him presiding as prætor at the celebration of the secular games in 88, and a member of one of the old priestly colleges, to which good family was an almost indispensable passport. Next year, it seems, he left Rome, and was absent till 93 on some provincial business, and it is possible that in these four years he may have made the acquaintance of Germany and its peoples. His father-in-law died the year of his return to Rome. In the concluding passage of his *Life of Agricola* he tells us plainly that he witnessed the judicial murders of many of Rome's best citizens from 93 to 96, and that being himself a senator he felt almost a guilty complicity in them. "Our hands," he says, "dragged Helvidius to prison; we were steeped in Senecio's innocent blood."[4] With the emperor Nerva's accession his life became bright and prosperous, and so it continued through the reign of Nerva's successor, Trajan, he himself, in the opening passage of his *Agricola*, describing this as a "singularly blessed time" (*beatissimum seculum*); but the hideous reign of terror had stamped itself ineffaceably on his soul, and when he sat down to write his *History* he could see little but the darkest side of imperialism. To his friend the younger Pliny we are indebted for all we know (and this is but trifling) about his later life. He was advanced to the consulship in 97, in succession to a highly distinguished man, Virginius Rufus, on whom he delivered in the senate a funeral eulogy. "The good fortune of Virginius," says Pliny,[5] "was crowned by having the most eloquent of panegyrists." In 99 he was associated with Pliny in the prosecution of a great political offender, Marius Priscus, under whom the provincials of Africa had suffered grievous wrongs. The prosecution was successful, and we have Pliny's testimony[6] that Tacitus spoke with his characteristic dignity. Both received a special vote of thanks from the senate for their conduct of the case. Of his remaining years we know nothing, and we may presume that he devoted them exclusively to literary work. It would seem that he lived to the close of Trajan's reign, as he seems[7] to hint at that emperor's extension of the empire by his successful Eastern campaigns from 115 to 117. Whether he outlived Trajan is matter of conjecture. It is worth noticing that the emperor Tacitus in the 3d century claimed descent from him, and directed that ten copies of his works should be made every year and deposited in the public libraries. He also had a tomb built to his memory, which was destroyed by order of Pope Pius V. in the latter part of the 16th century. Tacitus, as we gather from one of Pliny's letters,[8] had a great reputation during his lifetime. On one occasion a Roman knight, who sat by his side in the circus at the celebration of some games, asked him, "Are you from Italy or from the provinces?" His answer was, "You know me from your reading." To which the knight replied, "Are you then Tacitus or Pliny?"

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[1] Pliny, *Epp.*, vi. 20.

[2] *Hist.*, i. 1.

[3] *Hist.*, i. 1.

[4] *Agricola*, 45.

[5] *Epp.*, ii. 1.

[6] *Epp.*, ii. 11.

[7] *Ann.*, ii. 61; iv. 4

[8] *Epp.*, ix. 23.

Pliny, as we see clearly from several passages in his letters, had the highest opinion of his friend's ability and worth. He consults him about a school which he thinks of establishing at Comum (Como), his birthplace, and asks him to look out for suitable teachers and professors. And he pays[1] him the high compliment, "I know that your *Histories* will be immortal, and this makes me the more anxious that my name should appear in them."

The following is a list of Tacitus's remaining works, arranged in their probable chronological order, which may be approximately inferred from internal evidence:—(1) the *Dialogue on Orators*, about 76 or 77; (2) the *Life of Agricola*, 97 or 98; (3) the *Germany*, 98, published probably in 99; (4) the *Histories* (*Historiæ*), completed probably by 115 or 116, the last years of Trajan's reign (he must have been at work on them for many years); (5) the *Annals*, his latest work probably, written in part perhaps along with the *Histories*, and completed subsequently to Trajan's reign, which he may very well have outlived.

The *Dialogue on Orators* discusses, in the form of a conversation which Tacitus professes to have heard (as a young man) between some eminent men at the Roman bar, the causes of the decay of eloquence under the empire. There are some interesting remarks in it on the change for the worse that had taken place in the education of Roman lads.

The *Life of Agricola*, short as it is, has always been considered an admirable specimen of biography. The great man with all his grace and dignity is brought vividly before us, and the sketch we have of the history of our island under the Romans gives a special interest to this little work.

The *Germany*, the full title of which is "Concerning the geography, the manners and customs, and the tribes of Germany," describes with many suggestive hints the general character of the German peoples, and dwells particularly on their fierce and independent spirit, which the author evidently felt to be a standing menace to the empire. The geography is its weak point; this was no doubt gathered from vague hearsay.

The *Histories*, as originally composed in twelve books, brought the history of the empire from Galba in 69 down to the close of Domitian's reign in 97. The first four books, and a small fragment of the fifth, giving us a very minute account of the eventful year of revolution, 69, and the brief reigns of Galba, Otho, and Vitellius, are all that remain to us. In the fragment of the fifth book we have a curious and interesting account of the Jewish nation, of their character, customs, and religion, from a cultivated Roman's point of view, which we see at once was a strongly prejudiced one.

The *Annals*—a title for which there is no ancient authority, and which there is no reason for supposing Tacitus gave distinctively to the work—record the history of the emperors of the Julian line from Tiberius to Nero, comprising thus a period from 14 A.D. to 68. Of these, nine books have come down to us entire; of books v., xi., and xvi. we have but fragments, and the whole of the reign of Caius (Caligula), the first six years of Claudius, and the last three years of Nero are wanting. Out of a period of fifty-four years we thus have the history of forty years.

An attempt has been made recently to prove that the *Annals* are a forgery by Poggio Bracciolini, an Italian scholar of the 15th century, but their genuineness is confirmed by their agreement[2] in various minute details with coins and inscriptions discovered since that period. Another important fact has been brought to light. Ruodolphus, a monk of a monastery at Fulda in Hesse-Cassel, writing in the 9th century, says that Cornelius Tacitus speaks of the river known to moderns as the Weser as the Visurgis. In the *Annals* as they have come down to us we find the Visurgis mentioned five times in the first two books, whence we may conclude that a manuscript of them was in existence in the 9th century. Add to this the testimony of Jerome that Tacitus wrote in thirty books the lives of the Cæsars, and the evidence of style, and there cannot be much doubt that in the *Annals* we have a genuine work of Tacitus.

Much of the history of the period described by him, especially of the earlier Cæsars, must have been obscure and locked up with the emperor's private papers and memoranda. As we should expect, there was a vast amount of floating gossip, which an historian would have to sift and utilize as best he might. Tacitus, as a man of good social position, no doubt had access to the best information, and must have talked matters over with the most eminent men of the day. There were several writers and chroniclers, whom he occasionally cites but not very often; there were memoirs of distinguished persons,—those, for example of the younger Agrippina, of Thrasea, and Helvidius. There were several collections of letters, like those of the younger Pliny; a number, too, of funeral orations; and the "acta senatus" and the "acta populi" or "acta diurna," the first a record of proceedings in the senate, the latter a kind of gazette or journal. Thus there were the materials for history in considerable abundance, and Tacitus was certainly a man who knew how to turn them to good account. He has given us a striking, and on the whole doubtless a true, picture of the empire in the 1st century. He wrote, it may be admitted, with a political bias and a decided turn for satire, but he assuredly wrote with a high aim, and we may accept his own account of it: "I regard[3] it as history's highest function to rescue merit from oblivion, and to hold up as a terror to base words and actions the reprobation of posterity." Amid great evils he recognized the existence of truly noble virtues even in his own degenerate age. Still for the most part he writes as a man who felt deeply that the world was altogether "out of joint"; the empire was in itself in his view a huge blunder, and answerable more or less directly for all the diseases of society, for all the demoralization and corruption of the great world of Rome, though as to the provinces he admits that they were better off in many ways under the emperors than they had been in the last days of the republic. But his political sympathies were certainly with the old aristocratic and senatorian régime, with the Rome of the Scipios and the Fabii; for him the greatness of his country lay in the past, and, though he felt her to be still great, her glory was, he thought, decidedly on the wane. He was, in fact, a political idealist, and could hardly help speaking disparagingly of his own day. In his *Germany* he dwells on the contrast between barbarian freedom and simplicity on the one hand and the servility and degeneracy of Roman life on the other. Yet he had a strong and sincere patriotism, which invariably made him minimize a Roman defeat and the number of Roman slain. There seems to have been a strange tinge, too, of superstition about him, and he could not divest himself of some belief[4] in astrology and revelations of the future through omens and portents, though he held these were often misunderstood and misinterpreted by charlatans and impostors. On the whole he appears to have inclined to the philosophical theory of "necessitarianism," that every man's future is fixed from his birth; but we must not fasten on him any particular theory of the world or of the universe. Sometimes he speaks as a believer in a divine overruling Providence, and we may say confidently that with the Epicurean doctrine he had no sort of sympathy.

His style, whatever judgment may be passed on it, is certainly that of a man of genius, and cannot fail to make a deep impression on the studious reader. Tacitean brevity has become proverbial, and with this are closely allied an occasional obscurity and a rhetorical affectation which his warmest admirers must admit. He has been compared to Carlyle, and there are certainly resemblances between the two both in style and tone of thought. Both affect singularity of expression; both incline to an unhopeful and cynical view of the world. Tacitus was probably never a popular author; to be understood and appreciated he must be read again and again, or the point of some of his acutest remarks will be quite missed. He has been several times translated, but it has always been felt that he presents very great, if not insuperable, difficulties to the translator.

Murphy's translation (a paraphrase we should call it) is perhaps one of the best known; it was published early in the present century. On this was based the so-called Oxford translation, published by Bohn in a revised edition. The latest translation is that by Messrs Church and Brodribb. There is on the whole a good French translation by Louandre. The editions of Tacitus are very numerous. Among more recent editions, the best and most useful are Orelli's (1859); Ritter's (1864); Nipperdey's (1879); Furneaux's (*Annals*, i.–vi.), vol. i., Clarendon Press, 1884. (W. J. B.)

TACITUS, M. CLAUDIUS, Roman emperor from September 25, 275, to April 276, was a native of Interamna (Terni) in Umbria, and was born about the year 200. In the course of his long life he discharged the duties of various civil offices, including that of consul in 273, with universal respect. Six months after the assassination of Aurelian he was chosen by the senate to succeed him, and the choice was cordially ratified by the army. During his brief reign he set on foot some domestic reforms, and sought to revive the authority of the senate, but, after a victory over the Alani near the Palus Mæotis, he succumbed to the hardships and fatigues of his new duties at Tyana in Cappadocia. Tacitus, besides being a man of immense wealth (which he bequeathed to the state), had considerable literary culture, and was proud to claim descent from the historian, whose works he caused to be transcribed at the public expense and placed in the public libraries.

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[1] *Epp.*, vii. 33.

[2] See Introduction to vol. i. of Furneaux's edition of the *Annals* of Tacitus, Clarendon Press Series, 1884

[3] *Ann.*, iii. 65.

[4] *Ann.*, vi. 21, 22.

TACTICS. See War.

TADMOR. See Palmyra.

TAFILELT, a large oasis in Morocco (see vol. xvi. p. 832). The principal place is Abuam.

TAGANROG, a seaport of southern Russia, on the northern shore of the Sea of Azoff, in the government of Ekaterinoslaff, and nearly 200 miles south-east of its chief town. It is built, principally of wood, on a low cape, and, with its extensive store-houses, exchange, and wholesale shops, has the aspect of an important commercial city. It is well provided with educational institutions for children, and has a library and a theatre. The imperial palace, where Alexander I. died in 1825, and the Greek monastery (under the patriarch of Jerusalem) are worthy of notice. The advantageous situation of Taganrog was well known as early as the 13th century, when Pisan merchants founded there a colony, Portus Pisanus, which, however, was destined soon to disappear during the great migrations of the Mongols and Turks. An attempt to obtain possession of the promontory was made by Peter I., but it was not definitely annexed by the Russians until seventy years afterwards (1769). Its commercial importance dates from the second half of the present century; in 1870 its population had risen to 38,000, and after it had been brought into railway connexion with Kharkoff and Voronezh, and thus with the fertile provinces of south and south-east Russia, the increase was still more rapid, the number reaching 63,025 in 1882;—Greeks, Jews, Armenians, and West-Europeans being important elements. Notwithstanding the disadvantages of its open roadstead, the foreign trade of Taganrog rapidly expanded, the annual value of the exports having recently reached £2,500,000. The chief article of export being corn, the trade of the city, depending on the crops in south Russia, is subject to great fluctuations. Linseed and other oil-bearing grains are also important articles of commerce, as well as tallow and butter. The imports, which consist chiefly of fruits (dried and fresh), wine, oil, and coffee, are much smaller than the exports; and of the 989 ships (499,500 tons) that entered the port in 1885 no fewer than 775 (446,500 tons) were in ballast. The coasting trade, chiefly with Rostoff, was represented in the same year by 1321 vessels (224,000 tons) entering and 1343 vessels clearing.

The roadstead of Taganrog is very shallow, and exposed to winds which cause great variations in the height of the water; it is, moreover, rapidly silting up. At the quay the depth of water is only 8 to 9 feet, and large ships have to lie 5 to 13 miles from the town.

Taganrog, with the surrounding territory of 137,000 acres, having a population of nearly 30,000, living in a dozen villages, constitutes a separate township, and, though reckoned to the Rostoff district of Ekaterinoslaff, has a separate governor and administration.

TAGLIACOZZI, Gasparo (1546–1599), a surgeon of wide repute, was born at Bologna in 1546, and studied at that university under Cardan, taking his degree in philosophy and medicine at the age of twenty-four. He was appointed professor of surgery and afterwards of anatomy, and achieved notoriety at least, and the fame of a wonder-worker He died at Bologna on November 7, 1599.

His principal work is entitled *De Curtorum Chirurgia per Insitionem Libri Duo* (Venice, 1597, fol.); it was reprinted in the following year under the title of *Chirurgia Nova de Narium, Aurium, Labiorumque Defectu per Insitionem Cutis ex Humero, arte hactenus omnibus ignota, sarciendo* (Frankfort, 1598, 8vo). The latter title sufficiently indicates the art which he professed of repairing nose, ears, and lips by a species of ingrafting of skin from the arm, that member being kept in apposition with the part to be repaired until such time as the semi-detached graft had formed its new vascular connexions. His Latinized name of Taliacotius is well known to the readers of Butler (*Hudibras*, i. 1), whose humorous representation of the nature of the Taliacotian art is, however, in some important particulars inaccurate.

TAGLIONI, Marie (1809–1884), a ballet dancer, was the daughter of Filippo Taglioni, an Italian master of the ballet, and was born at Stockholm 23d April 1809. She was trained by her father, who in his discipline is said to have been pitilessly severe. It was to his care and her own special talent for dancing that she owed her success, for she possessed no remarkable personal attractions. Her first appearance was at Vienna, 10th June 1822, in a ballet of which her father was the author, *La Réception d'une jeune nymphe à la cour de Terpsichore*. Her success was immediate, and was repeated in the chief towns of Germany. On 23d July 1827 she made her debut at the Opera House, Paris in the *Ballet de Sicilien*, and aroused a furore of enthusiasm. Her style was entirely new, and may be termed ideal as opposed to the realistic and voluptuous ballet previously in vogue. Among her more remarkable performances were the dancing of the Tyrolienne in *Guillaume Tell* and of the *pas de fascination* in Meyerbeer's *Robert le Diable*. At this period the ballet was a much more important feature in opera than it is now, and in fact with her retirement in 1845 the era of grand ballets may be said to have closed. In 1832 she married Comte Gilbert de Voisins, by whom she had two children. Losing her savings in speculation, she afterwards supported herself in London as a teacher of deportment, especially in connexion with the ceremony of presentation at court. During the last two years of her life she stayed with her son at Marseilles, where she died in April 1884. Taglioni is frequently mentioned in the novels of Balzac; and Thackeray, in *The Newcomes*, says that the young men of that epoch "will never see anything so graceful as Taglioni in *La Sylphide*."

TAGUS (Span. *Tajo*, Portug. *Tejo*), the longest river of the Iberian Peninsula. Its length is 566 miles, of which 192 are on or within the frontier of Portugal, and the area of its basin, according to Strelbitsky, is 31,864 square miles. The basin is comparatively narrow, and the Tagus, like the other rivers of the Iberian tableland, generally flows in a rather confined valley, often at the bottom of a rocky gorge at a considerable depth below the general level of the adjacent country. The source of the river is at the height of 5225 feet above sea-level, on the western slope of the Muela de San Juan, in the south-west of the province of Teruel. Thence it flows at first north-westwards, but, after receiving the Rio Gallo on the right, it flows west, and then south-west or west-south-west, which is its general direction for the rest of its course. The rocky gorges which occur in its course (the principal being where the river is overhung on the right bank by the ancient city of Toledo, and again at the Puente del Arzobispo, near the frontier of Estremadura) all belong to the Spanish section of the river, and in this section the stream is frequently encumbered by sandy shallows or broken by rocky rapids, and is not navigable except for short distances. The Portuguese section has a quieter current, and Villavelha, the highest point to which boats can ascend, lies within the Portuguese frontier. Regular river-navigation begins only at Abrantes, a few miles below which the Tagus is greatly widened by receiving on its right bank the impetuous Zezere from the Serra da Estrelha. Passing Santarem, the highest point to which the tide ascends, and the limit of navigation for large sailing vessels and steamers, the river divides below Salvaterra into two arms, called the Tejo Novo (the only one practicable for ships) and the Mar de Pedro, and these arms enclose a deltaic formation, a low tract of marshy alluvium known as the Lezirias, traversed by several natural canals or minor branches of the river. Both these arms enter the upper end of the fine Bay of Lisbon (11½ miles long by about 7 broad), and the Tagus leaves this bay in the form of a channel 4½ miles long by 2 wide (see vol. xiv. p. 692), communicating with the ocean, but having unfortunately a bar at its mouth. On the north side of this channel stands the city of Lisbon. Only slight traces are still to be found of the gold for which the sands of the Tagus were anciently celebrated.

The narrower part of the Tagus basin lying to the south, the tributaries on the left bank are almost all mere brooks, most of which dry up in summer. The principal exception is the Rio Zatas or Sorraya, which, rising in the Serra d'Ossa, flows westwards across the plateau of Alemtejo, and joins the Mar de Pedro. The principal tributaries on the right bank, besides the Zezere, are the Jarama, descending from the tableland of New Castile a little below Aranjuez, the Alberche and the Tietar, which collect their head waters from opposite sides of the Sierra de Gredos, and the Alagon, from the rough and broken country between the Sierras de Gredos and Gata.

See vol. xix. Plate III.

TAHITI ARCHIPELAGO. The eastern Polynesian island-group generally known as the Society Islands (*Isles de la Société*, or *Taïti*) lies between 16° and 18° S. lat. and 148° and 155° W. long., and stretches for nearly 200 miles in a north-west and south-east direction; the total area does not exceed 650 square miles, of which 600 fall to Tahiti alone. To the east and north-east a channel of only 140 miles in breadth, but over 2000 fathoms in depth, separates this group from the great chain of the Low Islands, beyond which the ocean extends unbroken to America. To the west as far as Fiji—the main islands of which group lie between the same degrees of latitude as those of Tahiti—there are 1500 miles of open water. About 300 miles south-west lies Cook's Archipelago, and at the same distance south are the Austral Islands. To the north, excepting a few coral banks, there is open sea to Hawaii, a distance of 2600 miles.

Tahiti occupies a central position in the Pacific. Sydney lies about 3400 miles to the west and San Francisco about as far to the north-north-east. Honolulu, Noumea, and Auckland are each somewhere about 2400 miles away; Panama is at a distance of 4600 miles.

The archipelago consists of eleven islands, which are divided into two clusters—the Leeward and the Windward Islands—by a clear channel of 60 miles in breadth. The Leeward Islands, to which alone the name of Society Islands was given by Cook, are Tubai or Motu-iti, a small uninhabited lagoon island, the most northern of the whole archipelago; Maupiti or Mau-rua—"Double Mountain," the most western; Bora-bora (Bola-Bola of the older navigators), or Fáarui; Tahaa; Raiatea or Ulietea (Boenshea's Princessa), the largest island of this cluster, and Huahine, which approach each other very closely, and are encircled by one reef. To the Windward Islands, the Georgian Islands of the early missionaries, belong Maiaiti or Tapamanu (Wallis's Sir Charles Saunders Island and Boenshea's Pelada); Morea or Eimeo (Wallis's Duke of York Island and Boenshea's San Domingo); Tahiti—Cook's Otaheiti (probably Quiros's Sagittaria; Wallis's King George's Island, Bougainville's Nouvelle Cythère, and Boenshea's Isla d'Amat), the most southern and by far the largest of all the islands; Tetuara or Tetiaroa—"The Distant Sea" (?Quiros's Fugitiva; Bougainville's Umaitia and Boenshea's Tres Hermanos); and Matia or Maitea (?Quiros's La Dezana, Wallis's Osnaburg Island, Bougainville's Boudoir and Pic de la Boudeuse, and Boenshea's San Cristoval), which is by a degree the most eastern of the archipelago. Bellinghausen, Scilly, and Lord Howe (Mopia) are three insignificant clusters of coral islets to the north-west and west, and, like Tubai and Tetuara, are atolls. The length of the Tetuara reef ring is about six miles; it bears ten palm-covered islets, of which several are inhabited, and has one narrow boat-passage leading into the lagoon. With the exception just named, the islands, which agree very closely in geological structure, are mountainous, and present perhaps the most wonderful example of volcanic rocks to be found on the globe. They are formed of trachyte, dolerite, and basalt. There are raised coral beds high up the mountains, and lava occurs in a variety of forms, even in solid flows; but all active volcanic agency has so long ceased that the craters have been almost entirely obliterated by denudation. Hot springs are unknown, and earthquakes are slight and rare. Nevertheless, under some of these flows remains of plants and insects of species now living in the islands have been found,—a proof that the formation as well as the denudation of the country is, geologically speaking, recent. In profile the islands are rugged. A high mountain, usually with very steep peaks, forms the centre, if not the whole island; on all sides steep ridges descend to the sea, or, as is oftener the case, to a considerable belt of flat land. These mountains, excepting some stony crags and cliffs, are clothed with dense forest, the soil being exceptionally fertile. All voyagers agree that for varied beauty of form and colour the Society Islands are unsurpassed in the Pacific. Innumerable rills, fed by the fleeting clouds which circle round the high lands, gather in lovely streams, and, after heavy rains, torrents precipitate themselves in grand cascades from the mountain cliffs—a feature so striking as to have attracted the attention of all voyagers, from Wallis downwards. Round most of the islands there is a luxuriant coral growth; but, as the reefs lie at no great distance, and follow the line of the coast, the inter-island channels are safer than those of the neighbouring Tuamotus, which exhibit the atoll formation in perhaps its fullest development, and in consequence have been justly called the "Low" or "Dangerous Archipelago." Maitea, which rises from the sea as an exceedingly abrupt cone, and Tapamanu appear to be the only islands which have not their fringing and more or less completely encircling barrier-reefs.[1] The coasts are fairly indented, and, protected by these reefs, which often support a chain of green islets, afford many good harbours and safe anchorages. In this respect the Society Islands have the advantage of most of the Polynesian groups.

The island of Tahiti, in shape not unlike the figure 8, has a total length of 35 miles, a coast-line of 120, and a superficial area of 600 square miles. It is divided into two distinct portions by a short isthmus (Isthmus de Taravao) less than a mile in width, and nowhere more than 50 feet above sea-level. The southern, the peninsula of Tairabu, or Tahiti-iti (Little Tahiti), alone as large as Raiatea (after Tahiti the most important island of the group), measures 12 miles in length by 6 miles in breadth; while the northern, the circular main island of Porionuu, or Tahiti-uni (Great Tahiti), has a length of 23 miles and a width of 20. The whole island is mountainous. A little to the north-west of the centre of Great Tahiti the Society Islands attain their greatest altitude. There the double-peaked Orohena rises to 7340 feet, and Aorai, its rival, is only a few hundred feet lower. Little Tahiti cannot boast of such mountains, but its tower-like peaks are very striking. The flat land of the Tahitian coast, extending to a width of several miles—with its chain of villages, its fertile gardens, and its belt of palms, sometimes intersected by stream-fed valleys which open on the sea-shore—forms a most pleasing foreground to the grand amphitheatre-like mountain ranges. A good road surrounds the entire island, which is divided into eighteen districts, each under a chief and a municipal council of which he is president. A railroad is in contemplation. By the last census the population of the entire island was 9194, one-eighth being French and foreigners. The majority of the natives profess the Protestant religion.[1]

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[1] Darwin, *Structure of Coral Reefs*, London, 1842.

The extreme north of the island is formed by Point Venus, to the east of which lies the Bay of Matavai, and some miles still farther east Papeete, the European town and the seat of government. The beautiful harbour, of fair size and depth, is entered by two passages in the reef, Papeete to the north, 7 fathoms in depth, and Taunoa to the east, the wider and more convenient, though shallower. The town, in 1881, had a population of 3224, half of whom were French or French half-castes, but at least a dozen different nations were represented by the 800 whites. The little city is decidedly French in character. "Papeete is the emporium of trade for the products of the South Sea Islands east of 160° E. long. Small schooners of from 20 to 50 tons burden bring the produce of the various groups to Tahiti, whence they are shipped direct for Europe, either by Cape Horn or the Cape of Good Hope, according to the season of the year. These schooners, of which about twenty fly the Tahitian flag, take back portions of the cargoes of vessels arriving from Europe for sale or barter amongst the islands. The chief exports are cocoa-nuts, mother-of-pearl, cotton, and some sugar, mainly to England and Germany, very little to France; and oranges, trepang (for China), and edible fungus to California."[2] Many whalers formerly visited Papeete harbour, but for some years there has been a steady diminution in their number. In 1845 forty-eight called there, in 1860 five, and none in 1874. Commerce has also in other respects decreased. Three sugar-mills with distilleries attached, two cotton manufactories, and a manufactory of cocoa-nut fibre were at work in 1886. Oranges and vanilla are profitably grown. The timber of the country is hardly used, great quantities of Californian pine being imported. Oxen and hogs are reared. The artificial culture of the pearl oyster is beginning to be discussed, but the pearls of the Society Islands are not to be compared in number or quality to those of the Tuamotus. A good deal of trading in fruit, fibre, shell, &c., is carried on with the natives, but still mainly by barter. The competition of the Chinese immigrants, of whom in 1886 there were already 400 on Tahiti and Eimeo, is beginning to be keenly felt. The importation of "labour," chiefly for the plantations, from other Polynesian islands was placed under Government control in 1862. The Tahitians themselves prefer handicrafts to agricultural work, and many are employed as artisans by European masters, who find them as handy and industrious as their own countrymen, but for domestic service they show no aptitude. Papeete is in direct sailing communication with San Francisco, and with Sydney by a Government steamer which calls every five months; also with France by Bordeaux steamers which touch on their way to Noumea.[3]

Climate.—The seasons are not well defined. Damp is excessive; there is little variation in the weather, which, though hot, is nevertheless not depressing, and the climate for the tropics must be considered remarkably healthy. The rainfall is largest between December and April, but there is so much at other times of the year also that these months hardly deserve the name of the rainy season. During this period north-west winds are frequent, continuing at times for weeks, and there are thunderstorms and hurricanes, though they are not nearly so destructive as in some of the neighbouring islands. During the eight drier and cooler months south-east winds (corresponding with the trades) prevail, but there are southerly winds which bring rain, and even westerly breezes are not unfrequent. The mean temperature for the year is 77° F.; maximum 84°, minimum 69°. The average rainfall from December to March (4 months) is 29 inches; from April to November (8 months), 19 inches. The above observations apply to the coast only.

Fauna.—Neither the zoology nor the botany of the archipelago has been thoroughly investigated. Mammalians, as in other Polynesian islands, are restricted to a few species of bats (mostly of the genus *Pteropus*), rats, and mice, none of them peculiar. Of domestic animals, the pig and the dog—the former a small breed which quickly disappeared before the stronger European strains—were plentiful even in Wallis's days. The ornithology is very poor as compared with that of the Western Pacific; and, in marked contrast to the isolated Hawaiian archipelago, the Society Islands possess no peculiar genera and but few peculiar species. They claim, however, a thrush, several small parrots of great beauty, doves, pigeons, rails, and a sandpiper. Of this sandpiper, *Tringa leucoptera*, which, with many of the birds here mentioned, was discovered as far back as Cook's stay in the islands, only one specimen (now in the Leyden museum) is known to exist; and of the rest, their range being often limited to one portion of a small island, several species are (through the increase in the number of cats, &c.) threatened with extermination. A jungle-fowl (var. of *Gallus bankiva*) is found in the mountains, but as domesticated fowls were abundant, even when Tahiti was first discovered by Europeans, these wild birds are doubtless the offspring of tame birds, probably imported with the pigs and dogs by Malay vessels. There are no peculiar reptiles, and batrachians are entirely wanting. The lagoons swarm with fish of many species. Insects are poor in species, though some of them are indigenous. Crustaceans and molluscs, on the other hand, are well represented; worms, echinoderms, and corals comparatively poorly. A noteworthy feature of Tahitian conchology is the number of peculiar species belonging to the genus *Partula*, almost every valley being the habitat of a distinct form.[4]

Flora.—This, though luxuriant, is not very rich. Like the zoology, it is much poorer than that of the more western groups of the Pacific. *Metrosideros*, *Melastoma*, and *Acacia* are the only links which this typically Polynesian region has retained to join it to Australia. Four genera are peculiar, of which three are claimed by the *Compositæ* and *Lobeliaceæ*, orders characteristic of Hawaii. It is rich in trees, shrubs, and hardwood plants, poor in the smaller undergrowth. Orchids, including some beautiful species, and ferns are abundant; but, here as in Polynesia generally, *Rubiaceæ* is the order best represented. Remarkable are the banana thickets, which, chiefly on Tahiti, grow at an altitude of from 3000 to 5000 feet. Along the shore—in some places almost to the extinction of all native growth—many exotics have established themselves; and a great variety of fruit-bearing and other useful trees have been successfully introduced into most of the islands.[5]

Inhabitants.—The Tahitians are a typical Polynesian race, closely connected physically with the Marquesans and Rarotongans, but widely divided from them in many of their customs. The dialects, also, of the three groups are different, the Tahitian being perhaps the softest in all Oceania. The women rank with the most beautiful of the Pacific, though the accounts given of them by early voyagers are much exaggerated; and for general symmetry of form the people are unsurpassed by any race in the world. Even now in its decadence, after generations of drunkenness and European disease and vice, grafted on inborn indolence and licentiousness, many tall and robust people (6 feet and even upwards in height) are to be found. The women, as a rule, are small in proportion to the men. Men and women of good birth can generally be distinguished by their height and fairness, and often, even in early age, by their enormous corpulence. The skin varies from a very light olive to a full dark brown. The wavy or curly hair and the expressive eyes are black, or nearly so; the mouth is large, but well-shaped and set with beautiful teeth; the nose broad (formerly flattened in infancy by artificial means); and the chin well developed. So long as the native costume was retained, the *tiputa*, an oblong piece of bark cloth with a hole in its centre for the head, and the *paru*, a plain piece of cloth round the loins, were worn alike by men and women of the higher classes. Men of all ranks wore, with or without these, the *maro*, or T bandage. The women concealed their breasts except in the company of their superiors, when etiquette demanded that inferiors of both sexes should uncover the upper part of the body. The chiefs wore short feather cloaks, not unlike those of the Hawaiians, and beautiful semicircular breastplates, dexterously interwoven with the black plumage of the frigate bird, with crimson feathers, and with sharks' teeth; also most elaborate special dresses as a sign of mourning. The priests had strange cylindrical hats, made of wicker-work and over a yard in height. Circumcision, and in both sexes tattooing, were generally practised, and much significance was attached to some of the marks. The houses (*fare*) were long, low, and open at the sides. Household utensils were few—plain round wooden dishes, sometimes on legs, cocoa-nut shells, baskets, &c. Low stools and head-rests were used. Pottery being unknown, all food was baked in the "native oven" or roasted over the fire. Their chief musical instruments were the nose-flute (*vivo*)—often used as the accompaniment of song—and the drum (*pahu*). Of the latter, those kept in the *marai* were huge elaborately carved hollow cylinders of wood, the upper end of which was covered with sharks' skin. Conch-shells (*bu*) were also used. Tahitian stone adzes, which are greatly inferior in finish to those of the Hervey Islands, are, like the adzes of eastern Polynesia in general, distinguished from those of western Polynesia by their triangular section and adaptation to a socket.

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[1] The best chart of Tahiti is that published by the French Government in 1876, and corrected down to 1881. Morea is given on the same sheet.

[2] Wallace, *Australasia*, London, 1884.

[3] For fuller statistics, see *Notices Coloniales*, Paris, 1886, vol. ii.

[4] Finsch and Hartlaub, *Fauna Central-Polynesiens*, Halle, 1867.

[5] De Castillo, *Illustrationes Floræ Insularum Maris Pacifici*, Paris, 1886.

Slings were perhaps the favourite weapons of the Tahitians; they had also plain spears expanding into a wide blade, and clubs. The bow and arrow seem only to have been used in certain ceremonial games (*tea*). Their canoes (*vaa*), from 20 to 70 feet in length, were double or single, and provided with sail and outriggers. They were not well finished, but the high curved sterns, rising sometimes to a height of 20 feet, of those destined to carry the images of their gods, were carved with strange figures and hung with feathers.[1] Cannibalism is unknown in the Society Islands, though some ceremonies which were performed in connexion with human sacrifices may possibly be survivals of this practice. The staple food of the islanders consisted of the bread-fruit, the taro-root, the yam, the sweet potato, and in some districts the wild plantain (*fei*); but they also ate much fish (the turtle was considered sacred food), as well as pigs and dogs, though of the latter, as pets, the women were so fond as to suckle the puppies sometimes even to the exclusion of their own children. *Popoi* was a favourite dish made of bananas and cocoa-nut. Kava (*ava*), which was prepared in the usual Polynesian manner, was drunk, but in moderate quantities and only by the chiefs.

Tahitians were good fishermen and bold seamen. They steered by the stars, of which they distinguished many constellations. The land was carefully tended and the fields well irrigated. Three great classes were recognized:—(1) the *huiari*, of divine origin, which included only the suzerain (*arirai*), who bore a semi-sacred as well as a political character, and the reigning chiefs of districts; (2) the *bue-raatira*, proprietors and cultivators of inherited land, who also built canoes, made arms, &c.; to these two classes also belonged the priests (*tahora*), who were medicine-men as well; (3) the *manahune*, fishers, artisans, &c., and slaves (*titi*). As wars and infanticide depopulated the island this class gradually acquired land and with it certain privileges. Rank is hereditary and determined by primogeniture, not necessarily in the male line. The firstborn of an arirai received at birth the title of *otu*; the father, who was the first to pay homage to his own child, then abdicated, and henceforth took up the position of regent. It is easy to see that, while this custom tended to keep honours within a family, it may have encouraged the practice of infanticide, which was common in all grades of society when Tahiti was first visited by Europeans. The age at which the otu's authority became real varied according to his own abilities and the will of his subjects. Though arbitrary, the power of the arirai was limited by the power of his vassals, the district chiefs (*raatiras*), who ruled absolutely over their respective districts, and who might be of as good blood as the arirai himself. The arirai had a councillor, but was alone responsible for any act. The bi-insular form of Tahiti promoted the independence of the chiefs, and war was rarely declared or an army or fleet despatched without the raatiras being first summoned to council. Without their favour nothing could be accomplished, for their power over their own people was absolute. The form of government was thus strictly feudal in character, but it gradually centralized into a monarchy, which, in the person of Pomare II., the English missionaries greatly helped to regulate and strengthen. The arirai sent his commands by a messenger (*vea*) whose credentials were a tuft of cocoa-nut film. This tuft was returned intact as a sign of assent or torn in token of refusal. After the chief the wife ranked first, and then his brother. The arirai was carried on the shoulders of his subjects, and chiefs were not allowed to feed themselves. Women always ate apart. Their places of worship (*marai*)—national, local, or private—were square tree-surrounded enclosures. They each had a single entrance, and contained several small courts, within which were houses for the images and attendant priests. A pyramidal stone structure, on which were the actual altars, stood at the further end of the square. The marais were also used as places of sepulture of chiefs, whose embalmed bodies, after being exposed for a time, were buried in a crouching position. Their skulls, however, were kept in the houses of their nearest relations. In the great marai at Atahura the stone structure was 270 feet long, 94 feet wide, and 50 feet high, and its summit was reached by a flight of steps, built of hewn coral and basalt. Sacrificial offerings, including human sacrifices, formed a prominent part of Tahitian worship. An eye of the victim was offered to the arirai, and placed within his mouth by the officiating priest. Every household possessed its own guardian spirits (*tii*), but there were several superior divinities, of which, at the beginning of this century, Oro was the most venerated. The images, which are less remarkable than those of Hawaii, were rough representations of the human form carved in wood. Some were covered from head to foot with small human figures cut in relief; others were mere sticks clothed with feathers. The *areoi*, a licentious association of strolling players, men and women, which numbered among its ranks the highest chiefs, and practised infanticide, was a special feature of Tahitian society.

The Tahitians are light-hearted, frivolous, courteous, and generous; but with these traits are blended deceit, irritability, and cruelty, which formerly reached an unexampled degree of savage brutality. Their notions of morality were never, according to our ideas, very precise; and their customs, such as the *tayo*, or exchange of name with the rights which it carried over the wife of the giver of the name and all her female relations, seemed to the earlier European observer strangely revolting. It would appear, however, that with the introduction of the vices of civilization such limitations as their primitive morality recognized have disappeared and all self-respect has been lost. Especially characteristic were the elaborate costume-dances (*heivas*) performed by women. Besides dancing, the singing of songs (*pehe*), and the recitation of historical and mythical ballads (*ubus*), the natives had also a variety of sports and games. During the periodical seasons of rejoicing wrestling (*maona*), boxing (*moto*), and spear-throwing (*vero patia*) matches, with foot and canoe-races, were held; also sham fights and naval reviews. They had several games in which a ball was used,—one, *apai*, not unlike our bandy, while another, *tuiraa* (played chiefly by women), was a kind of football; but surf-swimming (*faahee*) was perhaps the most favourite sport with both sexes. Kites were known. Cock-fighting (*faatitoraamoa*) was much practised.

Discovery and Exploration.—There is little doubt that the main island and some other members of the group were visited by the Spaniard Pedro Fernandez de Quiros in February 1607. They were rediscovered in June 1767 by Wallis in the "Dolphin," who took nominal possession of Tahiti for George III. and named it after him. In the following year Bougainville visited Tahiti, claimed it as French, and called it La Nouvelle Cythère. With Tetuara (called by him Umaitia) and Eimeo it makes up the Archipel de Bourbon of his most inaccurate chart. Almost all we know of the early state of the islands is, however, due to Captain Cook's visits in 1769, 1773, 1774, and 1777. The name of Society Islands was given to the Leeward group on his first voyage in honour of the Royal Society. In 1774 Tahiti was also visited by two Spanish vessels, which left two priests, who remained for ten months on the island. The Spaniards named it Isla d'Amat. The islands were again visited in 1788 by the "Lady Penrhyn." Bligh in the "Bounty" spent five months on the island in the same year, and it was revisited by that ship after the famous mutiny. At this time the leading chief was Pomare, whose family had been pre-eminent in the island for more than a century. Aided by sixteen of the "Bounty" mutineers, and armed with guns procured from Bligh and a Swedish vessel, Pomare greatly strengthened his power and brought to a successful close a long struggle with Eimeo. In 1791 the "Pandora" carried off fourteen of the "Bounty" mutineers, and from this time forward visits were frequent.

Missions.—The attempt of the Spaniards in 1774 was followed by the settlement of twenty-five persons brought in 1797 by the missionary ship "Duff." Though befriended by Pomare I. (who lived till 1805), they had many difficulties, especially from the constant wars, and at length they fled with Pomare II. to Eimeo and ultimately to New South Wales, returning in 1812 when Pomare renounced heathenism. In 1815 he regained his power in Tahiti. For a time the missionaries made good progress,—a printing press was established (1817), and coffee, cotton, and sugar were planted (1819); but soon there came a serious relapse into heathen practices and immorality. Pomare II. died of drink in 1824. His successor Pomare III. died in 1827, and was succeeded by his half-sister Aimata, the unfortunate "Queen Pomare." In 1828 a new fanatical sect, the "Mamaia," arose, which gave much trouble to the missions and whose influence is still felt. The leader proclaimed that he was Jesus Christ, and promised to his followers a sensual paradise.

French Annexation.—In 1836 the French Catholic missionaries in Mangareva attempted to open a mission in Tahiti. Queen Pomare, advised by the English missionary and consul Pritchard, refused her consent, and removed by force two priests who had landed surreptitiously and to whom many of the opposition party in the state had rallied. In 1838 a French frigate appeared, under the command of M. Du Petit-Thouars, and extorted from Pomare the right of settlement for Frenchmen of every profession. Other acts of interference followed, and at length, in 1842, Admiral du Petit-Thouars procured the signature of a document placing the islands under French protection, the authority of the queen and chiefs being expressly reserved. In 1843 Petit-Thouars reappeared, and, alleging that the treaty of 1842 had not been duly carried out, deposed the queen and took possession of the islands. His high-handed action was not countenanced by the French Government, but, while it professed not to sanction the annexation, it did not retrace the steps taken. Two years were spent in reducing the party in the islands opposed to French rule; an attempt to conquer the western islands failed; and at length, by agreement with England, France promised to return to the plan of a protectorate and leave the western islands to their rightful owners. The London missionaries were replaced by French Protestants, but neither they nor the priests have been very successful, possibly because French is a compulsory subject in the Government schools. In 1880

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[1] The museum of the London Missionary Society and the British Museum contain important collections of Tahitian images, dresses, weapons, &c.

Tahiti, including Eimeo, was proclaimed a French colony. It is the residence of the governor-general of the French dependencies in the Pacific.

Literature.—The following list includes the books which seem most to deserve mention: Hawkesworth's *Voyages*, especially Wallis's Voyage, H.M.S. "Dolphin," in vol. i., London, 1773; Cook's *Three Voyages*, with Forster's account of the second voyage; Freycinet, *Voyage de la Coquille*, and Lesson's account of the same voyage, Paris, 1839; Bennett, *Whaling Voyage*, London, 1840. For manners and customs of the natives, see Cook, Duff, Ellis. For modern statistics, see Desgraz, *La Tahiti*, Paris, 1848; *Notices Coloniales*, Paris, 1886, vol. ii. For the early history of the islands, see Ellis, *Polynesian Researches*, London, 1829; Vincendon-Dumoulin and Desgraz, *Îles Taiti*, Paris, 1844. For mission history, see *Voyage of the Duff*, London, 1799; Ellis; Williams, *Missionary Enterprise in the South Sea Islands*, London, 1839. For the French occupation, see Moerenhout, *Voyage aux Îles du Grand Océan*, Paris, 1837; Vincendon-Dumoulin and Desgraz; Pritchard, *Polynesian Reminiscences*, London, 1866. (A. V. H.)

TAIWAN. See FORMOSA.

TAJAK, TAJIK, or TAUSIK, a term originally occurring in the Pahlavi writings, and explained to mean, first, the Arabs in general, then their descendants born in Persia and elsewhere out of Arabia, and, lastly, the Persians in general and their descendants born in Turkestán and elsewhere out of Persia. Tajak has thus come to be the collective name of all communities of Iranian stock and Persian speech, wherever found in Central Asia. These are co-extensive with the former eastward and northward limits of the Persian empire; but, since the ascendency of the Tûrki races, they have become the subject element in Turkestán, Afghánistán, Bokhára, Khiva, Kashgaria, while still politically dominant in Badakhshán, Wakhán, Darwáz, Kost, and Karatéghin. In most of these places the Tajaks, with the kindred Galchas, seem to form the bulk of the population, the distinction being that *Tajak* is applied rather to the settled and more civilized lowlanders of modern Persian speech, *Galcha* to the ruder highlanders of Ferghána, Kohistán, Wakhán, &c., who speak either archaic forms of Persian or dialects intermediate between the Iranian and Sanskritic (Indian) branches of the Aryan linguistic family. The Tajaks are thus a settled Iranian people, agriculturists in the country, traders and artisans in the towns, and are essentially "Parsiván," that is, men of Persian speech,—this term, however, being more specially applied to those of Afghánistán. But, although mainly of Iranian stock, with light complexion and regular features, the Tajaks claim Arab descent, regarding the district about Baghdád as their primeval home, and considering themselves the descendants of the Arabs who overran Central Asia in the first century of the Flight. At the same time, "it is evident that the inhabitants of the greater part of this region (Central Asia) must from an early period have come in contact with the successive waves of Turkish (Tûrki) and even Mongol population which broke over them; accordingly we find that, although the type is essentially Iranian, it has undergone a certain modification, . . . face, though obviously Persian, is more oblong than that of the Turk, more or less heavy cheeks, thick nose, large mouth, wide forehead, . . . middle height, powerful frame, and broad shoulders, . . . dark hair, but among the Galchas a few fair people are found" (Capt. J. M. Trotter, *Bokhára*, p. 169). The term Tajak must also be distinguished from *Sarte*, the latter simply meaning "trader" or "shopkeeper," and being applied indiscriminately to the settled as opposed to the nomad element, and especially to the urban populations, of whatever race, in Central Asia.[1] The Tajaks are known as Tâts on the west side of the Caspian (Baku, Lenkoran, &c.).

TAKA. See NUBIA.

TALAVERA DE LA REINA, a town of Spain, in the province of Toledo, is situated on the right bank of the Tagus, and on the railway from Madrid to Caceres, some 40 miles below Toledo and 64 miles south-east from Madrid. It was formerly surrounded by a triple circumvallation, portions of which still remain. It has no buildings of special interest, and its commerce and manufactures are inconsiderable. The population within the municipal limits in 1877 was 10,029.

Talavera is the birthplace (1536) of Mariana the historian. Wellington overcame a superior French force here on July 27-28, 1809.

TALBOT, FAMILY OF. Apart from its achievements, this is one of the few families in the English aristocracy which traces alike its descent and its surname from the Norman conquerors of England; and it may really be said that there has hardly been a time during the last eight hundred years in which the Talbots have not been of considerable account in public life. Yet in some periods they appear rather as a potential influence, while at certain marked epochs they stand out among the most prominent actors in English history. The name of Richard Talbot occurs in Domesday Book as the holder of nine hides of land in Bedfordshire under Walter Giffard, earl of Buckingham. There is no evidence that he came over to England with the Conqueror himself; and, as he did not hold of the king *in capite*, it is clear that he was not a leader. His son Geoffrey Talbot took part with the empress Maud against King Stephen. But apparently it was another son Hugh who continued the line; of whom it is recorded that he held the castle of Plessi against Henry I. for Hugh de Gournay, and afterwards became a monk at Beaubec in Normandy. His son Richard obtained from Henry II. the lordship of Linton in Herefordshire, and from Richard I. the custody of Ludlow castle; and his descendants for some generations appear to have been wardens of various castles on the borders of Wales. Under Edward II. a Gilbert Talbot was head of the house, and invaded Scotland in the king's company, but afterwards took part with Thomas of Lancaster against the king. He, however, was pardoned, and obtained from Edward III. a confirmation of the grant of the manor of Linton and other lands to himself and his heirs.

His son Richard, who had married a daughter of John Comyn of Badenoch, laid claim to certain lands in Scotland in her right, and, when restrained from entering that country by land (Edward III. having then made an alliance with King David), he joined in a successful expedition which invaded it by sea in the interests of Edward Baliol. Three years later he was taken prisoner in Scotland, and redeemed for 2000 marks, after which the king made him governor of Berwick. He took part also in Edward's wars against France, as did likewise his son Gilbert, who succeeded him. At this time the family possessed lands in the counties of Oxford, Gloucester, Hereford, and Kent, and a little later in Berkshire, Wilts, Salop, and Essex. Another Gilbert Talbot, grandson of the last, claimed to carry the great spurs at the coronation of Henry V., and had a commission to receive the submission of Owen Glendower and his adherents. He also distinguished himself in the invasion of Normandy. He was twice married, his second wife being a Portuguese lady, but he left no male issue, and was succeeded by his brother John, the special hero of the family.

Hitherto the head of the house had borne the name of Lord Talbot; but this John, after obtaining by marriage the title of Lord Furnivall, was for his distinguished actions created earl of Shrewsbury. He made his name so terrible in France that for several generations afterwards French mothers used to threaten refractory children that the Talbots would come if they were not quiet (Brown's *Venetian Calendar*, ii. 75). He rescued Maine from the

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[1] "Quand un Usbeg est devenu complètement sédentaire . . . il devient *Sarte*; le mot *Sarte* n'est donc pas une appellation ethnique" (Charles de Ujfalvy in *Bul. Soc. Géogr.*, June 1878). But the Tajaks, being always settled, were the first to be known as Sartes; whence the still prevalent erroneous impression that the word had a racial meaning, implying an Iranian as opposed to a Tûrki element. Nevertheless there is a certain local etiquette observed in the use of the two words *Tajak* and *Sarte*, embodied in the popular saying: "When a stranger presents himself and eats your bread, call him a *Tajak*; when he is gone you may call him a *Sarte*."

French and took Pontoise; but his own capture by the Maid of Orleans was what probably discouraged the English most of all in their disasters beyond sea. He was exchanged for an eminent French prisoner and a heavy ransom besides. He served also several times as lieutenant of Ireland, and in 1446 was created earl of Wexford and of Waterford, in addition to the title of Shrewsbury, which had been conferred upon him in 1442. He died in 1453, in an unsuccessful expedition for the recovery of Guienne, which had lately submitted to the French. His son John, Viscount Lisle, was slain along with him in the same fatal battle.

But, besides his martial exploits which live in history, this John claims some attention for his family alliances. His first wife Maud, a granddaughter of Thomas, Lord Furnivall, brought him the castle of Sheffield as part of her inheritance, and he was accordingly summoned to parliament in the days of Henry IV. as John Talbot of Hallamshire, otherwise Lord Furnivall, more than thirty years before he was made earl of Shrewsbury. The property remained in the hands of his descendants, and became a favourite residence of the family during the whole of the Tudor era; and, but for the death in 1616 of Gilbert, seventh earl of Shrewsbury, without male issue, it has been remarked by Hunter that Sheffield might have remained much longer a centre of feudal magnificence rather than of commerce and manufactures. The second wife of John, earl of Shrewsbury, was Margaret, the eldest of three daughters of Richard Beauchamp, earl of Warwick, by *his* second wife, a daughter of Thomas, Lord Berkeley. By her he obtained a third part of the Berkeley property; and, though she did not become the mother of a line of earls, her eldest son, John Talbot, was created Viscount Lisle, and it was he who fell along with his father at the disastrous battle of Chatillon in Gascony. His son Thomas, who inherited the title of Viscount Lisle, was also slain at the early age of twenty-two in a feudal contest with Lord Berkeley, arising out of a dispute as to the possession of Berkeley castle, at Nibley Green, near Wotton-under-Edge, March 20, 1470; and the title was afterwards conferred on Edward Grey, the husband of one of his two sisters.

John, the second earl of Shrewsbury, was the first earl's son by his first wife. He had been knighted at Leicester in 1426 along with the infant king Henry VI., had served in the wars of France, and been made chancellor of Ireland during his father's lifetime, when he was only Lord Talbot. Afterwards he was made lord high treasurer of England, and in 1459 was rewarded for his services to the house of Lancaster with a grant of 100 marks a year out of the lordship of Wakefield, forfeited by Richard, duke of York. But next year he and his brother Christopher were slain at the battle of Northampton, fighting in the cause of Henry VI. His son John succeeded him, and then his grandson George, who fought for Henry VII. at Stoke, and whom King Henry VIII. sent as his lieutenant against the rebels in that most formidable insurrection, the Pilgrimage of Grace. But perhaps the thing which most redounds to his credit is the humanity with which (as related by Cavendish) he received the fallen Cardinal Wolsey into his house at Sheffield when he was on his way up to London as a state prisoner, and endeavoured to remove those gloomy anticipations of his fate which in fact brought on his last illness.

Francis, the fifth earl, took a leading part in the invasions of Scotland under Henry VIII. and Edward VI., and was one of the two peers who alone opposed the bill for abolishing the pope's jurisdiction under Elizabeth. His son George, who succeeded, was the earl to whom the custody of Mary Stuart was committed, his delicate and onerous task being rendered all the more difficult for him by the intrigues of his bold, ambitious second wife, Bess of Hardwick, the builder of Chatsworth, who had married three husbands before her union with him. Two sons of this last earl succeeded one another, and the title then devolved, for want of male issue, on the lineal descendants of Sir Gilbert Talbot of Grafton in Worcestershire, third son of John, the second earl. This Sir Gilbert had fought for Henry VII. at Bosworth, where he was severely wounded, was knighted on the field, and was throughout one of the first Tudor's most trusted councillors. He fought also at Stoke against the insurgents with Lambert Simnel, was made a knight banneret, governor of Calais, and lord chamberlain.

The ninth earl, George, descended from this Gilbert, is not distinguished by any prominent actions. He died unmarried, and his brother, who followed next, was succeeded by his grandson Francis, chiefly memorable for his unhappy fate. His second wife, a daughter of the earl of Cardigan, was seduced by the duke of Buckingham, whom the outraged husband challenged to a duel. The countess, it is said, was present at the scene, and held Buckingham's horse in the disguise of a page, saw her husband killed, and then clasped her lover in her arms, receiving blood-stains upon her dress from the embrace. Charles, the twelfth earl, son of this unfortunate nobleman, was raised by William III. to the dignity of a duke for his important diplomatic services. His position in those slippery times was altogether exceptional. Abandoning the religion of his ancestors he became a Protestant, was one of the seven who signed the invitation to William of Orange to come over, and was continually consulted by him on state affairs after he became king. Yet, being apparently of a very sensitive disposition, he seems to have at times repented what he had done, and even corresponded with James at St Germain; yet again, in times of danger, he was as ready as ever to stake his life and fortunes in the service of his country to preserve the new settlement. It was apparently his extreme sensitiveness that caused him to be spoken of as "the king of hearts." In 1694 he was created marquis of Alton and duke of Shrewsbury, but as he left no son these titles died along with him, and the earldom of Shrewsbury devolved on his cousin Gilbert, a Roman Catholic priest.

From this time the direct line of Sir Gilbert Talbot of Grafton began to fail. A nephew three times succeeded to an uncle, and then the title devolved upon a cousin, who died unmarried in 1856. On the death of this cousin the descent of the title was for a short time in dispute, and the lands were claimed for the infant son of the duke of Norfolk under the will of the last earl; but the courts decided that, under a private Act obtained by the duke of Shrewsbury in the sixth year of George I., the title and estates must go together, and the true successor to the earldom was found in Earl Talbot, the head of another line of the descendants of Sir Gilbert Talbot of Grafton, sprung from a second marriage of Sir Gilbert's son, Sir John Talbot of Albrighton. The head of this family in the beginning of the last century was a divine of some mark, who died bishop of Durham in 1730. His son Charles, who filled the office of lord chancellor, was created Baron Talbot of Hensol in Glamorganshire in 1733; and his son again was advanced to the dignity of Earl Talbot in 1761, to which was added that of Baron Dynevor in 1780. Then succeeded a nephew, who was also created Viscount Ingestre, and assumed by royal licence the surname of Chetwynd before Talbot, from his mother.

The Earl Talbot who successfully claimed the Shrewsbury title (as the eighteenth earl) was the present earl's grandfather, and all the titles just mentioned have been united in his line ever since. (J. GA.)

TALBOT, WILLIAM HENRY FOX (1800-1877), a discoverer in photography, was the only child of William Davenport Talbot, of Laycock Abbey, Wilts, and of Lady Elizabeth Fox Strangways, daughter of the second earl of Ilchester. He was born in February 1800, and educated at Harrow and at Trinity College, Cambridge, where he gained the Porson prize in 1820, and graduated as twelfth wrangler in 1821. From 1822 to 1872 he frequently communicated papers to the Royal Society, many of them on mathematical subjects. At an early period he had begun his optical researches, which were to have such important results in connexion with photography. To the *Edinburgh Journal of Science* in 1826 he contributed a paper on "Some Experiments on Coloured Flame"; to the *Quarterly Journal of Science* in 1827 a paper on "Monochromatic Light"; and to the *Philosophical Magazine* a number of papers on chemical subjects, including one on "Chemical Changes of Colour." Before Daguerre exhibited in 1839 pictures taken by the sun, Talbot had obtained similar success, and as soon as Daguerre's discoveries were whispered communicated the results of his experiments to the Royal Society (see PHOTOGRAPHY, vol. xviii. p. 824). In 1841 he made known his discovery of the calotype process, but after the discovery of the collodion process by Scott Archer, with whom he had a lawsuit in reference to his patent rights, he relinquished this field of inquiry. For his discoveries, the narrative of which is detailed in his *Pencil of Nature* (1844), he received in 1842 the medal of the Royal Society. While engaged in his scientific researches he devoted a considerable portion of his time to archæology, and this field of inquiry latterly occupied his chief attention. Besides reading papers on these subjects before the Royal Society of Literature and the Society of Biblical Archæology, he published *Hermes, or Classical and Antiquarian Researches* (1838-39), and *Illustrations of the Antiquity of the Book of Genesis* (1839). With Sir Henry Rawlinson and Dr Hincks he shares the honour of having been one of the first decipherers of the cuneiform inscriptions of Nineveh. He was also the author of *English Etymologies* (1846). He died at Laycock Abbey, 17th September 1877.

TALC. See GEOLOGY, vol. x. p. 228, and MINERALOGY, vol. xvi. p. 414.

TALCA, a town of Chili, capital of the province of Talca, is situated on the Claro, a tributary of the Maule, nearly due south of Santiago, with which it is connected by rail. The town has a lyceum and some woollen manufactures (especially of "ponchos"). In 1875 the population numbered 17,496, and in 1885 about 19,000

TALENT. See NUMISMATICS, vol. xvii. p. 631.

TALES are, in the usual acceptance of the word, fictitious narratives, long or short, ancient or modern. In this article "tale" is used in a stricter sense, as equivalent to the German "Volks-märchen" or the French "conte populaire." Thus understood, popular tales mean the stories handed down by oral tradition from an unknown antiquity, among savage and civilized peoples. So understood, popular tales are a subject in mythology, and indeed in the general study of the development of man, of which the full interest and importance is scarcely yet recognized. Popular tales won their way into literature, it is true, at a very distant period. The Homeric epics, especially the *Odyssey*, contain adventures which are manifestly parts of the general human stock of popular narrative. Other examples are found in the *Rigveda*, and in the myths which were handled by the Greek dramatists. Collections of popular tales, more or less subjected to conscious literary treatment, are found in Sanskrit, as in the work of Somadeva, whose *Kathá Sarit Ságara*, or "Ocean of the Streams of Story," has been translated by Mr Tawney (Calcutta, 1880). The THOUSAND AND ONE NIGHTS (*q.v.*) are full of popular tales, and popular tales are the staple of the mediæval *Gesta Romanorum*, and of the collections of Straparola and other Italian conteurs. In all these and similar gatherings the story, long circulated from mouth to mouth among the people, is handled with conscious art, and little but the general outline of plot and character of incident can be regarded as original. In the *Histoires ou Contes du Temps Passé* of Perrault (Elzevir, Amsterdam, 1697; the Parisian edition is of the same date) we have one of the earliest gatherings of tales which were taken down in their nursery shape as they were told by nurses to children. This at least seems probable, though M. Alfred Maury thinks Perrault drew from literary sources. Perrault attributed the composition to his son, P. Darmaucour, at that time a child, and this pretext enabled him to give his stories in a simple and almost popular guise. In the dedication signed by the boy, Perrault offers remarks which really do throw a certain light on the origin and characteristics of "märchen." He says, "Ils renferment tous une morale très sensée . . . . . et donnent une image de ce qui se passe dans les moindres familles, où la louable impatience d'instruire les enfans fait imaginer des histoires dépourvûes de raison pour s'accomoder à ces mêmes enfants, qui n'en ont pas encore." It seems that popular tales in many cases probably owe their origin to the desire of enforcing a moral or practical lesson. It appears that their irrational and "infantile" character—"dépourvûes de raison"—is derived from their origin, if not actually among children, at least among childlike peoples, who have not arrived at "raison," that is, at the scientific and modern conception of the world and of the nature of man.

The success of Perrault's popular tales brought the genre into literary fashion, and the Comtesse d'Aulnoy invented, or in some cases adapted, "contes," which still retain a great popularity. But the precise and scientific collection of tales from the lips of the people is not much earlier than our century. The chief impulse to the study was given by the brothers Grimm. The first edition of their *Kinder- und Haus-Märchen* was published in 1812. The English reader will find a very considerable bibliography of popular tales, as known to the Grimms, in Mrs Alfred Hunt's translation, *Grimm's Household Tales, with Notes* (London, 1884). "How unique was our collection when it first appeared," they exclaim, and now merely to enumerate the books of such traditions would occupy much space. In addition to the märchen of Indo-European peoples, the Grimms became acquainted with some Malay stories, some narratives of Bechuanas, Negroes, American Indians, and Finnish, Esthonian, and Magyar stories. Thus the Grimms' knowledge of non-European märchen was extremely slight. It enabled them, however, to observe the increase of refinement "in proportion as gentler and more humane manners develop themselves," the monstrosities of Finnish and Red-Indian fancy gradually fading in the narratives of Germans and Italians. The Grimms notice that the evolution of popular narrative resembles the evolution of the art of sculpture, from the South-Sea idol to the frieze of the Parthenon, "from the strongly marked, thin, even ugly, but highly expressive forms of its earliest stages to those which possess external beauty of mould." Since the Grimms' time our knowledge of the popular tales of non-European races has been greatly enriched. We possess numbers of North-American, Brazilian, Zulu, Swahili, Eskimo, Samoan, Maori, Kaffir, Malagasy, Bushman, and even Australian märchen, and can study them in comparison with the stories of Hesse, of the West Highlands of Scotland, of Scandinavia.

While the popular romances of races of all colours must be examined together, another element in this subject is not less important. It had probably been often observed before, but the fact was brought out most vividly by Von Hahn (*Griechische und albanesische Märchen*, Leipsic, 1864), that the popular tales of European races turn on the same incidents, and display the same succession of situations, the same characters, and the same plots, as are familiar in the ancient epic literature of Greece, India, Germany, and Scandinavia. The epics are either fully-developed märchen evolved by the literary genius of poets and saga-men, or the märchen are degenerate and broken-down memories of the epics and sagas, or perhaps there may be examples of both processes. The second view,—namely, that the popular tales are, so to speak, the scattered grains of gold of which the epic is the original "pocket" or "placer,"—the belief that the märchen are the detritus of the saga,—was for a long time prevalent. But a variety of arguments enforce the opposite conclusion, namely, that the märchen are essentially earlier in character than the epic, which is the final form to which they have been wrought by the genius of Homer or of some other remote yet cultivated poet. If this view be accepted, the evolution of märchen and of certain myths has passed through the following stages:—

(1) The popular tale, as current among the uncultivated peoples, such as Iroquois, Zulus, Bushmen, Samoans, Eskimo, and Samoyedes. This tale will reflect the mental condition of rude peoples, and will be full of monstrous and miraculous events, with an absence of reason proper, as Perrault says, "a ceux qui n'en ont pas encore." At the same time the tale will very probably enforce some moral or practical lesson, and may even appear to have been invented with this very purpose, for man is everywhere impressed with the importance of *conduct*.

(2) The same tale—or rather a series of incidents and a plot essentially the same—as it is discovered surviving in the oral traditions of the illiterate peasantry of European races. Among them the monstrous element, the ferocity of manners observed in the first stage, will be somewhat modified, but will be found most notable among the Slavonic tribes. Nowhere, even in German and Scottish märchen, is it extinct, cannibalism and cruel torture being favourite incidents.

(3) The same plot and incidents as they exist in the heroic epics and poetry of the cultivated races, such as the Homeric books, the Greek tragedies, the Cyclic poets, the *Kalewala* of the Finns, certain hymns of the *Rigveda*, certain legends of the Brahmanas, the story of the Volsungs,—in these a local and almost historical character is given by the introduction of names of known places, and the adventures are attributed to national heroes,—Odysseus, Œdipus, Sigurd, Wainamoinen, Jason, Pururavas, and others. The whole tone and manners are nobler and more refined in proportion as the literary workmanship is more elaborate.

This theory of the origin of popular tales in the fancy of peoples in the savage condition (see MYTHOLOGY), of their survival as märchen among the peasantry of Indo-European and other civilized races, and of their transfiguration into epics, could only be worked out after the discovery that savage and civilized popular tales are full of close resemblances. These resemblances, when only known to exist among Indo-European peoples, were explained as part of a common Aryan inheritance, and as the result of a malady of language. This system, when applied to myths in general, has already been examined (see MYTHOLOGY). According to another view, märchen everywhere resemble each other because they all arose in India, and have thence been borrowed and transmitted. For this theory consult Benfey's *Panchatantra* and M. Cosquin's *Contes de Lorraine* (Paris, 1886). In opposition to the Aryan theory, and the theory of borrowing from India, the system which is here advocated regards popular tales as kaleidoscopic arrangements of comparatively few situations and incidents, which again are naturally devised by the early fancy. Among these incidents may be mentioned, first, kinship and intermarriage between man and the lower animals and even inorganic phenomena. Thus a girl is wooed by a frog, pumpkin, goat, or bear, or elephant, in Zulu, Scotch, Walachian, Eskimo, Ojibway, and German märchen. This incident is based on the lack of a sense of difference between man and the things in the world which is prevalent among savages (see MYTHOLOGY). Other incidents familiar in our nursery tales (such as "Cinderella" and "Puss in Boots") turn on the early belief in metamorphosis, in magic, in friendly or protecting animals (totems or beast manitous). Others depend on the early prevalence of cannibalism (compare Grimm, 47, "The Juniper Tree"). This recurs in the mad song of Gretchen in *Faust*, concerning which a distinguished student writes, "This ghost of a ballad or rhyme is my earliest remembrance, as crooned by an old East-Lothian nurse." (Compare Chambers's *Popular Rhymes of Scotland*, 1870, p. 49.) The same legend occurs among the Bechuanas, and is published by Casalis. Yet another incident springs from the taboo on certain actions between husband and wife, producing the story of Cupid and Psyche (see Lang's *Custom and Myth*, 1884, p. 64). Once more, the custom which makes the youngest child the heir is illustrated in the märchen of the success, despite the jealousy of the elders, of Cinderella, of the Zulu prince (Callaway's *Tales from the Amazulu*, pp. 64, 65), and in countless other märchen. In other cases, as in the world-wide märchen corresponding to the Jason epic, we seem in presence of an early romantic invention,—how diffused it is difficult to imagine. Moral lessons, again, are inculcated by the numerous tales which turn on the duty of kindness, or on the impossibility of evading fate as announced in prophecy. In opposition to the philological explanation of the story of Œdipus as a nature-myth, this theory of a collection of incidents illustrative of moral lessons is admirably set forth in Prof. Cauparetti's *Edipo e la Mitologia Comparata* (Pisa, 1867).

On a general view, then, the stuff of popular tales is a certain number of incidents and a certain set of combinations of these incidents. Their strange and irrational character is due to their remote origin in the fancy of men in the savage condition; and their wide distribution is caused, partly perhaps by oral transmission from people to people, but more by the tendency of the early imagination to run everywhere in the same grooves. The narratives, in the ages of heroic poetry, are elevated into epic song, and in the Middle Ages they were even embodied in legends of the saints. This view is maintained at greater length, and with numerous illustrations, in the introduction to Mrs Hunt's translation of Grimm's *Kinder- und Haus-Märchen*, and in *Custom and Myth*, already referred to.

A complete bibliography of the literature of popular tales would fill many pages. The reader who is curious about savage popular tales may turn to Theal's *Kaffir Folk Lore* (2d ed., London, 1886); Callaway's *Nursery Tales of the Amazulu* (London, 1868); Schoolcraft's *Algic Researches*; Gill's *Myths and Tales of the South Pacific*; Petitot's *Traditions Indiennes* (1886); Shortland's *Maori Religion and Mythology* (London, 1882); The *South African Folk Lore Record*; the *Folk Lore Record* (London, 1879-85, Malagasy stories); Rink's *Tales and Traditions of the Eskimo*; Bleek's *Hottentot Tales and Fables* (London, 1864); Castrén's *Samoyedische Märchen*; and Leland's *Algonquin Legends* (London, 1884). For European tales, the bibliography in the translation of Grimm already referred to may be used, and the Maisonneuve collection, *Les Littératures populaires* may be recommended. The names of

Liebrecht, Köhler, Dasent, Ralston, Nigra, Pitré, Cosquin, Afanasief, Gaidoz, Sébillot, may serve as clues through the enchanted forest of the nursery tales of Europe. (A. L.)

TALFOURD, Sir Thomas Noon (1795–1854), was at once eminent as a lawyer, as a writer, and as a member of a brilliant and polished society. He had the faculty of winning friendships; so sympathetic indeed was his nature that he unconsciously biassed many of the most acute among his acquaintances towards an estimate of his genius as an author—more especially as a dramatist—hardly commensurate with what more impartial criticism has decided to be his just meed of praise. But, though even his most excellent work in literature has now ceased to be generally cared for, his poetry must always be interesting to the literary student.

The son of a brewer in good circumstances, Talfourd was born on January 26, 1795, at Doxey, near Stafford (some accounts mention Reading). He received his early education, first at an institution near Hendon, and later at the Reading grammar-school under Dr Valpy. Here, it is said, he acquired his taste for dramatic poetry, presumably under the guidance of Dr Valpy. At the age of eighteen the lad was sent to London to study law under Mr Chitty, the special pleader. Early in 1821 he joined the Oxford circuit, having been called to the bar at the Middle Temple in February of that year. When, fourteen years later, he was created a serjeant-at-law, and when again he in 1849 succeeded Mr Justice Coltman as judge of the Court of Common Pleas, he attained these distinctions more perhaps for the zeal and laborious care which he invariably displayed in his conduct of the cases confided to him than on account of any brilliance of forensic talent or of any marked intellectual subtlety. A parliamentary life had always had an attraction for him, and at the general election in 1835 he was returned for Reading. This seat he retained for close upon six years, and he was again returned in 1847. In the House of Commons he was no mere ornamental member. Those efforts of his which have most interest for us of later date were made on behalf of the rights of authors, for whose benefit he introduced the International Copyright Bill; his speech on this subject was considered the most telling made in the House during that session. The bill met with strong opposition, but Talfourd had the satisfaction of seeing it ultimately pass into law in 1842, albeit in a greatly modified form.

At the period of his elevation to the bench he was created a knight, and thenceforward his life was, in the intervals of his professional labours, devoted to scholarly and literary pursuits. From his school days he had entertained dreams of attaining eminence as a writer; and to the last he remained a diligent student of literature, ancient and modern. During his early years in London Talfourd found himself forced to depend—in great measure, at least—upon his literary exertions. He was at this period on the staff of the *London Magazine*, and was an occasional contributor to the *Edinburgh* and *Quarterly* reviews, the *New Monthly Magazine*, and other periodicals; while, on joining the western circuit, he acted as law reporter to *The Times*. His legal writings on matters germane to literature are excellent expositions, animated by a lucid and sufficiently telling, if not highly polished, style. Among the best of these are his article "On the Principle of Advocacy in the Practice of the Bar" (in the *Law Magazine*, January 1846); his *Proposed New Law of Copyright of the Highest Importance to Authors* (1838); *Three Speeches delivered in the House of Commons in Favour of an Extension of Copyright* (1840); and his famous *Speech for the Defendant in the Prosecution, the Queen v. Moxon, for the Publication of Shelley's Poetical Works* (1841).

But Talfourd cannot be said to have gained any position among men of letters until the production of his tragedy *Ion*, which was privately printed in 1835, and produced in the following year at Covent Garden theatre. The tragedy was also well received in America, and it met with the honour of reproduction at Sadler's Wells in December 1861. This dramatic poem, its author's masterpiece, turns upon the voluntary sacrifice of Ion, king of Argos, in response to the Delphic oracle, which had declared that only with the extinction of the reigning family could the prevailing pestilence incurred by the deeds of that family be removed. As a poem *Ion* has many high qualities. The blank verse, if lacking the highest excellence, is smooth and musical, and the lines are frequently informed with the spirit of genuine poetry; the character of the high-souled son of the Argive king is finely developed, and the reader is affected throughout by that same sense of the relentless working and potency of destiny which so markedly distinguishes the writings of the Greek dramatists.

Two years later, at the Haymarket theatre, *The Athenian Captive* was acted with moderate success. In 1839 *Glencoe, or the Fate of the Macdonalds*, was privately printed, and in 1840 it was produced at the Haymarket; but this home drama is indubitably much inferior to his two classic plays. *The Castilian* (1853) did not excite a tenth part of the interest called forth by *Ion*. Before this he had produced various prose writings other than those already referred to,—among them his "History of Greek Literature," in the *Encyclopædia Metropolitana*.

Besides the honour of knighthood and his various legal distinctions, Talfourd held the honorary degree of D.C.L. from the university of Oxford. He died in court during the performance of his judicial duties, at Stafford, on March 13, 1854.

In addition to the writings above-mentioned, Talfourd was the author of *The Letters of Charles Lamb, with a Sketch of his Life* (1837); *Recollections of a First Visit to the Alps* (1841); *Vacation Rambles and Thoughts*, comprising recollections of three Continental tours in the vacations of 1841, 1842, and 1843 (2 vols., 1844); and *Final Memorials of Charles Lamb* (1849–50).

TALISMAN. See Amulet.

TALLAGE, or Talliage (from the French *tailler*, *i.e.*, a part cut out of the whole), appears to have signified at first a tax in general, but became afterwards confined in England to a special form of tax, the assessment upon cities, boroughs, and royal demesnes—in effect, a land tax. Like Scutage (*q.v.*), tallage was superseded by the subsidy system in the 14th century. The last occasion on which it was levied appears to be the year 1332. The famous statute of 25 Edw. I. (in some editions of the statutes 34 Edw. I.) *De Tallagio non Concedendo*, though it is printed among the statutes of the realm, and was cited as a statute in the preamble to the Petition of Right in 1627, and by the judges in John Hampden's case in 1637, is probably an imperfect and unauthoritative abstract of the *Confirmatio Cartarum*. The first section enacts that no tallage or aid shall be imposed or levied by the king and his heirs without the will and assent of the archbishops, bishops, and other prelates, the earls, barons, knights, burgesses, and other freemen in the kingdom. *Tallagium facere* was the technical term for rendering accounts in the exchequer, the accounts being originally kept by means of *tallies* or notched sticks. The tellers (a corruption of *talliers*) of the exchequer were at one time important financial officers. The system of keeping the national accounts by tallies was abolished by 23 Geo. III. c. 82. the office of teller by 57 Geo. III. c. 84.

TALLEYRAND DE PÉRIGORD, Charles Maurice (1754–1838), created by Napoleon a prince of the empire under the title of the Prince de Bénévent, was born at Paris on 2d February 1754. His father, who was of a younger branch of the princely family of Chalais, was an officer in the army of Louis XV., and his mother, also of noble family, was a member of the royal household at Versailles. An accident in infancy rendered Talleyrand lame for life, and changed his whole career. His upbringing was, in accordance with the fashionable heartlessness of the day, entirely left to strangers; and while a boy he was, in consequence of his lameness, formally deprived by a *conseil de famille* of his rights of primogeniture,—his younger brother, the Comte d'Archambaud, taking his place; and he was destined for the church. He keenly felt the blow, but was powerless to avert it; and he used his enforced profession only as a stepping-stone to his ambition, always despising it, and coolly and defiantly forsaking it when he found it an embarrassment.

When he was removed from the country he was sent to the Collége d'Harcourt, where he speedily distinguished himself; and in 1770, when sixteen years of age, he became an inmate of the Séminaire de St Sulpice, his education being completed by a course in the Sorbonne. Much as Talleyrand despised the church as a career, he never ceased highly to appreciate theology as a training, and he publicly testified to its value to the statesman and specially to the diplomatist. While achieving distinction as a student, he carefully cultivated such society as might promote his advancement; and it was in the circle of Madame du Barry that his cynicism and wit, reported by her to the king, gained him the position of abbé. To his arts of manner were added, not only his advantages of birth and scholarship, but a penetrating judgment of men and affairs, a subtle audacity, and a boundlessly selfish ambition. As early as 1780 we find this *abbé malgré lui* to have reached the important position of "agent-general" of the French clergy. His ability and his flagrant immorality alike rendered him a marked man, and the latter did not prevent his appointment, in accordance with his father's dying request to the king, as bishop of Autun in January 1789. The clergy of his own diocese immediately elected him a member of the states-general; and he delivered before his constituents one of the most remarkable speeches which the crisis produced, containing a sagacious and statesmanlike programme of the reforms which the condition of France demanded. He thus entered the assembly as one of its leaders.

The states-general had hardly met ere Talleyrand's influence was called into play. He successfully urged the clergy to yield to the demand of the commons that the three estates should meet together; and the nobles could thereafter only follow the example thus set. On the question of the extent of the assembly's authority he again sided with the popular leaders. As a financier of great foresight and power he soon became justly celebrated; and his position in the assembly may be estimated by his appointment as one of a committee of eight to frame the project of a constitution. All his previous successes were, however, eclipsed by the daring with which he attacked the rights and privileges of his own order. He had seconded the proposals that the clergy should give up their tithes and plate for the benefit of the nation, and on 10th October 1789 he himself proposed a scheme whereby the landed property of the church should be confiscated by the state. On 2d November, after violent debates, his project was carried, and the old clergy thereafter ranked him as an enemy. But his general popularity so much increased that he was charged by the national assembly to prepare a written memoir in defence of its labours; and the manifesto, read on February 10, 1790, was received with great approval throughout the country. On the 16th he was elected president of the assembly for the usual brief term. On various subjects he was now looked up to as an authority,—on education, on electoral and ecclesiastical reform, on banking, and on general finance. His career as a diplomatist had not yet begun.

On July 14, 1790, Talleyrand, at the head of 300 clergy, assisted at the fête in the Champ de Mars in commemoration of the fall of the Bastille, and publicly blessed the great standard of France. By this time, however, the dispute as to the civil constitution of the clergy had broken out, the decision of the assembly being resisted by the king, backed by the pope. When in November the king yielded, Talleyrand boldly took the required oath, only two bishops following his example. New bishops were elected by the assembly, and these he, in open defiance of the church, consecrated. In the end of April 1791 he was suspended from his functions and excommunicated by the pope. Without a moment's hesitation Talleyrand abandoned his profession, which he never afterwards resumed. He had been false to its vows, and had scandalized it by his shameless life. It was only in the preceding February that he had, in declining nomination for the archbishopric of Paris, felt, indiscreetly enough and contrary to his usual practice, the necessity of writing to the *Moniteur* a hypocritical confession of his gambling propensities, stating his gains at 30,000 francs. Although in 1801 the excommunication was recalled, it was nearly half a century after his first act of defiance ere he became personally reconciled to the church, and then only when he was at the point of death.

On purely political lines, however, Talleyrand's career became more and more celebrated. In the beginning of the same month of April 1791, his friend Mirabeau having just died, he was appointed to succeed him as a director of the department of Paris, a position which still further increased his influence in the circles of the metropolis. On the flight of the king in June, Talleyrand leaned at first and cautiously towards the duke of Orleans, but finally declared for a constitutional monarchy with Louis XVI. still on the throne. Ere the constitutional assembly brought its existence to a close on 14th September, he unfolded before it his magnificent scheme of national education, which, in the words of Sir Henry Bulwer, "having at one extremity the communal school and at the other the Institute, exists with but slight alterations at this very day." The assembly had voted that none of its members should be members of the new legislative body, so that Talleyrand was free; besides, events were hurrying on with strange and critical rapidity; and Talleyrand left France for England, reaching London in the end of January 1792. With this visit his diplomatic career may be said to have begun.

He was not formally accredited, but had in his pocket an introduction to Lord Grenville by Delessart the foreign minister; the king himself was aware of his mission, the ostensible object of which was to conciliate England. Talleyrand for his part shared the ulterior views of Narbonne, the minister of war, that it would be for the advantage of his country to divert its energies, which were morbidly directed to its internal troubles, into another channel, and to precipitate an Austrian war. Although received well in London society, he found the want of official credentials a fatal obstacle to his diplomatic negotiations, and he returned to Paris, whence he was almost immediately again despatched to the English court under much more favourable conditions. He was nominally only attendant with De Chauvelin, the minister plenipotentiary, but he was really the head of the embassy, and he carried with him a letter of Louis XVI. to George III. At this time, indeed, Talleyrand's relations with Louis were very close,—far closer than he afterwards cared or dared to avow. All, however, was of no avail. The startling course of the Revolution made the English look askance upon his mission, and he returned baffled to Paris, where he arrived shortly before the *coup d'état* of the 10th of August. But this place, where his wariest manœuvres were outdone by the rapidity of the popular movements, and where at any turn of affairs he might lose his head, was not to his liking; and by the middle of September he is for the third time in London. It is characteristic of the man—of the dexterity as well as audacity of his intrigue—that he who had but shortly before carried with him a letter of favour from Louis XVI. was, now that royalty was abolished, the bearer of a specific passport—"going to London by our orders"—under the hand of Danton. Equally characteristic is the express falsehood with which he opens his negotiations: he writes at once to Lord Grenville, "I have at this time absolutely no kind of mission in England"—he was selling his library and seeking repose. His courtesies were not returned; and, although he succeeded in making friends in certain high quarters, he was, in the end of January 1794, under the provisions of the Alien Act, ordered to leave England. Fortified with an introduction by Lord Lansdowne to Washington, he sailed for the United States.

A decree of the convention had issued against Talleyrand during his stay in England. He was an *émigré*. But as the excesses of the period drew to a close the proscription was recalled on the appeal of Chénier, who founded on Talleyrand's relations with Danton and his mission to England in the service of the Revolution! On July 25, 1795, he arrived at Hamburg, whence he passed to Berlin, and, after a short stay there, to Paris. He was received with enthusiasm in the circles of fashion and intrigue. He would have been eagerly welcomed by any of the political parties as a strength; but the Directory was in power, and he supported it. Within the Directory he supported Barras, as against his compeers. He was thus a moderate constitutionalist and in the way of advancement.

During his absence from France he had been elected a member of the Institute. He was now elected its secretary. In this capacity he read before it two memoirs—one on the "commercial relations of the United States with England," and the other "on the advantages of withdrawing from new colonies in present circumstances." These memoirs exhibit Talleyrand at the very maturity of his powers, and are sufficient to establish his position as one of the most far-seeing and thoughtful statesmen that France ever possessed. The first paper shows how, in spite of the War of Independence, the force of language, race, and interest must in his view bind England and the States together as natural allies; and it contains that remarkable passage (which once read is never forgotten) in which the civilization of America is described as exhibited in space as well as in time,—as the traveller moves westward from State to State he appears to go backward from age to age. The papers, which were read in April and July of 1797, made his claim to state recognition irresistible, and towards the end of the latter month he was appointed to the post of foreign minister.

He had been carefully scanning the political situation, and he accurately foresaw that the Directory, which represented no one set of opinions, but only a vain compound of all, could not stand against unity of policy backed by force, and in the meantime could be manipulated. Thus with a brutal swiftness its personnel becomes changed. Barras with his sluggish moderation remains; but, behind and through him, it is the dexterous purpose of Talleyrand that is at work. This is the first characteristic of his administration. Its second is the ability which he displays in his communications with the diplomatic service, in view of the rupture with England. Its third is the shamelessly corrupt manner in which he approaches the American ambassadors on the subject of the seizure of certain ships, on the conclusion of a commercial treaty between England and the States, putting himself in his public and powerful position at their service,—if the bribe were suitably large. And its fourth is that he is hardly in the chair of office until he has shrewdly selected Bonaparte as the object of his assiduous flatteries, writing to him in semi-confidence, and laying the basis of their future intimacy. But his first term of office was short: the American ambassadors spurned his offer and let his conduct be publicly known, with the result that for this and other reasons he resigned his post. Public opinion was outraged. His official corruption, however, was not ended, for Talleyrand turned everything into gold; in his later diplomacy also he could always be bought; and this public immorality was but too faithfully reflected in his private life, in which gambling was his passion and a source of his vast wealth.

Out of office, but still pulling the strings of the Directory, he awaited the arrival of Napoleon in Paris, and it was his hand which was most powerful in shaping the events of the 18th and 19th Brumaire—9th and 10th November 1799. He reconciled Sieyès to Bonaparte; a majority of the Directory—Sieyès, Ducos, and at last at his persuasion even Barras—resigned; the Directory collapsed, and the consulate was established (see NAPOLEON and SIEYÈS). Napoleon was the first and Talleyrand the second man in France.

He was now an absolutist, the whole drift of his influence being in the direction of consolidating, under whatever title, the power of Bonaparte. For many years henceforward Talleyrand's career is part of the general history of France. He is soon again foreign minister; and he is acknowledged to have been the ablest diplomatist of an age when diplomacy was a greater power than it has ever been before or since To him falls a full share of responsibility for the kidnapping and murder of the Duc d'Enghien in March 1804 (see SAVARY). He had assisted at the councils when the atrocity was planned, and he wrote to the grand-duke justifying the seizure of the prince while on Baden territory. His hand in the matter was of course concealed. But, when one advised him to tender his resignation, he demurely remarked, "If, as you say, Bonaparte has been guilty of a crime, that is no reason why I should be guilty of a folly." In other and more agreeable directions he had prostrated himself before Napoleon's purposes, approving among other things of the policy of the Concordat (15th July 1801), and securing thereby the recall of his excommunication. To the pope's grateful brief, which gave him liberty "to administer all civil affairs," he coolly gave a wide interpretation, and he shortly thereafter married. He of course supported and defended first the consulship for life and then the crowning of the emperor.

By and by, however, a change comes over his political attitude, and it is not long ere Napoleon detects it. This change we date, with Sainte-Beuve, from the end of January 1809. Before the peace of Tilsit, July 8, 1807, from Jena onwards, he had personally accompanied the great conqueror; after it they stood apart, for the statesman saw in those brilliant but ceaseless conquests the prelude to the ruin of his master and his country. He was now prince of Benevento, and he withdrew from the ministry, receiving at his own desire the title of vice-grand-elector of the empire. Yet he had not disapproved of the Spanish war; the young princes had even been entrusted to his surveillance at his country house at Valençay. But anything might have happened to the emperor in Spain, and Talleyrand had evidently been calculating the chances of the future. So at the date stated the explosion occurs, Napoleon pouring upon Talleyrand all the fury of his invective, reproaching him with the affair of the Duc d'Enghien, and clamouring to know where his enormous wealth had come from,—how much he had gained at play or on the stock exchange, and what was the sum of his bribes by foreign powers. Over and over again such scenes are repeated, the burden of the fierce reproaches being always the same; but Talleyrand stands impassive as a statue, remarking once, but not till he is out of the room, and is limping away, "What a pity that such a great man has been so badly brought up!" or sending in, at another time, a resignation, which of course is not accepted. The reproaches of the emperor were only too well founded, his minister having reaped a vast harvest from the smaller powers at the formation of the Rhenish Confederation; it is indeed recorded that Talleyrand once put a figure upon his gains in this department of corruption—the figure being no less than sixty million francs.

It is undoubtedly to his credit, however, that he steadily resisted a warlike policy, and that he was particularly opposed to the Russian invasion. He was occasionally employed in diplomatic negotiations, and was even again offered the post of foreign minister if he would give up that of vice-grand-elector. This offer, which would have placed him at the mercy of Napoleon, he declined, and the breach between the two widened. Before the events of 1814 his hotel had become the centre of anti-Napoleonic intrigue; as the crisis approached he communicated with the allies; when it was at hand he favoured a regency, and appeared anxious that Marie Louise should remain in Paris; and when this was abandoned he carefully arranged a feigned departure himself, but that his carriage should be turned back at the city gates; he did return; and the emperor Alexander was his guest at the Hôtel Talleyrand! The revolution was his work; and his nominee Louis XVIII. ascended the throne. For a third time, and again under a new master, he was appointed foreign minister. It would be difficult to overestimate the splendid services which he now rendered to France. In Paris, on 23d April, the treaty was concluded under which the soldiers of the allies were to leave French soil; and Talleyrand successfully urged that the territory of France should be the enlarged territory of 1792, and also that the great art treasures of which so many European cities had been despoiled should remain in Paris. A final treaty of peace between Europe and France was concluded on 30th May, and in September the congress of Vienna assembled. It was the scene of Talleyrand's greatest triumphs. He succeeded single-handed in breaking up the confederation of the allies, and in reintroducing the voice of France into the deliberations of the European powers. Further, on January 3, 1815, a secret treaty was concluded between Austria, France, and England.

When Napoleon escaped from Elba and advanced towards Paris, Louis XVIII. retired to Ghent. Although the congress of Vienna was thus broken up, Talleyrand made no haste to follow him thither. He was puzzled, and remained so during the Hundred Days. He despised Louis, and an early approach to Bonaparte was out of the question. He therefore coolly betook himself to Carlsbad, remarking, when an explanation was asked for, that the first duty of a diplomatist after a congress was to attend to his liver! Waterloo of course decided him. He appeared at Ghent, and was but coldly received. The foreign powers, however, intervened, conscious after Vienna of Talleyrand's value; and, among others, Wellington insisted that the great diplomatist must be taken into the councils of Louis,—with the result that he became prime minister at the second restoration. But his position was one of extreme difficulty. The king disliked him; there were scenes bordering on violence in the royal presence; the Russian emperor intimated his hostility to him; he shared the odium of having a man like Fouché for a colleague; Chateaubriand and his party hated and beset him. Fortunately an excuse of a broad and national kind soon presented itself. He objected to the conditions which the allies were imposing upon France, refused to sign the treaty, and on 24th September resigned office.

He retired into private life, in which he remained for fifteen years. He only spoke in the House of Peers three times during this period,—twice (1821 and 1822) in favour of the liberty of the press, and once (1823) to protest against the Spanish war. But in 1830, when Charles X.'s reign was evidently imperilled, he again is at the centre of intrigue; and it is actually at his private but urgent suggestion that Louis Philippe heads the revolution, taking, to begin with, the title of lieutenant-general of the kingdom. Declining the post of foreign minister, he proceeded to London as ambassador, conducting himself and serving his country with his usual consummate skill. He returned crowned with success after the formation of the Quadruple Alliance. In November 1834 he resigned, and quitted public life for ever.

He emerged from his retirement on March 3, 1838, to pronounce before the Institute the éloge of Reinhard, and in so doing to treat of diplomacy in general, and to suggest an indirect but adroit apology for his own career. He was received with unbounded enthusiasm by the élite of French literature and society—Cousin even exclaiming that the éloge was worthy of Voltaire. His last illness, which had by this time shown itself, soon prostrated him. He was visited on his death-bed by crowds of celebrities, including the king. He died on May 17, 1838, at the great age of eighty-four. He is buried at Valençay.

According to his desire, his memoirs under his own hand will not appear till 1890.

There is a considerable body of anonymous and untrustworthy literature both in French and English on the subject of this sketch. For the earlier part of Talleyrand's career, see the general literature of the Revolution; for the Napoleonic, the general histories, including especially the *Memoirs* of the Duc de Rovigo; for the third and last, also the general histories, and especially the *Correspondence between Talleyrand and Louis XVIII.*, edited by Pullain (1880; transl. into English, 1881), and the *Memoirs* of Guizot. References abound to the private life of Talleyrand, and on it see also the *Histoire Politique et Vie Intime*, by G. Touchard-Lafosse (1848), and the *Souvenirs Intimes sur M. de Talleyrand*, by Amedée Pichot (1870). The student must be on his guard in perusing most of this last-mentioned literature. For many years the *Histoire Politique et Privée*, by G. Michaud (1853), stood practically uncorrected, although evidently a studied and bitter attack. The view taken by Louis Blanc in his *Dix Ans* (translated into English in 1845) is also quite distorted, and if one wishes to see a complete misreading of Talleyrand's career it can be found in Blanc's tenth chapter of his fifth book. Sir Henry Lytton Bulwer rendered great service by his life of Talleyrand, published in his *Historical Characters*; and the worth and accuracy of Bulwer's biography, which was speedily translated into French, has been amply acknowledged by Sainte-Beuve in his valuable treatise (lectures) on Talleyrand, published in 1870. Reference should also be made to Miguet, Bastide, and the *Mémoires Politiques* of Lamartine.

Caution will have to be exercised in reading Talleyrand's autobiography, which will not appear till 1890. The testimony of contemporaries will not be available to check it, and Talleyrand is proved to have presided at the destruction of much documentary evidence implicating himself, *e.g.*, at the moment when the Russian emperor was living at his house. (T. S.)

TALLIEN, JEAN LAMBERT (1769-1820), the chief leader of the party that overthrew Robespierre, was the son of the *maître d'hôtel* of the Marquis de Bercy, and was born in Paris in 1769. The marquis, perceiving the boy's ability, had him well educated, and got him a place as a lawyer's clerk. Being much excited by the first events of the Revolution, he gave up his desk to enter a printer's office, and by 1791 he was overseer of the printing department of the *Moniteur.* While thus employed he conceived the idea of the *journal-affiche,* and from January to May 1791 he placarded a large printed sheet on all the walls of Paris twice a week under the title of the *Ami des Citoyens.* This enterprise of his, of which the expenses were defrayed by the Jacobin Club, made him well known to the revolutionary leaders; and he made himself still more conspicuous in organizing the great "Fête de la Liberté" on April 15, 1792, in honour of the released soldiers of Château-Vieux, with Collot d'Herbois. On July 8, 1792, he was the spokesman of a deputation of the section of the Place Royale which demanded from the legislative assembly the reinstatement of Pétion and Manuel, and he was one of the most active popular leaders in the attack upon the Tuileries on 10th August, on which day he was appointed secretary or clerk to the revolutionary commune of Paris. In this capacity he exhibited an almost feverish activity; he perpetually appeared at the bar of the assembly on behalf of the commune; he announced the massacres of September in the prisons in terms of praise and apology; and he sent off the famous circular of 3d September to the provinces, recommending them to do likewise. At the close of the month he resigned his post on being elected, in spite of his youth, a deputy to the Convention by the department of Seine-et-Oise, and he commenced his legislative career by defending the conduct of the commune during the massacres. He took his seat upon the Mountain, and showed himself one of the most vigorous Jacobins, particularly in his defence of Marat; he voted for the execution of the king, and was elected a member of the Committee of General Security on January 21, 1793. After a short mission in the western provinces he returned to Paris, and took an active part in the *coups d'état* of 31st May and 2d June, which resulted in the overthrow of the Girondins. For the next few months he remained comparatively quiet, but on September 23, 1793, he was sent with Ysabeau on his famous mission to Bordeaux. This was the very month in which the Terror was organized under the superintendence of the Committees of Public Safety and General Security, and Bordeaux was one of the cities selected to feel its full weight. Tallien showed himself one of the most vigorous of the proconsuls sent over France to establish the Terror in the provinces; though with but few adherents, he soon awed the great city into quiet, and kept the guillotine constantly employed. It was at this moment that the romance of Tallien's life commenced. Among his prisoners was Theresa, Comtesse de Fontenay, the daughter of the great Spanish banker Cabarrus, the most beautiful and fascinating woman of her time, and Tallien not only spared her life but fell deeply in love with her. She quickly abated the fierceness of his revolutionary ardour, and from the lives she saved by her entreaties she received the name of "Our Lady of Pity." This mildness, however, displeased the members of the committees; Tallien was recalled to Paris; and Madame de Fontenay was imprisoned there. Danton and his friends had but just fallen, and the members of the committees were half afraid to strike again at the moderates, so Tallien was spared for the time, and was even elected president of the Convention on March 24, 1794. But the Terror could not be maintained at the same pitch: Robespierre began to see that he must strike at many of his own colleagues in the committees if he was to carry out his theories, and Tallien was one of the men condemned with them. They determined to strike first, and on the great day of Thermidor it was Tallien who, urged on by the danger in which his beloved lay, opened the attack upon Robespierre. The movement was successful; Robespierre and his friends were guillotined; and the young Tallien, as the leading Thermidorian, was elected to the Committee of Public Safety. Now came the great months of his career: he showed himself a vigorous Thermidorian; he was instrumental in suppressing the Revolutionary Tribunal and the Jacobin Club; he attacked Carrier and Lebon, the proconsuls of Nantes and Arras; and he fought bravely against the insurgents of Prairial. In all these months he was supported by his Theresa, whom he married on December 26, 1794, and who became the leader of the social life of Paris. His last political achievement was in July 1795, when he was present with Hoche at the destruction of the army of the émigrés at Quiberon, and ordered the executions which followed. After the close of the Convention Tallien's political importance came to an end, for, though he sat in the Council of Five Hundred, the moderates attacked him as terrorist, and the extreme party as a renegade. Madame Tallien also got tired of him, and became the mistress of the rich banker Ouvrard. Bonaparte, however, who is said to have been introduced by him to Barras, took him to Egypt in his great expedition of June 1798, and after the capture of Cairo he edited the official journal there, the *Décade Égyptienne.* But Menou sent him away from Egypt, and on his passage he was captured by an English cruiser and taken to London, where he had a good reception among the Whigs and was well received by Fox. On returning to France in 1802 he got a divorce from his unfaithful spouse (who eventually married the Prince de Chimay), and was left for some time without employment. At last, through Fouché and Talleyrand, he got the appointment of consul at Alicante, and remained there until he lost the sight of one eye from yellow fever. On returning to Paris he lived on his half-pay until 1815, when he received the especial favour of not being exiled like the other regicides. His latter days were spent in the direst poverty; he had to sell his books to get bread. He died at Paris on November 16, 1820.

TALLIS (TALLYS, TALYS, or TALLISIUS), THOMAS (*c.* 1515–1585), justly styled "the father of English cathedral music," was born, as nearly as can be ascertained, about the year 1515. The history of his youth is involved in some obscurity; there seems, however, but little doubt that, after singing as a chorister at old Saint Paul's under Thomas Mulliner, he obtained a place among the children of the chapel royal. His next appointment was that of organist at Waltham abbey, where, on the dissolution of the monastery in 1540, he received, in compensation for the loss of his preferment, 20s. for wages and 20s. for reward. An interesting relic of this period of his career is preserved in the library of the British Museum, in the form of a volume of MS. treatises on music, once belonging to the abbey, on the last page of which appears his autograph, "Thomas Tallys," with the final letter prolonged into an elaborate flourish—the only specimen of his handwriting now known to exist.

Not long after his dismissal from Waltham, Tallis was appointed a gentleman of the chapel royal; and thenceforward he laboured so zealously for the advancement of his art that his genius has left an indelible impression upon the English school, which owes more to him than to any other composer of the 16th century, and in the history of which his name plays a very important part indeed.

One of the earliest compositions by Tallis to which an approximate date can be assigned is the well-known *Service in the Dorian Mode,* consisting of the *Venite, Te Deum, Benedictus, Kyrie, Nicene Creed, Sanctus, Gloria in Excelsis, Magnificat,* and *Nunc Dimittis,* for four voices, together with the *Preces, Responses, Paternoster,* and *Litany,* for five, all published for the first time, in the Rev. John Barnard's *First Book of Selected Church Music,* in 1641, and reprinted, with the exception of the *Venite* and *Paternoster*, in Boyce's *Cathedral Music* in 1760.[1] That this work was composed for the purpose of supplying a pressing need, after the publication of the second prayer-book of King Edward VI. in 1552 there can be no reasonable doubt; and its perfect adaptation to its intended purpose is sufficiently proved by the fact that, for more than three hundred years, its claim to occupy the first and highest place among compositions of its class has been undisputed. Written in the style known among Italian composers as *lo stile famigliare*, *i.e.*, in simple counterpoint of the first species, *nota contra notam*, with no attempt at ingenious points of imitation, or learned complications of any kind—it adapts itself with equal dignity and clearness to the expression of the verbal text it is intended to illustrate, bringing out the sense of the words so plainly that the listener cannot fail to interpret them aright, while its pure rich harmonies tend far more surely to the excitement of devotional feeling than the marvellous combinations by means of which too many of Tallis's contemporaries sought to astonish their hearers, while forgetting all the loftier attributes of their art. In this noble quality of self-restraint the *Litany* and *Responses* bear a close analogy to the *Improperia* and other similar works of Palestrina, wherein, addressing himself to the heart rather than to the ear, the *princeps musicæ* produces the most thrilling effects by means which, to the superficial critic, appear almost puerile in their simplicity, while those who are able to look beneath the surface discern in them depths of learning such as none but a very highly cultivated musician can appreciate. Of this profound learning Tallis possessed an inexhaustible store; and the rich resources it opened to his genius not only placed his compositions on a level with those produced by the best of his Italian and Flemish contemporaries, but enabled him to raise the English school itself to a height which it had never previously attained, and which, nevertheless, it continued to maintain undiminished until the death of its last representative, Orlando Gibbons, in 1625. Though this school is generally said to have been founded by Dr Tye, there can be no doubt that Tallis was its greatest master, and that it was indebted to him alone for the infusion of new life and vigour which prevented it from degenerating, as some of the earlier Flemish schools had done, into a mere vehicle for the display of fruitless erudition. Tallis's ingenuity far surpassed that of his most erudite contemporaries; but he never paraded it at the expense either of intrinsic beauty or truthfulness of expression. Like every other great musician of the period, he produced occasionally works confessedly intended for no more exalted purpose than the exhibition of his stupendous skill, one of the most remarkable characteristics of which was the apparent ease with which it disposed of difficulties that, to composers of ordinary ability, would have proved insurmountable. In his canon, *Miserere nostri*, the intricacy of the contrapuntal devices seems little short of miraculous; yet, so smooth and flowing is the effect produced by their dizzy involutions, that no one unacquainted with the secret of their construction would suspect the presence of any unusual element in the composition. In his motet, *Spem in alium non habui*, written for forty voices disposed in eight five-part choirs, each singer is intrusted with a part, agreeable and interesting in itself, yet never for a moment interfering with any one of the thirty-nine equally interesting parts with which it is associated. These *tours de force*, however, though approachable only by the greatest contrapuntists living in an age in which counterpoint was cultivated with a success that has never since been equalled, serve to illustrate one phase only of Tallis's many-sided genius, which shines with equal brightness in the eight psalm-tunes (one in each of the first eight modes) and unpretending little *Veni Creator*, printed in 1567 at the end of Archbishop Parker's *First Quinquagene of Metrical Psalms*, and many other compositions of like simplicity.

In 1575 Tallis and his pupil William Byrd—as great a contrapuntist as himself, though by no means his equal in depth of expression—obtained from Queen Elizabeth royal letters patent granting them the exclusive right of printing music and ruling music-paper for twenty-one years; and, in virtue of this privilege, they issued, in the same year, a joint work, entitled *Cantiones quæ ab argumento Sacræ vocantur, quinque et sex partium*, containing sixteen motets by Tallis and eighteen by Byrd, all of the highest degree of excellence. Some of these motets, adapted to English words, are now sung as anthems in the Anglican cathedral service. But no such translations appear to have been made during Tallis's lifetime; and there is strong reason for believing that, though both he and Byrd outwardly conformed to the new religion, and composed music expressly for its use, they remained Catholics at heart to the end of their days.

Tallis's contributions to the *Cantiones Sacræ* were the last of his compositions published during his lifetime. He did not, indeed, live to witness the expiration of the patent, though Byrd survived it and published two more books of *Cantiones* on his own account in 1589 and 1591, besides numerous other works. Tallis died November 23, 1585, and was buried in the parish church at Greenwich, where a quaint rhymed epitaph, preserved by Strype, and reprinted by Burney and Hawkins, recorded the fact that he served in the chapel royal during the reigns of Henry VIII., Edward VI., Mary, and Elizabeth. This was destroyed with the old church about 1710; and it was not until about twenty years ago that a copy was placed in the present building. Portraits, professedly authentic, of Tallis and Byrd were engraved by Vandergucht in 1730, for Nicolas Haym's projected *History of Music*, but never published. One copy only is known to exist.

Not very many works besides those already mentioned were printed during Tallis's lifetime; but a great number are still preserved in MS. Unhappily, it is to be feared that many more were destroyed, in the 17th century, during the spoliation of the cathedral libraries by the Puritans (W. S. R.)

·TALLOW is the solid oil or fat of ruminant animals, but commercially it is almost exclusively obtained from oxen and sheep. The fat is distributed throughout the entire animal structure; but it accumulates in large quantities as "suet" in the body cavity, and it is from such suet that tallow is principally melted or rendered. The various methods by which tallow and other animal fats are separated and purified have been dealt with under OILS (see vol. xvii. p. 743). In commerce ox tallow and sheep tallow are generally distinguished from each other, although much nondescript animal fat is also found in the market. Ox tallow occurs at ordinary temperatures as a solid hard fat having a yellowish white colour; when fresh and new it has scarcely any taste or smell; but it soon acquires a distinct odour and readily becomes rancid. The fat is insoluble in cold alcohol, but it dissolves in boiling spirit of 0·822 sp. gr. in chloroform, ether, and the essential oils. The hardness of tallow and its melting-point are to some extent affected by the food, age, state of health, &c., of the animal yielding it, the firmest ox tallow being obtained in certain provinces of Russia, where for a great part of the year the oxen are fed on hay. New tallow melts at from 42°·5 to 43° C., old tallow at 43°·5, and the melted fat remains liquid till its temperature falls to 33° or 34° C. Tallow consists of a mixture of two-thirds of the solid fats palmitin and stearin, with one-third of the liquid fat olein. A fluid oil known as tallow oil is obtained from solid tallow by the separation by pressure of the greater part of the olein. To facilitate the separation of the olein, tallow is first melted and just before resolidifying it is mixed with about 10 per cent. of benzene or petroleum spirit. The mixture is then allowed to solidify in flat cakes or slabs, which are placed in press bags and piled between iron plates in a hydraulic press. On the application of pressure the olein mixed with the solvent hydrocarbon flows freely out, leaving a hard dense cake of stearin and palmitin in the bags. The volatile solvents are subsequently driven off by blowing steam through the oil, which remains a turbid fatty fluid from the proportion of solid fats it carries over with it from the hydraulic press. Tallow oil is a useful lubricant and a valuable material for fine soap making, but it is not now abundantly prepared. Mutton tallow differs in several respects from that obtained from oxen. It is whiter in colour and harder, and contains only about 30 per cent. of olein. Newly rendered it has little taste or smell, but on exposure it quickly acquires characteristic qualities and becomes rancid. Sweet mutton tallow melts at 46° and solidifies at 36° C.; when old it does not melt under 49°, and becomes solid on reaching 44° or 45° C. It is sparingly soluble in cold ether and in boiling spirit of 0·822 sp. gr.

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[1] Boyce's unaccountable omission of the very beautiful *Venite* is a misfortune which cannot be too deeply deplored, since it has led to its consignment to almost hopeless oblivion.

In early times tallow was a most important candle-making substance, and candles made from this material are still consumed in no inconsiderable quantity, but the greater proportion of the supply is now absorbed by the soap trade; the artificial butter trade which has sprung up since 1872 also takes up large quantities of sweet tallow. Tallow is further used extensively as a lubricant and in leather dressing, &c. It is of course a product of all cattle and sheep-rearing countries, and it forms an important article of export from the United States, the Argentine Republic, and the Australian colonies. Till within the last quarter of a century Russia supplied nearly all the tallow imported into the United Kingdom; but now the imports from that source are on the most meagre scale, although Russian P. Y. C. (pale yellow candle) continues to represent the finest commercial brand.

TALLOWS, Vegetable. See Oils, vol. xvii. p. 746.

TALMA, Joseph François (1763-1826), French tragedian, was born at Paris 15th January 1763. After attending the Mazarin college, he accompanied his father, who was a dentist, to London, where he studied in the hospitals. While in London he took part in some amateur theatricals, and, his talents at once attracting notice, a professional engagement was offered him. To this, however, his father would not consent, and shortly afterwards he was sent to Paris, where for some years he was assistant to a dentist. His predilection for the drama could not be restrained, and on 21st November 1787 he made his début at the Comédie Française in *Mahomet*. His efforts from the first won appreciation, but for a considerable time he was restricted to secondary parts. It was in *jeune premier* parts that he first came prominently into notice, and he attained only gradually to his unrivalled position as the exponent of strong and concentrated passion. In 1791 he and other dissentients founded the Théâtre Français de la rue de Richelieu,—a name changed in 1792 to Théâtre de la République, where he won his most striking successes. Talma was among the earliest advocates of realism in scenery and costume, being greatly aided in his reforms by his friend the painter David. He possessed in perfection the physical gifts fitting him to excel in the highest tragic parts, an admirably proportioned figure, a striking countenance, and a voice of great beauty and power, which, after he had conquered a certain thickness of utterance, enabled him to acquire a matchless elocution. At first somewhat stilted and monotonous in his manner, he gradually emancipated himself from all artificial trammels, and became by perfection of art a model of simplicity. Talma enjoyed the intimacy of Napoleon, with whom he had an acquaintance before Napoleon attained greatness; and he was a friend of Chénier, Danton, Camille Desmoulins, and other revolutionists. He made his last appearance 11th June 1826 and died at Paris 19th October of that year.

Talma was the author of *Mémoires de Le Kain, précédés de Réflexions sur cet Acteur et sur l'Art Théâtral*, contributed to the *Collection des Mémoires sur l'Art Dramatique*. It was published separately at Paris in 1856, under the title *Réflexions de Talma sur Le Kain et l'Art Théâtral*. See *Mémoires de J. F. Talma, écrits par lui-même, et recueillis et mis en ordre sur les papiers de sa famille*, by Alex. Dumas (1856).

TALMUD signifies—(1) "study of and instruction in anything (whether by any one else or by oneself)";[1] (2) "learning acquired";[2] (3) "style, system":[3] as such it is synonymous with *Mishnah* in its fifth signification, vol. xvi. p. 503; (4) "theory," in contradistinction to "practice,"[4]—synonymous with *Midrash* in its fourth signification, vol. xvi. p. 285; (5) such interpretation of the Mosaic law as is apparent on the surface thereof and does not necessitate any further disquisition;[5] (6) *Boroitho*, or the non-canonical *Mishnah*;[6] (7) *Gemara*, *i.e.*, the oldest commentary on the canonical *Mishnah*;[7] (8) the texts of *Mishnah* and *Gemara* combined,—the meaning which is the one most commonly attached to the term *Talmud*. Although the word *Talmud* is not to be found in the Bible, there can be little doubt that it is a classical Hebrew term, as may be seen by the analogy of *Taḥănūn*, "supplication," *Tanḥūm*, "consolation," &c.

Recensions of the Talmud.—The Talmud exists in two recensions,—the Palestinian, commonly, but by mistake, called *Talmud Yerushalmi* (see below), and the Babylonian, correctly called *Talmud Babli*. The *Talmud Yerushalmi* embodies the discussions on the Mishnah (*q.v.*) of hundreds of doctors, living in Palestine, chiefly in Galilee from the end of the 2d till about the middle of the 5th century, whilst the Babylonian Talmud embodies chiefly the discussions on the same *Mishnah* of hundreds of doctors living in various places in Babylonia, such as Nehardo'a,[8]

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[1] Compare *Mishnah*, *Peah*, i. 1, ותלמוד תורה כנגד כלם ("and the studying of the Law balances them all"); *Aboth*, iv. 13, הוי זהיר בתלמוד ("be circumspect as regards instruction").

[2] See Perek Rabbi Meir, 6, ולא מגיס לבו בתלמודו ("whose heart is not arrogant on account of his learning"); *cf.* T. B., *Pesaḥim*, leaf 49*a*; ותלמודו משתכח ממנו ("his learning becomes forgotten by him").

[3] See T. B., *Synhedrin*, leaf 24*a*, תלמודה של בבל ("the mode of study prevalent in Babylonia"); comp. T. B., *Pesaḥim*, 34*b*, בבלאי טפשאי משום דיתבי בארעא דחשוכא אמריתון שמעתתא דמחשכו ("foolish Babylonians, who, because ye dwell in a land of darkness, say sayings that are obscure"), and T. B., *Baba Meṣi'a*, leaf 85*a*; Rabbi Zera fasted a hundred fasts on going up to Palestine, so that he might forget the style of Babylonico-Talmudic study (גמרא בבלאה or תלמודא בבלאה), that it should not trouble him any further. Rashi takes the quotation from *Baba Meṣi'a* to signify the concrete Babylonian Talmud, which, however, is impossible.

[4] See T. B., *Ḳiddushin*, leaf 40*b*: "Is theory (תלמוד) greater or practice (מעשה) greater? . . . They all answered, Theory (למוד) is greater because it leads to practice." *Talmud*, as will have been seen, is here given as synonymous with *Limmud*.

[5] See T. B., *Baba Kamma*, leaf 104*b*, יש תלמוד קאמינא ("I say this is a plain [Mosaic] teaching").

[6] See T. B., *Baba Bathra*, leaf 130*b*, catchword אין למדין, and *Variæ Lectiones in loco*.

[7] See T. B., *Baba Meṣi'a*, leaf 33*b*, and compare Rashi *in loco*.

[8] The rector of this academy was Shemuel, court physician of Shapur I., and astronomer. Whilst his friend and fellow-pupil Rab (*q.v.*; they both attended the lectures of the principal editor of the *Mishnah*) excelled in the other parts of the Jewish law, Shemuel was preeminent in the civil law. On account of this he is repeatedly called in the Talmud both "Shapur" (like his master) and "Aryokh" (lion, king, teacher). To him is due the legal principle that "the law of

Ḳaphri,[1] Maḥuza,[2] Shekhansib,[3] but notably at the two great academies of Sura and Pumbaditha, from about 190 to nearly the end of the 6th century. The doctors of both recensions, although they primarily discuss the correctness of the text and meaning of the *Mishnah*, and what should be the right legal decision according to it, do not confine themselves to this. They introduce, as occasion serves, not merely the whole of the oral tradition handed down to their time, and the necessary references to, and interpretations of, the various laws to be found in the Pentateuch and the other sacred writings, but exhibit also, though only in a fragmentary manner, an almost complete cycle of the profane sciences as current orally and known to them by books composed by Jews and Gentiles. The doctors of both these recensions were and are called *Amoraim* (אֲמוֹרָאִים), *i.e.*, mere "discussers, speakers,"[4] because, unlike the Mishnic doctors, who were and are called *Tannaim* (תַּנָּאִים), *i.e.*, "learners, teachers," they abstained from making new laws unless absolutely compelled by circumstances to do so.[5] These *Amoraim* stand, on the whole, in the same relation to their Mishnic predecessors as counsel giving a legal opinion, or judges deciding legal cases, stand to the legislature which frames the laws. In these points the doctors of both recensions agree. There are, however, also points of considerable difference between the two Talmuds. These are not merely geographical, and so necessarily linguistic,[6] but also material. Whilst the discussions in the Palestinian Talmud are simple, brief, and to the point, those in the Babylonian Talmud are subtle, long-winded, and, although always logical, sometimes even far-fetched.[7] But there is another difference. The Palestinian Talmud, besides containing legal and religious discussions, is a storehouse of history, geography, and archæology, whilst the Babylonian Talmud, taking into consideration that it is treble[8] the size of its fellow Talmud, contains less of these. On the other hand, it bestows more care upon the legal and religious points, and, being the later and the more studied of the two, it is also the more trustworthy.

System of the Talmud.—Most people imagine not only that the Talmuds are a pathless wilderness, without so much as grammatical rules in their respective languages, but that the laws laid down in them rest on mere tradition. In reality their languages have strictly grammatical rules (see below under *Aids*, &c.), and their laws rest on a strictly logical system. The laws in both Talmuds are discussed and argued on philosophical rules, for which it is claimed that they have existed from time immemorial, and can be traced to the Pentateuch itself. These are—(1) the Seven Rules (שבע מדות), put forth by Hillel (*Tosephto Synhedrin*, vii., last §; *Siphro*, towards the end of the Introduction; *Aboth de-Rabbi Nathan*, xxxvii.) but a great deal older than his time; (2) the Thirteen Rules (שלש עשרה מדות), put forth by R. Yishma'el (Introduction to *Siphro*), which can, however, be traced *in nuce* to the foregoing "Seven Rules": both these are for the *Halakhah*; and (3) there are also the Thirty-two Rules (שלשים ושתים מדות), put forth by R. Eli'ezer b. R. Yose Haggalili (vol i. of most editions of the Babylonian Talmud), which are for the *Agadah*. In addition, most of the points to which these rules apply are secured by early tradition. It is quite true that by idiosyncrasy digressions are very frequent both in Talmud and *Midrash*; but in the *Halakhah* the digression, however long, invariably ends in coming back to the original cause of the logical combination, whilst in the *Agadah* the digression either comes back to the place from which it started, or else will be found, on examination, to have been introduced for its own sake, and have served its own purpose. As the doctors of Talmud and *Midrash* are mostly introduced in dialogues, this is the only practical if somewhat uncommon, method.

Division of the Talmud.—The external division of both Talmuds is identical with the division, subdivision, and sub-subdivision of the *Mishnah*, although there is not always *Gemara* in the one when there is *Gemara* in the other.[9] This, however, need not be further discussed here, as all on this head is minutely specified in MISHNAH (*q.v.*). Concerning the internal division into *Halakhah* and *Agadah*, it ought to be said that the former is more largely represented in the Babylonian Talmud, whilst the latter is more largely and more interestingly given in the Palestinian Talmud. Whole collections of *Midrashim* now in our hands have constituted (if we may judge from the known to the unknown) part of the Palestinian Talmud,[10] and seem to have chiefly belonged to those portions of it which have been gradually lost.

Purpose.—The Talmud, unlike the *Mishnah*, contains not only individual decisions, but everything that is necessary for arriving at legal and religious decisions of whatever description these may be, whilst, like the *Mishnah*, it is not itself a handbook of decisions. This is only in accordance with the nature and spirit of an oral law which delegates the decisions to the Talmudico-speculative capacities of the teachers of every age. Even several of the comparatively few instances in which the words . . . והלכתא כ׳ ("and the

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the civil government is *the* law," *i.e.*, that except in religious matters the Jew must submit to the laws of his country (T. B., *Baba Bathra*, 54*b*). Shemuel and Rab (like Rabbi Yohanan and Resh Lakish, Abayye and Raba, and others), though intimate friends, nevertheless differ on nearly all imaginable points, so that when the Talmud wishes to give firmness to a certain decision or opinion, it uses the phrase: "Rab and Shemuel, &c., both agree."

[1] The rector of this school was Rab Ḥisda, the father-in-law of RABA (*q.v.*).

[2] The rector of this school was RABA (*q.v.*).

[3] The rector of this school was Rab Naḥman b. Yiṣḥaḳ (T. B., *Gittin*, 31*b*, Rashi, catchword אזא), husband of the learned and accomplished Yaltha, the daughter of the resh galutha (T. B., *Ḥullin*, leaf 109*b*), &c.

[4] *Amora* may also mean an interpreter. The great teachers of the first five centuries had generally a man (or several men) at their side, who to the learning requisite to translate the master's teaching given in Hebrew, and dilate on it in Aramaic, added a Stentor's voice, and could by fascinating speech command the attention of the audience. The first Babylonian *Amora*, *i.e.*, explainer of the *Mishnah*, who had an *Amora*, *i.e.*, a popular teacher, was Rabbi Shila. The first who is known to have acted as *Amora*, *i.e.*, popular teacher, to an *Amora*, *i.e.*, an explainer of the *Mishnah*, was the famous RAB (*q.v.*). See T. Y., *Berakhoth*, iv. 1, 2, &c.; T. B., *Berakhoth*, leaf 27*b*; and T. B., *Yoma*, leaf 20*b* (against Rapoport, *'Erekh Millin*, s.v. "Amora").

[5] This certainly was not unfrequently the case, but even then they did so only in the spirit of the *Tannaim*.

[6] The Palestinian *Amoraim*, teaching people who understood Greek, had not to explain the Greek terms which frequently occur in the *Mishnah* and other works kindred to it. The Babylonian *Amoraim*, however, who in common with their hearers were ignorant of Greek, had a somewhat irregular though certainly effective way (received by them traditionally) of explaining the Greek terms in the *Mishnah*, &c., by Aramaic etymology. We will give two instances only of this practice:—(1) אפותיקי, which is evidently the Greek ὑποθήκη, is explained T. B., *Baba Meṣi'a*, leaf 66*b*, לא יהא לך פרעון אלא מזו, "thou shalt get no payment except from this,"—evidently – אפה תהא קאי – "upon this thou shalt stand," *i.e.*, "if I do not pay, this shall serve as my security"; compare Rashi on *Baba Ḳamma*, 11*b*, catchword אפותיקי; (2) דיתיקי is evidently the Greek διαθήκη, and is explained as being a compound of (קים) דא תהא למיקם, "this shall stand when I am no more," *i.e.*, "this is my last will and testament." From T. B., *Baba Bathra*, leaf 135*b* (evidently a Babylonian *Boroitho*), we see that in T. B., *Baba Meṣi'a*, leaf 19*a*, three words (כל שכתוב בה׳) have fallen out.

[7] Compare p. 35, footnote 3.

[8] Bibliographers generally fall into a mistake in describing the size of the Babylonian as twelve times that of the Palestinian Talmud. They forget that two-thirds of the size of the former is simply owing to the commentaries by which it is invariably accompanied.

[9] The only thing that ought to be mentioned here is, that to the Palestinian Talmud the *Sheba' Massekhtoth Ḳetannoth Yerushalmiyyoth* (Frankfort, 1851, 8vo) must be added, whilst *Gemara Sheḳalim* and the *Massekhtoth Ḳetannoth*, which now form an integral part of the Babylonian Talmud, are (*Aboth de-Rabbi Nathan* excepted) unjustifiably attached to it.

[10] See Rashi on Gen. xlvii. 2.

decision is according to so and so") occur in the Babylonian Talmud are a later addition. They belong to the *Halakhoth Gedoloth*,[1] and are consequently, at the earliest, of the 8th century, but are probably of even much later date.

Editors.—The editorship of the Palestinian Talmud is generally, after Maimonides,[2] ascribed to Rabbi Yoḥanan (b. Napha). But this, if literally taken, is a gross mistake, as that teacher (*ob.* 279) died more than a hundred years before the latest *Amora* (*c.* 450) mentioned in that Talmud. A similar error is made with respect to the editor or editors of the Babylonian Talmud, whose names are given as Rab Asshi (see RAB) (*ob.* 427) and Rabina (*ob.* 550), and who lived still much earlier than the last teachers mentioned in that Talmud (8th century). But it ought to be remembered that when the ancients speak of editors of books of such a mixed character as the *Mishnah*, the *Zohar*, both Talmuds, &c., they mean the person or persons who gave the first impulse to the collection or redaction of such books. In this sense, certainly, Rabbi Yoḥanan was the editor of the Palestinian and Rab Asshi and Rabina were the editors of the Babylonian Talmuds. For, whilst the first of the latter pair went more than once through the discussion of the whole *Mishnah* by the *Amoraim* from 190 to his time (*c.* 427), the latter supplemented the collection down to his own time (550). As regards the Babylonian Talmud, the *Amoraim* were succeeded by a new order of men called *Saboraim* (רבנן סבוראי), *i.e.*, "opiners," who ventured only occasionally to revise and authenticate the sayings of their predecessors. The last of these *Saboraim* were Rab 'Ina (or Giza) and Rab Simona (*c.* 550–590). In any case neither the one Talmud nor the other was written down, slight private notes excepted (מגלות סתרים), before the close of the 6th century, if then. The apparently insurmountable difficulty of keeping such vast masses of literature in the head is removed when one takes into consideration that both teacher and student had means of help to their memory fully corresponding to the vastness of the literature. In the first place, they had the *numbers* already occurring in the *Mishnah* (*e.g.*, *five* must not separate the heave-offering or account of the benediction to be recited in connexion with the act; *Terumoth* i. 1), &c. Secondly, they had *names*. Since to the sayings of the Talmud were generally attached the names of those who uttered them, saying and name became in the memory of the student identical. If somebody who had heard a certain saying from somebody, who in his turn had heard it from somebody else, was mentioned in the Talmud, all other sayings, however unlike these in nature, if they had only the same link of tradition, were recited on the same occasion: *e.g.*, in the Palestinian Talmud, *Megillah* iv. 1, "says Rabbi Ḥaggai, says Rabbi Shemuel b. Rab Yisḥaḳ," &c.; T. B., *Berakhoth*, leaf 3*b*, &c., "says Rabbi Zeriḳa, says Rabbi Ammi, says Rabbi Yehoshua' b. Levi," &c. Thirdly, *other oral traditions*, which went by the order of the Pentateuch, received in the written Pentateuch vast aids to memory. Fourthly, the *Mishnah* (although itself not written down), by its divisions, subdivisions, and sub-subdivisions, became, in its turn, a mighty aid to memory. Fifthly, as regards the Babylonian Talmud, there are additional means of aiding memory in existence, for every now and then one meets with a *Mnemosynon* (*Siman*), which strings together the order of subjects (*e.g.*, T. B., *Berakhoth*, 32*a*, last line). Both in MSS. and printed editions these *Simanim* are given in brackets. Rapoport and his followers would have us believe that these mnemonic phrases are late inventions, but they have as yet failed to make good their assertions. See T. B., *Shabbath* 104*a*, and T. B., *'Erubin*, 54*b*, where these *Simanim* are positively mentioned early in the 4th century; *cf.* Rashi *in loco*.

Value.—The value of the Talmuds may be estimated by the fact that they contain the *Mishnah* in various recensions and a large portion of the contents of Midrashic collections, and in addition comprise a vast amount of Sopheric literature not to be found in the canonical *Mishnah* and Agadic matter not to be found in the known *Midrashim*, and have thousands of notices on secular knowledge of all kinds. Here, however, the reader ought to be again reminded that, whilst the Babylonian Talmud, the one of much larger extent, contains a great deal more Judæo-religious matter, the Palestinian Talmud—of much smaller extent—is of much greater value for the historian, the geographer, the numismatist, and other students.

Vicissitudes of the Talmud.—Whilst the Babylonian Talmud commanded the attention of a hostile world, and was proscribed, mutilated,[3] and condemned, and finally delivered over to the flames[4] by popes and kings, the Palestinian Talmud suffered still more from one single enemy—neglect.[5] Thousands of copies of the former recension were destroyed in the course of time, but, this Talmud being studied in all parts of the world, the few copies surviving became the means of an endless supply. Not so as regards the Palestinian Talmud, which found no students, or but few, after the closing (*c.* 450) of the Jewish academies in Palestine; and we have even to thank the enemies of traditional Judaism, the Ḳaraites, who used it in controversy with their Rabbanite opponents, for the preservation of some copies of it. By degrees the neglect of the book became so great that whole chapters of treatises, whole treatises of orders, and almost two whole orders themselves, disappeared, and are lost to this day.[6]

Aids to the Study of the Talmuds.—(*a*) *Lexicons.*—The first rank is occupied by lexicons for both Talmuds and *Midrashim*, and of these that by R. Nathan b. Yehiel of Rome, compiled in the 11th and 12th centuries, claims the first place. All other lexicons, from Elias Levita, Philip Aquinas, Johannes Buxtorf, &c., down to Levy and Jastrow, are more or less based upon this grand work called *'Arukh*.[7] (*b*) *Grammars.*—A slight attempt at compiling a grammar, and this only for the Babylonian Talmud, was made by the late learned S. D. Luzzatto. It exists in Italian (Padua, 1865), German by Krüger (Breslau, 1873), English by Goldammer (New York, 1876), and Hebrew by Lerner (St Petersburg, 1880). Of more value, however, is Noldeke's *Mandaitic Grammar*, although it stands in connexion with the Babylonian Talmud only in an indirect way. (*c*) *Commentaries.*—Commentaries on the greater portion of the Babylonian Talmud are extant, by the famous Rabbenu Ḥananeel of Kairwan, the teacher of Riph (*q.v.*), by Rashi (*q.v.*), and by the descendants and disciples of this latter commentator, who composed the *Tosaphoth*. All these are included in the latest Talmud edition of Vilna. It is asserted by Rabad II. (*q.v.*) that the whole (B.) Talmud had been commented on in Arabic. As regards the commentaries on the Palestinian Talmud, it ought to be said that the *Pene Mosheh*, &c., by R. Mosheh Margaliyyoth, and the *Ḳorban Ha'edah*, &c., by R. David Frankel (the teacher of Mendelssohn), make more than one commentary on the whole, and they are embodied in the Zhitomir edition (1860–67). (*d*) *Methodology.*—Among the many Introductions to the Babylonian Talmud that of R. Shemuel Hannagid must now be considered the first, not only in time but also in value. There was indeed an earlier, and perhaps a still more valuable one in existence (see Saadia), but it is now unfortunately lost. As regards the Palestinian Talmud, the only one in existence is that by the late Z. Frankel (Breslau, 1870, 8vo). The author was a most learned man, but somewhat confused in his diction. (*e*) *Translations.*—Renderings of isolated treatises of the Babylonian Talmud exist in Latin, Ugolini, *Thesaurus*, xix., *Zebaḥim* and *Menaḥoth*, and xxv., *Synhedrin*;[1] in French, *e.g.*, *Berakhoth*, by Chiarini (Leipsic, 1831, 8vo); and in German, *e.g.*, *Berakhoth*, by Rabo (Halle, 1777, 4to), regard being had also in both to the same treatise of the Palestinian recension, and again by Pinner (1842); *Baba Meṣi'a*, by Sammter (1876), both at Berlin and in folio; *'Abodah Zarah*, by Ewald (Nuremberg, 1856, 8vo); *Ta'anith*, by Straschun (Halle, 1883); *Megillah* and *Rosh Hasshanah*, by Rawicz (Frankfort-on-the-Main, 1884 and 1886). The assertion that the whole of this Talmud has been translated into Spanish has yet to be proved. As regards the Palestinian Talmud, Ugolini's *Thesaurus* contains the following treatises in Latin:—*Pesaḥim* (vol. xvii.); *Sheḳalim, Yoma, Sukkah, Rosh Hasshanah, Ta'anith, Megillah, Ḥagigah, Beṣah, Mo'ed Ḳaṭan* (vol. xviii.); *Ma'aseroth, Ma'aser Sheni, Ḥallah, 'Orlah, Bikkurim* (vol. xx.); *Synhedrin, Makkoth* (vol. xxv.); *Ḳiddushin, Soṭah, Kethuboth* (vol. xxx.). M. Schwab (of the Bibliothèque Nationale, Paris) has undertaken a French translation of the entire Palestinian Talmud, which is now in progress; from this *Berakhoth* has been translated into English (London, 1886, 4to).

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[1] *E.g.*, T. B., *Berakhoth*, leaf 36*a*. See Rashi and *Tosaphoth*, catchword והלכתא; *Ibid.*, 36*b*, and in other places.

[2] In his Introduction to the commentary on the *Mishnah* (commonly, but by mistake, called Introduction to the *Seder Zera'im*) and in his Introduction to the *Mishneh Torah*.

[3] Raymundus Martin (Ramon Martinez), backed up by his teacher Pablo Cristiani (see RAMBAN), was one of the first five (or rather six) mutilators (called censors) of the Talmud and kindred books. See Touron, *Histoire des Hommes Illustres de l'Ordre de Saint Dominique*, i. (Paris, 1743, 4to) p. 492; *Jour. Philol.*, xvi. 134.

[4] In the midsummer of 1244 twenty-four waggons full of Talmud copies were burned in France (see *Journal of Philology*, xvi. 133). A certain Donin (afterwards called Nicolaus), a converted Jew, by his accusations against the Talmud, managed that Rabbi Yehiel of Paris had to dispute with him publicly about its contents. The disputation took place in the midsummer of 1240; and R. Yeḥiel came out of it so victoriously that only after four years' further machinations the Talmud was actually burned. The disputation is printed under the name of *Disputatio cum Nicolao A. 1252* (!) *habita cum Versione Latina* in Wagenseil's *Tela Ignea Satanæ* (Altdorf, 1681, 4to); a less incorrect Hebrew edition came out in 1873, 8vo, at Thorn. This event of burning the Talmud called forth three elegies—(1) by R. Binyamin b. Abraham De' Mansi, beginning אבות עולם, and the refrain of which was אי משנה ונמרא. אי חכמה מפארה (see MS. Add. 374, Camb. Univ. Lib., leaves 307*a*–308*a*); (2) by R. Meir of Rothenburg (see ROSH), the beginning of which is שאלי שרופה באש (in the Ashkenazic ritual for the 9th of Ab); and (3) by R. Abraham b. Yisḥaḳ (see Zunz, *Zur Gesch. u. Lit.*, pp. 463–4). This Abraham b. Yisḥaḳ is the father of the famous En-bonet Abram Bederesi (not Bedarshi; see Schiller-Szinessy, *Catal.*, i. correction 5), the author of the *Beḥinath 'Olam*.

[5] See Schiller-Szinessy in the *Academy*, 1878, p. 171, and extract from Excursus iii. (to the *Catalogue*) on the Palestinian Talmud in *Occasional Notices*, &c., i., Cambridge, 1878, 8vo.

[6] See the before-mentioned *Occasional Notices*.

[7] Rabbenu Nathan b. Yehiel b. Abraham was, on his father's side an 'Anav (ענו)—and not an 'Akko (עכו) as Rapoport, no doubt after Ibn Yahya, writes it in *Bikkure Ha'ittim*, x. 7—*i.e.*, of the family 'Anavim (Dei Mansi, Dei Mansueti, Dei Piatelli, Dei Pietosi, Dei

Editions.—The editions of the Palestinian Talmud, in what was then called its entirety, are only four:—(*a*) Venice, 1523, without any commentary; (*b*) Cracow, 1609, with a short commentary, the text apparently from a different MS. from that used for the *editio princeps*; (*c*) Krotoschin, 1866, with a short commentary differing from that of Cracow: these three editions are each comprised in one volume; (*d*) the fourth edition came out at Zhitomir, with commentaries by different men (see *Commentaries* above). All these editions are in folio. Of the editions of isolated treatises, which are not a few, we will only mention those of *Berakhoth* (Vienna, 1874) and *Peah* and *Demai* (Breslau, 1875, both in 4to), with a new commentary by Z. Frankel. The editions of the Babylonian Talmud are so numerous that they would require several entire sheets for enumeration. There is in existence an approximately good treatise on them (see *Variæ Lectiones*, vols. i. and viii.). We will only name three of the entire editions:—(1) the *editio princeps*, Venice, 1520–23,[2]—which, though disfigured by numerous misprints, was not mutilated by the censor; (2) the edition of Basel (1578–81), which omits *'Abodah Zarah* altogether, and has a cheering (!) notice in Latin;[3] (3) the latest edition, now printing at Vilna, with old commentaries hitherto unpublished. Of isolated treatises, which may be counted by more than hundreds, we will only mention one (the Portuguese of at least *Berakhoth*), the existence of which was asserted in the last century (*Paḥad Yiṣḥaḳ*, s.v. גנבא במחתרתא), then again called in question in our own times, but positively proved by the present writer from an early work composed at the time when but few editions of the Talmud existed. It is the *Zera' Abraham* (Camb. MS. Ti. 6. 50, leaf 59*b*). Materials for the critical edition of the Babylonian Talmud from an ancient MS. formerly in the monastery of Pfersee, but now in the Royal Library of Munich, and other MSS. and early prints of isolated treatises in various public and private libraries of Europe, Asia, and Africa, have been collected and are being published by Rabbinovicz. Of this important work fifteen volumes, containing the following treatises, have already come out:—the whole *Seder Zera'im* (1867); *Beṣah, Ḥagigah, Mo'ed Ḳaṭan* (1869); *Sukkah, Ta'anith* (1870); *Rosh Hasshanah, Yoma* (1871); *'Erubin* (1873); *Pesaḥim* (1874); *Shabbath* (1875); *Megillah, Sheḳalim* (1877); *Synhedrin* (1878); *'Abodah Zarah, Makkoth, Shebu'oth, Horayoth, 'Eduyyoth* (1879); *Baba Bathra* (1881); *Baba Ḳamma* (1882); *Baba Meṣi'a* (1883); *Zebaḥim* (1884); *Menaḥoth* (1886).[4] All these were printed in 8vo and at Munich, except vol. ix., which came out at Mainz.

Influence of the Talmud.—It must be admitted by every critical student of history that the Talmud has not merely been the means of keeping alive the religious idea among the Jews, but has formed their strongest bond of union. When, after the fall of the city of Jerusalem and its temple, and the expatriation of the Jews from Palestine, a goodly portion of the Mosaic law lost its application, the Talmud became the spirit which put fresh life into the letter which

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Umani, Dei Umili), and, on his mother's side, of the *Tappuḥim*, *i.e.*, De Pomis, to which the celebrated author of the Lexicon *Ṣemaḥ David* belonged. Rabbenu Nathan's father and grandfather, like Rabbenu Nathan himself and his brother's descendants, were, no doubt, papal court Jews (and not linendrapers, as the latest editor of the *'Arukh*, by misreading and misinterpreting the somewhat hard verses of his author, contrives to show). This lucrative position furnished them with ample means not only for their noble charities to congregational institutions (a synagogue, religious bath, &c.), but also with the leisure necessary for the pursuit of Talmudic studies. Rabbenu Nathan was *resh kallah* (rector of the Jewish university), and unquestionably the greatest Talmudist, even as he was the poorest Hebrew poet, in Italy in the 11th and 12th centuries. As regards his teachers we know four, three of whom he attended, whilst he studied and digested the works of the fourth so well that, though personally unknown to one another, they may be justly called master and disciple. His first teacher was his own father; his second teacher, from whom Rabbenu Nathan no doubt obtained his thorough knowledge of Babylonian habits, was R. Masliaḥ of Sicily, who had been a hearer of the greatest "gaon" of Pumbaditha; his third teacher was R. Mosheh b. Ya'aḳob b. Mosheh b. Abbun of Narbonne (or Toulouse; better known under the name of R. Mosheh Haddarshan); and the fourth was Rabbenu Ḥananeel of Kairwan. He owed so much to this teacher that as soon as the *'Arukh* had appeared most people took it for granted that Rabbenu Ḥananeel had lived at Rome, and accordingly called him "a man of Rome—'Ish Romi"; see MS. Brit. Mus. Add. 27,201, leaf 73*b*, and *Tosaphoth, passim*. (That Rabbenu Gershom, Rabbenu Mosheh נפוסי, and others were his teachers, as Rapoport, *loc. cit.*, asserts, is a fiction.) Rabbenu Nathan, in his *'Arukh*, does not merely explain the foreign (*i.e.*, Aramaic, Persian, Greek, Latin, and Arabic) words occurring in the Targums, Talmuds, and *Midrashim*, but the subject-matter also, and thereby proves himself a doubly useful guide. In this, although he had been preceded by no less a personage than the *Gaon* Ṣemaḥ b. Paltoi (fl. 870), who also composed such an *'Arukh*, Rabbenu Nathan was virtually the first, as the *Gaon's* work had been early lost. The assertion that the fourth of the four men captured by the Spanish admiral (see below, p. 39) was R. Nathan Habbabli, that he lived in Narbonne, and that he also composed a similar *'Arukh*, rests on a misunderstanding, as the quotation in the *Yoḥasin* clearly shows. The passages there given under R. Nathan Habbabli are taken *verbatim* from the *'Arukh* of our author (compare the article שנש, &c.). That Rome has been at times called in Jewish writings "Babel," and that consequently *Habbabli* may mean "the Roman," is clear from the writings of the New Testament. We will only add here a few words concerning the bibliography of the book. Of the *'Arukh* exist so far ten editions, the first of which came out undated, but before or about 1480. The seventh edition was enriched by the physician R. Binyamin Musaphia's *Musaph*, *i.e.*, *Additamenta* (Musaphia was a Greek and Latin scholar), and the latest edition by Dr Kohut is now in progress. As regards the MSS. of this remarkable lexicon the best copies are to be found partly in the University Library, Cambridge (Add. 376, which has all the verses of the author and *additamenta* by R. Shemuel Ibn נסע, and Add. 471–72), and partly at the Court Library, Vienna (Cod. cvi. 1 and 2). The latter were carried off by Napoleon I. to Paris in 1809, but in 1815 were returned to Vienna.

[1] Various writers assert that there exist many books containing Latin translations of various treatises of the Babylonian Talmud. Upon examination these books turn out to contain either a translation only of Mishnic treatises with or without excerpts from, and with or without scholia on, *Gemara*, or disputations which introduce small pieces of *Gemara*. The utmost they contain is a chapter or two translated from *Gemara* itself (as, for example, "Edzard, Aboda Sara," &c., Hamburg, 1705–10 4to which contains *Gemara* of the first two *Peraḳim*).

[2] The paging of this has been followed in all subsequent editions.

[3] Nunc ab omnibus iis quæ contra religionem Christianam faciebant recognitum, et juxta mentem Sacri concilii Tridentini expurgatum et approbatum, ut non modo citra impietatem verum etiam cum fructu a nostris legi possit.

[4] The notes in the first fourteen volumes go under the name of דברי סופרים, whilst those of the fifteenth volume have the title of זכור לאברהם, in memory of the late Abraham Merzbacher, who not merely proved the Mæcenas of this publication during his lifetime, but left a considerable sum for its continuation and completion.

had become to a great extent dead. Moreover, by the Talmud, the interpretation of which was chiefly in the hands of the academies of Sura and Pumbaditha, the Jews of all the world found, if not a new Jerusalem, at least a new Yabneh (Jamnia), *i.e.*, a place where the old learning was not merely continued, but made to shine with a yet greater splendour. This fact will be the more readily acknowledged and appreciated when one casts a glance at the miserable religious condition of the Ḳaraites, the so-called Scriptural Jews.

Transference of Talmudic Learning from the East to the West.—There naturally came a time when Talmudic learning, if it was to maintain its influence upon the Jews, could not be confined to one spot. We have seen under Rashi (*q.v.*) that the great emperor of the West (Charlemagne) had been the means, towards the close of the 8th century, of bringing learned Talmudists not only to Provence but to the north of France and the south of Germany.[1] But when nearly two hundred years later the academies of Babylonia were threatened with extinction (because of their lacking, from various causes, the means of subsistence), so that they had to send out members of their body to supplicate the support of their richer brethren in other countries, it providentially happened that the four men whom they sent were taken by a Spanish corsair admiral and sold in four different slave-markets. Rabbi Shemaryah was sold at Alexandria, and was redeemed by the Jews, and great was their astonishment when they recognized in him a most able Talmudist. He became the head of the Cairo community, and one of the most successful Jewish Talmud teachers Egypt ever had. Rabbi Ḥusshiel was taken to Kairwan, in Africa. There the Jews redeemed him; and when his great learning was found out he was named the spiritual head of the Jews in that place. From the school which he founded sprang not merely his own son, the famous Rabbenu Ḥananeel, but also the great Rabbenu Nissim, both teachers of Riph (*q.v.*). Another learned captive, R. Mosheh, was brought to the slave-market of Cordova, the rabbi of which town, a noble and rare example of unselfishness, modesty, and love of truth, placed the ragged stranger who had only been ransomed for charity's sake a day or so before at the head of the community instead of himself. The name of the fourth is unknown (see Rabad II., and *Yoḥasin*, ed. Cracow, leaf 125*b*). Some assert that he was R. Nathan Habbabli, and that he became the teacher of the Jews in Narbonne, but this is a mere conjecture, the truth of which has yet to be proved (see page 37, footnote 7). Be this, however, as it may, four great Talmudists, who had come direct from the Babylonian academies, became the means of bringing Babylonico-Talmudic learning to places the Jews of which had been dependent on the religious and literary crumbs that fell from the richly-laden tables of Sura and Pumbaditha. Some years afterwards the former academy was closed, and a short time afterwards the same fate befell that of Pumbaditha, the sunset of which, if not the noonlight, in the persons of Rab Sherira Gaon and his son Rab Haï Gaon was even more glorious than that of the sister academy, the last "gaon" of which was Rab Shemuel b. Ḥophni, father-in-law of Rabbenu Haï. Meanwhile, however, Talmudic learning had not merely become naturalized, but eventually indigenous in various parts of Africa, and part of Europe (Spain, Italy, Provence, the south of Germany, and the north of France). Rabbenu Gershom b. Yehudah of Metz and his disciple Rabbenu Yiṣḥaḳ of Troyes, Rabbenu Ya'aḳob b. Yaḳar of Worms, Rabbenu Eli'ezer Haggadol and his disciple and successor Rabbenu Yiṣḥaḳ Segan Leviyyah, Rabbenu Yiṣḥaḳ b. Yehudah of Mainz, Rabbenu Elyaḳim of Spires, Rabbenu Nathan b. Yehiel of Rome, and last but not least Rashi himself, and his sons-in-law and other disciples, represented Talmudic learning in such perfection as had not been found before as regards the Babylonian Talmud, even in the land of its birth and growth. It was the disciples' disciples of these men who studied and taught in various towns of England within a hundred years (1150) after the Conquest. When, towards the end of the 13th century and the commencement of the 14th, the Jews were driven out of England (1290) and France (1306), and flocked chiefly to Italy, Greece, Germany, and Poland, the last-named country appropriated the lion's share of Talmudic learning, so that till within our own century the rabbis of the chief communities in Hungary, Moravia, Bohemia, and other Austrian states, and in Germany, Holland, England, &c., had to be fetched from Poland. Talmudic learning, since Mendelssohn and his school arose, threatened to die out not merely among the Jews in Germany, but also among those of the other countries where the Jews spoke the German tongue in some form or other. Within the last twenty-five years, however, fresh impulse has been given to these studies, not merely among Jews but also among Christians. (S. M. S.-S.)

TAM, commonly called Rabbenu Tam, more correctly Rabbenu Tham (רַבֵּנוּ תָּם=ר״ת). By this title are known two eminent Rabbinic scholars, both named Ya'aḳob, to whom this epithet was given in allusion to Genesis xxv. 27: "And Jacob was a *perfect* man" (*Ish Tam*, אִישׁ תָּם). They belonged to the north of France, lived in the 12th century, and were master and pupil.

1. Rabbenu Ya'aḳob b. Meir b. Shemuel was, on his mother's side, a grandson of Rashi (*q.v.*). He was his parents' third son, younger brother of Ribam and Rashbam (*q.v.*), older brother of Rabbenu Shelomoh of Rameru,[2] and brother-in-law of Rabbenu Shemuel b. Simḥah of Vitry the younger[3] (the reputed author of the *Maḥzor Vitry*,[4] now apparently lost[5]). Rabbenu Tham had, like his grandfather Rashi, six teachers:—(1) his own father, (2) his brother Ribam, (3) his brother Rashbam, (4) Rabbenu Ya'aḳob b. Shimshon,[6] (5) his grandfather Rashi,[7] and (6) Rabbenu Yoseph Tob-Elem the younger.[8] Rabbenu Tham had at least five children.[9] The names of three of his sons were Yoseph,[10] Yiṣḥaḳ,[11] and Shelomoh.[12] Rabbenu Tham was unquestionably among Jews the foremost man of his age. For not only was he the greatest Talmudist after his maternal grandfather's death, but he also added reading wide and varied to a stupendous memory and a marvellous

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[1] Italy, notably Sicily, was apparently the country which obtained its teachers direct from Iraḳ.

[2] See MS. Add. 27,200 in the Br. Mus., leaf 158*b*.

[3] See Rashi's *Siddur*, i. leaf 1*b*.

[4] See Schiller-Szinessy, *Catalogue*, ii. p. 88.

[5] See art. Rashi (vol. xx. p. 284, note 10).

[6] This rabbi was a disciple of R. Shemuel Hallevi (see Schiller-Szinessy, *Catal.*, ii. p. 65, note 1) and of Rashi, and was not only a great Talmudist, as were all the disciples of the last-named eminent teacher, but also a great mathematician and astronomer, though a terribly bad poet. His commentary on *Aboth* is in part printed, and is to be found, more or less perfect, in various libraries in Europe, although not recognized as his. It is ascribed variously to Rashi, to Rashbam, and others. There are copies of it in Cambridge (Add. 1213; Add. 1523), Oxford (Opp. 317), the British Museum (Add. 27201), the Beth-Hammidrash of the Ashkenazim in London, &c. (The master of St John's, Cambridge, is preparing an edition of it.) A work on intercalation by Rabbenu Ya'aḳob b. Shimshon exists in MS. at the Bodleian (Opp. 317) under the name of *Sepher Haelḳoshi*. From him, no doubt, Rabbenu Tham imbibed his love for science. On the fact that Rabbenu Ya'aḳob b. Shimshon was Rabbenu Tham's teacher (against Zunz), see Schiller-Szinessy, *Catal.*, ii. p. 66, note.

[7] Rabbenu Tham, dying an old man, must have been from fourteen to sixteen years of age when Rashi died.

[8] See *Sepher Hayyashar*, § 620 (leaf 74*a*, col. 2).

[9] See Camb. MS. Add. 667, 1, leaf 64*b*, col. 1.

[10] See Brit. Mus. MS. Add. 27200, leaf 158*b*.

[11] See *Sepher Hayyashar*, § 604.

[12] See *Shibbole Halleḳet* (ed. Buber), p. 10

power of combination, such as appeared only again in the last century in the persons of R. Yehonathan Eybenschütz (*ob.* 1764) and R. Yehezkel Landau (*ob.* 1793). Let us add that he was a lexicographer, grammarian, and Biblical commentator of no mean order; that he was a poet in Hebrew and Aramaic[1] inferior only to Ibn Gebirol (AVICEBRON, *q.v.*), Mosheh Ibn 'Ezra, and Yehudah Hallevi (and by far greater in this art than the commentator, Abraham Ibn 'Ezra): that he was held in high esteem by prince and nobles;[2] and that he was a man of great wealth, with which he generously supported, not merely his own poorer hearers, but other itinerant scholars also.[3]

His works are the following:—

(1) Commentary on Job, and, no doubt, on other parts of the Bible (see Camb. Univ. Lib. MS. Dd. 8. 53, leaves 1*b*, 4*a*, 11*a*, 12*b*). All these are apparently now lost. (2) *Hakhra'oth*, *i.e.*, lexical and grammatical decisions between Menahem Ibn Seruk and Dunash b. Labrat (see *Sepher Teshuboth Dunash b. Labrat*, Edinburgh, 1885, 8vo). That these "decisions" are really by Rabbenu Tham is proved by the before-named MS., leaves 10*a* and 16*a*, where the book is quoted by an author of the 13th century. (3) *Sepher Hayyashar* (Vienna, 1810, folio). Although this work, in its present form, is the compilation of one of Rabbenu Tham's disciples, R. Yishak b. Durbal by name (also called Isaac of Russia; see Schiller-Szinessy, *Catalogue*, i. p. 164, and ii. p. 66), not only is the foundation Rabbenu Tham's (see Preface), but the contents also are virtually his. Compare the Cambridge MS. Add. 667. 1, *passim*. (4) The greater part of the *Tosaphoth* in the Babylonian Talmud are indirectly also by Rabbenu Tham; and he is virtually the first Tosaphist. It is true that his father, his brother RASHBAM (*q.v.*), and his uncle Rabbenu Yehudah b. Nathan had written *Tosaphoth* before him, and that this kind of literary activity lasted to within the first quarter of the 14th century. Still, most and the best of the *Tosaphoth* now in our hands rest on Rabbenu Tham and his school. (5) *Mahzor*, *i.e.*, a prayer-book, &c., for the whole year, with Rabbinic ordinances, &c. See *Tosaphoth* on T. B., *Berakhoth*, leaf 37*a*, catchword הכוסס, and *Birekhoth Maharam* of R. Meir b. Barukh of Rothenburg (Riva di Trento, 1558, 8vo), leaf 4*a*. (6) Poems. These are partly didactic and partly liturgical. Of the former kind a specimen will be found ("On the Accents," communicated by Halberstam) in Kobak's *Yeshurun*, v. p. 125 *sq.* The liturgical poems, again, are of two kinds: (*a*) such as have no metre and rhyme only by means of plurals, possessive pronouns, and such like (rhymed prose), and which perfectly resemble most of the productions of the Franco-Ashkenazic school (see, for example, the facsimile in Muller's *Catalogue*, Amsterdam, 1868, 8vo); (*b*) such as have metre and rhyme, and resemble the productions of the Sephardic school, *e.g.*, the one beginning יי בך מעיני (and not בו; see MS. Add. 667, leaf 102*a*).[4] (7) Various ordinances, &c., are to be found in later writers (see MS. Add. 667, in Cambridge, *passim*, and *Teshuboth Maharam*, Prague, 1608, folio, § 1023, &c.). Rabbenu Tham died in 1171; see Rashi's *Siddur*, ii. (formerly Luzzatto's, then Halberstam's, and now the property of the master of St John's College, Cambridge), leaf 48*a*.

2. RABBENU YA'AḲOB of Orleans, rabbi of London (?). He is often quoted in the *Tosaphoth* (both on the Pentateuch and on the Babylonian Talmud). No independent works of his, however, are extant. He was killed at London in the tumult on the coronation day of Richard Cœur-de-Lion (September 3, 1189; Schiller-Szinessy, *Catal.*, i. p. 117). (S. M. S.-S.)

TAMAQUA, a borough of Schuylkill county, Pennsylvania, United States, in a broken, hilly country, upon the Little Schuylkill river, 98 miles nearly north of Philadelphia. It is in the midst of the anthracite coal region, and coal mining is one of its principal interests. It is an important railroad centre, upon the Philadelphia and Reading system, being the point of intersection of three main lines and the terminus of several minor branches. The borough had a population of 5960 in 1870 and of 5730 in 1880.

TAMARIND. This name is popularly applied to the pods of a Leguminous tree, which are hard externally, but within filled with an acid juicy pulp containing sugar and various acids, such as citric and tartaric, in combination with potash. The acid pulp is used as a laxative and a refrigerant, the pods being largely imported both from the East and the West Indies. The tree is now widely distributed in tropical countries, but it is generally considered that its native country is in eastern tropical Africa, from Abyssinia southward to the Zambesi. Sir Ferdinand von Mueller notes that it is truly wild in tropical Australia. The name (meaning in Arabic "Indian date") shows that it entered mediæval commerce from India, where it is used, not only for its pulp, but for its seeds, which are astringent, its leaves, which furnish a yellow or a red dye, and its timber. The tree (*Tamarindus indica*, L.) attains a height of 70 to 80 feet, and bears elegant pinnate foliage and purplish or orange veined flowers arranged in terminal clusters. The flower-tube bears at its summit four sepals, but only three petals and three perfect stamens, with indications of six others. The stamens, with the stalked ovary, are curved away from the petals at their base, but are directed towards them at their apices. The anthers and the stigmas are thus brought into such a position as to obstruct the passage of an insect attracted by the brilliantly-coloured petal, the inference of course being that insects are necessary for the fertilization of the flower.

TAMARISK. The genus *Tamarix* gives its name to a small group of shrubs or low trees constituting the tamarisk family. The species of tamarisk and of the very closely allied genus *Myricaria* grow in salt deserts, by the sea-shore, or in other more or less sterile localities in south temperate, subtropical, and tropical regions of the eastern hemisphere. Their long slender branches bear very numerous small appressed leaves, in which the evaporating surface is reduced to a minimum. The flowers are minute and numerous, in long clusters at the ends of the branches or from the trunk. Each has 4–6 free sepals, and as many petals springing with the 4–12 stamens from a fleshy disk. In *Tamarix* the stamens are free, while in *Myricaria* they are united into one parcel. The free ovary is one-celled, with basal placentas, and surmounted by 3–5 styles. The fruit is capsular, and contains numerous seeds, each usually with a long tuft of hairs at one end. The great value of these shrubs or trees lies in their ability to withstand the effects of drought and a saline soil, in consequence of which they grow where little else can flourish. It is on this account that the common tamarisk, *T. gallica*, is planted on our sea-coasts, and affords shelter where none other could be provided. The light feathery appearance of the branches, and the pretty rose-coloured flowers, render it also an elegant and attractive shrub, very different in character from most others.

Some species produce galls, valued for their tannin, while the astringent bark of others has been valued for medicinal purposes. The ashes of the plant, when grown near the sea, are said to contain soda: but, when cultivated inland or on sweet soil, they are, it is alleged, free from soda.

For tamarisk manna, see MANNA, vol. xv. p. 193.

TAMBOFF, one of the largest and most fertile governments of central Russia, extends from north to south between the basins of the Oka and the Don, and has

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[1] See his *Yeṣib Pithgam* (in the Ashkenazic ritual; it is introductory to the prophetic lesson for the second day of Pentecost). If we have the correct reading of that poem there, Rabbenu Tham must have been a Levite; and if so, the Shemuel Hallevi mentioned by R. Ya'aḳob b. Shimshon as his teacher, in the Cambridge MS. Add. 1213, leaf 27*b*, is very possibly Rabbenu Tham's paternal grandfather.

[2] See *Sepher Hayyashar*, § 595 (leaf 67*a*, col. 1), and § 610 (1st) *in fine*. To this high position it is no doubt to be ascribed that his life was saved by a knight during the second crusade, in which the whole congregation of Rameru was reduced to beggary, after many of its members had been ruthlessly slain.

[3] For example, the poverty-stricken Abraham Ibn 'Ezra, to whom he not only gave money but kind words also, in good verses (*Kerem Ḥemed*, vii. p. 35).

[4] For other metrical poems by Rabbenu Tham, see Zunz, *Literaturg. der Syn. Poesie* (Berlin, 1865, 8vo), p. 266.

Vladimir and Nijni-Novgorod on the N., Penza and Saratoff on the E., the Don Cossacks and Voronezh on the S., Tula and Ryazañ on the W. It consists of an undulating plain intersected by deep ravines and broad valleys, ranging between 450 and 800 feet above sea-level. Chalk and Jurassic deposits, thickly covered by boulder-clay and loess, are widely spread over its surface, concealing the underlying Devonian and Carboniferous deposits. These last appear only in the deeper ravines, and seams of coal have been noticed at several places. Iron ore (in the north-west), limestone, clay, and gypsum are obtained for building and manufacturing purposes; traces of naphtha have been discovered at Tamboff. The mineral waters of Lipetsk, similar to those of Franzensbad in their alkaline elements, and chalybeate like those of Pyrmont and Spa, are well known in Russia. Tamboff is watered by the tributaries of the Oka and the Don. The Oka itself only touches the north-west corner of the government, but its tributaries, the Moksha and the Tsna, are important channels of traffic The Don also only touches Tamboff, and of its affluents only the Voronezh and the Khoper and its tributary the Vorona are at all navigable. As a whole, it is only in the north that Tamboff is well watered; in its southern part, which is exposed to the influence of the dry south-eastern winds, the want of moisture is much felt, especially in the district of Borisoglyebsk, which belongs to the dry steppes of the lower Volga.

The climate is continental, and, although the average temperature at Tamboff is 42° F., the winter is comparatively cold (January, 13°; July, 68°). The rivers remain frozen for four months and a half. Forests occupy less than one-sixth of the total area, and occur chiefly in the west; in the south-east wood is scarce, and straw is resorted to for fuel. The soil is fertile throughout; in the north, indeed, it is clayey and sometimes sandy, but the rest of the government is covered with a sheet, 2 to 3 feet in thickness, of the most fertile *tchernozem*, of such richness, indeed, that in Borisoglyebsk corn-fields which have not been manured for eighty years still yield good crops.

Tamboff is one of the densely peopled provinces of Russia. Its population in 1883 reached 2,519,660, and in several districts (Kozloff, Lebedyañ, Lipetsk) there are from 110 to 130 inhabitants per square mile. It is Great Russian in the central portion, but has a notable admixture of MORDVINIANS (*q.v.*) and Mescheriaks in the west and north-west, as also of Tartars: the Mordvinians (who are rapidly becoming Russified) constitute 4 per cent. of the aggregate population of Tamboff; the Tartars number about 20,000, and the Mescheriaks about 4000. Nonconformity is widely spread, although the official figures disclose only 14,300 Raskolniks. Notwithstanding a high birth-rate (45 in the thousand), the annual increase of population is but slow (0·5 per cent. annually).

The prevailing occupation is agriculture, and in 1883 only 168,200 persons had their residence in towns, which are mostly themselves nothing but large villages of agriculturists living together, with a few merchants. More than two-thirds of the area is arable, and of this proportion 53 per cent. belongs to peasant communities, 36 per cent. to private individuals, and 11 per cent. to the crown. The crops of the years 1883 to 1885 yielded on the average 8,885,000 quarters of grain (half being rye, and one-third oats). Corn is exported to a considerable extent from the south, although it is deficient in the north. Hemp and linseed are also cultivated for exportation. The cultivation of tobacco is yearly increasing: 5220 acres were under this crop in 1885, and yielded nearly 50,000 cwts. In the same year 15,950 acres were under beetroot, and yielded 1,660,000 cwts. Cattle-breeding, though less extensively carried on than formerly, is still important (656,800 horses, 399,500 horned cattle, and 1,326,600 sheep in 1883). Excellent breeds of horses are met with, not only on the larger estates, but also in the hands of the wealthier peasants, those of the Bityug river being most esteemed. Manufactures are represented chiefly by distilleries, tallow-melting works, sugar-works, and a few woollen-cloth mills. The petty trades are not very extensively carried on in the villages. Commerce is very brisk, owing to the large amounts of corn exported,—Kozloff, Morshansk, Tamboff, and Borisoglyebsk being the chief centres for this traffic, and Lebedyañ for the trade in horses and cattle. Tamboff is rather backward educationally: in 1883 there were only 629 schools, attended by 34,739 boys and 5680 girls. The government is divided into twelve districts, the chief towns of which, with their populations in 1884, are Tamboff (34,000 inhabitants), Borisoglyebsk (13,000), Elatma (7560), Kirsanoff (7770), Kozloff (27,900), Lebedyañ (6250), Lipetsk (15,860), Morshansk (21,200), Shatsk (7260), Spassk (5010), Temnikoff (13,700), and Usmañ (8110 in 1880). A distinctive feature of Tamboff is its very large villages of crown-peasants, a dozen of which have from 5000 to 7000 inhabitants each. Several of them—like Raskazovo (a great centre of Nonconformity), Atabukhi, Sasovo, Izberdei, and Arkhangelskoye—are important commercial centres.

The region now included in the north of the government was settled by Russians during the earliest centuries of the principality of Moscow, but until the end of the 17th century the fertile tracts to the south remained too insecure for settlers. In the following century a few immigrants began to come in from the steppe, and landowners who had received large grants of land as gifts of the czars began to bring their serfs from central Russia. The population has very rapidly increased within the present century.

TAMBOFF, capital of the above government, 300 miles distant from Moscow, is situated on the Tsna river, and on the railway from Kozloff to Saratoff. It is almost entirely built of wood, with broad unpaved streets, lined with low houses surrounded by gardens. It has a small public library, a theatre, and the few educational institutions which are usual in the chief towns of Russian provinces. Its manufactures are insignificant; and its trade, in local grain and in cattle purchased in the south and sent to Moscow, is far less important than that of Morshansk or Kozloff. The population in 1884 was 34,000.

TAMERLANE. See TIMUR.

TAMILS. The word *Tamil* (properly *Tamiḻ*) has been identified with Draviḍa, the Sanskrit generic appellation for the South Indian peoples and their languages; and the various stages through which the word has passed—Dramiḍa, Dramila, Damila—have been finally discussed by Bishop Caldwell in his *Comparative Grammar of the Dravidian Languages* (2d ed., 1875, p. 10 *sq.*), and the derivation has recently been endorsed by Col. Yule and Dr Burnell in their *Glossary* (p. 251*b*). The identification was first suggested by Dr Graul (*Reise nach Ostindien*, vol. iii., 1854, p. 349), and then adverted to by Dr G. U. Pope (*Tamil Handbook*, 1859, Introduction) and Dr Gundert (*Malayâḻma Dictionary*, 1872, *s.v.*). It should, however, be mentioned that the former prefers now to take the word Tamiḻ to be a corruption of *tenmoḻi*, southern speech, in contradistinction to *vaḍugu*, the northern, *i.e.*, Telugu language. As in the case of the Kafir, Turkish, Tagala, and other typical languages, the term Tamulic or Tamulian has occasionally been employed as the designation of the whole class of Dravidian peoples and languages, of which it is only the most prominent member. The present article deals with Tamil in its restricted sense only.

The Tamils, taken as the type and representatives of the Dravidian race, do not now, owing to early intermixture with the Aryan immigrants, materially differ in physical character from the other curly-haired indigenous population of India. They were at one time, on the ground of the general structure of their language, classed with the Mongoloid (Turanian, Scythian) and even the Australian races, but that classification is rejected by all the leading ethnologists. They form, in fact, with the other members of the group, a separate and distinct family, which is of the dolichocephalic class, and comes near the Indo-European or Aryan type; while there are scattered remnants of a still earlier population of India (Mundas, Kolarians), whose race characteristics, however, do not so essentially differ from those of the Dravidians as to constitute them a class by themselves. The Tamils proper are smaller and weaker-built than the Europeans, though more graceful in shape. Their physical appearance is described as follows:—a pointed and frequently hooked pyramidal nose, with conspicuous nares, more long than round; a marked sinking in of the orbital line, producing a strongly defined orbital ridge; hair and eyes black; the latter, varying from small to middle-sized, have a peculiar sparkle and a look of calculation; mouth large, lips thick and frequently turgid; lower jaw not heavy, its lateral expansion greater than in the Aryan and less than in the Turanian type, giving to the middle part of the face a marked development and breadth, and to the general contour an obtuse oval shape, somewhat bulging at the sides; forehead well-formed, but receding, inclining to flattish, and seldom high; occiput somewhat projecting; beard considerable, and often strong; colour of skin very dark, frequently approaching to black (*Manual of the Administration of the Madras Presidency*, Madras, 1885, vol. i., Introd., p. 36; see also Caldwell, *Comparative Grammar of the Dravidian Languages*, 1875, pp. 558–79). The Tamils have many estimable qualities,—frugality, patience, endurance, politeness,—and they are credited with astounding memories; their worst vices are said to be lying and lasciviousness. Of all the South-Indian tribes they are the least sedentary and the most enterprising. Wherever money is to be earned, there will Tamils be found, either as merchants or in the lower capacity of domestic servants and labourers. The tea and coffee districts of Ceylon are peopled by about 800,000; Tamils serve as coolies in the Mauritius and the West Indies. In Burmah, the Straits, and Siam the so-called Klings are all Tamils (Graul, *Reise nach Ostindien*, Leipsic, 1855, vol. iv. pp. 113–212).

Language.—The area over which Tamil is spoken extends from a few miles north of the city of Madras to the extreme south of the eastern side of the peninsula, throughout the country below the Ghâts, from Pulicat to Cape Comorin, and from the Ghâts to the Bay of Bengal, including also the southern portion of Travancore on the western side of the Ghâts and the northern part of Ceylon. According to the census of 1881, the number of Tamil-speaking people throughout the province was 12,413,517, inclusive of 21,992 Yerkalas, 3843 Kurumbas, and 287 Irulas, three tribes speaking rude dialects of the language. To these should be added about 160,000 in the French possessions. But, as of all the Dravidian languages the Tamil shows the greatest tendency to spread, its area becomes ever larger, encroaching on that of the contiguous languages. Tamil is a sister of Malayâḷma, Telugu, Canarese, Tulu, Kudagu, Toda, Kôta, Gôṇḍ, Khond (Ku), Urâon, Râjmahâl, Keikâdi, and Brahui, the nine last-named being uncultivated tongues; and, as it is the oldest, richest, and most highly organized of the Dravidian languages, it may be looked upon as typical of the family to which it belongs. The one nearest akin to it is Malayâḷma, which originally appears to have been simply a dialect of Tamil, but differs from it now both in pronunciation and in idiom, in the retention of Old-Tamil forms obsolete in the modern language, and in having discarded all personal terminations in the verb, the person being always indicated by the pronoun (F. W. Ellis, *Dissertation on the Malayâḷma Language*, p. 2; Gundert, *Malayâḷma Dictionary*, Introd.; Caldwell, *Comparative Gr.*, Introd., p. 23; Burnell, *Specimens of South Indian Dialects*, No. 2, p. 13). Also, the proportion of Sanskrit words in Malayâḷma is greater, while in Tamil it is less, than in any other Dravidian tongue. This divergence between the two languages cannot be traced farther back than about the 10th century; for, as it appears from the Cochin and Travancore inscriptions, previous to that period both languages were still substantially identical; whereas in the *Râmacharitam*, the oldest poem in Malayâḷma, composed probably in the 13th century, at any rate long before the arrival of the Portuguese and the introduction of the modern character, we see that language already formed. The modern Tamil *characters* originated "in a Brahmanical adaptation of the old Grantha letters corresponding to the so-called Vaṭṭeluttu," or round-hand, an alphabet once in vogue throughout the whole of the Pâṇḍyan kingdom, as well as in the South Malabar and Coimbatore districts, and still sparsely used for drawing up conveyances and other legal instruments (F. W. Ellis, *Dissertation*, p. 3). It is also used by the Mâppilas in Tellicherry. The origin of the Vaṭṭeluttu itself is still a controverted question. The late Dr Burnell, the greatest authority on the subject, has stated his reasons for tracing that character through the Pehlevi to a Semitic source (*Elements of South Indian Palæography*, 2d ed., 1878, pp. 47–52, and plates xvii. and xxxii.). In the 8th century the Vaṭṭeluttu existed side by side and together with the Grantha, an ancient alphabet still used throughout the Tamil country in writing Sanskrit. During the four or five centuries after the conquest of Madura by the Cholas in the 11th it was gradually superseded in the Tamil country by the modern Tamil, while in Malabar it continued in general use down to the end of the 17th century. But the earliest works of Tamil literature, such as the *Tolkâppiyam* and the *Kuṛal*, were still written in it. The modern Tamil characters, which have but little changed for the last 500 years, differ from all the other modern Dravidian alphabets both in shape and in their phonetic value. Their angular form is said to be due to the widespread practice of writing with the style resting on the *end* of the left thumb-nail, while the other alphabets are written with the style resting on the left side of the thumb.

The Tamil alphabet is sufficiently well adapted for the expression of the twelve vowels of the language (*a, â, i, î, u, û, e, ê, o, ô, ei, au*),—the occasional sounds of *ö* and *ü*, both short and long, being covered by the signs for *e, ê, i, î*; but it is utterly inadequate for the proper expression of the consonants, inasmuch as the one character *k* has to do duty also for *kh, g, gh*, and similarly each of the other surd consonants *ch, ṭ, t, p* represents also the remaining three letters of its respective class. The letter *k* has, besides, occasionally the sound of *h*, and *ch* that of *s*. Each of the five consonants *k, ch, ṭ, t, p* has its own nasal. In addition to the four semivowels, the Tamil possesses a cerebral *ṛ* and *ḷ*, and has, in common with the Malayâḷma, retained a liquid *ḻ*, once peculiar to all the Dravidian languages, the sound of which is so difficult to fix graphically, and varies so much in different districts, that it has been rendered in a dozen different ways (*Manual of the Administration of the Madras Presidency*, vol. ii. p. 20 *sq.*). Fr. Müller is probably correct in approximating it to that of the Bohemian *ř*. There is, lastly, a peculiar *n*, differing in function but not in pronunciation from the dental *n*. The three sibilants and *h* of Sanskrit have no place in the Tamil alphabet but *ch* often does duty as a sibilant in writing foreign words, and the four corresponding letters as well as *j* and *ksh* of the Grantha alphabet are now frequently called to aid. It is obvious that many of the Sanskrit words imported into Tamil at various periods (Caldwell, *loc. cit.*, Introd., pp. 86 *sq.*) have, in consequence of the incongruity of the Sanskrit and Tamil notation of their respective phonetic systems, assumed disguises under which the original is scarcely recognizable: examples are *ulagu* (loka), *uruvam* (rûpa), *arukken* (arka), *arpputam* (adbhutam), *natchattiram* (nakshatram), *irudi* (ṛishi), *tîrkam* (dîrgha), *arasen* (râjan). Besides the Sanskrit ingredients, which appear but sparsely in the old poetry, Tamil has borrowed from Hindustani, Arabic, and Persian a large number of revenue, political, and judicial terms, and more recently a good many English words have crept in, such as *tiraṭṭi*, treaty, *paṭlar*, butler, *âkṭ*, act, *kulôb*, club, *kavarnar*, governor, *pinnalkôḍu*, penal code, *sikku*, sick, *mejastiraṭṭu*, magistrate. But, as compared with its literary sister languages, it has preserved its Dravidian character singularly free from foreign influence. Of Tamil words which have found a permanent home in English may be mentioned curry (*kari*), mulligatawny (*milagu*, pepper, and *taṇṇîr*, cool water), cheroot (*suruṭṭu*), pariah (*pareyan*).

The laws of euphony (avoiding of hiatus, softening of initial consonants, contact of final with initial consonants) are far more complicated in Tamil than in Sanskrit. But, while they were rigidly adhered to in the old poetical language (Sen-Tamiḻ), there is a growing tendency to neglect them in the language of the present day (Koḍun-Tamiḻ). It is true the Tamil rules totally differ from the prevailing Sanskrit; still the probability is in favour of a Sanskrit influence, inasmuch as they appear to follow Sanskrit models. Thus, *iruḷ nîkkinân* becomes *iruṇîkkinân*; *pon pâttiram*, *porpâttiram*; *vâḷḷil kanḍên*, *vâḷḷir kanḍên*; *vîlsirumei*, *vîḷsirumei*; *palan tandân*, *palanrandân*. Nouns are divided into high-caste or personal and low-caste or impersonal,—the former comprising words for rational beings, the latter all the rest. Only in high-caste nouns a distinction between masculine and feminine is observed in the singular; both have a common plural, which is indicated by change of a final *n* (feminine *ḷ*) into *r*; but the neuter plural termination *kaḷ* (*gaḷ*) may be superadded in every case. Certain nouns change their base termination before receiving the case affixes, the latter being the same both for singular and plural. They are for the acc. *ei*, instr. *âl*, social *ôdu* (*oḍu*, *uḍan*), dat. *ku*, loc. *il* (*idattil*, *in*), abl. *ilirundu* (*ininṛu*), gen. *uḍeiya* (*adu*). There is, besides, a general oblique affix *in*, which is not only frequently used for the genitive, but may be inserted before any of the above affixes, to some of which the emphatic particle *ê* may also be superadded. In the old poetry there is a still greater variety of affixes, while there is an option of dispensing with all. Adjectives, when attributive, precede the noun and are unchangeable; when predicative they follow it and receive verbal affixes. The pronouns of the 1st person are sing. *nân* (*yân*), inflexional base *en*, plural *nâm* (*yâm*), infl. *nam*, including, *nângaḷ*, infl. *engaḷ*, excluding the person addressed; of the 2d person *nî*, infl. *un* (*nin*, *nun*), plural *nîr* (*nîyir*, *nîvir*), *nîngaḷ*, infl. *um*, *ungaḷ* (*num*). To each of those forms, inclusive also of the reflexive pronouns *tân*, *tâm*, *tângaḷ*, a place is assigned in the scale of honorific pronouns. As in the demonstrative pronouns the forms beginning with *i* indicate nearness, those with *a* distance, and (in the old poetry) those with *u* what is between the two, so the same forms beginning with *e* (or *yâ*, as in *yâr*, *âr*, who?) express the interrogative. The verb consists of three elements—the root (generally reducible to one syllable), the tense characteristic, and the personal affix. There are three original moods, the indicative, imperative, and infinitive (the 2d singular imperative is generally identical with the root), as well as three original tenses, the present, past, and future. The personal affixes are—sing. (1) *-ên*; (2) *-ây*, honorific *-îr*; (3) masc. *-ân*, fem. *-âḷ*, honor. *-âr*, neuter *-adu*; plural (1) *-ôm* (*-âm*, *-êm*); (2) *-îrkaḷ*; (3) masc. fem. *-ârkaḷ*, neut. *-ana*. These affixes serve for all verbs and for each of the three tenses, except that, in the future, *-adu* and *-ana* are replaced by *-um* (*kkum*). It is only in the formation of the tenses that verbs differ, intransitive verbs generally indicating the present by *-kiṛ-* (*-kinṛ-*), the past by *-d-*, *-nd-*, or *-in-*, and the future by *-v-* (*-b-*), and transitive verbs by the corresponding infixes, *-kkiṛ-* (*-kkinṛ-*), *-tt-* (*-nd-*), and *-pp-*; but there are numerous exceptions and seemingly anomalous formations. Other tenses and moods are expressed with the aid of special affixes or auxiliary verbs. Causal verbs are formed by various infixes (*-ppi-*, *-vi-*, *-ttu-*), and the passive by the auxiliary *paḍu*, to fall, or by *uṇ*, to eat, with a noun. The following four peculiarities are characteristic of Tamil:—first, the tenseless negative form of the verb, expressed by the infix *a*, which is elided before dissimilar vowels; second, the predicative employment of two negative particles *illei* and *alla*, the one denying the existence or presence, the other denying the quality or essence; third, the use of two sets of participles,—one, called adjective or relative participle, which supplies the place of a relative clause, the language possessing no relative pronouns, and an ordinary adverbial participle or gerund; and, fourth, the practice of giving adjectives a verbal form by means of personal affixes, which form may again be treated as a noun by attaching to it the declensional terminations, thus: *periya*, great; *periyôm*, we are great; *periyômukku*, to us who are great. The old poetry abounds in verbal forms now obsolete. Adjectives, adverbs, and abstract nouns are derived from verbs by certain affixes. All post-positions were originally either nouns or verbal forms. *Oratio indirecta* is unknown in Tamil, as it is in all the other Indian languages, the gerund *enṛu* being used, like *iti* in Sanskrit, to indicate quotation. The structure of sentences is an exact counterpart of the structure of words, inasmuch as that which qualifies always precedes that which is qualified. Thus the attributive precedes the substantive, the substantive precedes the preposition, the adverb precedes the verb, the secondary clause the primary one, and the verb closes the sentence. The sentence, "Having called the woman who had killed the child, he asked why she had committed such infanticide," runs in Tamil as follows:—

Kuḷandeiyei kkonṛupoṭṭavaḷei aḻeippittu nî ên ippaḍi
The child her who had killed having caused to be called, "Thou why thus
ppaṭṭa sisu-v-atti seydây enṛu kêṭṭân.
made child-murder didst?" having said he asked.

Much as the similarity of the structure of the Tamil and its sister languages to that of the Ugro-Tartar class may have proved suggestive of the assumption of a family affinity between the two classes, such an affinity, if it exist, must be held to be at least very distant, inasmuch as the assumption receives but the faintest shade of support from an intercomparison of the radical and least variable portion of the respective languages.

Literature.—The early existence, in southern India, of peoples, localities, animals, and products the names of which, as mentioned in the Old Testament and in Greek and Roman writers, have been identified with corresponding Dravidian terms goes far to prove the high antiquity, if not of the Tamil language, at least of some form of Dravidian speech (Caldwell, *loc. cit.*, Introd., pp. 81–106; *Madras District Manual*, i., Introd., p. 131 *sq.*). But practically the earliest extant records of the Tamil language do not ascend higher than the middle of the 8th century of the Christian era, the grant in possession of the Israelites at Çochin being assigned by the late Dr Burnell to about 750 A.D., a period when Malayâḷma did not exist yet as a separate language. There is every probability that about the same time a number of Tamil works sprung up, which are mentioned by a writer in the 11th century as representing the old literature (Burnell, *loc. cit.*, p. 127, note). The earlier of these may have been Saiva books; the more prominent of the others were decidedly Jaina. Though traces of a north Indian influence are palpable in all of them that have come down to us (see, *e.g.*, F. W. Ellis's notes to the *Kuṛaḷ*), we can at the same time perceive, as we must certainly appreciate, the desire of the authors to oppose the influence of Brahmanical writings, and create a literature that should rival Sanskrit books and appeal to the sentiments of the people at large. But the refinement of the poetical language, as adapted to the genius of Tamil, has been carried to greater excess than in Sanskrit; and this artificial character of the so-called High-Tamil is evident from a comparison with the old inscriptions, which are a reflex of the language of the people, and clearly show that Tamil has not undergone any essential change these 800 years (Burnell, *loc. cit.*, p. 142). The rules of High-Tamil appear to have been fixed at a very early date. The *Tolkâppiyam*, the oldest extant Tamil grammar, is assigned by Dr Burnell (*On the Aindra School of Sanskrit Grammarians*, pp. 8, 55) to the 8th century (best edition by C. Y. Tâmodaram Pillei, Madras, 1885). The *Vîrasôliyam*, another grammar, is of the 11th century. Both have been superseded by the *Nannûl*, of the 15th century, which has exercised the skill of numerous commentators, and continues to be the leading native authority (English editions in Pope's *Third Tamil Grammar*, and an abridgment by Lazarus, 1884). The period of the prevalence of the Jainas in the Pâṇḍya kingdom, from the 9th or 10th to the 13th century, is justly termed the Augustan age of Tamil literature. To its earlier days is assigned the *Nâlaḍiyâr*, an ethical poem on the three objects of existence, which is supposed to have preceded the *Kuṛaḷ* of Tiruvaḷḷuvan, the finest poetical production in the whole range of Tamil composition. Tradition, in keeping with the spirit of antagonism to Brahmanical influence, says that its author was a pariah priest. It consists of 1330 stanzas on virtue, wealth, and pleasure. It has often been edited, translated, and commented upon; see the introduction to the excellent edition, just published, by the Rev. Dr Pope, in which also a comprehensive account of the peculiarities of High-Tamil will be found. To the Avvei, or Matron, a reputed sister of Tiruvaḷḷuvan, but probably of a later date, two shorter moral poems, called *Attisûḍi* and *Konṛeivêyndan*, are ascribed, which are still read in all Tamil schools. *Chintâmani*, an epic of upwards of 3000 stanzas, which celebrates the exploits of a King Jîvakan, also belongs to that early Jain period, and so does the *Divâkaram*, the oldest dictionary of classical Tamil. The former is one of the finest poems in the language; but no more than the first and part of the third of its thirteen books have been edited and translated. Kamban's *Râmâyaṇam* (about 1100 A.D.) is the only other Tamil epic which comes up to the *Chintâmani* in poetical beauty. The most brilliant of the poetical productions which appeared in the period of the Saiva revival (13th and 14th centuries) are two collections of hymns addressed to Siva, the one called *Tiruvâsakam*, by Mânikka-Vâsakan, and a later and larger one called *Tivâram*, by Sambandhan and two other devotees, Sundaran and Appan. Both these collections have been printed, the former in one, the latter in five volumes. They are rivalled both in religious fervour and in poetical merit by a contemporaneous collection of Vaishṇava hymns, the *Nâlâyira-prabandham* (also printed at Madras). The third section of it, called *Tiruvâymoḷi*, or "Words of the Sacred Mouth," has lately been published in Telugu characters, with ample commentaries, in ten quartos (Madras, 1875–76). After a period of literary torpor, which lasted nearly two centuries, King Vallabha Deva, better known by his assumed name Ativirarâma Pâṇḍiyan (second half of the 16th century), endeavoured to revive the love of poetry by compositions of his own, the most celebrated of which are the *Neiḍadam*, a somewhat extravagant imitation of Srî Harsha's Sanskrit *Naishadham*, and the *Verrivêrkei*, a collection of sententious maxims. Though he had numerous followers, who made this revival the most prolific in the whole history of Tamil literature, none of the compositions of every kind, mainly translations and bombastic imitations of Sanskrit models, have attained to any fame. An exceptional place, however, is occupied by certain Tamil sectarians called *śittar* (*i.e.*, *śiddhas* or sages), whose mystical poems, especially those contained in the *Sivavâkyam*, are said to be of singular beauty. Two poems of high merit, composed at the end of the 17th century, also deserve favourable notice—the *Nîtineṛiviḷakkam*, an ethical treatise by Kumâragurupara Desikan, and the *Prabhulingalîlei*, a translation from the Canarese of a famous text-book of the Vîra-Saiva sect. See the analysis in W. Taylor's *Catalogue*, vol. ii. p. 837–47.

The modern period, which may be said to date from the beginning of the last century, is ushered in by two great poets, one native and the other foreign. Tâyumânavan, a philosopher of the pantheistic school, composed 1453 stanzas (*pâdal*) which have a high reputation for sublimity both of sentiment and style; and the Italian Jesuit Joseph Beschi (d. 1742), under the name Vîramâmuni, elaborated, on the model of the *Chintâmaṇi*, a religious epic *Têmbâvaṇi*, which, though marred by blemishes of taste, is classed by native critics among the best productions of their literature. It treats of the history of St Joseph, and has been printed at Pondicherry in three volumes, with a full analysis. English influence has here, as in Bengal and elsewhere in India, greatly tended to create a healthier tone in literature both as to style and sentiment As one of the best Tamil translations of English books in respect of diction and idiom may be mentioned the *Bâlavyâpârikaḷ*, or "Little Merchants," published by the Vernacular Text Society, Madras. P. Percival's collection of *Tamil Proverbs* (3d ed., 1875) should also be mentioned. The copper-plate grants, commonly called *śâsanams*, and stone inscriptions in Tamil, many of which have been copied and translated (*Archæological Survey of Southern India*, vol. iv.; R. Sewell, *Lists of the Antiquarian Remains in the Presidency of Madras*, vols. i., ii.), are the only authentic historical records. (See also Sir Walter Elliot's contribution to the *International Numismata Orientalia*, vol. iii. pt. 2.) As early as the time of the Chinese traveller Hwen Tsang, books were written in southern India on talipot leaves, and Albiruni mentions this custom as quite prevalent in his time (1031). It has not died out even at the present day, though paper imported from Portugal has, during the last three centuries, occasionally been used. Madras is now the largest depository of Tamil palm-leaf MSS., which have been described in Wilson's *Catalogue of the Mackenzie Collection* (Calcutta, 1828, 2 vols.), W. Taylor's *Catalogue* (Madras, 1857, 3 vols.), and Condaswamy Iyer's *Catalogue* (vol. i., Madras, 1861). The art of printing, however, which was introduced in southern India at an early date, while it has tended to the preservation of many valuable productions of the ancient literature, has also been the means of perpetuating and circulating a deal of literary rubbish and lasciviousness which would much better have remained in the comparatively safe obscurity of manuscript. Dr Burnell has a note in his *Elements of South Indian Paleography* (2d ed., p. 44), from which it appears that in 1578 Tamil types were cut by Father João de Faria, and that a hundred years later a Tamil and Portuguese dictionary was published at Ambalakkâḍu. At present the number of Tamil books (inclusive of newspapers) printed annually far exceeds that of the other Dravidian vernaculars put together. The earliest Tamil version of the New Testament was commenced by the Dutch in Ceylon in 1688; Fabricius's translation appeared at Tranquebar in 1715. Since then many new translations of the whole Bible have been printed, and some of them have passed through several editions. The German missionary B. Ziegenbalg was the first to make the study of Tamil possible in Europe by the publication of his *Grammatica Damulica*, which appeared at Halle in 1716. Some time later the Jesuit father Beschi devoted much time and labour to the composition of grammars both of the vulgar and the poetical dialect. The former is treated in his *Grammatica Latino-Tamulica*, which was written in 1728, but was not printed till eleven years later (Tranquebar, 1739). It was twice reprinted, and two English translations have been published (1831, 1848). His *Sen-Tamil Grammar*, accessible since 1822 in an English translation by Dr Babington, was printed from his own MS. (*Clavis humaniorum litterarum sublimioris Tamulici idiomatis*) at Tranquebar in 1878. This work is especially valuable, as the greater portion of it consists of a learned and exhaustive treatise on Tamil prosody and rhetoric. (See, on his other works, Graul's *Reise*, vol. iv. p. 327.) There are also grammars by Anderson, Rhenius, Graul (in vol. ii. of his *Bibliotheca Tamulica*, Leipsic, 1855), Lazarus (Madras, 1878), Pope (4th edition in three parts, London, 1883–5), and *Grammaire Française-Tamoule*, by the Abbé Dupuis, Pondicherri, 1863. The last two are by far the best. The India Office library possesses a MS. dictionary and grammar "par le Rév. Père Dominique" (Pondicherri, 1843), and a copy of a MS. Tamil-Latin dictionary by the celebrated missionary Schwarz, in which 9000 words are explained. About the like number of words are given in the dictionary of Fabricius and Breithaupt (Madras, 1779 and 1809). Rottler's dictionary, the publication of which was commenced in 1834, is a far more ambitious work. But neither it nor Winslow's (1862) come up to the standard of Tamil scholarship; the *Dictionnaire Tamoul-Français*, which appeared at Pondicherri in 2 vols. (1855–62), is superior to both, just as the *Dictionarium Latino-Gallico-Tamulicum* (*ibid.*, 1846) excels the various English-Tamil dictionaries which have been published at Madras.

Compare the following works of reference:—A. T. Mondière and J. Vinson in *Dictionnaire des Sciences Anthropologiques*, *s.v.* "Dravidiens"; S. C. Chitty, *The Tamil Plutarch*, Jaffna, 1859; J. Murdoch, *Classified Catalogue of Tamil Printed Books*, Madras, 1865; C. E. Gover, *Folk-Songs of Southern India*, Madras, 1871; Bishop Caldwell's *Comparative Grammar of the Dravidian Languages*, 2d ed., London, 1875; Graul's *Reise nach Ostindien*, vols. iv. and v.; the quarterly *Lists of Books* registered in the Madras presidency; [Dr Maclean's] *Manual of the Administration of the Madras Presidency*, vols. i. and ii., Madras, 1885, folio; and F. Müller, *Grundriss der Sprachwissenschaft*, Vienna, 1884, iii. i. 162–246. (R. R.)

TAMWORTH, a municipal borough and market-town of England, on the borders of Staffordshire and Warwickshire, chiefly in the former, is situated at the junction of the Tame with the Anker, and on branches of the London and North-Western and Midland Railway lines, 7 miles south-east of Lichfield, 20 north-west of Coventry, and 110 north-west of London. The castle, situated on a height above the Anker near its junction with the Tame, is now chiefly of the Jacobean period, but is enclosed by massive ancient walls. It was long the residence of the Saxon kings, and, after being bestowed on the Marmions by William the Conqueror, remained for many years an important fortress. Through the female line of the Marmions it has descended to the Marquis Townshend. Formerly the town was surrounded by a ditch called the King's Dyke, of which some trace still remains. The church of St Editha, originally founded in the 8th century, was rebuilt, after being burned by the Danes, by Edgar, who made it collegiate, but the present building in the Decorated style was erected after a fire in the 14th century. Since 1870 it has been undergoing restoration at a cost of £10,000. The free grammar school, refounded by Edward VI., was rebuilt in 1677, and again in 1867–68 at a cost of £3000. The other public buildings are the swimming bath and boys' institute (1885), the town-hall (1701), and the arcade, formerly used as a covered market, but recently obtained by the Salvation Army. The charities include Guy's almshouses, endowed in 1678 by Thomas Guy, founder of Guy's Hospital, London, and the cottage hospital with twenty-one beds. Waterworks have recently been erected at a cost of over £25,000. On the "moors" burgesses have rights for cattle. Coal, fireclay, and blue and red brick clay are dug in the neighbourhood; and there are also market gardens. The town possesses a clothing factory, paper-mills, and manufactories of small wares. The population of the municipal borough (area

200 acres) in 1871 was 4539, and in 1881 it was 4891,—that of the parliamentary borough (area 11,602 acres) in the same years being 11,493 and 14,101. Tamworth ceased to be a parliamentary borough in 1885.

Tamworth is situated near the old Roman Watling Street, and occupies the site of a fort which, from the beginning of the 8th century, was the chief royal residence in Mercia. The town, after being burnt by the Danes, was rebuilt and fortified by Ethelfleda, daughter of Alfred the Great. From the reign of Edward the Martyr to that of William Rufus it was a royal mint, and some of the coins struck at Tamworth are still in existence. The town was incorporated in the 3d year of Elizabeth, from whom it obtained the grant of a fair and the confirmation of various privileges bestowed by Edward III. The Elizabethan charter was superseded by one conferred by Charles II., which continued to be the governing charter of the town till the passing of the Municipal Act. The town, with occasional intermissions, returned members to parliament from the reign of Henry I. till 1885. Among its more distinguished representatives have been Thomas Guy and Sir Robert Peel.

TANAGER, a word adapted from the quasi-Latin *Tanagra* of Linnæus, which again is an adaptation, perhaps with a classical allusion, of *Tangara*, used by Brisson and Buffon, and said by Marcgrave (*Hist. Rer. Nat. Brasiliæ*, p. 214) to be the Brazilian name of certain birds found in that country. From them it has since been extended to a great many others mostly belonging to the southern portion of the New World, now recognized by ornithologists as forming a distinct Family of *Oscines*, and usually considered to be allied to the *Fringillidæ* (*cf.* Finch, vol. ix. p. 191); but, as may be inferred from Prof. Parker's remarks in the Zoological *Transactions* (x. pp. 252, 253, and 267), the *Tanagridæ* are a "feebler" form, and thereby bear out the opinion based on the examination of many types both of Birds and Mammals as to the lower morphological rank of the Neotropical Fauna as a whole (*cf.* Birds, vol. iii. p. 743).

The Tanagers are a group in which Mr Sclater has for many years interested himself, and his latest treatment of them is contained in the British Museum *Catalogue* (xi. pp. 49–307). Therein he admits the existence of 375 species, which he arranges in 59 genera, forming six Subfamilies, *Procniatinæ*, *Euphoniinæ*, *Tanagrinæ*, *Lamprotinæ*, *Phœnicophilinæ*, and *Pitylinæ*. These are of very unequal extent, for, while the first of them consists of but a single species, *Procnias tersa*,—the position of which may be for several reasons still open to doubt,—the third includes more than 200. Nearly all are birds of small size, the largest barely exceeding a Song-Thrush. Most of them are remarkable for their gaudy colouring, and this is especially the case in those forming the genus called by Mr Sclater, as by most other authors, *Calliste*, a term inadmissible through preoccupation, to which the name of *Tanagra* of right seems to belong, while that which he names *Tanagra* should probably be known as *Thraupis*. The whole Family is almost confined to the Neotropical Region, and there are several forms peculiar to the Antilles; but not a tenth of the species reach even southern Mexico, and not a dozen appear in the northern part of that country. Of the genus *Pyranga*, which has the most northern range of all, three if not four species are common summer immigrants to some part or other of the United States, and two of them, *P. rubra* and *P. æstiva*,—there known respectively as the Scarlet Tanager and the Summer Redbird,—reach even the Dominion of Canada, visiting as well, though accidentally, Bermuda. *P. æstiva* has a western representative, *P. cooperi*, which by some authors is not recognized as a distinct species. The males of all these are clad in glowing red, *P. rubra* having, however, the wings and tail black. The remaining species, *P. ludoviciana*, the males of which are mostly yellow and black, with the head only red, does not appear eastward of the Missouri plains, and has not so northerly a range. Another species, *P. hepatica*, has just shewn itself within the limits of the United States. In all these the females are plainly attired; but generally among the Tanagers, however bright may be their coloration, both sexes are nearly alike in plumage. Little has been recorded of the habits of the species of Central or South America, but those of the north have been as closely observed as the rather retiring nature of the birds renders possible, and it is known that insects, especially in the larval condition, and berries afford the greater part of their food. They have a pleasing song, and build a shallow nest, in which the eggs, generally 3 in number and of a greenish-blue marked with brown and purple, are laid.

On a whole the *Tanagridæ* may perhaps be considered to hold the same relation to the *Fringillidæ* as the *Icteridæ* do to the *Sturnidæ* and the *Mniotiltidæ* to the *Sylviidæ* or *Turdidæ*, in each case the purely New-World Family being the "feebler" type. (A. N.)

TANCRED (d. 1112), son of the marquis Odo the Good and Emma the sister of Robert Guiscard, one of the most famous heroes of the first crusade. See Crusades, vol. vi. p. 624 *sq.*

TANCRED, the last Norman king of Sicily, reigned 1189–1194. See Sicily, vol. xxii. p. 26.

TANGANYIKA, a lake in East Central Africa, called *Msaga* ("tempestuous") by the Wakawendi and *Kimana* by the Warungu. The meaning of the name Tanganyika is, according to Cameron, nothing more than "the mixing place." It is the longest freshwater lake in the world being about 75 miles longer than Lake Michigan. Although the Arabs had long known of the existence of the lake, the first Europeans who discovered it were Speke and Burton in 1858. It has since been visited by Livingstone, Cameron, Stanley, Thomson, and Hore, who have all added to our knowledge of it. Tanganyika, which is situated some 600 miles as the crow flies from the east coast of Africa, extends from 3° 16′ S. lat. to 8° 48′ S. lat., and lies between 29° 10′ E. long. and 32° 30′ E. long. Its length is 420 miles, and its breadth varies from 10 to 50 miles. Its area is 12,650 square miles, and its altitude may be taken as 2700 feet above sea-level (Cameron, 2710; Stanley, 2770; Hore, 2750; Popelin, 2665). It has a coast-line of 900 miles in extent. Its greatest depth has not yet been determined, but Hore states that a 168-fathom rope often failed to reach the bottom. Tanganyika may be described as an enormous crevasse. It is bordered on all sides by hills and mountains, some of which rise to from 5000 to 10,000 feet above its waters. The scenery is marked by exceptional grandeur, and is well calculated to impress the traveller. Burton says:—

> "It filled us with admiration, with wonder, and delight. Beyond the short foreground of rugged and precipitous hill-fold, down which the footpath painfully zigzags, a narrow plot of emerald green shelves gently towards a ribbon of glistening yellow sand, here bordered by sedgy rushes, there clear and cleanly cut by the breaking wavelets. Farther in front stretches an expanse of the lightest, softest blue, from 30 to 35 miles in breadth, and sprinkled by the east wind with crescents of snowy foam. It is bounded on the other side by tall and broken walls of purple hill, flecked and capped with pearly mist, or standing sharply pencilled against the azure sky. To the south lie high bluff headlands and capes; and as the eye dilates it falls on little outlying islets, speckling a sea horizon. Villages, cultivated lands, the frequent canoes of the fishermen, give a something of life, of variety, of movement to the scenery."

Tanganyika is fed by numerous rivers and streamlets which flow from the surrounding hills, the yearly rainfall being about 27 inches, but the rainy seasons vary extremely in different years, altering the surface area of the lake accordingly. Hore found that between March 1879 and August 1880 the waters had fallen 10 feet 4½ inches, as marked by a water-gauge he had erected at Ujiji, and he also saw evident signs of the receding of the waters all round the shores of the lake—belts of dead timber and bleached rock. Some 120 rivers and streams flow into the lake; the most important river is the Malagarasi, near Ujiji. Just below the rapids its width is 500 feet, and the average depth 5 feet. For many years Tanganyika was a riddle to African explorers,—Livingstone, Baker, and others believing that it belonged to the Nile system, and that it was connected with the Albert Nyanza. That this theory is incorrect was proved when Livingstone and Stanley explored the north end of the lake in November 1871, finding no outlet. It was Cameron, in March 1874, who first solved the riddle, and found that the outlet of Tanganyika was the river Lukuga, at about the centre of the western shore of the lake, 5° 52′ 45″ S. lat. In 1876 this outlet was visited by Stanley, who found that there was no apparent outflow, and doubt was thrown upon Cameron's observations, which, however, have been proved to be correct by Hore, who in 1880 found a strong current setting unequivocally out of the lake. Not only so, but he obtained good views of the river, which gradually widens soon after the rapids near the lake are passed. He followed the river to 5° 50′ S. lat., and, from an altitude of 1100 feet above the river, he saw it flowing far away to the westward. The question is therefore settled that Lake Tanganyika belongs to the Congo system, but it is only an occasional tributary to that mighty river, its contribution depending upon the rainfall. The lake is subject to frequent storms, especially from the S.S.E. and S.W., lasting sometimes for two or three days, and leaving a heavy swell, which proves a great hindrance to navigation. Hore says —"I have never witnessed such wondrous cloud-scenery and majestic effects of thunder and lightning as on Tanganyika."

The shores and water of the lake abound in animal life,—crocodiles, the hippopotamus, otters, and many kinds of fish being found in its waters. Flocks of waterfowl abound in the river mouths: gulls, divers, herons, kingfishers, eagles, fish-hawks, and black ibis are very numerous. The shores are very fertile,—rice, manioc, kaffre corn, two kinds of ground nuts, maize, uleysi, pumpkins, sweet potatoes, sugar-cane, castor-oil tree, tamarind, cotton, tomato, and cucumber growing luxuriantly. The oil palm grows at Ujiji, Urundi, and at the south end of the lake, the borassus near the Malagarasi river, the screw palm in Uguha, and the raphra in several localities. The tsetse fly is found on the shores of the lake from Ujiji round the southern end as far as Ubwari on the west coast. Amongst the useful timber trees may be noticed the gigantic mbule, the mininge, lignum vitæ, and ebony. The people inhabiting the countries on the borders of the lake form ten distinct tribes, with separate national peculiarities and customs. They live in well-organized villages, in which considerable social order is maintained. They have also learnt, to some extent at any rate, to utilize the products of their country: they work their own iron and copper; salt is prepared for barter; palm oil is collected; and in some places there are large pottery works. Their fishing industry is extensive, and dried fish is exported; boatbuilding is carried on to a small extent; cotton cloth is manufactured at several places, and at others the famous grass or palm-fibre cloth; whilst the dairy farms of Uhha export packages of butter. There are several London Missionary Society stations on Lake Tanganyika, also one belonging to the Roman Catholics; and a station of the African International Association is situated at Karema. Ujiji, an Arab town of some importance, stands on the eastern shore of the lake.

TANGIERS, or **TANGIER** (*Tanja*), a seaport of Morocco and capital of a pashalik, on the Strait of Gibraltar, about 14 miles to the east of Cape Spartel, stands on two eminences at the north-west extremity of a spacious bay. The town has a fine appearance from the sea, rising gradually in the form of an amphitheatre, and defended by walls and a castle. The streets, which are unpaved, are very narrow and crooked, and the houses, except those occupied by foreign ambassadors or consuls and a few others, are mean. The main thoroughfare is that which leads from the Bab-al-Marsa (Gate of the Port) to the Bab-al-Sok (Gate of the Market Place); the sok presents a lively spectacle, especially on Sundays and Thursdays. The manufactures of Tangiers are of little importance, consisting chiefly of coarse woollen cloth, mats, and pottery; tanning is also carried on, but the leather, though much esteemed in Europe, is inferior to that made in other parts of Morocco. The harbour is a mere roadstead, but it is the best Morocco possesses, and affords good anchorage and shelter to the largest vessels, except during the prevalence of strong winds from the north-west or east. Tangiers has a large trade with Gibraltar. The climate is temperate and healthy, but the inhabitants often suffer much in summer from deficiency of water-supply. Tangiers, which is the residence of all the foreign ministers and consuls to the court of Morocco, has a population estimated at about 20,000, of whom some 400 are Europeans.

The Roman *Tingis*, which stood in the immediate vicinity of the site of Tangiers, boasted of great antiquity; under Augustus it became a free city, and Claudius made it a Roman colony and capital of Tingitana. It was held successively by Vandals, Byzantines, and Arabs, and fell into the hands of the Portuguese towards the end of the 15th century. In 1662 it was made part of the dowry of Catherine of Braganza on her marriage with Charles II. of England; the English defended it in 1680, but, on account of its expense, dismantled it in 1684 and abandoned it to the Moors, who fortified it anew. It was bombarded by a Spanish fleet in 1790 and by the French in 1844.

TANHÄUSER, or **TANNHÄUSER**, the subject of one of the most famous of old German legends, is represented as a knight who after many wanderings comes to the Venusberg. He enters the cave where the Lady Venus holds her court, and abandons himself to a life of sensual pleasure. By and by he is overcome by remorse, and, invoking the aid of the Virgin Mary, he obtains permission to return for a while to the outer world. He then goes as a pilgrim to Rome, and entreats Pope Urban to secure for him the forgiveness of his sins. The pope, who happens to have a rod in his hand, says it is as impossible for him to be pardoned as for the rod to blossom. Tanhäuser therefore departs in despair, and returns to the Lady Venus. In three days the rod begins to put forth green leaves, and the pope sends messengers in all directions in search of the penitent; but he is never seen again. This legend was at one time known in every part of Germany, and as late as 1830 it survived in a popular song at Entlibuch, a version of which was given by Uhland in his *Alte hoch- und niederdeutsche Volkslieder*. It can be traced back to the 14th century, but in its original form seems to have belonged to the period of Teutonic paganism. According to some legends, the Venusberg is the Hoselberg or Hörselberg, a hill near Eisenach associated with the Teutonic goddess of the nether world, who was known by various names, such as Hulda, Hilda, and Hel. To this goddess the name of Venus appears to have been transferred. Among the attendants of Hulda was the faithful Eckhart, and in the preface to the *Heldenbuch* he is said to sit before the Venusberg, and to warn passers-by of the dangers to which they may be exposed if they linger in the neighbourhood. The legend has been reproduced by several modern German poets, and forms the subject of one of Wagner's operas.

In the 13th century, contemporary with Pope Urban IV., there was a German knight called Tanhäuser, who was well known as a minnesinger at the court of Frederick II., duke of Austria. After Duke Frederick's death Tanhäuser was received at the court of Otho II., duke of Bavaria; but, being of a restless disposition, and having wasted his fortune, he spent much time in wandering about Germany. He also went as a crusader to the Holy Land. His poems (printed in the second part of the *Minnesinger*, edited by Von der Hagen) are fresh, lively, and graceful, but lack the ideal tone which marks the writings of the earlier minnesinger. He was much esteemed by the meistersinger, and it is possible that the story of his adventurous life may have been connected with the old legend about the Venusberg.

See Kornmann, *Mons Veneris* (1614), and Grässe, *Die Sage vom Ritter Tanhäuser*, and *Der Tanhäuser und Ewige Jude*; also Zander, *Die Tanhäuser Sage und der Minnesänger Tanhäuser.*

TANJORE, a district of British India, in the Madras presidency, lying between 9° 50′ and 11° 25′ N. lat. and between 78° 55′ and 79° 55′ E. long., with an area of 3654 square miles. It forms a portion of the Southern Carnatic, and is bounded on the N. by the river Coleroon, which separates it from Trichinopoly and South Arcot districts, on the E. and S.E. by the Bay of Bengal, on the S.W. by Madura district, and on the W. by Madura and Trichinopoly and Pudukotta state. Tanjore is known as the garden of Southern India. It is well watered by an elaborate system of dams, cuts, and canals in connexion with the rivers Cauvery and Coleroon, and the soil is exceedingly productive. The delta of the Cauvery occupies the flat northern part, which is highly cultivated with rice, dotted over with groves of cocoa-nut trees, and densely populated. Tanjore is a land of temples, many of them being of very early date. The great temple of Tanjore city is said to be the finest in India; it is of the 11th century, and remains in excellent preservation to the present day. The district has a coast-line of 140 miles, but communication with shipping is unsafe, owing to a heavy surf which breaks incessantly on the shore. The rainfall, as elsewhere on the Coromandel coast, varies considerably from year to year; the mean annual fall, as observed at ten stations for four years, was 47·14 inches. Tanjore is amply provided with means of communication. It is traversed by two branches of the South Indian Railway.

The census of 1881 returned the population of the district at 2,130,383 (males 1,026,528, females 1,103,855), of whom 1,939,421 were Hindus, 112,058 Mohammedans, and 78,258 Christians. Tanjore is the first district in which Protestant missions began, and now it is second only to Tinnevelly in the number of its Christian missions. These establishments were taken over in 1826 by the Society for the Propagation of the Gospel, which subsequently founded missions in several parts of the district. The total number of native Protestants belonging to the various societies in 1881 was 8255. Roman Catholic missions in Tanjore date from the first half of the 17th century, and the number of native Roman Catholics in 1881 was 67,745. Five towns have populations exceeding 10,000, viz., Tanjore (see below), Negapatam 53,855, Combaconum 50,098, Mayavaram 23,044, and Munnargudi 19,409.

Of the total area of the district, reckoned at 2,392,117 acres, 1,468,500 were returned in 1884–85 as cultivated, and 149,228 as available for cultivation, while forests covered 21,422 acres. Rice is the staple crop, and is raised almost entirely by artificial irrigation; green crops are common; plantain and betel-vine gardens abound in the delta, where sugar-cane and tobacco are also cultivated. The chief manufactures are metal wares, silk cloths, carpets, and pith-work. Imports consist chiefly of cotton piece goods, twist and yarn, metals, timber, and betel nuts. Rice is by far the most important article of export alike by sea and land. The gross revenue in 1884–85 was £549,982, the land yielding £389,755.

The modern history of Tanjore commences with its occupation by the Mahrattas in 1678 under Venkají, the brother of Sivají the Great. The British first came into contact with Tanjore by their expedition in 1749 with a view to the restoration of a deposed rájá. In this they failed, and a subsequent expedition was bought off. The Mahrattas practically held Tanjore until 1799. In October of that year it was ceded to the East India Company in absolute sovereignty by Rájá Sharabhoji, pupil of the missionary Schwartz, the company engaging to pay the rájá of Tanjore one-fifth of the net revenue of the territory which was transferred to them, with a further sum of £35,000. Rájá Sharabhoji retained only the capital and a small tract of country around. He died in 1833, and was succeeded by his son Sivají, on whose death in 1855 without an heir the house became extinct, the rights and privileges appertaining to it ceased, and Tanjore became British territory.

TANJORE, capital and administrative headquarters of the above district, is situated in 10° 47′ N. lat. and 79° 10′ 24″ E. long. As the last capital of the ancient Hindu dynasty of the Cholas, and in all ages one of the chief political, literary, and religious centres of the south, the city is full of interesting associations. Its monuments of Indian art and early civilization are of the first importance. Besides its great temple, the city is famed for its artistic manufactures, including silk carpets, jewellery, *repoussé* work, copper wares, &c. It contained a population in 1881 of 54,745 (26,272 males and 28,473 females). The South Indian Railway connects Tanjore with Negapatam, its seaport on the east, and Trichinopoly on the west.

TANNAHILL, Robert (1774–1810), one of the most popular of the successors of Burns in song-writing, was a weaver in Paisley, where he was born in 1774. He was apprenticed to his father's trade at the age of twelve, in the year of the first publication of the poems of Burns, which quickened the poetic ambition of so many Scottish youths in humble life. The young apprentice studied and composed poetry as he drove the shuttle to and fro, with shelf and ink-bottle rigged up on his loom-post. Apart from his poetry, he had little variety in his life. He was shy and reserved, of small and delicate physique, and took little part in the vigorous social life of the town, beyond sitting and smoking at a club of local worthies, and occasionally writing humorous verses for their amusement. He had apparently but one love affair, the heroine of which was the original of "Jessie, the Flower of Dunblane." He bade her farewell in indignant rhymes after three years' courtship. The steady routine of his trade was broken only by occasional excursions to Glasgow and the land of Burns, and a year's trial of work at Bolton. He began in 1805 to contribute verses to Glasgow and Paisley periodicals, and published an edition of his poems by subscription in 1807. Three years later the life of the quiet, gentle, diffident, and despondent poet was brought by his own act to a tragic end. Tannahill's claims to remembrance rest upon half a dozen songs, full of an exquisite feeling for nature, and so happily wedded to music that their wide popularity in Scotland is likely to be enduring. "Loudon's Bonnie Woods and Braes," "Jessie, the Flower of Dunblane," and "Gloomy Winter's Noo Awa" are the best of them.

Tannahill's centenary was celebrated with great honour at Paisley in 1874; and, in an edition by Mr David Semple, published in 1876, there is an exhaustive and minutely learned account of all that has been preserved concerning the poet, his ancestry, and the occasions of his various poems.

TANNIN, a generic name for a class of vegetable substances which, as the name indicates, are all available for tanning, meaning the conversion of animal hide into leather. Tannin is widely diffused throughout the vegetable kingdom. An enumeration of the principal materials which form the commercial sources of the substance will be found under Leather, vol. xiv. p. 381, and in various special articles referred to from that heading.

Our chemical knowledge on the subject is very limited; and, as long as we know no better, each of the various tanning materials must be viewed as containing a "tannin" of its own kind.[1] Only a few have as yet been obtained in a state approximating chemical purity. The following characters are common to them all:—

(1) All are colourless or little-coloured non-volatile solids, soluble in water and in alcohol; the solution has an astringent taste.

(2) They colour blue litmus paper feebly red, yet all unite with the alkalies into soluble salts; the solutions of these eagerly absorb oxygen from the air, with formation of dark-coloured products.

(3) They form insoluble salts with the oxides of lead, zinc, copper, producible by addition of solution of the tannin to one of the respective acetate.

(4) They form very dark-coloured (green or blue) compounds with ferric oxide, conveniently producible by addition of the tannin to ferric or ferroso-ferric acetate. Ordinary old-fashioned black (gall-nut) ink may be quoted as an illustration.

(5) Tannin solutions precipitate gelatine as an insoluble compound, generally assumed to be chemically similar to the substance of leather.

(6) If a piece of raw hide be placed in a solution of any tannin, it imbibes the latter with formation of Leather (*q.v.*).

(7) Aqueous tannin-solutions, if mixed with dilute sulphuric acid, are readily oxidized by solution of permanganate of potash, which, being reduced to manganous salt, loses its intense violet colour.

Upon the last two propositions Löwenthal has based a convenient method for the assaying of tannin materials. A known weight of the substance to be analysed (say sumach) is extracted with water, and the extract diluted to a known volume. An aliquot part of the extract is then mixed with a certain proportion of a standard solution of indigo-carmin and of sulphuric acid, and, after large dilution with water, standard permanganate is dropped in from a burette (graduated glass tube) until the colour of the indigo is completely discharged. After deducting the volume of reagent which would have been taken up by the indigo alone, the rest is put down as corresponding to the "permanganate reducers generally." Another measured volume of the extract is then poured over a sufficient weight of dry shavings of raw hide, after having been suitably diluted, and the whole is allowed to stand until the tannin has all passed into the hide. The liquid is then filtered, and a measured volume, corresponding to exactly the quantity of extract used for the assay, tested with permanganate. The volume of reagent used this time is deducted from that used in the assay as a correction. From the net permanganate the weight of pure gallotannic acid which it would oxidize is calculated on the basis of standard experiments, and from this weight the "percentage of tannin" is deduced. The method is purely empirical, and the results are of no value unless obtained according to a rigorously prescribed mode of procedure. Of individual tannins that of the gall-nuts, known as *gallotannic acid*, is best known. For its preparation (according to Pélouze) powdered gall-nuts are placed in an apparatus for extraction "by displacement," and in it soaked in a mixture of 9 parts of ether and 1 part of water for twenty-four hours. The liquid is then allowed to drain off, and the residue washed with aqueous ether. The liquid on standing separates into two layers,—a lower heavy layer, which contains the tannin, and an upper more purely ethereal layer, which contains gallic acid and other impurities. The lower layer is drawn off, washed once or twice with ether, and then evaporated to dryness at a gentle heat; the tannin remains as a porous friable mass of a slightly greyish-yellow colour This is the tannin of the pharmaceutist.

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[1] Coffee beans and tea leaves contain peculiar tannins.

Such tannin is not by any means an absolutely unitary substance. Its solution, if allowed to stand in the presence of a ferment which is naturally present in gall-nut extract, or more readily if boiled with sulphuric acid, yields a large proportion of *gallic acid*, which is easily obtained in pure crystals. According to Strecker, glucose is formed at the same time, whence he viewed tannin as a glucoside (see SUGAR). But this is now recognized as a mistake, since Hugo Schiff showed that *pure* tannin is only digallic acid, $C_{14}H_{10}O_9 = 2C_7H_6O_5$ (gallic acid) minus $1H_2O$. Pure tannin, according to Schiff, can be obtained by dehydrating pure gallic acid by means of chloride of acetyl. The tannin of the Chinese gall-nuts seems to be identical with gallotannic acid.

Quercitannic Acid.—The tannin of oak bark is certainly different from gallotannic acid, because it yields no gallic acid when boiled with dilute vitriol. Etti (*Jahresb. über die Fortschr. der Chemie* for 1880, p. 898) prepares it by extracting the powdered bark with dilute alcohol at a gentle heat, adding ordinary ether to the alcoholic extract, and shaking out the tannin with acetic ether. The acetic ether extract is distilled to recover the solvent, the residue filtered, and the filtrate evaporated to dryness to obtain the pure (?) tannin as a reddish-white powder of the composition $C_{17}H_{16}O_9$. At 130–140° C. it loses water and forms *phlobaphen*, $C_{34}H_{30}O_{17}$, a brown solid insoluble in water but soluble in solution of the tannin. Quercitannic acid forms quite a series of such anhydrides: $C_{34}H_{30}O_{17}$; $C_{34}H_{28}O_{16}$; $C_{34}H_{26}O_{15}$; $C_{34}H_{24}O_{14}$. Some, if not all, of these are contained in aqueous oak-bark extract, and they play an important part in its application for tanning. According to Etti, quercitannic acid is a tri-methyl substitution-product of digallic acid, $C_{14}H_{10}O_9$ minus 3H plus $3CH_3 = C_{17}H_{16}O_9$.

Besides these two tannins, those of coffee and cachou are the only ones which have been obtained in a relatively definite form.

TANNING. See LEATHER.

TANTALUM. A rare element closely allied to NIOBIUM. See vol. xvii. p. 513.

TANTALUS, a hero of ancient Greek myth and legend. He was a son of Zeus and Pluto ("Wealth"), and became the father of Pelops, Proteus, and Niobe. He dwelt in splendour on Mount Sipylus near Smyrna, and was admitted to the table of the gods themselves. But he abused the divine favour by revealing to mankind the secrets he had learned in heaven, or by killing his son Pelops and serving him up to the gods at table. Another story was that he stole nectar and ambrosia from heaven and gave them to men. According to others, Pandareus stole a golden dog which guarded the temple of Zeus in Crete, and gave it to Tantalus to take care of. But, when Pandareus demanded the dog back, Tantalus denied that he had received it. Therefore Zeus turned Pandareus into a stone, and flung down Tantalus with Mount Sipylus on the top of him. The punishment of Tantalus in the lower world was famous. He stood up to his neck in water, which fled from him when he tried to drink of it; and over his head hung fruits which the wind wafted away whenever he tried to grasp them. From this myth is derived the English word "tantalize." Another story is that a rock hung over his head ready to fall and crush him. The tomb of Tantalus on Mount Sipylus was pointed out in antiquity, and has been in modern times identified by Texier with the great cairn beneath Old Magnesia; but Prof. W. M. Ramsay inclines to identify it with a remarkable rock-cut tomb beside Magnesia. The story of Tantalus contains a reminiscence of a semi-Greek kingdom which had its seat at Sipylus, the oldest and holiest city of Lydia, and one of the chief birthplaces of early Greek civilization. Of this ancient city the remains are still visible on the northern slope of Mount Sipylus, and about 4 miles east of Magnesia. They consist of sepulchral mounds, rock-cut tombs, and a small acropolis perched on an almost inaccessible crag which juts out from the nearly perpendicular limestone wall of Mount Sipylus. There was a tradition in antiquity that the city of Tantalus had been swallowed up in a lake on the mountain; but the legend may, as Prof. W. M. Ramsay thinks, have been suggested by the vast ravine which yawns beneath the acropolis.[1] This acropolis is too small ever to have been the seat of a great empire; rather, like Pessinus and other great religious centres of Asia Minor, it may have been "the seat of a priestly suzerainty maintained over the *hiero-douloi* [sacred slaves] of the surrounding district." Connected as the city was on the one hand with the sea, and on the other with the capital of the ancient kingdom of Phrygia by means of the "royal road," it was a natural meeting-place for Greek and Oriental culture. A comparison of the art of Phrygia with the early art of Mycenæ and Olympia has fully confirmed the legend which connects the family of Tantalus with the Peloponnesus.

See PELOPS, PHRYGIA, and a paper by Prof. W. M. Ramsay in *Journal of Hellenic Studies*, iii. p. 33 *sq.*

TAOISM. See LAO-TSZE.

TAORMINA (*Tauromenium*), now an unimportant village of about 3000 inhabitants, is magnificently situated at the edge of a precipitous cliff 900 feet high on the east coast of Sicily, about 32 miles from Messina and the same from Catania. The original city was founded by a tribe of Siculi after the destruction of the neighbouring city of Naxos in 403 B.C. by Dionysius of Syracuse. It was built on the hill of Taurus, whence came the name Ταυρομένιον (Diod., xiv. 58). In 358 B.C. the city was increased by the settlement of the exiled survivors from Naxos, which was only 3 miles distant; and hence Pliny (*H. N.*, iii. 8) speaks of Naxos as having been the original name of Tauromenium. Owing to its commanding site, the city has frequently been the scene of important struggles. When with the rest of Sicily it passed into the possession of the Romans, it shared with two other Sicilian cities the privileges of a "civitas fœderata." During the Servile War (134–132 B.C.) Tauromenium was occupied by a body of rebel slaves, but was finally taken by the consul Rupilius, and the whole garrison slaughtered. In 36 B.C. it was one of Sextus Pompey's chief strongholds in his war with Augustus, who after his victory established a Roman colony there. Under the empire it was a flourishing city, famed for its wine (Pliny, *H. N.*, xiv. 6) and red mullets (Juv., v. 93). In 902 A.D. it was taken from the Byzantine emperor by the Saracens, who called the place Moezzia. In 1078 it was captured by the Normans. A large number of ancient remains bear witness to its former importance. Fine autonomous silver coins of *c.* 300 B.C. exist, with *obv.* a laureated head of Apollo, and *rev.* a tripod, with the legend ΤΑΥΡΟΜΕΝΙΤΑΝ, and a magistrate's initials ΑΙ. The theatre is, next to that at Aspendus (Pamphylia), the best preserved in existence. It is Greek in plan, but the existing structure belongs mostly to the Roman period, and is specially remarkable for the preservation of its lofty scena wall, and two large chambers which form entrance-porches to the cavea. It is excavated in an elevated peak of rock, and commands one of the most magnificent views in the world, with Mount Etna in the distance. Remains of five piscinæ and a large bath, popularly called a naumachia, still exist, together with remains of the ancient city wall and that of the arx.

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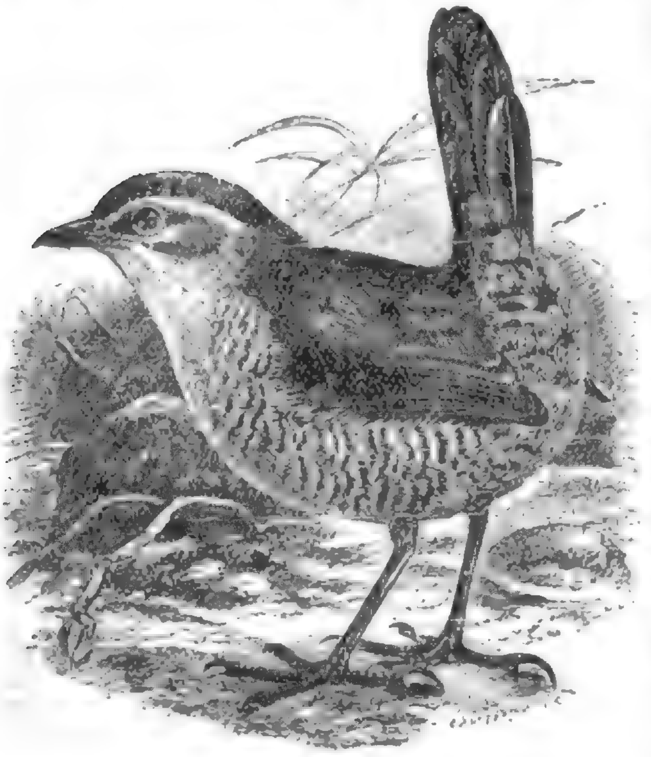
[1] Legends of submerged cities and castles are common in different parts of Europe. It has been suggested that they are confused recollections of the ancient villages built on piles in lakes (Wood-Martin, *Lake Dwellings of Ireland*, p. 28).

See Serradifalco, *Antichità di Sicilia*, Palermo, 1834–42, vol. v.; Hittorff and Zanth, *Architecture Antique de la Sicile*, Paris, 1870.

TAPACULO, the name[1] given in Chili to a bird of singular appearance,—the *Pteroptochus albicollis* of ornithology,—and, throughout this series of articles (BIRDS, vol. iii. p. 743; ORNITHOLOGY, vol. xviii. p. 40, *et alibi*), applied in an extended sense to its allied forms, which are now found to constitute a small Family, *Pteroptochidæ*, belonging to the Tracheophonous division of *Passeres*, and therefore peculiar to South America. About 20 species, which are disposed by Mr Sclater (*Ibis*, 1874, pp. 189–206) in 8 genera, are believed to belong to this group.



Tapaculo.

The species of the Family first made known is *Scytalopus magellanicus*, originally described in 1783 by Latham (*Synopsis*, iv. p. 464) as a Warbler. Even in 1836 Gould not unnaturally took it for a Wren, when establishing the genus to which it is now referred; but some ten years after Johannes Müller found that *Scytalopus*, together with the true Tapaculo, which was first described by Kittlitz in 1830, possessed anatomical characters that removed them far from any position previously assigned to them, and determined their true place as above given. In the meanwhile a kindred form, *Hylactes*, also first described in 1830, had been shewn by Eyton to have some very exceptional osteological features, and these were found to be also common to *Pteroptochus* and *Scytalopus*. In 1860 Prof. Cabanis recognized the *Pteroptochidæ* as a distinct Family, but made it also include *Menura* (*cf.* LYRE-BIRD, vol. xv. p. 115), and in 1874 Mr Sclater (*ut supra*) thought that *Atrichia* (*cf.* SCRUB-BIRD, vol. xxi. p. 554) might belong here. It was Garrod in 1876 and 1877 who finally divested the Family of these aliens, but, until examples of some of the other genera have been anatomically examined, it may not be safe to say that they all belong to the *Pteroptochidæ*.

The true Tapaculo (*P. albicollis*) has a general resemblance in plumage to the females of some of the smaller Shrikes (*Lanius*), and to a cursory observer its skin might pass for that of one; but its shortened wings and powerful feet would on closer inspection at once reveal the difference. In life, however, its appearance must be wholly unlike, for it rarely flies, hops actively on the ground or among bushes, with its tail erect or turned towards its head, and continually utters various and strange notes,—some, says Mr Darwin, are "like the cooing of doves, others like the bubbling of water, and many defy all similes." The "Turco," *Hylactes megapodius*, is larger, with greatly developed feet and claws, but is very similar in colour and habits. Two more species of *Hylactes* are known, and one other of *Pteroptochus*, all of which are peculiar to Chili or Patagonia. The species of *Scytalopus* are as small as Wrens, mostly of a dark colour, and inhabit parts of Brazil and Colombia, one of them occurring so far northward as Bogota. (A. N.)

TAPESTRY. See TEXTILES.

TAPE-WORMS, or CESTODA, are a group of worms forming one of the three main divisions of the *Platyhelminthes*, the other two being the *Turbellaria* (see PLANARIANS and NEMERTINES) and *Trematoda* (see TREMATODA). They have been defined as follows:—"Flat worms without mouth or alimentary canal, which typically develop by alternation of generations, by budding from a generally pear-shaped nurse, with which they remain united for a lengthened period as a ribbon-like colony or 'strobila.' The individual joints of the colony, *i.e.*, the sexual animals or 'proglottides,' increase in size and maturity as they are removed farther from their origin by the intercalation of new buds, but are not distinguished in any special way. The nurse, however, known by the name of the 'head' (*scolex*) is provided with four or two suckers, and usually with curved claw-like hooks. The dorsal and ventral surfaces of the head are perfectly identical, so that the arrangement of the hooks presents a strikingly radiate appearance. By means of this apparatus the worms fasten themselves on the intestinal membrane of their hosts, which (except in the case of the otherwise peculiar *Archigetes*) all belong to the *Vertebrata*. The nurses develop from little round six-hooked embryos in a more or less complicated fashion as so-called 'bladder-worms.' The latter inhabit very diverse, but usually parenchymatous, organs of the higher and lower animals, and are thence passively transferred to the intestine of their subsequent host" (Leuckart, 1,[2] p. 270).

Historical Sketch.—Certain forms of Cestodes have been known from time immemorial. The hydatid cyst is alluded to by early medical writers, and Aristotle speaks of examining the tongue of pigs to ascertain the presence of bladder-worms. By this author and Hippocrates the Cestodes and other flat worms are spoken of as *ἕλμινθες πλατεῖαι*, in opposition to the *στρογγύλαι* or "round worms"; the word *Tænia* (Gr. *ταινία*) does not occur in Greek authors, but is first used by the Romans (Pliny, *H. N.*, xi. 33). In the treatises of the Middle Ages the tape-worm figured as *Lumbricus latus*, only one species being recognized. Felix Plater (23) separated *Bothriocephalus* from the other human tape-worms, and Andry (24) gave it the name *Ténia à épine*, mistaking the nodular generative organs for vertebræ. The appellation *Bothriocephalus latus* dates from Bremser, 1819 (25). Like other *Entozoa*, the tape-worms and bladder-worms were supposed to arise by spontaneous generation; it was found, however, that animal forms strikingly like the *Entozoa* sometimes lived freely. Pallas (19), seeing that the eggs of intestinal worms are expelled from the animals in which they live, and may remain for some time unaltered in water, suggested the hypothesis that the *Entozoa* agree with other animals in originating from eggs which can be carried from one animal to another. He also supposed that they reached the liver and other internal organs by means of the blood-stream. Other authorities endeavoured to explain the presence of *Entozoa* by supposing that they were transmitted from parents to children. Von Siebold (26) in 1838 discovered the six-hooked embryos of *Tænia*, and came to the conclusion that they could only pass into the fully-formed animal by a kind of metamorphosis. The subject was fully discussed by Eschricht (27), who endeavoured to prove that this phenomenon was of common occurrence among the *Entozoa*. Shortly afterwards appeared Steenstrup's famous work upon the alternation of generations (28), which furnished a ready explanation of the isolated facts till then observed regarding the Cestodes. The most important advances in modern times have been due to the introduction of helminthological experiment by Küchenmeister, by means of which the demonstration has been furnished that certain bladder-worms are the larval stages of particular tape-worms. The first of these experiments took place in 1851, when Küchenmeister fed a dog with bladder-worms from the rabbit, and a cat with specimens from the mouse, and succeeded in rearing tape-worms in their intestines (29). Similar investigations on different species have been made by Van Beneden, Leuckart, and others. Of systematic treatises the most important are those of Rudolphi (35), Diesing (20), and Van Beneden (13), while Von Linstow, in addition to numerous scattered papers (30, 36), has given us an invaluable list of hosts with their respective parasites (21).

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[1] Of Spanish origin, it is intended as a reproof to the bird for the shameless way in which, by erecting its tail, it exposes its hinder parts. It has been sometimes misspelt "Tapacolo," as by Mr Darwin, who gave (*Journal of Researches*, chap. xii.) a brief but entertaining account of the habits of this bird and its relative, *Hylactes megapodius*, called by the Chilenos "El Turco."

[2] These figures refer to the bibliography, pp. 55, 56.

Anatomy.

In considering the anatomical peculiarities of the *Cestoda* it will be convenient to describe one particular species and afterwards to indicate the chief differences presented by other members of the group. For this purpose *Tænia saginata*, Göze (*T. mediocanellata*, Küchenmeister), may be selected as a type, as it has been perhaps more studied than any other, and is one of the species most commonly found in man; for further details, see Sommer (31).

Dimensions.—An average specimen of this tape-worm (fig. 1, A) will measure in a state of moderate contraction about 500 cm., and consist of nearly 1400 segments; of those which immediately follow the head more than 250 will be found within a length of 5 cm.; they gradually widen posteriorly, until the widest, which are situated about half-way down the chain, have a breadth of 14 mm. and a length of 6 mm.; whilst the terminal segments measure 5 mm. in breadth by 19 mm. in length.

The head (fig. 1, B) is spheroidal, 1·5 mm. in diameter, and bears on its lateral surface four equidistant suckers, which serve for the attachment of the whole worm. After death these are generally retracted, but during life they can be protruded and moved in all directions. They are a special development of the musculature of the body-wall, the radial fibres being the most conspicuous. The tape-worm now being described is abnormal, inasmuch as the front of its head is not provided with a circlet of hooks; these are well seen, however, in the other common human tape-worm (*Tænia solium*), which bears a double ring of them, situated around a button-shaped muscular pad (*rostellum*) which forms the apex of the head (fig. 1, C). By the varying contraction of the separate parts of this organ the hooks may be moved in different directions, and when the worm is attaching itself they are first extended directly forwards, and then brought back so as to force the rostellum into the tissues of the host. Each hook has a broad bifid base, to which the muscles are attached, supporting a long curved point. In *Tænia saginata*, to the consideration of which we now return, the rostellum is quite rudimentary, and has been described by earlier authors as a fifth sucker or even as a mouth; it is interesting to note that during its incipient stages it bears a number of minute spines homologous with the hooks of other species. The head contains furthermore the anterior portions of the nervous and excretory systems. The latter of these consists of an annular vessel placed immediately below the rostellum, from which four canals, corresponding to the four suckers, pass backwards: two of these gradually disappear, leaving two which pursue their course down the proglottides, in connexion with which they will be again alluded to, and open at the hinder extremity of the worm by a common pore. The nervous system of the Cestodes was long sought in vain: although some early investigators described a ganglion, they were unable to give any satisfactory proof of its existence, this having been first furnished by Schneider. It seems generally to consist of a central ganglion lying within the head, from which two cords proceed backwards; these were regarded by Sommer and Landois as part of the alimentary system. Niemiec (6) has recently given a detailed account of its structure in several different species, and its relations have been discussed by Lang (7).

The proglottides arise by a species of budding in the narrow neck which immediately succeeds the head; they are separated from each other by grooves, which are at first so shallow and indistinct that it is impossible to say with certainty where the segmentation really begins. The proglottides which have attained sexual maturity are situated some 30–40 cm. from the head, and measure 1·5 mm. in length by 5 mm. in breadth. The segments, like the head, consist of a solid mass of tissue in which the various organs are imbedded. Like the Trematodes, the Cestodes were long thought to have no body-cavity or cœlom, and hence were called "parenchymatous" worms. Recently, however, a series of intercellular spaces has been described by Fraipont (8) as leading into the terminal excretory organs, and these spaces have been interpreted both by himself and others as the homologue of a body-cavity, although this opinion has not been allowed to pass unchallenged (see Pintner, 9). The surface of the body is covered by a thin clear homogeneous cuticle, which, according to some authorities, is perforated by fine closely-set pores. The hooks which have been described above, as well as the small spines and bristles found in certain species, are developments of this cuticle. This external covering cannot, according to Leuckart (1, p. 289), be regarded as homologous with the cuticle of other invertebrates, inasmuch as it is not a secretion from a special layer of subjacent cells, but is "the structureless limiting membrane of the connective tissue substance, and is comparable with the so-called basement-membrane found in the other flat-worms . . . between the muscular layer and the dermal epithelium." It is to be observed, however, that this view has by no means found universal acceptance (see

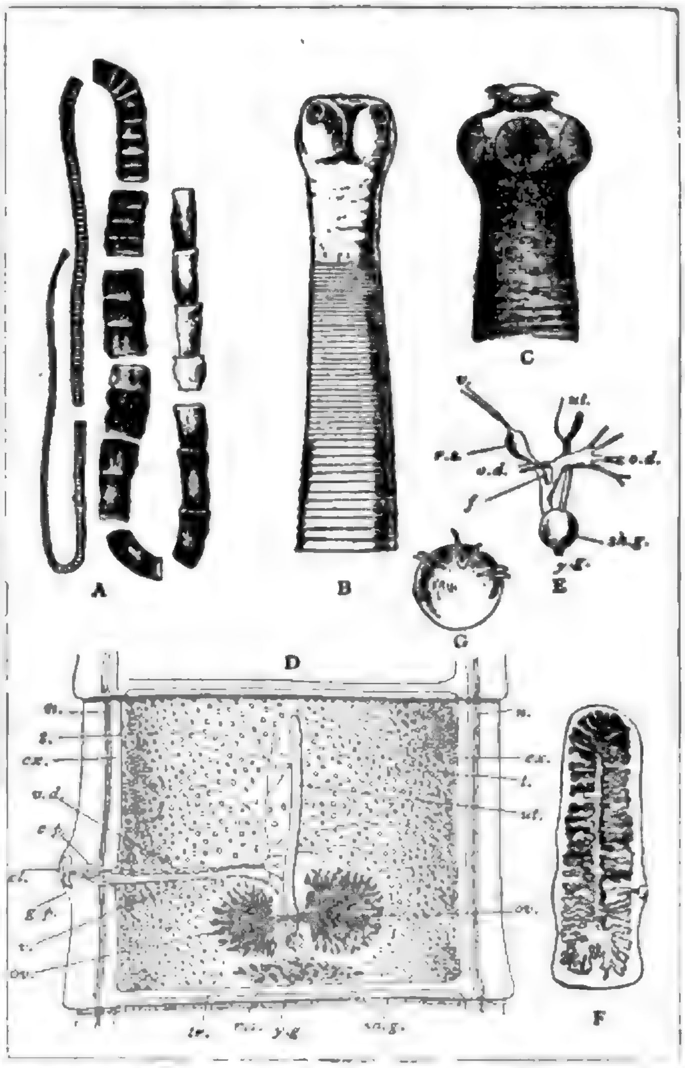

Fig. 1.—Anatomy of *Tænia* (from Leuckart). A, Portions of *Tænia saginata*; × ½. B, head of the same; × 8. C, head of *T. solium*, showing the crown of hooks; × 22. D, a segment of *T. saginata*, showing the generative organs: *n.*, nervous system; *ex.*, longitudinal excretory tubes; *tr.*, transverse vessel; *g.p.*, genital papilla; *cl.*, cloaca; *c.p.*, cirrus pouch; *v.d.*, vas deferens; *t.t.*, testes; *v.*, vagina; *ov. ov.*, ovaries; *sh.g.*, shell gland; *y.g.*, yolk gland; *r.s.*, receptaculum seminis; *ut.*, uterus; × 7. E, the connexions of the generative organs, lettering as above; *o.d.*, *o.d.*, oviducts; *f.*, fertilising canal; × 30. F, detached segment of *T. saginata*, showing ripe uterus; × 2. G, six-hooked embryo, highly magnified.

Steudener, 10), and it is *a priori* improbable, since the Cestodes (and Trematodes) would thus form an exception to the general rule by which all animals are clad with an epithelium derived from the embryonic ectoderm. The subcuticular layer is described as consisting of long fusiform cells (probably modified connective-tissue cells) disposed perpendicularly to the cuticle. It seems possible that they are in direct connexion with the transverse muscles of the body. The matrix of the Cestode body consists of connective tissue, the cells composing which are seldom provided with a distinct membrane, and sometimes can only be separately distinguished by their nuclei. The layer of muscles (see below) separates this matrix into a central and a cortical portion. Distributed in it, and especially in its cortical portion, are numerous calcareous corpuscles, which are generally spheroidal in form, varying up to 0·019 mm. in diameter and concentrically laminated; they contain a large amount (often 20 per cent.) of lime salts, diffused through an organic basis, from which the salts can be removed with effervescence by the action of acids. These corpuscles have been variously interpreted by the older authors as eggs, or as lymph or blood corpuscles, but the only theories which have been seriously maintained in modern times are—(1) that they are skeletal (Von Siebold); (2) that they are excretory (Claparède, Griesbach); or (3) that they form a reserve store of calcareous material to be used either in counteracting the acid digestive juices of the host or for the production of egg-shells (Leuckart, 1, p. 233).

The muscular system consists of three sets of fibres—longitudinal, transverse, and sagittal. The first are the best developed, and run down the inner part of the cortical layer in the form of strong bands; the second set lie immediately below them and pass across the body in the form of two flat muscular plates, which converge towards each other as they approach the margins of the proglottis; the sagittal muscles run primitively straight from one flat surface of the body to the other, but their direction is much modified after the growth of the genital organs, between the various parts of which they lie as isolated bundles; they are the weakest of all the sets. The muscular fibres are non-striated, and when they are fully developed no nucleus can be detected in them. They taper towards the extremities, sometimes branching dichotomously, and, as above mentioned, a connexion has been asserted to be visible between them and the subcuticular cells.

The excretory system in the proglottides consists of two or four longitudinal canals which lie along their two narrow margins (fig. 1, D, *ex.*). The origin of these in the head has been already noted, and they pass continuously down the whole worm until they open into a vesicle at the posterior extremity of the terminal segment. In the hinder part of each proglottis they are connected by a transverse vessel (fig. 1, D, *t.v.*), immediately above which a valve is formed by a duplicature of the wall, so that it is impossible to inject the excretory system from behind whilst fluid can be readily forced along it from before backwards. Fraipont has drawn a distinction between ascending and descending canals. Excretory openings have been described by various observers in the anterior portion of the worm, near the suckers (Wagener, 11; Fraipont, 8; Riehm, 12), and, although their presence is denied by Pintner (9), there seems sufficient evidence to show that they are more generally present than was formerly supposed. A ramifying network of smaller vessels connected with the main trunks just described is found in the more superficial parenchyma, and this in its turn gives off still finer capillaries which terminate in ciliated funnels. According to Fraipont these open into the intercellular lacunæ which are the representatives of the cœlom (see above), whilst Pintner maintains that the terminal funnels are completely closed, and are to be regarded as unicellular glands. The subject, however, is one of extreme difficulty and demands further investigation. It is worthy of notice that each of the three systems of canals above described maintains its proper diameter throughout, and that no intermediate sizes can be found. The "plasmatic vascular system" described by Sommer and Landois, and regarded by them as part of the alimentary system, consists partly of some of these delicate canals and partly of the two cords of the nervous system. The main canals open posteriorly into a pulsatile vesicle, at the end of the last proglottis; when, however, some of these have been cast off the opening may be either by a shortened transverse vesicle, as Leuckart (1) maintains to be the case in the present species, or by separate openings, one for each canal.

The reproductive organs are serially repeated in the proglottides, each of which contains a complete set of male and female organs (fig. 1, D). The male organs may be discussed first. The testes (*t., t.*) are very numerous and scattered throughout the greater part of the proglottis; they are round vesicles (0·15 mm. in diameter) containing spermatozoa, and attached like berries to the terminal ramifications of the vas deferens (*v.d.*); these gradually unite, forming larger and larger branches until they reach the main canal, which runs in a series of coils transversely half way across the joint a little behind its middle, and ends in a common cloaca (*cl.*), which receives both the male and female organs, and is connected with the outer world by the porus genitalis. The outer portion of the vas has a thickened muscular wall, and this part of it is capable of extrusion and retraction, thus forming the male intromittent organ or "cirrus" (*c.p.*). The cuticle which lines all the distal portion of the vas deferens is here thin and delicate and armed with a series of minute spines, which are directed backwards (*Echeneibothrium*). The cirrus in the present species is very short, but in other forms its length is sometimes considerable. The protrusion is effected by circular muscles placed around the end of the vas deferens, while the retraction is brought about by special longitudinal fibres, lying along the walls of the evaginable portion.

The female organs may be most conveniently studied by tracing them inwards from the cloaca. The vagina (*v.*) opens immediately posterior to the vas deferens, and like it is lined by a continuation of the external cuticle. After passing about half way across the segment it bends backwards and terminates in a small cyst, the receptaculum seminis (fig. 1, E, *r.s.*); this receives and stores up the male fertilizing elements, retaining them until the ova are ripe. From its posterior extremity there passes a thin-walled canal, wider than the vagina (*f.*), which serves to convey the spermatozoa to the ova, and hence is termed the "fertilizing canal" (Befruchtungscanal of German authors). It unites with the common oviduct, a tube formed by the union of the two oviducts (*o.d.*), and the two together pass backwards into a spherical glandular structure, called from its discoverer "Mehlis's body" or the shell gland (fig. 1, D and E, *sh.g.*). Within this apparatus it receives the duct of the yolk-gland (*y.g.*), and then passes directly forwards to open into the uterus. The ovaries (*ov.*) are two in number, situated one on each side of the middle line of the body; they are fan-shaped, and consist of a system of blind tubules situated on a branched efferent duct. The cells of the ovary (primitive eggs) have a sharp contour and a large nucleus; the yolk-gland (*y.g.*) is very similar to the ovaries, behind and between which it is situated, but is distinguished by various histological details (it is called "ovary" by Moniez). The shell-gland, formerly regarded as the ovary, consists of closely compressed nucleated cells, and is provided with small thin ducts opening into the narrow internal cavity of the organ. The uterus (*ut.*), in its early stage of development, is a long straight tube, lying almost in the longitudinal axis of the proglottis, and receiving posteriorly the oviduct after it emerges from the shell-gland (fig. 1, E, *ut.*). From what has been said it will appear that the ova on their way down the common oviduct are impregnated as they pass the end of the fertilizing canal, and then receive in succession, first their supply of food-yolk and their shell, during their sojourn in Mehlis's body, after which they go forwards into the uterus, where they undergo the first stages of their development. The uterus assumes a very different shape as it becomes distended with eggs, which are far too numerous to be contained in a simple straight tube; small protuberances arise from its walls, growing rapidly and bifurcating here and there, so as to produce the complicated branched appearance seen in fig. 1, F. As the uterus grows, the male, and later the female, genitalia degenerate and disappear, and in the proglottides which are ready to be liberated the only organ visible is the distended uterus. One of the most characteristic peculiarities in the sexual system just described is that there is no passage by which the ripe eggs can make their exit from the proglottis; these are therefore extruded only on its rupture; a very different state of things obtains in the genus *Bothriocephalus* (see below). Self-impregnation certainly occurs, and is probably the rule; it is obvious that the contrary case can only happen where two individuals lie side by side within the same host. Furthermore, the cirrus has been seen protruded into the vagina of the same joint, and the emission of sperm has been witnessed (Leuckart, 1; Van Beneden, 13, p. 601).

The eggs are ovoid or spherical, and consist of the germ-cell (nucleus and protoplasm) with an albuminous enveloping substance, which is again surrounded by a thin transparent skin. The shell frequently presents one or more appendages, probably the secretion of the shell-gland drawn out into threads. The structure of the egg has been best studied in *Tænia serrata* (Van Beneden, 14), where it consists of a delicate shell containing a germ-cell, with a quantity of secondary yolk; the former divides into a "granular" cell, which segments no further, and an "embryonic" globe, which again divides into a number of cells, of which three are larger and constitute the "albuminogenous layer," whilst the remainder are smaller and form the "embryonic mass," and secrete a delicate superficial cuticle, the cell-limits being indistinct. In the embryonic mass from three to five flattened cells form a chitinogenous layer, and give origin to a superficial homogeneous coat, a shell of radially disposed chitinoid cylinders, and an internal faintly striated lining, whilst the remaining cells become the six-hooked embryo or proscolex, a superficial layer to which the hooks belong, and a central mass of clearer cells. When the proscolex is mature the original egg-shell and the albuminogenous layer disappear, and only the chitinoid coats remain.

The proglottides are cast off by muscular action; the fibres are not continuous between the successive segments, so that these are connected merely by soft connective tissue, which readily gives way; the rupture takes place through the transverse vessel above described, and, as the hinder margin of the proglottis contracts forcibly when the next one has left it, the transverse vessel gives rise to the rounded vesicle which forms the termination of the excretory system.

Life-History and Development.

The six-hooked embryo (fig. 1, G) may be conveyed to the intermediate host in several ways, but the commonest is for it to be taken into the alimentary canal along with food to which it may have adhered, or with water in which it was swimming; the infection may take place either by means of free eggs or by whole proglottides. In the latter case the soft tissues are first digested by the gastric juice of the host, and in either case the egg-shell is dissolved or rendered so brittle that the embryo readily escapes by the movements of its hooks. The proscolex, after spending a longer or shorter time free in the stomach or intestine, proceeds to perforate the wall of these organs by means of active burrowing motions. Although the embryo of a *Tænia* has only once been captured in its progress through the wall of the alimentary canal (Raum, 15, p. 28), there can be no doubt that this is the route by which it usually proceeds, and that its next locality is a blood-vessel, probably some small branch of the portal vein, in the blood of which it has been found by more than one observer. This would explain the frequency with which the next stage is found in the liver. There seems, however, reason to believe that many embryos penetrate the intestinal wall completely and reach the body-cavity, in which they can wander freely. When the six-hooked embryo has reached its resting-place, which in addition to the liver may be lung, muscles, brain, connective tissue, or eye, it at once commences its further development, and in a few days becomes visible to the naked eye. Like any other foreign body, it causes a proliferation of cells, which in due time form a sheath of connective tissue, with a cellular lining, and smooth like a serous cavity within; this covering, however, is not found when the parasite is situated in the brain or the eye. The embryo now grows in size, generally becoming somewhat elongated, and the hooks drop off. Sometimes they can be found lying detached in the connective-tissue sheath. The central cells enlarge and become clear, and in all the *Tæniæ* they liquefy, forming a quantity of fluid which fills the centre of the bladder-worm. At this stage the larvæ constitute the so-called "measles" of beef (that of pork being due to *Cysticercus cellulosæ*, the immature stage of *Tænia solium*); they are ovoid vesicles lying between the muscle fibres and varying in length from 4 to 8 mm. and being usually about 3 mm. in diameter (fig. 2, A). At a point on one side of the bladder there appears a small thickening, the meniscus or rudiment of the future head; this is soon followed by an invagination of the cuticle (fig. 2, B). When the rudimentary head thus formed is about 0·2 mm. in length (the bladder being 1·5 mm. in diameter) the formation of muscles in its walls commences. At four equidistant points near the bottom of the invagination the suckers are developed, and at the lowest part of the cavity the rostellum (and the double circlet of hooks in the armed species) is formed. Surrounding the head-rudiment on that surface which is towards the cavity of the bladder is a thin layer, known as the "receptacle." This is best seen in *Cysticercus cellulosæ*, in which there is also a very characteristic bend or kink in the pedicle of invagination, which in most other bladder-worms remains straight (see fig. 2, C). The rudiments of the vascular system of the bladder have already appeared before the formation of the head, and now they extend into it as four longitudinal vessels, which become connected at the bottom of the invagination by a circular vessel. About this time, too, the calcareous corpuscles above described make their appearance. When the hooks and suckers are fully formed, the head undergoes a process of evagination, so that what was previously a hollow cavity becomes a solid cylinder, and the hooks, which were below the suckers, come to lie above them. Mature bladder-worms vary in size from *Cysticercus fasciolaris*, the size of a pea, to *Cysticercus tenuicollis*, six inches or more in length.

The development into the adult tape-worm takes place only after the *Cysticercus* has been swallowed by the permanent or definitive host. The course of this metamorphosis has been followed experimentally, and it has been found that first the bladder and next the neck of the worm are dissolved by the gastric juice. The head only is left; in the moist warmth of the intestine its suckers and rostellum exhibit very lively motions, which serve to bring about its attachment to the intestinal wall. It gradually increases in length, and the formation of segments speedily commences.

The life history of the Cestodes is generally summed up as consisting of three different forms:—(1) the proscolex, or six hooked embryo, which gives rise to the bladder-worm; (2) the scolex, which develops the chain or strobila by a process of budding; and (3) the proglottis, or sexual animal, which produces eggs. Each of these three forms has certain claims to be regarded as a zoological "individual." Van Beneden (13, *Vers Int.*, p. 251) has laid great stress upon the correspondence between a Trematode and a ripe proglottis, and it has been since pointed out that a proglottis may under favourable circumstances (that is, within the intestine) continue to grow after being detached from the parent chain; it cannot be said, however, that the evidence upon which this rests is quite incontrovertible. Regarded from this point of view the life-history of the tape-worms furnishes an admirable instance of the alternation of generations. The individuality of the proglottides, however, although maintained by authorities so eminent as Leuckart, is by no means universally accepted; a distinction has been drawn between their formation and true budding seen in other animal colonies, such as the *Polyzoa*; and Riehm, in a recent work (12), has pointed out that the casting-off of these sexual segments is in some respects comparable to the detachment of the hectocotylized arm of a Cephalopod, and the formation of new joints to the development of an Oligochætous worm from a few segments; furthermore, certain organs—for example, the nervous and excretory systems—are continuous throughout the whole chain, and an isolated proglottis is unable to maintain its existence for more than a very limited period. According to this view, alternation of generations only occurs in Cestodes in forms such as *Cœnurus*, where there is a proliferation of heads in the wall of the bladder.[1]

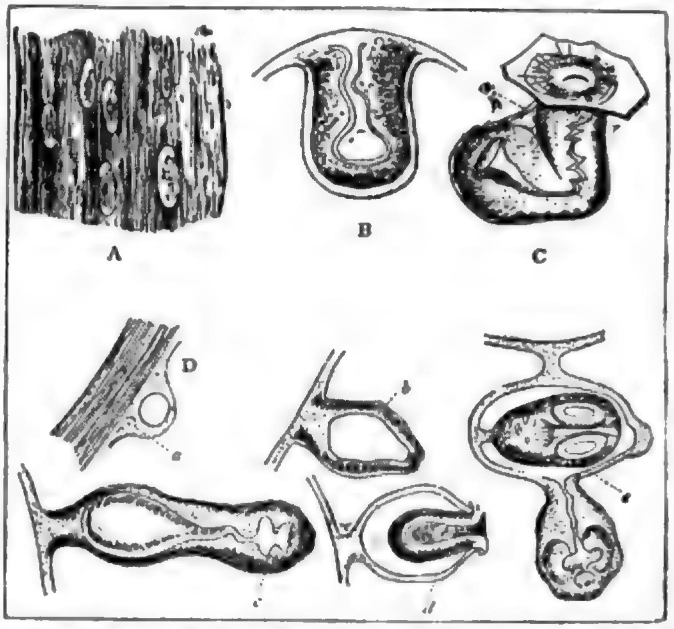

FIG. 2.—Development of *Tænia* (from Leuckart). A, *Cysticercus bovis* in beef; nat. size. B, invaginated head of a *Cysticercus* before the formation of the suckers; × 25. C, invaginated head of *Cysticercus cellulosæ*, showing the bent neck and receptacle *r*; × 30. D, stages in the development of the brood-capsules in *Echinococcus*: *a*, the thickening of the parenchyma of the bladder; *b*, subsequent formation of a cavity in it; *c*, development of the suckers; *d*, a capsule with one head inverted into its cavity; *e*, a capsule with two heads; × 90.

The Cestode larvæ corresponding to the stage which has just been described present considerable variations both in form and structure, and upon these classifications of the group have been based, and generic names have been given to the different forms; Von Linstow (36) has, however, pointed out the undesirableness of this, as they are all parts of the life-history of one genus, *Tænia*. The most recent arrangement is that of Villot (16), which is as follows:—

I. The caudal bladder arises from the proscolex by simple growth and structural modification, without the formation of any new parts. A larger or smaller quantity of fluid is present, and also a connective-tissue sheath; the host is a vertebrate. *Cysticercus* (true bladder-worms), *Piestocystis*, *Cœnurus*, *Echinococcus*.

II. The caudal bladder arises from the proscolex by budding, that is, by the formation of new parts; there is no connective-tissue sheath, and the host is an invertebrate. *Cysticercoidei*, Leuckart. (*a*) Caudal bladder formed by endogenous budding; the head is surrounded, not only by the body of the worm and the caudal bladder, but also by the blastogen (proscolex). *Polycercus* (from the earthworm), *Monocercus* (from the black slug, *Arion*). (*b*) Caudal bladder formed by exogenous budding; the head is only surrounded by the body of the worm and the caudal bladder. *Cercocystis* (from *Tenebrio*), *Staphylocystis*, *Urocystis*, *Cryptocystis*.

Of these the most important are the first group, and regarding some of them a few words must be added. In the great majority of species only one tape-worm head is produced, and such bladder-worms constituted the genus *Cysticercus* of the older helminthologists. In certain cases, however, notably in the worm which produces the "staggers" of sheep, numerous heads are formed in the wall of each bladder; such larvæ formed the genus *Cœnurus*, but apart from their polycephalous condition there are no structural peculiarities calling for special notice. The third variety of bladder-worm (*Echinococcus*) is characterized by the fact that the tape-worm heads are not directly developed in the wall of the bladder itself, but from "brood capsules" which lie in numbers on the inner wall of the bladder.

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[1] At the moment of going to press, Grassi (*Zeitschr. f. Parasitenk.*, ii. 11) makes the important communication that *Tænia murina* (= *T. nana*) may develop without an intermediate host.

Development of the Echinococcus.—The smallest bladder yet seen was reared by Leuckart in the pig, and consisted of a minute protoplasmic mass surrounded by a structureless cuticle. This cuticle thickens by deposition of new layers as growth proceeds, and the lamination of the cuticle is one of the characteristic peculiarities of the *Echinococcus*, another being the absence of an excretory system. At certain points in the parenchyma lining the cyst small warts are noticed (fig. 2, D, *a*), which enlarge and become hollow; then the cavity enlarges in a direction opposite to the point of origin, and at the extremity of this hollow suckers and hooks are formed as in the case of *Cysticercus* described above (*b*, *c*). No sooner has the development of the first of these reached a certain degree of completeness than others are formed in similar fashion. The first part of the invagination takes place, by which the future head comes to lie within the brood-capsule and the pedicle is no longer hollow but solid (*e*); the suckers and hooks are, however, still invaginated, and remain so for a considerable period. Seeing that the interior of the brood-capsule is lined with cuticle, it corresponds to the outside of the parent cyst, and hence is probably the representative of a previous invagination. If this be so then the development of *Echinococcus* would be quite comparable with that of *Cysticercus*, the only difference being that, instead of the head being an invagination of the wall of the cyst itself, it is a secondary invagination, the primary being the brood-capsule. This does not, however, exhaust the peculiarities of the *Echinococcus*; the form just described, with a simple cyst and brood-capsules, is common in cattle, and hence goes by the name of *Echinococcus veterinorum*; but cases are frequent, and are the most common in the human subject, in which the cyst contains daughter-vesicles, differing from those just described in being sterile—giving rise to no heads. These daughter-bladders may originate in three different ways: (1) from little granular heaps, which are seen between the different layers of the cuticle, and which are probably derived primarily from the parenchymal layer,—since new layers of cuticle are continually formed internally, these bladders gradually make their way outwards, until they come to lie externally to the mother-vesicle (*Echinococcus exogena*, Kuhn; *E. scolecipariens*, Küchenmeister); (2) from brood-capsules; (3) from *Echinococcus*-heads; these last two modes of development give rise to vesicles, which are within the mother-vesicle, and produce a form which has been variously called *Echinococcus endogena*, Kuhn, *E. altricipariens*, Küchenmeister, and *E. hydatidosus*. A very remarkable form is *Echinococcus multilocularis*, which consists of a number of very small vesicles embedded in a common soft stroma; it is found exclusively in man, and for long was regarded as a form of alveolar cancer. The mode of its development is unknown (for further information, see Virchow, 17). Compound bladders occur in man and the ox, whilst other ruminants, swine, and monkeys usually harbour the simple or exogenous forms. The organs most often affected are liver and lungs. The adult tape-worm (*T. echinococcus*) is found in the intestine of the dog, jackal, and wolf, occurring in considerable numbers between the villi. Its length (fig. 3, A) is at most 5 mm. and it consists of only three or four segments; the head has four suckers and a double circlet of hooks.

Pathological Effects.

The pathological effects of Cestodes fall naturally into two categories—(1) those due to the adult worm, and (2) those due to the larvæ or bladder worms.

(1) Those of the first group are in general slight, being confined to the abstraction of a certain amount of nutriment, and to a more or less acute feeling of irritation, sometimes amounting even to colic-like pains, in the intestine. There have indeed been many authorities who have maintained that they were beneficial; Jördens went so far as to describe them as the good angels and unfailing helpers of children, and Schimper records that the Abyssinians consider that they prevent constipation, and only regard them as disadvantageous when they grow too long. Notwithstanding all this, however, there are not a few cases on record in which anæmia and neurotic, or even mental, diseases have been caused by the malnutrition and irritation which they occasion.[1]

(2) The effects of Cestode larvæ may again be divided into two subdivisions. (*a*) That due to the invasion and wandering of a large brood of six-hooked embryos has been most successfully studied in cases in which animals have been fed for experimental purposes with fragments of ripe tape-worms; in such instances a train of symptoms has been observed to which the name "acute cestodic tuberculosis" has been given. It is characterized by loss of appetite, fatigue, ruffling of the hair, and fever; on post-mortem examination it has been found that the lymphatic system is in a state of inflammation, while the muscles present the appearance which has already been described. (*b*) The effects of formed bladder-worms may be summed up as dependent upon the pressure of the growing cyst and the consequent absorption of the surrounding tissues of the host, so that the importance of the results depends almost entirely upon the organ which is affected. Bladder-worms in the brain are, of course, the most frequently fatal, especially when, as is not unfrequently the case, they exert pressure upon the ganglia at its base. Küchenmeister has collected a considerable number of occurrences of cystic worms in the brain; among these sixteen were not accompanied by pathological symptoms during life; in six others these were slight; twenty-four were cases of epilepsy, six of cramp, forty-two of paralysis, and twenty-three of mental disturbances of varying intensity. *Cysticerci* in the brain vary greatly in size and form according to the precise situation which they occupy; in its ventricles they have been found as large as a pigeon's egg. In the meshes of the arachnoid the bladder sometimes grows into a remarkably branched structure, which has been called *Cysticercus racemosus* by Zenker (3). Another peculiar form from the same organ has been described by Köberle (4); it is characterized by the great length of its head-process (2 cm.), which is coiled up into a regular spiral of sometimes three turns, it has received the name *Cysticercus turbinatus*, though its specific distinctness is doubtful. The occurrence of *Cysticerci* in the eye is of special interest, because of the opportunity it affords of observing, by means of the ophthalmoscope, the development of the worm in its natural environment. It seems generally to lie at first below the retina, and is visible as a bluish-white sharply defined body; subsequently the retina is destroyed by the pressure, and the worm falls forward into the vitreous body; sometimes the head may be seen protruding first through the opening; in the chambers of the eye the *Cysticercus* is almost always free, that is, without a capsule, and swimming in the fluid, so that its form and motions may be readily and accurately observed. A large number of cases of this affection have been recorded, principally by Von Graefe in Berlin (5), and in some the bladder has been successfully removed by operation.

The special symptoms of the *Echinococcus* vary, like those of other bladder-worms, with its situation and size: when it grows within cavities with more or less firm limits compression of adjoining vessels and glandular passages often results, producing œdema, varicose veins, congestion of various organs, or even dyspnœa, if the parasite occur in the thorax. The liver is its most frequent seat, and next the lung; but there is scarcely any organ of the body in which it has not been found, even the bones being sometimes affected. Since the expanding cyst grows in the direction of least resistance, it has a tendency to pass towards the surface of organs, and sometimes a cure is effected spontaneously by its rupturing into the alimentary canal or into some other passage leading to the exterior. Cases in which the cyst opens into the blood-vessels are almost always suddenly fatal. When the *Echinococcus* occurs near the surface of the body, it may be evacuated by puncture and a cure effected with but little risk.

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[1] The method of treatment for the removal of these tape-worms from the human body consists in the administration, first of purgatives, and thereafter of one or other of the following anthelmintics:—turpentine male fern (*Lastrea Filix-mas*), pomegranate, or kousso.—of which the first two are the most reliable. Turpentine may be given in half-ounce doses along with castor oil, or made up into an emulsion with yolk of egg; while the male fern is usually administered in the form of liquid extract (half a drachm to one drachm). Careful search should be made in the evacuations for the head or scolex, without the expulsion of which there is no certain evidence that the parasite has been removed from the body.

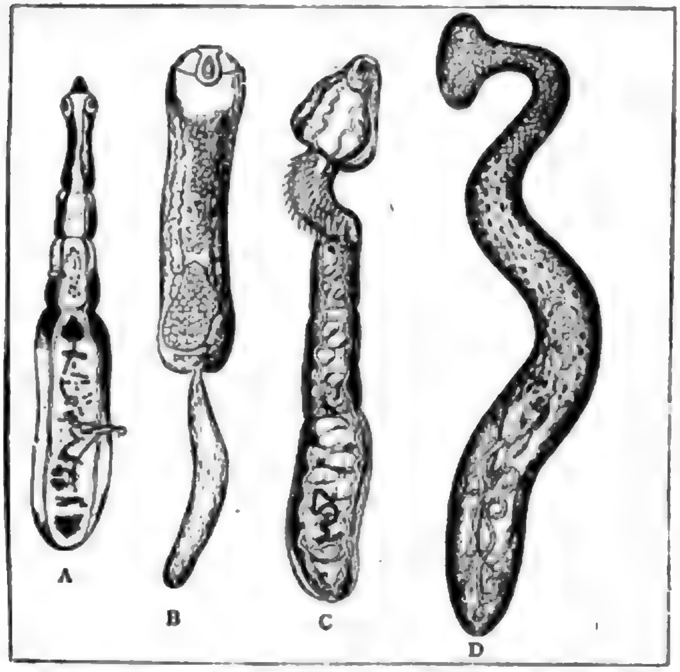


FIG. 3.—Various Forms of Tape-Worms. A, *Tænia echinococcus*; × 12 (from Leuckart). B, *Archigetes sieboldi*; × 60 (from Leuckart). C, *Echinobothrium typus*; × 10 (from Van Beneden). D, *Caryophyllæus mutabilis*; × about 5 (from Carus).

Systematic Arrangement of the Cestoda.

The following classification of the Cestodes, based mainly on that of Van Beneden, exhibits the present state of our knowledge of the group:—

Class *Cestoda*.

Family I. *Amphilinidæ*.—Body oval, flattened, with a sucker at the anterior extremity; testes vesicular, vas deferens opening posteriorly; ovary (germarium) single, yolk glands double, vagina opening near the vas deferens, uterus opening anteriorly; embryo ciliated in front and with ten hooks. Examples: *Amphilina*, Wagener (see below), *Amphiptyches*, Wagener.

Family II. *Caryophyllæidæ*.—Body unsegmented, flat, extended; head expanded, bilobed, and without hooks; a single set of sexual organs in the hinder portion; development probably a simplified metamorphosis. Example: *Caryophyllæus mutabilis*, from the intestine of Cyprinoid fishes (fig. 3, D).

Family III. *Pseudophyllidæ*.—Head provided with two sucking grooves; proglottides not always well defined; a uterine aperture always present in addition to the openings of the vas deferens and vagina; embryo always (?) with a ciliated coat, and egg-shell with an operculum. Examples: *Bothriocephalus* (see below), *Triænophorus* (= *Tricuspidaria*), *Solenophorus*, *Schistocephalus*, *Ligula*, *Archigetes*, and perhaps *Duthiersia* (see below).

Family IV. *Diphyllidæ*.—Neck and two suckers armed with hooks. Example: *Echinobothrium*, two species known from Selachians, one immature from a mollusc (fig. 3, C).

Family V. *Tetrarhynchidæ*.—Head provided with four suckers and four protractile proboscides armed with hooks; sexual openings marginal. Example: *Tetrarhynchus* (see below), about forty species known, many only described from immature forms.

Family VI. *Tetraphyllidæ*.—Head with four very mobile and distinct suckers, which are often armed with hooks or chitinous rods; body segmented, proglottides cast off when mature; sexual openings marginal.

Subfamily i. *Phyllobothrinæ*.—Suckers without hooks or spines. Examples: *Echeneibothrium*, *Phyllobothrium*, *Anthobothrium*, a few species of each, all from Elasmobranch fishes.

Subfamily ii. *Phyllacanthinæ*.—Suckers each with two to four hooks. Examples: *Calliobothrium*, *Onchobothrium*, *Acanthobothrium*, two or three species of each genus known from Selachians.

Family VII. *Tæniadæ*.—Head furnished with four suckers and often with a single or double circlet of hooks; proglottides well-defined and cast off when mature; no uterine aperture. Example: *Tænia* (see below).

It seems advisable to add a few details regarding some of the forms alluded to in the above synopsis.

Amphilina foliacea, described as a Trematode by Rudolphi, is found in the body-cavity of the sturgeon. A number of unicellular glands open into the sucker, and are surrounded by the muscles of that organ; the nervous system consists of two ganglia, with a commissure, and two lateral nerves; the male organs resemble those of *Bothriocephalus*, the female those of the Trematodes; the family is generally regarded as furnishing a connecting link between the *Cestoda* and *Trematoda*; see Salensky (18) and Lang (7).

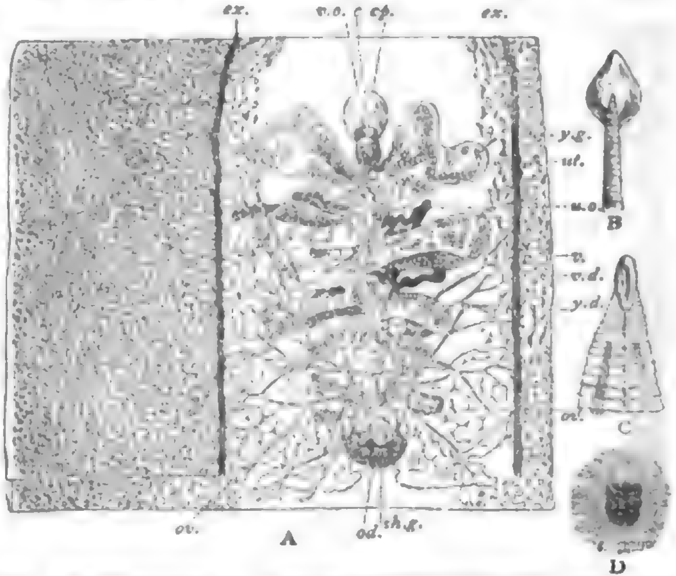


FIG. 4.—*Bothriocephalidæ*. A, A segment of *Bothriocephalus latus*, showing the generative organs from the ventral surface; *ex.*, excretory vessels; *c*, cirrus; *c.p.*, cirrus pouch; *v.d.*, vas deferens; *v.o.*, vaginal opening; *v*, vagina; *sh.g.*, shell-gland; *od.*, oviduct; *ov.*, ovary; *y.g.*, yolk-gland; *y.d.*, its duct; *ut.*, uterus; *u.o.*, uterine opening; the testes are not visible from this side; × 23 (from Sommer and Landois). B, C, marginal and lateral views of the anterior part of *B. cordatus*, showing the cephalic grooves; × 3 (from Leuckart). D, Ciliated embryo of *B. latus*; × 60 (from Leuckart).

Bothriocephalus latus (32) is the most conspicuous example of the family *Pseudophyllidæ*; and is, moreover, noteworthy as being the largest tape-worm found in man; its length often reaches 8 to 9 metres, and its extreme breadth 10 to 12 mm. The head bears two grooves, which correspond in position with the flat sides of the body. There are two (more correctly three) genital openings, which are situated, not on the margin but on the flat side of the body, on that surface which is usually called the ventral. The most anterior of these is the male aperture (fig. 4, A, *c.*), and immediately behind it is that of the vagina (*v.o.*), so close that on superficial examination the two often seem to coincide. This vaginal opening, like that of the *Tæniadæ*, serves for the intromission of the penis and for the fertilization of the ova, but not for the exit of the ripe eggs; this being provided for by a special aperture at the other end of the uterus from that at which the eggs enter it. This uterine opening (*u.o.*) is situated at a short distance behind the other two. The result of this arrangement is that the eggs can be evacuated without any injury to the proglottis, and consequently their discharge commences before its separation from the parent worm and may continue for a long period. The uterus (*ut.*) itself, owing to its disposition in folded coils, when full of eggs, presents an irregular, round, lobular appearance, which has been compared to a flower or heraldic lily. The yolk-gland (*y.g.*) is widely disseminated in the lateral areas of the segments, and its ducts (*y.d.*) form a series of branching tubules, first described by Eschricht (27) under the name "yellow ducts." The excretory organs (*ex.*) differ from those of the *Tæniadæ* in that the canals exhibit a reticulate arrangement. The embryo (fig. 4, D) as it leaves the egg is covered with a ciliated mantle, which corresponds to the firm egg-shell and associated membrane of the cystic tape-worms, and perhaps also to the ciliated envelope of certain Trematode larvæ (see TREMATODA). This ciliated organism swims freely about in the water, but after a time the six-hooked proscolex escapes from it. The next stage in its life-history is not yet known, but it has been recently shown by Braun of Dorpat (33) that at a subsequent stage it inhabits the pike and burbot, and develops into the sexual adult when transferred to the intestine of the human subject. The geographical distribution of *Bothriocephalus* is limited; it has been recorded with certainty in but few places outside Europe; while within that continent the coasts of the Baltic and Switzerland are the principal localities; it is widely distributed in Russia, and has been recorded from Poland, Denmark, Germany, as well as from France and Britain, though it is possible that the cases occurring in these latter countries have been due to importation.

The genus *Ligula* has the segmentation obscure or indistinguishable. About six species are known. One is found encapsuled in a monkey, one in the common seal, others in reptiles and teleosteans. *Archigetes sieboldi* (fig. 3, B) occurs in the body-cavity of an Oligochætous worm (*Tubifex rivulorum*); it is about 3 mm. long, and consists of an oval body (scolex), to which is attached a cylindrical tail (proscolex), bearing at the posterior extremity three pairs of hooks; both these parts are capable of motion. The scolex has eight longitudinal excretory canals, and a terminal vesicle; the ventrally situated genital aperture is the common exit of the vas deferens, the vagina, and a uterus separate from the latter; the development is direct, and it attains sexual maturity without a change of host. *Duthiersia*, Perrier (34), contains two species, both from the intestines of varanian lizards. The genus is characterized by the presence of two large compressed frilled suckers, separated by a septum and perforated at their bases. The proglottides have three genital apertures resembling those of *Bothriocephalus*.

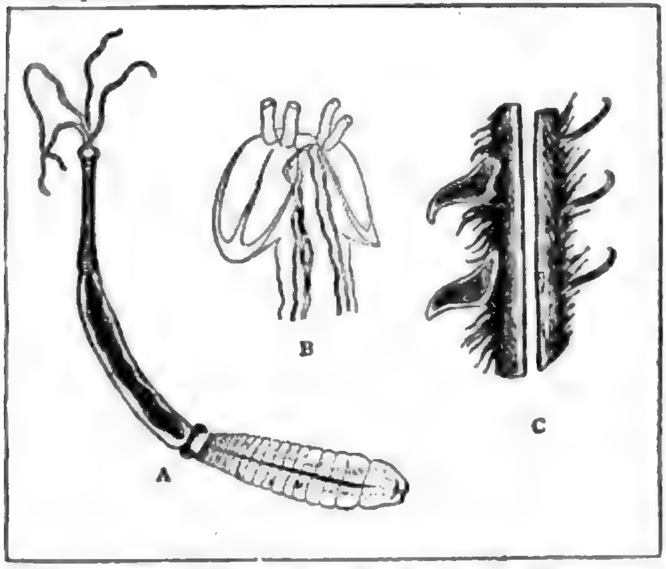


FIG. 5.—*Tetrarhynchus*. A, General view of the worm; × 4. B, head showing the suckers, proboscides, and excretory canals; × 25. C, portion of a proboscis showing the two forms of hooks; highly magnified. (All from Pintner.)

The genus *Tetrarhynchus* was, a few years ago, made the subject of an elaborate memoir by Pintner (9), who investigated *T. longicollis*, V. Ben. The head, in which its most striking anatomical peculiarities are situated, really includes both the head and neck of previous authors (fig. 5, A); it is some 9·94 mm. long, but only 0·75 mm. in diameter, and bears at its anterior end two obliquely placed oval disks (fig. 5, B), each of which is perforated towards the apex by two round holes through which the four proboscides protrude. Each of these disks, moreover, shows traces of a division into two, a fact which indicates that it is formed by the fusion of two suckers corresponding to those commonly found in tape-worms. The flattening in this genus seems to be in a direction at right angles to that in which it usually takes place. The proboscides, which are the most characteristic organs of the genus, are four in number, and protrude from or can be retracted into the anterior surface of the head. Each consists of three parts:—(1) the toothed portion is the most anterior; it is shaped like a long narrow glove-finger, like which it is invaginable; on its external surface it bears rows of hooks, closely set in diagonal lines (fig. 5, C); there are two forms of these: those which are directed outwards are large triangular hooks, with apices pointing backwards, whilst those situated on that surface of the proboscis which is turned towards the other proboscides are fine, delicate, and curved; between the hooks are fine chitinous hairs; (2) the membranous sheath is firmly attached where the general surface of the body passes over into the toothed portion around the orifice of the invagination; it consists of a thick homogeneous transparent skin, apparently an excretion of cells lining the cavity of the proboscis; (3) the muscular portion is the most posterior of all, and is composed of six layers, remarkable as containing striped muscular fibres; throughout all these three portions of the proboscis there extends a retractor muscle. The action of these various structures is not thoroughly understood, but it is probable that the proboscis is protruded by the action of the last-named muscular sheath, whilst it is retracted, after the relaxation of this, partly by the retractor muscle and partly by the pressure of the surrounding medium.

The family *Tæniadæ* is usually described as containing only the one genus *Tænia*, but, owing to the number and variety of its species, of which more than 350 have been described, it has been subdivided into groups, regarded by different authors as genera or subgenera. The subjoined arrangement is mainly that of Leuckart. It labours under the disadvantage that its chief divisions are based upon the bladder-worm or larval stage, which is only known in the case of comparatively few species.

- I. *Cystici* (cystic tape-worms).—Head rarely unarmed; usually provided with a rostellum and with one or more rows of hooks; proglottides longish oval when mature; uterus with median stem and lateral branches; the larva has a caudal bladder containing fluid.
  - 1. *Cystotænia*, Leuckart.—The head arises in the wall of the embryonic bladder.
    - a. *Tænia saginata*, Göze.—Without hooks (= *T. mediocanellata*, Küchenmeister, = genus *Tæniarhynchus*, Weinland).
    - b. *Tænia solium*, Rudolphi.—Head with a double circlet of hooks.
    - c. *Tænia acanthotrias*, Weinland.—Head with a triple circlet of hooks (= genus *Acanthotrias*, Weinland).
  - 2. *Echinococcifer*, Weinland.—The heads arise in special brood-capsules. *Tænia echinococcus*, V. Siebold.
- II. *Cystoidei* (ordinary tape-worms).—The larva has no distended caudal bladder containing fluid.
  - 1. *Hymenolepis*, Weinland.—Proboscis with a single row of small hooks. *Tænia nana*, V. Siebold, *T. flavopunctata*, Weinland.
  - 2. *Dipylidium*, Leuckart.—Head with several rows of hooks, each with a discoidal base; a right and left set of genital organs in each joint, the uterus, however, being single and common to the two. *Tænia cucumerina*, Rudolphi (= *T. elliptica*, Batsch).

Hamann (2) has recently proposed a new genus, *Ptychophysa*, for *Tænia lineata*, Göze, which is defined by the following characters:—(1) the porus genitalis is on the surface and not on the margin of the joints; (2) the vaginal opening is anterior to that of the cirrus; (3) at a certain period the uterus is convoluted; (4) there is a peculiar shell-gland. In many of these characters the species shows a resemblance to the *Bothriocephalidæ*.

Occurrence in Man.—The Cestodes which in the adult state infest man, with their corresponding larvæ and temporary hosts, are as follows:—

Tænia saginata.	*Cysticercus bovis.*	Ox.
T. solium.	*C. cellulosæ.*	Pig, man.
T. nana.	(?)	(?)
T. flavopunctata.	(?)	(?)
T. madagascariensis.	(?)	(?)
T. cucumerina.	*C. T. cucumerinæ.*	*Trichodectes canis.*
Bothriocephalus latus.		Pike, burbot.
B. cristatus.		(?)
B. cordatus.		Fish (?)

Other species, however, inhabit the human body in their larval condition; a list of them, with the corresponding adult forms and permanent hosts, is subjoined:—

Cysticercus cellulosæ.	*Tænia solium.*	Man.
C. acanthotrias.	*T. acanthotrias* (incog.)	(?)
C. tenuicollis.	*T. marginata.*	Dog, wolf.
Echinococcus.	*T. echinococcus.*	Dog.

Phylogeny.—There can be no doubt that the Cestodes and Trematodes are intimately related and have sprung from a common ancestor; there are so many structural peculiarities in which they agree (compare TREMATODES), and they are connected by so many intermediate forms, that their affinity can admit of no doubt. According to Leuckart, the original ancestor of both was probably allied to the Planarians, while Huxley (22, pp. 213, 676) points out that it is at all events possible that they have no connexion with free forms but have always been anenterous, and in fact are nothing but "gigantic morulæ, so to speak, which have never passed through the gastrula stage."

Bibliography.—(1) Leuckart, *Die Parasiten des Menschen*, Leipsic, 1863-76; 2d ed. 1879-86; Eng. transl., *The Parasites of Man*, 8vo, Edinburgh, 1886. (2) Hamann, *Zeitschr. f. wiss. Zool.*, xlii., 1885. (3) Zenker, in *Ziemssen's Cyclop. of Prac. Med.*, iii. (4) Küberlé, *Des Cysticerques des Tænias de l'Homme*, Paris, 1861. (5) Graefe, *Archiv f. Ophthalmologie*, xii., 1874. (6) Niemiec, *Rec. Zool. Suisse*, ii., 1885. (7) Lang, *Mitth. Zool. Stat. Neapel*, ii., 1881. (8) Fraipont, *Archives de Biol.*, i., 1880, ii., 1881. (9) Pintner, *Arb. Zool. Inst.*, iii., Vienna, 1881. (10) Steudener, *Abhandl. naturf. Gesellsch.*, xiii., Halle, 1877. (11) Wagener, *Nova Acta Cæs. Leop.-Carol. Acad.*, xxiv., Suppl., 1854. (12) Riehm, *Correspbl. d naturw. Ver. f. Sachsen u. Thuringen*, 1882. (13) P. J. Van Beneden, "Vers Cestoïdes," *Mém. Acad. Bruxelles*, xxv., 1851, and "Vers Intestinaux," *Comptes Rendus*, Paris, Suppl., ii., 1861. (14) Ed. Van Beneden, *Archives de Biol.*, ii., 1881. (15) Raum, *Beitr. zur Entwickelungsgesch. der Cysticercen*, Dorpat, 1883. (16) Villot, *Rev. Sci. Nat. Montpellier*, Sept. 1882, 1883. (17) Virchow, *Verhandl. Würzb. phys.-med. Gesellsch.*, vi., 1856. (18) Salensky, *Zeitschr. f. wiss. Zool.*, xxiv., 1874. (19) Pallas, *Neue nordische Beiträge*, i., ii., 1781. (20) Diesing, *Systema Helminthum*, 8vo, Vienna, 1850. (21) Linstow, *Comp. der Helminthologie*, 8vo, Hanover, 1878. (22) Huxley, *Anat. Invertebr. Anim.*, 8vo, London, 1877. (23) Plater, *Opus Praxeos Medicæ*, 1601. (24) Andry, *An Account of the Breeding of Worms in Human Bodies*, 8vo, London, 1701 (transl.). (25) Bremser, *Ueber lebende Würmer im lebenden Menschen*, 4to, Vienna, 1819. (26) Burdach's *Physiologie*, ii., Leipsic, 1828. (27) Eschricht, *Nova Acta Cæs. Leop.-Carol. Acad.*, xix., Suppl., 1841. (28) Steenstrup, *On the Alternation of Generations*, Ray Society, 8vo, London, 1845. (29) Küchenmeister, *Animal Parasites*, Sydenham Society, 8vo, London, 1857; new German ed., Leipsic, 1880-81. (30) Linstow, *Archiv f. Naturgesch.*, 1872 *sq.* (31) Sommer, *Zeitschr. f. wiss. Zool.*, xxiv., 1874. (32) Sommer and Landois, *op. cit.*, xxii., 1872. (33) Braun, *Zur Entwickelungsgesch. des breiten Bandwurmes*, Würzburg, 1883. (34) Perrier, *Arch. de Zool. Exper.*, ii., 1873. (35) Rudolphi, *Entozoorum Hist. Nat.*, 8vo, Amsterdam, 1808. (36) Linstow, *Arch. f. Naturgesch.*, 1886, p. 113. For a concise account of the comparative anatomy and copious bibliography, see Jackson, in Rolleston's *Forms of Animal Life*, 2d ed., Oxford, 1887. (W. E. HO.)

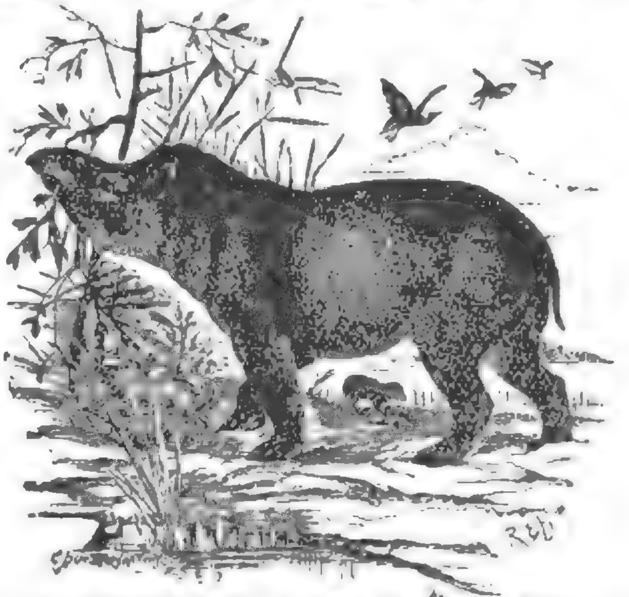
TAPIOCA is a farinaceous food substance prepared from cassava starch, the product of the large tuberous roots of the cassava or manioc plant, *Manihot utilissima* (*Jatropha manihot*), native of Brazil (see CASSAVA, vol. v. p. 182, and comp. ARROWROOT, vol. ii. p. 631, fig. 6). Cassava starch, being separated from the fibrous and nitrogenous constituents of the roots, is in a moist condition spread upon iron plates, and with constant stirring exposed to such heat as causes a partial rupture of the starch granules, which agglomerate into irregular pellets, becoming hard and translucent when cooled. In this partly torrefied condition the starch forms the tapioca of commerce, a light, pleasant, and digestible food, much used in puddings and as a thickener for soups. The French prepare an artificial tapioca from potato starch, mixed with various vegetable substances, for use in soups, &c., which is found in the market under such names as tapioca Crecy, tapioca Julienne, &c., according to the dried vegetables with which the preparations are made.

TAPIR. The general characters of the animals of the perissodactyle or odd-toed section of the hoofed mammals are described under MAMMALIA, vol. xv. p. 427. This once numerous group is at present represented by only three rather isolated families, the Horses, Rhinoceroses, and Tapirs. The last of these have retained much more of the original characters of the primitive Ungulates of the Eocene period than the others, and have indeed remained practically almost unchanged since the Miocene period, while almost all other mammalian forms which existed then have either become extinct or undergone extensive modification. The tapirs constitute the single genus, *Tapirus*, of the family *Tapiridæ*.

The dentition is $i\,\frac{3}{3}$, $c\,\frac{1}{1}$, $p\,\frac{4}{4}$, $m\,\frac{3}{3}$; total 42. Of the upper incisors, the first and second are nearly equal, with short, broad crowns; the third is large and conical, considerably larger than the true canine, which is separated from it by an interval. Lower incisors diminishing in size from the first to the third; the canine, which is in contact with the third incisor, large and conical, working against (and behind) the canine-like third upper incisor. In both jaws there is a long interspace between the canines and the commencement of the teeth of the molar series, which are all in contact. First upper premolar with a triangular crown, narrow in front owing to the absence of the anterior inner cusp. The other upper premolars and molars all formed on the same plan and of nearly the same size, with four roots and quadrate crowns, rather wider transversely than from before backwards, each having four cusps, connected by a pair of transverse ridges, anterior and posterior. The first lower premolar compressed in front; the others composed of a simple pair of transverse crests, with a small anterior and posterior cingular ridge.

Skull elevated and compressed. Orbit and temporal fossa widely continuous, there being no true post-orbital process from the frontal bone. Anterior narial apertures very large, and extending high on the face between the orbits; nasal bones short, elevated, triangular, and pointed in front. Vertebræ: C 7, D 18, L 5, S 6, C about 12. Limbs short and stout. Fore feet with four toes, having distinct hoofs: the first is absent, the third the longest, the second and fourth nearly equal, the fifth the shortest and scarcely reaching the ground in the ordinary standing position. Hind feet with the typical perissodactyle arrangement of three toes,—the middle one being the largest, the two others nearly equal. Nose and upper lip elongated into a flexible, mobile snout or short proboscis, near the end of which the nostrils are situated. Eyes rather small. Ears of moderate size, ovate, erect. Tail very short. Skin thick and but scantily covered with hair.

The existing species of tapir may be grouped into two sections, the distinctive characters of which are only recognizable in the skeleton. (A) With a great anterior prolongation of the ossification of the nasal septum (mesethmoid), extending in the adult far beyond the nasal bones, and supported and embraced at the base by ascending plates from the maxillæ (genus *Elasmognathus*, Gill). Two species, both from Central America, *Tapirus bairdi* and *T. dowi*. The former is found in Mexico, Honduras, Nicaragua, Costa Rica, and Panama; the latter in Guatemala, Nicaragua, and Costa Rica. (B) With ossification of the septum not extending farther forward than the nasal bones (*Tapirus* proper). Three species, *T. indicus*, the largest of the genus, from the Malay Peninsula (as far north as Tavoy and Mergui), Sumatra, and Borneo, distinguished by its peculiar coloration, the head, neck, fore and hind limbs being glossy black, and the intermediate part of the body white; *T. americanus* (*T. terrestris*, Linn.), the common tapir of the forests and lowlands of Brazil and Paraguay; and *T. roulini*, the Pinchaque tapir of the high regions of the Andes. All the American species are of a nearly uniform dark brown or blackish colour when adult; but it is a curious circumstance that when young (and in this the Malay species conforms with the others) they are conspicuously marked with spots and longitudinal stripes of white or fawn colour on a darker ground.



American Tapir, from a living specimen in the London Zoological Gardens.

The habits of all the kinds of tapirs appear to be very similar. They are solitary, nocturnal, shy, and inoffensive, chiefly frequenting the depths of shady forests and the neighbourhood of water, to which they frequently resort for the purpose of bathing, and in which they often take refuge when pursued. They feed on various vegetable substances, as shoots of trees and bushes, buds, and leaves. They are hunted by the natives of the lands in which they live for the sake of their hides and flesh.

The singular fact of the existence of so closely allied animals as the Malayan and the American tapirs in such distant regions of the earth and in no intervening places is accounted for by what is known of the geological history of the race, for, if we may judge from the somewhat scanty remains which have been preserved to our times, consisting chiefly of teeth, the tapirs must once have had a very wide distribution. There is no proof of their having lived in the Eocene epoch, but in deposits of Miocene and Pliocene date remains undistinguishable generically and perhaps specifically from the modern tapirs (though named *T. priscus*, *T. arvernensis*, &c.) have been found in France, Germany, and in the red crag of Suffolk. Tapirs appear, however, to have become extinct in Europe before the Pleistocene period, as none of their bones or teeth have been found in any of the caves or alluvial deposits in which those of elephants, rhinoceroses, and hippopotamuses occur in abundance; but in other regions their distribution at this age was far wider than at present, as they are known to have extended eastward to China (*T. sinensis*, Owen) and westwards over the greater part of the southern United States of America, from South Carolina to California. Lund also distinguished two species or varieties from the caves of Brazil. Thus we have no difficulty in tracing the common origin in the Miocene tapirs of Europe of the now widely separated American and Asiatic species. It is, moreover, interesting to observe how very slight an amount of variation has taken place in forms isolated during such an enormous period of time. (W. H. F.)

TAR is a product of the destructive distillation of organic substances. It is a highly complex material, varying in its composition according to the nature of the body from which it is distilled,—different products, moreover, being obtained according to the temperature at which the process of distillation is carried on. As commercial products there are two principal classes of tar in use—(1) wood tar, the product of the special distillation of several varieties of wood, and (2) coal tar, which is primarily a bye-product of the distillation of coal for the manufacture of illuminating gas. These tars are intimately related to the bitumen, asphalt, mineral pitch, and petroleum obtained in very many localities throughout the world.

Wood Tar.—Wood tar, known also as Stockholm and as Archangel tar, is principally prepared in the great pine forests of central and northern Russia, Finland, and Sweden. The material chiefly employed is the resinous stools and roots of the Scotch fir (*Pinus sylvestris*) and the Siberian larch (*Larix sibirica*), with other less common fir-tree roots. A large amount of tar is also prepared from the roots of the swamp pine (*P. australis*) in North and South Carolina, Georgia, and Alabama, in the United States. In the distillation of wood a series of products, including gas, tar, pyroligneous acid and wood spirit, and charcoal may be obtained, and any of these may be the primary object of the operation. When tar is the substance sought, the ancient and crude method of working is yet largely adopted in the north of Europe. The wood to be treated is closely piled up into a huge conical stack or pile on an elevated platform, the sole of which is covered with clay and tiles. The sole slopes inwards from every side to the centre, where an opening communicates with a vaulted cavity under the elevated platform. The pile of wood is closely covered over with layers of turf and earth or sand to a depth of several inches, but leaving at first near the bottom numerous apertures for the admission of air to promote ignition. The pile is ignited from below, and as the fire spreads through the heap the various apertures are closed up and a slow smouldering combustion goes on for some days till, by the sinking of the pile, the top of the stack falls in, and a bright flame springs up at that point. About ten days after ignition tar first begins to flow, and it is at once collected into barrels. According to the size of the pile, the distillation may continue several weeks, the tar secured amounting to about 17·5 per cent. of the wood operated on. In this method several valuable products—the gas, the crude pyroligneous acid, and much charcoal—are lost or wasted; and a more economical process of treating the wood in closed stills or retorts is now largely used in Russia, the gas evolved serving as fuel under the retorts. The heavier tar products of the distillation collect at the bottom of the retort, whence they are carried off by a pipe to a receiver; the volatile portion passes off at the upper part of the retort, and is separately condensed, the lightest portion passing through a worm condenser. From treatment in close retorts resinous roots yield from 16 to 20 per cent. of tar, with some oil of turpentine and pyroligneous acid.

Wood tar is a semi-fluid substance, of a dark brown or black colour, with a strong pungent odour and a sharp taste. Owing to the presence of acetic (pyroligneous) acid, which is a collateral product, it has an acid reaction; it is soluble in that acid, as well as in alcohol and the fixed and essential oils, &c. Tar consists essentially of a mixture of homologous hydrocarbons, and by redistillation it can be fractionated into a series of bodies having fixed boiling points. Some varieties of tar have a granular appearance, from the presence of minute crystals of pyrocatechin, which dissolve and disappear on heating the substance. Pyrocatechin dissolves freely in water, and to it the tar water (*liquor picis*) of pharmacy probably owes its value.

Crude tar from retorts, when submitted to redistillation, gives off wood spirit (methyl-alcohol), and then acetic (pyroligneous) acid, and finally, on forcing the heat, pitch oil is driven off. The residuum left in the still hardens into a solid vitreous mass, which forms the black pitch of commerce. Tar and pitch are most largely used as protective coatings for woodwork and other materials much exposed to water and the weather. Thus tar is of great value in connexion with shipbuilding and shipping generally. A considerable quantity is used in manufacturing tarred ropes, and in the "smearing" of highland sheep to afford a protection against the weather. Pitch also is the basis of the Berlin black or Brunswick black used for coating cast-iron goods and for "japanning" preparations.

Coal Tar.—The art of distilling coal for the production of tar was discovered and patented by the earl of Dundonald in 1787, and till the general introduction of coal gas some amount of coal was yearly distilled in Scotland for the production of coal tar. The demand for the substance was limited, it being principally used for coating iron castings and smith work, for making an inferior lamp black, and as a source of a solvent oil. With the extensive use of coal gas the necessity for this separate distillation ceased, and soon tar was produced in the manufacture of gas in quantities that could not be disposed of. It was burned up for heating gas-retorts; it was mixed with coal dust, sawdust, &c., for making patent fuel; and it was distilled for producing a series of hydrocarbon oils, heavy tar, and pitch; but it was only after the discovery and introduction of "tar-colours" that the substance came for some time to be really valuable. Since that time its price has fluctuated greatly; and in the United Kingdom alone there are now distilled annually about 10,000,000 tons of coal for gas-making, producing 120,000,000 gallons of crude tar,—a quantity greatly in excess of the ordinary demand.

If wood be distilled slowly at low temperatures, the gases consist chiefly of carbonic oxide and carbonic acid, mixed with only very little of carburetted hydrogens, and consequently little luminous on combustion; the watery part of the tar includes relatively much of methyl-alcohol, acetone, and acetic acid; the oily part of the tar (tar proper) has a certain proximate composition characteristic of this mode of distillation. Our present knowledge in regard to this last-named point is very incomplete: of definite species the following have been discovered:—

(1) Phenol, $C_6H_5\,OH$ (synonym carbolic acid).
(2) Cresol, $(C_6H_4.CH_3)OH$.
(3) Phlorol, $(C_6H_4.OH)C_2H_5$.
(4) Pyrocatechine, $(C_6H_4)(OH)_2$, one of three isomerides.
(5) Guaiacol, $C_6H_4\left\{\begin{matrix}OH\\OCH_3\end{matrix}\right.$, methyl-ester of No. 4.
(6) Homo-pyrocatechine, $\left\{C_6H_3(CH_3)\right\}(OH)_2$.
(7) Creosol, $\left\{C_6H_3(CH_3)\right\}\begin{matrix}OH\\OCH_3\end{matrix}$, methyl-ester of No. 6.

Genuine creosote consists of (1), (2), (5), and (7). In addition, there are numberless bodies which still await scientific definition.

If the distillation of wood is carried out at a very high temperature,—if, for instance, the wood is placed in a relatively large retort previously brought up to a bright red heat and kept at such temperature, or if the vapours produced at a relatively low temperature are passed through intensely heated pipes before reaching the condenser (Pettenkofer's method for producing illuminating gas from wood),—the gas produced contains a considerable admixture of luminiferous hydrocarbons, the proportions of methyl-alcohol, acetone, and acetic acid get less, and the tar proper assumes more of the character of coal-gas tar (see below). Similar observations we make in the case of coal. About 1862 Wigan cannel coal used to be distilled industrially at low temperatures to produce "light oils." Schorlemmer examined these and found them to consist chiefly of "paraffins" (see PARAFFIN) from C_5H_{12} upwards. A similar result is obtained with ordinary coal, although in its case the "benzols" are more largely represented. If we distil any kind of coal at high temperatures—*i.e.*, in the way customary for illuminating-gas making—the distillable part of the tar proper consists chiefly of benzene, C_6H_6, and benzene-derivatives, *i.e.*, benzols, $C_6H_6 + nCH_2$; phenols, C_6H_6O, and homologues, $(C_6H_5.nCH_2)OH$; amido-bodies, $C_6H_5NH_2$ (aniline), and homologues; condensed benzols, such as naphthalene, $C_{10}H_8 = 2C_6H_6 - C_2H_4$; anthracene, $C_{14}H_{10} = 3C_6H_6 - C_4H_8$; chrysene, $C_{18}H_{12} = 4C_6H_6 - C_6H_{12}$, &c. The paraffins then become an altogether subordinate feature.

A great and meritorious research of Berthelot's has thrown considerable light on the chemical mechanism of dry distillation. As found by him, even the most complex of the substances named are producible by the interaction upon one another of a few bodies of very simple constitution, or even one or other of these by the mere action of a high temperature. To give a few examples. Marsh-gas, CH_4, when passed through red-hot tubes, yields olefines, C_2H_4, C_3H_6, C_4H_8, &c., with elimination of hydrogen, H_2. The same CH_4, if subjected to a spark-current (*i.e.*, local application of intense heat), yields acetylene and hydrogen, $2CH_4 = C_2H_2 + 3H_2$, and the acetylene produced passes partly into benzene, $C_6H_6 = 3C_2H_2$. Ethylene, C_2H_4, when passed through a porcelain tube kept at a moderate red heat, yields benzene, C_6H_6, styrolene = phenyl-ethylene, $C_2H_3.C_6H_5$, naphthalene, $C_{10}H_8$, and perhaps also its hydride, $C_{10}H_{10}$. Acetylene, *qua* potential benzene, and ethylene yield styrolene and hydrogen, $C_6H_6 + C_2H_4 = C_6H_5.C_2H_3 + H_2$; and styrolene plus ethylene yields hydrogen and naphthalene, $C_{10}H_8$.

Benzol at a high temperature loses hydrogen, and, so to say, doubles up into di-phenyl, $C_{12}H_{10}$; and this latter, when heated with ethylene, yields anthracene, $C_{14}H_{10}$, and hydrogen, $C_{12}H_{10} + C_2H_4 = C_{14}H_{10} + 2H_2$. Conversely, hydrogen may, so to say, turn out its equivalent of a hydrocarbon; thus, for instance, chrysene, $C_{18}H_{12} + 2H_2$, yields di-phenyl, $C_{12}H_{10}$, + benzene, C_6H_6.

Pyrogenic reactions generally are reversible; thus, any of the following three equations is correct, whether we read it from the left to the right or from the right to the left:—

(1) C_2H_6 (ethane), at a red heat becomes $C_2H_4 + H_2$.
(2) $C_{12}H_{10} + C_6H_6 = C_{18}H_{12} + 2H_2$.
(3) $C_{14}H_{10} + 2H_2 = 2C_6H_6 + C_2H_2$.

Hence no single pyrogenic reaction goes to the end; if it does not, so to say, check its own progress, other secondary reactions set in and do so, the general result being that ultimately, but in general slowly, a state of dynamic equilibrium is attained in which a set of synthetic reactions on the one hand and a set of analytic reactions on the other compensate one another.

Industrial Working of Coal Tar.[1]—Coal tar, as it comes from the gas-works, is used for a variety of purposes, such as—(1) for fuel, the tar being made into a spray by means of a steam-injector, and the spray kindled; (2) for the preservation of building materials, porous stones, and bricks, &c.; (3) for making roofing-felt (in 1868, five-sixths of the 9000 tons of tar produced at the Berlin gas-works was thus utilized; the case, however, is different now); (4) for making a low quality of lamp-black. At present, however, most of the tar produced, in centres of industry at least, is worked up by distillation. The tar as it comes from the gas-works is allowed to rest in a "pond" until the tar-water (solution chiefly of ammonia and certain ammonia salts) has gone to the top. The tar proper is then pumped into a large wrought-iron still (of upright-cylinder form preferably) and therein subjected to distillation over a naked fire. A necessary preliminary, however, is the removal of the unavoidable remnant of water, which is best effected by cautiously heating the tar in the still so as to render it more fluid and enable the water to rise to the top and then letting the upper stratum run out by an overflow tap at the side. The distillation is then started. It involves the formation of two sets of volatile products, namely—(1) combustible gases (including sulphuretted hydrogen and bisulphide of carbon vapour), which must be led away to avoid nuisance and danger of fire, and (2) a very complex liquid or semi-liquid distillate. This latter is collected in successive fractions, generally in this manner:—(1) as "first runnings," what comes over at temperatures below 105° to 110° C.; (2) as "light oils," at temperatures between 110° and 210° C.; (3) as "carbolic oil," at temperatures between 210° to 240° C.; (4) as "creosote oil," at temperatures between 240° to 270° C.; (5) as anthracene oil, at temperatures above 270°.

In the earlier part of the "first runnings" and light-oil period the condenser must be kept cold; towards the end it must be kept warm to prevent choking by solidified naphthalene. In practice, the operator does not go entirely by the boiling point, but to a great extent by the specific gravity of the distillate, which, in general, increases as the boiling point rises. As soon as a drop of the last runnings floats in water (exhibits the specific gravity 1), the "light oil" is supposed to be over. That the fractionation is not always and everywhere effected in the same way needs hardly be said. If the manufacture of carbolic acid is aimed at, it is best (according to Lunge) to select the fraction 170° to 230° C. for this purpose. Naphthalene boils as high as 217°, yet a deal goes into this carbolic-acid fraction. As soon as naphthalene begins to crystallize out largely (on cooling down a sample of distillate), the carbolic acid may be presumed to be over. What follows next is put aside as creosote oil, until, after the disappearance of the naphthalene, a new solid product, namely, anthracene, begins to show itself. With any tar that contains a remunerative proportion of anthracene, the anthracene oil is the most valuable of the products, as the raw material for the making of artificial alizarins.

Supposing the anthracene to have been extracted as completely as practicable, the residue in the still consists of "hard pitch," a viscid black fluid which on cooling freezes into a fragile solid. In former times more commonly than now "soft pitch" used to be produced by leaving more or less of the anthracene oil and even creosote oil in the still. At the end of the anthracene stage of the distillation it is as well, if not necessary, to help the very high boiling vapour out of the still by means of superheated steam, and to keep the worm at 100° C. to prevent choking. At a German establishment a vacuum is used with great advantage.

We come now to explain briefly how the several fractions are worked up.

The pitch (which we assume to be "hard pitch") must be run off hot through a tap at the bottom of the still and led into a low-roofed and well closed-in "house," because it would take fire in the open air. After it has cooled down sufficiently in the "house," the pitch is run into pitch-holes in front of the house and allowed to freeze there. The depth of pitch in a hole is about 12 inches. The solid pitch is hacked out with pickaxes and sent into commerce. A superior apparatus for the recovery of the pitch, which precludes all danger of conflagration and many inconveniences of the ordinary system, has been devised for the Paris gas-works by Regnault.[2] Lunge found, from many distillations, that tar from the midland counties yields about 65 per cent. of hard pitch.

Hard pitch is used chiefly for making the following. (1) *Asphalt.*—The pitch is fused up—perhaps in the still which produced it—with the requisite proportion of creosote and anthracene oil, previously freed from their valuable components. Such asphalt is used for street-paving, *i.e.*, filling up the spaces between the paving stones, and, in admixture with sand and generally more or less of natural asphalt, for the making of footpaths and floorings generally. In Germany it serves for the making of pipes for conveying acid liquids in works and chemical laboratories, &c. Endless hemp-paper is soaked in liquefied asphalt and wound spirally around an iron core, previously smeared over with soft soap, in about 100 layers. The whole is then exposed to strong pressure while still hot, and is separated from the core after being allowed to cool. Such pipes stand almost any kind of acid, but they must not be used for hot liquids. (2) *Varnishes.*—The pitch is dissolved in suitable tar oils,—creosote oil for a lower and light oil for a higher quality. (3) *Coke.*—In former times more frequently than now pitch was made into coke by transferring it to a special flat still and distilling as long as any volatile products came off. The coke which remains is a very pure and consequently valuable fuel. (4) *Lamp Black* (as a last resource, if no other mode of utilization is practicable).—The pitch is subjected to partial combustion on hot iron plates and the smoke conveyed into chambers to deposit its carbon. The yield is about 40 per cent.

Anthracene Oil.—The oil is allowed to stand cold for a week or so until the anthracene has crystallized out as completely as possible. The mother-liquor is then eliminated, the bulk by means of a filter-press, the rest, at a higher than the ordinary temperature, by hydraulic pressure. The crude product includes far more than half its weight of impurities—phenanthrene, paraffin, naphthalene, &c. To remove these as far as possible, the crude anthracene is ground up and treated with petroleum spirit (boiling at 70° to 100° C.) or coal tar naphtha (120° to 190°), in which real anthracene is relatively insoluble. The insoluble part is separated by filtering arrangements and presses (so constructed as to avoid danger of fire), and at last sublimed, more with the view of bringing it into a customary convenient form than with the object of effecting further purification. Such final anthracene may contain 50 to 65 per cent. of pure substance. The only reliable method for determining its strength is to convert a known weight into anthraquinone, $C_{14}H_{18}O_2$, by boiling it with a glacial acetic acid solution of chromic acid, separating out the quinone by diluting with water, collecting and weighing the product. One part of quinone corresponds to 0·8558 of anthracene.

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[1] For wood tar, see WOOD SPIRIT and VINEGAR.

[2] It is described in Lunge's *Treatise on the Distillation of Coal Tar*, London, 1882, to which this article is largely indebted.

Creosote Oil is either used as it is for pickling timber, softening of pitch, &c., or else redistilled to extract from it what there is of anthracene oil and carbolic acid oil, which are worked up with the respective principal quantities.

Carbolic Oil.—Assuming this oil to have been collected (as it should be if intended for the making of carbolic acid) between 170° and 230°, the process of extraction is, briefly, as follows. The oil is mixed with a suitable proportion of caustic-soda ley (ascertained by an assay) in an iron vessel at 40° to 50° C. Charles Lowe recommends ley of 1·34 sp. gr., diluted with water to five times its volume. After settling, the aqueous layer is withdrawn into a lead-lined vessel, and the soda supersaturated by sulphuric acid. Crude carbolic acid rises to the top as an oil, and is withdrawn to be sold as such or purified. See CARBOLIC ACID.

Naphthalene abounds in the oil left after extraction of the carbolic acid by caustic soda and in the more volatile fractions of the creosote oil. From these it separates out (not completely), on standing, in crystals. These are collected, best in a filter-press, and then subjected to hydraulic pressure to force out the rest of the mother-liquor. The crude naphthalene thus obtained contains an impurity which causes it to become red on standing in the air. To remove it, the crude product is mixed with 5 to 10 per cent. of vitriol of at least 1·7 sp. gr., at a moderate heat (addition of a little binoxide of manganese is an improvement, Lunge); it is then washed, first with water, then with dilute alkali, and lastly again with water, to be ultimately distilled or sublimed. In the latter case it is obtained in the form of thin colourless plates of great beauty. It fuses at 80° C. and boils at 217° C. Naphthalene is used largely in the making of certain tar colours, such as Manchester yellow, $C_{10}H_6(NO_2)_2$, and the beautiful scarlets and crimsons made by the "farbwerke" in Höchst, Germany; these latter are diazo-compounds derived from β-naphthol, $C_{10}H_7(OH)$. Coal gas, if impregnated at a suitable temperature with naphthalene vapour immediately before issuing from the burner, gains greatly in luminosity. This is the principle of the "albo-carbon" gas lamps.

First Runnings and Light Oil.—These may be said to include all the industrially valuable "benzols" (taking "benzol" as a generic term for benzol or benzene itself and its higher homologues, C_6H_6, C_7H_8, C_8H_{10}, &c.). As the distiller in most cases does not aim at an actual separation of all the individual benzols from one another, but at the production of certain benzol mixtures demanded by the trade, the mode of working may assume a great variety of forms; yet the first aim in all cases is the same, being the elimination of all the *non*-benzol from the given oil or oils. For this purpose the light oil is, as a rule, subjected to a preliminary fractionation over a naked fire to split it up into fractions fit to be worked for (crude) benzol (C_6H_6 and C_7H_8), for carbolic acid (C_6H_6O), and to be incorporated with the creosote oil respectively; the carbolic acid is extracted, and the creosote-oil part put aside, and thus one or more mixtures of "benzols" are obtained.

The first runnings contain the bulk of the benzene, C_6H_6, and a little of its higher homologues, associated, however, with bisulphide of carbon, low-boiling olefines, C_nH_{2n}, traces of carbolic acid, &c. To remove these impurities as far as possible, the oil is thoroughly agitated with concentrated oil of vitriol (which takes up the impurities except the bisulphide of carbon), and the "dirty" acid allowed to settle out. The acid is then withdrawn as neatly as possible, and the residual oil washed, first with water, then with dilute caustic soda, and, lastly, again with pure water. The washed oil then is subjected to a preliminary fractionation by distillation over a naked flame in the "crude benzol still."

The several mixed benzols obtained are subjected finally to a further fractionation in stills worked with steam, to be divided into mixed products known by specific names in commerce. But these we cannot possibly consider here. We will rather give an idea of the way in which the several chemical species (benzene, toluene, &c.) are being isolated in a state of approximate purity to meet the demands of the tar-colour industry. To do so even for one named component by means of ordinary stills would require an endless number of fractional distillations. The work is very materially shortened if, as proposed by Mansfield long ago, we combine the still with an inverted condenser (still-head, dephlegmator), inserted between the still and the worm, and keep that intermediate condenser at a suitable constant temperature, so that all the less volatile part of the vapour is recondensed and sent back to the still. An excellent apparatus of this kind was constructed and worked successfully by Coupier. His apparatus consists of three parts, viz.:—(1) a still heated by means of a coil of close steam pipes; (2) a columnar rectifier—"colonnen-apparat" as the Germans call it,—which communicates with the still, and which is divided into many compartments by horizontal septa so contrived that the vapour in passing from a compartment to the next higher one must bubble through the liquid condensed there from preceding vapour,—an overflow pipe, trapped below by condensate, hindering accumulation of the liquid in any compartment beyond a certain level; (3) a constant temperature still-head, consisting of a succession of communicating ring-shaped tubes, which are immersed in a bath of water or molten paraffin kept at a prescribed constant temperature. Only the most volatile part of the vapour survives as such in the columnar rectifier, the degree of its volatility depending, of course, other things being equal, on the rate at which we distil. This most volatile part suffers partial condensation at the prescribed temperature in the still-head; the condensed parts are sent back to compartments of the "column" by pipes bent into the shape of a U at the point where they join the "column," so as to prevent vapour from entering them. The uncondensed vapour goes to the worm, and is condensed as usual.

To prepare benzene, the still-head is kept at 60° to 70° C. At first a mixture of low-boiling bodies and benzene goes over, which is rejected, but soon pure benzol follows and continues until almost all this component has distilled over. The benzol obtained boils between 80° and 82° C., and consequently is practically pure. In order now to extract the toluene, C_7H_8, we raise the temperature of the still-head to 100° C. A small quantity of a mixture of benzene and toluene follows, which is rejected. After it comes a continuous distillation of almost pure toluene, boiling at 110° to 112° C. In a similar manner (relatively) pure xylene, C_8H_{10}, boiling point 137° to 140°, and tri-methyl-benzene, C_9H_{12}, boiling point 148° to 150°, can be extracted successively; but the process becomes troublesome with anything above toluene on account of the high temperatures involved for still and still-head. Coupier's apparatus is now superseded by other constructions, but they all work on the same principle,—that of the Coffey still, as used for the rectifying of spirit of wine.

Pure benzene, toluene, and xylene are used largely for the manufacture of tar-colours. The following (and other) mixtures are produced directly from the light oil or first runnings:—

(1) 90 per cent. benzol	initial boiling point	82° C.
(2) 50 per cent. benzol	" "	88
(3) "Toluol"	" "	100
(4) Carburetting naphtha	" "	108
(5) Solvent naphtha	" "	110
(6) Burning naphtha	" "	138

No. 4 serves for enriching coal-gas and adding to its luminiferous power, No. 5 for varnishes, No. 6 for feeding primitive lamps used in the open air, where smoke is no objection.

The following percentage table for the tar from the Berlin gas-works (given in *Chemische Industrie* for 1879) gives an idea of the quantitative composition of this most complex material:—

Benzol (including toluol, &c.)	0·80	
Higher benzols	0·60	
Crystallized carbolic acid	0·20	
Cresol for disinfecting purposes	0·30	
Naphthalene	3·70	
		5·60
Creosote oil		24·00
Anthracene (pure)		0·20
Pitch		55·00
Water and loss		15·20

(J. PA.—W. D.)

TARAI, a British district in the Kumáun division of the lieutenant-governorship of the North-West Provinces and Oudh, India, lying between 28° 51′ and 29° 30′ N. lat. and 78° 46′ and 79° 47′ E. long. It contains an area of 938 square miles, and is bounded on the N. by the Khumáun Bhábar, on the E. by Nepál and Pilibhit subdivision of Bareilly district, on the S. by the districts of Bareilly and Moradábád and the native state of Rámpur, and on the W. by Bijnaur. The headquarters of the district are at Naini Tal. Tarai ("moist land") consists of a long narrow strip of country running for about 90 miles east and west along the foot of the Himalayas, with an average breadth of about 12 miles. At its northern edge, where the waterless forest tract of the Bhábar ends, a series of springs burst from the surface, and these, increasing and uniting in their progress, form the numerous streams that intersect the Tarai. The Deoha is the great river of the Tarai proper, and is navigable at Pilibhit. Elephants, tigers, bears, leopards, hyænas, and other wild animals are found in the district. The climate is normally bad, but improvement is gradually following the spread of sanitary measures.

According to the census of 1881 the population was 206,993 (113,315 males and 93,678 females). Hindus numbered 131,966 and Mohammedans 74,982. The only town with a population exceeding 10,000 is Kásipur, with 14,667 inhabitants. The whole tendency of the population is to agricultural and not to urban life.

The total area under crop in 1884–85 was 254,288 acres, of which rice occupied 92,186 acres, wheat 54,627, and other food grains 80,304 acres. There are no manufactures worthy of note, and the chief trade is the export of grain. The gross revenue in 1884–85 amounted to £42,048, the land yielding £35,507. The Tarai came under British rule at the time (1802) when Rohilkhand was ceded to the East India Company. The Government is said to have looked with indifference on this uninviting tract, but since 1831, when the revenue settlements were revised, this reproach has been less deserved. With an improved system of embankments and irrigation in 1851, the formation of the Tarai into a separate district in 1861, and its complete subjection to Kumáun in 1870, the moral and material history of this tract has greatly improved.

TARANTO. See TARENTUM.

TARANTULA. The tarantula (*Lycosa tarantula*) belongs to the mining section of the family *Lycosidæ* or Wolf Spiders. Its cephalothorax is dorsally of a brownish grey colour, whilst the abdomen is more distinctly brown, and marked with either two or three pairs of triangular black spots above the apex of the triangles pointing backwards. One of the most striking specific characteristics of this spider is a large circular black spot which covers the anterior ventral half of the abdomen, the remainder of this surface presenting an ochreous hue. The largest species does not exceed ¾ inch in length. The eight eyes are arranged in three transverse rows, the anterior containing four small eyes, while behind this two pairs of larger eyes are arranged in two rows, the eyes of the hindermost row having between them a wider interval than the first pair.

The tarantula is widely distributed in southern Europe, round the shores of the Mediterranean. It occurs throughout Spain and is found in southern France, and extends into Asia. In Italy it is said to be especially common in Apulia, round the town of Taranto, from which place the name of this spider is usually derived. A species has also been described from northern Africa. It is usually to be found in dry pieces of waste land exposed to the sun. It lives in an underground passage, which it digs for itself and lines with its web. These passages are round in section, and sometimes an inch in diameter, and may extend to a depth of a foot or more below the surface. The tube first descends vertically for some inches, then bends at an obtuse angle, becoming vertical again near its closed end. The tarantula takes up its position at the first bend, where it can command the entrance, on the look-out for prey. In some cases the tube is prolonged above the surface of the earth by the formation of a small funnel, built up of fragments of wood and earth, and lined like the walls of the tunnel by the web. The females show considerable maternal care for their offspring, and sometimes sit upon their egg sacs; and the species, although somewhat fierce and combative amongst themselves, are capable of being tamed.

TARANTISM. The tarantula has given its name to one of those dancing manias which overspread Europe during the Middle Ages. The bite of the spider threw the sufferer into a depressed state of melancholy, accompanied by various nervous disorders. The condition was accompanied by an increased sensibility to the power of music. The excitement of the nervous system amounted in some cases almost to insanity. The symptoms of the patient seem to have varied a good deal with the character of the individual attacked: the most common were a lividity of the body, icy coldness, great depression, nausea, sexual excitement, and loss of sight and hearing. The only means of arousing the sufferer from the lethargy into which he sank was music. Under the influence of this he awoke as it were, and commenced moving rhythmically, then began to dance, and continued increasing the rapidity of the motion until he fell exhausted to the ground. By this means it was considered that the poison of the tarantula was distributed through the system and worked out through the skin. If the music ceased whilst the patient was dancing, he at once sank back into the state of lethargy from which he had been aroused, but when thoroughly exhausted he generally awoke relieved and cured at least for a time. This dancing mania became contagious: one person caught it from another quite independently of the bite of the tarantula, and in this way whole districts became affected. One of the most peculiar characteristics was the attraction that bright pieces of metal, or brilliant pieces of colour, exercis over the imagination of the dancers. This was particularly marke in the later history of the disease. Each sufferer apparently admire one particular hue, the sight of which seemed to cause him th greatest rapture. Red was a very general favourite, though thi colour threw St Vitus's dancers into a frenzy of rage; green yellow, and other colours also had numerous admirers. Othe colours, on the contrary, they detested, and attempted to destro articles of the obnoxious shade.

In marked contrast to the effect produced by hydrophobia tarantism appeared to evoke in its victims an intense longing fo the sea, into which at times they would precipitate themselves at all times they seemed to prefer the vicinity of water, sometime carrying globes of this fluid whilst dancing.

In its origin tarantism appears to have been contemporaneous with the St Vitus's dance of Germany. It first appeared towards the end of the 14th century in Apulia; thence it spread gradually throughout Italy, and reached its height during the 17th century, by which time the dancing manias of the North had already died out. It affected not only inhabitants of the country but foreigners visiting it; age appears to have had no saving influence: children and old people alike commenced dancing at the sound of the tarantella, but as a rule women were more susceptible than men. From the 17th century onwards it has gradually declined, and is now practically unknown, the only relic of it being the graceful dance of southern Italy called the tarantella. The bite of the tarantula is painful but not dangerous, and the real cause of the phenomena described above must be sought in the temporary epidemic prevalence of an hysterical condition.

The *Lycosa tarantula* is figured in *Ann. Sc. Nat.*, 2d ser., iii. Zoologie, 1835.

TARARE, on the Turdine, a manufacturing town of France, and the second most populous in the department of Rhône, is 25 miles north-west of Lyons. Within a circle drawn 25 or 30 miles from the town more than 60,000 workmen are employed, and the value of the textile fabrics produced exceeds £600,000 per annum. Tarlatans are made in Tarare on more than 3000 Jacquard looms. The manufacture of Swiss cotton yarns and crochet embroideries was introduced at the end of last century; in the beginning of the 19th figured stuffs, openworks, and zephyrs were first produced. The manufacture of silk plush for hats and machine-made velvets, which was set up a few years ago, now employs 2900 workmen and 500 girls, the latter being engaged in silk throwing and winding. There are, besides, four or five dyeing and printing establishments, and silk looms working for the Lyons trade. An important commerce is carried on in corn, cattle, linen, hemp, thread, and leather. In 1886 the population was 11,848 (commune 12,980).

Till 1756, when Simonnet introduced the manufacture of muslins from Switzerland, Tarare lay unknown among the mountains. On the old castle to which the town owes its origin may be seen the arms of the family of Albon.

TARASCON, a town of France, in the department of Bouches-du-Rhône, is situated on the left bank of the Rhone, opposite Beaucaire, with which it is connected by a suspension and a railway bridge. It is on the Lyons and Marseilles Railway, 156 miles south of the former town. The church of St Martha, built in 1187–97 on the ruins of a Roman temple, rebuilt in 1379–1449, has a Gothic spire, and many interesting pictures in the interior, which is of fairly pure Pointed architecture. Of the original building there remain a porch, and a side portal with capitols like those of St Trophimus at Arles. The former leads to the crypt, where are the tombs of St Martha and Louis II., king of Provence. The castle, picturesquely situated on a rock, was begun by Count Louis II. in the 14th century and finished by King René of Anjou in the 15th. It contains a turret stair and a chapel entrance, which are charming examples of 15th-century architecture, and fine wooden ceilings. It is now used as a prison. The civil court of the arrondissement of Arles is situated at Tarascon, which also possesses a commercial court, a hôtel de ville, and fine cavalry barracks. Hats, and the so-called Arles sausages, are made here. The population in 1886 was 6647 (commune 9314).

The town wakes up for the fair of Beaucaire and the fête of La Tarasque, the latter in celebration of St Martha's deliverance of the town from a legendary monster of that name. King René presided in 1469, and grand exhibitions of costume and strange ceremonies take place during the two days of the festival. Tarascon was originally a settlement of the Massaliots, built on an island of the Rhone. The mediæval castle, where Pope Urban II. lived in 1096, was built on the ruins of a Roman castrum. The inhabitants of Tarascon preserved the municipal institutions granted them by the Romans, and of the absolute power claimed by the counts of Provence they only recognized the rights of sovereignty. Tarascon played a bloody part in the White Terror of 1815.

TARAXACUM is the name usually applied in medical practice to the common dandelion (*Taraxacum officinale*, Wiggers). The DANDELION (*q.v.*) is a plant of the northern hemisphere, extending to the Arctic regions, and is cultivated in India. The preparations chiefly employed are the fluid extract, the preserved juice of the root, or succus, and the solid extract. The dried and roasted root, mixed with ground coffee, is often sold under the name of dandelion coffee for use as a beverage. The root is most bitter from March to July, but the milky juice it contains is less abundant in the summer than in the autumn. For this reason, the extract and succus are usually prepared during the months of September and October. After a frost a change takes place in the root, which loses its bitterness to a large extent. In the dried state the root will not keep well, being quickly attacked by insects. Externally it is brown and wrinkled, internally white, with a yellow centre and concentric paler rings. It is 2 inches to a foot long, and about ¼ to ½ inch in diameter. The juice when first exuded is bitter and neutral, but on exposure to the air soon acquires an acid reaction and a brown tint, coagulating and depositing a complex substance, to which the name of "leontodonium" has been given. From this deposit a bitter principle, "taraxacin," and an acrid crystalline substance, "taraxacerin," soluble in alcohol, have been obtained, but to which of these the medicinal properties are due is not known. In autumn the root contains about 24 per cent. of inulin, but in summer barely 2 per cent. When the juice has fermented, mannite is found in it. Taraxacum is chiefly employed as a stimulant tonic in hepatic disorders. In some cases it acts as a cholagogue and mild aperient, and in others as a diuretic.

The roots of other Composite plants are sometimes gathered by careless collectors for dandelion, especially that of *Leontodon hispidus* (L.). The root of this plant is tough when fresh, and rarely exudes any milky juice. The flowers, moreover, have feathery pappus, while in the dandelion it is simple.

TARBES, a town of France, chef-lieu of the department of Hautes-Pyrénées, is situated in one of the most beautiful plains of France, on the left bank of the Adour, streams from which are conducted through all parts of the town. The lines of railway from Paris to Pierrefitte and from Toulouse to Bayonne cross here. Among the many gardens and open spaces for which Tarbes is distinguished is the Massey garden (35 acres), given to his native town by a Versailles official of that name, in which his statue faces the town museum, founded by the collector Achille Jubinal. The varied collections include Roman remains, and specimens of the fauna and flora of the Pyrenees. The architecture of the cathedral is heavy and unpleasing, but the cupola of the transept (14th century), the modern glass in the 12th-century apse, and a rose window of the 13th century, in the north transept, are worthy of notice. The Carmelite church has an interesting steeple, and there are the ruins of a chapel and cloister, and Roman remains in the garden of the former episcopal palace, now occupied by the prefecture. The municipal buildings, with the public library (22,000 volumes), the lyceum, the court of justice, and the barracks (which are large and fine) may also be mentioned among the public buildings. The garrison and artillery establishments, the latter associated with an arsenal and large workshops, nave considerable importance. Other industrial establishments are a foundry machine manufactory, felt and woollen factories, and wool and flax spinning mills. Paper, lace, knitted goods, carriages, and leather are also made here, and marble from the Pyrenees is prepared for the market. There are important fairs and markets, particularly for horses, as Tarbes is a well-known centre for a special breed of light horses, its stud being the most important in the south of France. The population of the town was 24,882 in 1886.

Tarbes, a mere *vicus* in the time of Gregory of Tours, rose into importance after the destruction of the ancient Aquitanian town of Turba. The seat of the bishopric was transferred to it about the 9th century, when a castle was also built. Raymond I., towards the middle of the 10th century, rebuilt the town, fortified it, and made it the capital of the county of Bigorre. The English held the town from 1360 to 1406. In 1569 Tarbes was burnt by Montgomery, and the inhabitants were driven out. This happened a second time, but in August 1570 the peace of St Germain allowed the inhabitants to return to the grass-grown streets. Subsequently Tarbes was four times taken and re-taken, and a number of the inhabitants of Bigorre were forced to take refuge in Spain, but in 1594 the members of the League were finally expelled. The English, under Wellington, gained a victory over the French near Tarbes in 1814. Théophile Gautier was born here in 1811.

TARENTUM, or TARAS, now Taranto, a famous Greek city of southern Italy, situated on the north coast of the bay of the same name, at the entrance of the only secure port on the gulf. This port, now called the *Mare Piccolo*, is a bay 16 miles in circuit, landlocked by a low rocky peninsula. The entrance is so narrow that it is crossed by a bridge of seven arches; it was already bridged in Strabo's time. The modern town, in the province of Lecce, which is the see of an archbishop and had in 1881 a population of 26,611, stands on the peninsula, which is now rather an island, the isthmus connecting it with the mainland having been cut through for defence by Ferdinand I. The ancient citadel occupied the same site, but the city in its best days was much larger, traces of the walls being visible about 2 miles from the gates of the modern town. The remains of antiquity are inconsiderable.

Tarentum was a Spartan colony founded about the close of the 8th century B.C. (Jerome gives the date 708) to relieve the parent state of a part of its population which did not possess, but claimed to enjoy, full civic rights. Legend represents these *Partheniæ* (so they are called) as Spartans with a stain on their birth, but the accounts are neither clear nor consistent, and the facts that underlie them have not been cleared up. The Greeks were not the first settlers on the peninsula: recent excavations have brought to light signs of a pre-Hellenic trading-place, and the name of Taras may be older than the colony. To the Greeks Taras was a mythical hero, son of Neptune, and he is sometimes confounded with the œcist of the colony, Phalanthus. Situated in a fertile district, especially famous for olives and sheep, with an admirable harbour, great fisheries, and prosperous manufactures of wool, purple, and pottery, Tarentum grew in power and wealth and extended its domain inland. Even a great defeat by the natives in 473 B.C., when more Greeks fell than in any battle known to Herodotus, did not break its prosperity, though it led to a change of government from aristocracy to democracy. A feud with the Thurians for the district of the Siris was settled in 432 by the joint foundation of Heraclea, which, however, was regarded as a Tarentine colony. In the 4th century Tarentum was the first city of Great Greece, and its wealth and artistic culture at this time are amply attested by its rich and splendid coins; the gold pieces in particular (mainly later than 360) are perhaps the most beautiful ever struck by Greeks (see NUMISMATICS, vol. xvii. p. 637). In the second half of the century Tarentum was in constant war with the Lucanians, and did not hold its ground without the aid of Spartan and Epirote *condottieri*. Then followed war with Rome (281), the expedition of Pyrrhus, and at length, in 272, the surrender of the city by its Epirote garrison (see the details in vol. xx. p. 743 *sq.*). Tarentum retained nominal liberty as an ally of Rome. In the Second Punic War it suffered severely, when it was taken by Hannibal (212), all but the citadel, and retaken and plundered by Fabius (209). After this it fell into great decay, but revived again after receiving a colony in 123 B.C. It remained a considerable seaport, and its purple, second only to that of Tyre, was still valued; but in Strabo's time it had shrunk nearly to the limits of the present town. After the fall of the Western empire it was held from time to time by

Goths, Lombards, and Saracens, but was not finally wrested from Byzantium till Robert Guiscard took it in 1063.

For special literature about Tarentum, see Busolt, *Griech. Gesch.*, i. 206 *sq.*

TARES, or VETCHES. See AGRICULTURE, vol. i. p. 376.

TARGUM (תַּרְגּוּם) in its concrete sense signifies the paraphrastic translation of the Hebrew Scriptures, or parts thereof, into the Aramaic tongue. It has, however, three other meanings:—(1) a translation from any language into another;[1] (2) an interpretation in any language;[2] and (3) the Aramaic portions of certain books of the Bible (notably Daniel and Ezra).[3]

The word is not itself found in the Bible; but the participle *methurgam* (מְתֻרְגָּם) occurs in Ezr. iv. 7. The noun *Targum*, a form similar to TALMUD (*q.v.*), occurs for the first time in the *Mishnah*, both canonical[4] and non-canonical,[5]—the latter being apparently the older source.

Origin.—Although none of the Targums now in our hands are as old as the SEPTUAGINT (*q.v.*), the public use of Targums on Sabbaths, festivals, &c., is very ancient, and indeed their language was for several hundreds of years the sole one understood by the majority of the Jews in Palestine and Babylonia. How the Hebrew people of Judæa came so entirely to unlearn their own Hebrew tongue as to stand in need of an Aramaic translation of their Scriptures need not be dwelt on here (see vol. xi. p. 597 and vol. xxi. p. 648). But an important contrast between the Aramaic and Greek versions deserves particular notice. The use of the Septuagint by the Greek-speaking Jews of Alexandria, Asia Minor, and elsewhere caused those who adopted it to forget entirely their own Hebrew tongue. The Aramaic version (Targum), however, springing from a religious necessity, was the cause of revival of the knowledge of Hebrew, which had been nigh forgotten. It is therefore easy to understand why the Jews in general have shown comparatively little attachment to the Septuagint, whilst they ever ardently revered the Aramaic version, even after the institution of publicly reciting it had ceased.[6] To this day pious Jews privately prepare themselves every Friday for the lessons of the coming Sabbath by reading the weekly portion twice in the sacred text and once in the Targum (שנים מקרא ואחד תרגום).

Former Use of the Targum in Public.—The following rules had to be observed in the reading of the Scriptures at the synagogal service:—

I. As regards the Law (Pentateuch). (1) The private person called to the Law (which chiefly contains halakhic[7] matter) read one verse of it, which the official methurgeman or turgeman (translator) immediately paraphrased; (2) whilst the reader of the Law was not allowed to take his eye off the written scroll, the methurgeman was forbidden, not merely to read out of a written Targum, but even to look into the sacred text;[8] (3) each of these had to wait till the other had quite finished the reading and translation respectively; (4) one was not allowed to raise his voice in a louder key than the other; (5) a certain number of passages, although allowed to be read, were not allowed to be translated; these were—(*a*) such as might reflect unfavourably on a father of a tribe, or on an eminent teacher (T. B., *Megill.*, 25*b*, *Tosaph.*, catchword מעשה); (*b*) such as might encourage the ignorant to think that there was some truth in idolatry; (*c*) such as might offend decency (*Mishnah, Megillah*, iv. 10; *Tosephto*, *ibid*, 35, 37; T. Yer., *ibid.*, iv. 10; and T. B., *ibid.*, leaf 25*b*); (*d*) such as were fixed by the Lord Himself to be read in Hebrew only (as the sacerdotal benediction, Num. vi. 24–26);[9] (6) the translator was neither allowed to give a literal translation nor to add anything that had no foundation in the Divine word; he had to give the spirit of the letter.[10]

II. As regards the Prophets. (1) The person called to read the Prophets (which chiefly contain agadic matter[11]) might read three verses, of which the translator, who might be the reader himself,[12] sought to render the meaning to the best of his ability; (2) the translator was allowed both to read out of a Targum volume and to look also into the book containing the prophetic text; (3) if reader and translator were two different persons they observed the third rule given above for the case of reading the Law; (4) here also certain passages were not allowed to be translated:—(*a*) such as reflected on great men of the Israelite nation; (*b*) such as offend decency; (5) any one sufficiently intelligent might read, and of course paraphrase, the portion from the Prophets.

III. As regards the Hagiographa. The widest range of liberty must have been granted both to reciters and translators, as very scanty mention of any particular provision concerning it is to be found in the Talmuds. The Psalms and the book of Esther are classed together in so far as they may be read and paraphrased even by ten persons (T. B., *Meg.*, 21*b*). For Job and Lamentations, see below.

Duration of this Practice.—The practice of publicly reciting the Targum continued somewhat later than the last of the geonim. Within the last 400 years of that period, however, the power of this ancient institution began to fluctuate, gradually declined, and finally almost—but not entirely[13]—died out. The causes of this were twofold. One was, that after the Mohammedan conquests Arabic supplanted Aramaic as the vernacular, and the Targums thus became unintelligible to the mass (see *Seder Rab 'Amram*, i., Warsaw, 1863, leaf 29*a*), even as was already the case in the Western world. A second and more important cause, however, was the spread of Karaism, whose criticism of the Rabbinic contents of the Targums provoked the Rabbanites to pay more attention to the etymology and grammar of the Hebrew text of the

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[1] Hence תרגום אשכנזי (German translation), &c.

[2] When the word is used in either of these two senses the language into which the translation is made, or in which an interpretation is given, must be specified, or otherwise indicated, *e.g.*, תרגום יוני (Greek translation), תרגום השבעים (Septuagint), תרגם עקילס (Aquila translated), except when it is Aramaic, in which case the language may be named (as in Ezra iv. 7) or not (*Tosephto, Shabbath*, xiii. [xiv.] 2).

[3] Compare *Mishnah*, *Yadayim*, iv. 5.

[4] See last note.

[5] *Siphere* (see vol. xvi. p. 507) on Deuteronomy (Pericope *Shophetim*), *Pisko* 161.

[6] "Let not the Aramaic be lightly esteemed by thee," says the Jerusalem Talmud, "seeing that the Holy One (blessed be He!) has given honour to it in the Pentateuch (Gen. xxxi. 47), in the Prophets (Jer. x. 11), and in the Hagiographa (Dan. ii. 4)," (*Sotah*, vii. 2). Instead of "Arammi" (Aramaic) the *Midrash Rabbah* on Genesis reads "Parsi" (Persian); the reading here is "Sursi" (Syriac).

[7] See MISHNAH, vol. xvi. p. 503.

[8] This was done to prevent its being thought that the Targum (the exponent of the oral Law) was to be found in writing in the Pentateuch (the exponent of the written Law).

[9] The Babylonian Talmud (*Megillah*, 25*b*) says that the priestly benediction was not to be recited in Aramaic on account of the phrase "the LORD shall lift up His countenance upon thee," which would appear as if the Lord had been a respecter of persons. In Talmudic times they had apparently, in Babylonia, lost the real reason of the Mishnic prohibition, which is that this benediction is doubly, yea, trebly Divine, being framed in its every word by God Himself, and can thus only be recited in those very words (כה, thus; Num. vi. 23). See *Mishnah*, *Sotah*, vii. 2; T. Yerushalmi, *ibid.*, and *Megillah*, iv. 11, and, finally, *Bemidbar Rabbah*, cap. xi. *in medio*.

[10] See *Tosephto*, *Megillah*, iv. *in fine*.

[11] See MIDRASH, vol. xvi. p. 285.

[12] Thus Jesus (Luke iv. 16–27) no doubt read the *Haphtarah* (prophetic portion) himself, and paraphrased it himself. From this custom of reading and paraphrasing by one and the same person the sermon (דרשה) sprang. The passage in question (Isa. lxi. 1, &c.) was read on the Sabbath before the New Year (day of memorial).

[13] Long after the institution of publicly reciting the Targum on the Law had generally declined, it was yet retained in Germany and Italy on certain days of the three high festivals, viz., (*a*) the seventh day of Passover, (*b*) the first day of Pentecost, and (*c*) the last day attached to the festival of Tabernacles (*i.e.*, שמחת תורה). The passages so recited were—(*a*) parts of the lesson for the day—the song of Moses and the children of Israel, with the introduction; (*b*) the Decalogue in Exodus; (*c*) the last portion of Deuteronomy. In the first case the paraphrase was from the three Targums mixed, in the second from the Targum Yonathan with deviations, in the last from the Targum Onkelos. (These pieces are interspersed with sundry bits of poetry; see Camb. MS. Add. 374, leaves 169*a*–171*b*, 199*a*–203*a*, 423*b*–427*b*.) Towards the end of the 14th century, as regards Passover and Pentecost, the custom fell into desuetude, but down to our own days some of the congregations of Italy continue the usage of reciting the Targum Onkelos in connexion with the narration of the death of Moses. This custom, however, is now rapidly dying out. As regards the recitation of the Targum on the Prophets, a small remnant of the congregations following the rite of Rome (*i.e.*, the so-called *Italiani*) continue it to this day on the festival of Passover. For the use of the Targum on Pentecost, see *Responsa*, by R. Meir of Rothenburg (ROSH, *q.v.* footnote 3), No. 59.

Bible. Thus the Targums, both in their periods of vigour and decay, exercised, directly and indirectly, a salutary influence. In each case the knowledge of Hebrew was promoted; and it advanced so much, that by 1000 A.D. the Jews of Irak, like those of the rest of the world then, and as in our own days, certainly knew the pure Hebrew better than the Aramaic idiom. The same was the case in other Arabic-speaking parts, as Spain, Africa, &c.,—Yemen then and still forming a solitary exception.[1]

Authorship and Age of the Various Targums.—The Targums on the various books of the Bible are not merely by various authors, but also of various ages. They have only one thing in common,—all of them rest on oral traditions, which are hundreds of years older than the earliest form of the written Targums now in our hands. We enumerate them according to Biblical order, although that is not necessarily the chronological order in which they were either composed or committed to writing.

I. *The Pentateuch.*—(*a*) There is a complete Targum known as *Onḳelos* (אונקלוס, אנקלס, אונקילוס). The person and even the name of Onḳelos have been for the last three hundred years a *crux criticorum.*

According to the Babylonian Talmud, *Megil.*, 3*a*, "Onḳelos (son of Calonicus, *Gitt.*, 56*b*, or of Calonymus, '*Ab. Zar.*, 11*a*), the proselyte, composed the Targum on the Pentateuch (אֲמָרוֹ) out of the mouth of R. Elî'ezer and R. Yehoshua'," who taught in the 1st and 2d centuries. In the Jerusalem Talmud, *Meg.*, i. 9, the same thing is related on the same authorities, and almost in the same words, of the proselyte Aquila (Akylas) of Pontus, whose Greek version of the Bible was much used by Greek-speaking Jews down to the time of Justinian (*Nov.*, cxlvi. cap. 1).[2] There are other parallels between what *Tosephto* and the Babylonian Talmud tell of Onḳelos and what the Jerusalem Talmud and the Midrash tell of Aquila. Both throw their idolatrous inheritance into the Dead Sea (*Tos.*, *Demai*, vi. 12; T. Y., *Demai*, vi. 10), and both have connexions with Roman emperors, Onḳelos being sister's son of Titus (*Gittin*, 56*b*), and Aquila of Hadrian (*Midr. Tanḥ.*, *Mishpatim*; see, also, for Onḳelos, '*Ab. Z.*, 11*a*, and for Aquila's connexion with Hadrian, T. Y., *Hag.*, ii. 1; *Shem. Rab.*, xxx.; Epiphanius, *De Mens. et Pond.*, xiv. *sq.*). From these facts some (see N. Adler, *Nethinah lagger*, in the Vilna Pent., 1874, Introd.) still argue that Onḳelos is but another name for Aquila, and that the Greek translator also wrote our Targum. This view was long ago refuted by R. 'Azaryah de' Rossi,[3] and is quite untenable. It is incredible that Aquila or any other Greek could have had the mastery of Aramaic and of traditional lore as well as of Hebrew which the Targum displays; and the phrase of T. Y., '*Megil.*, i. 9, "an untutored person picked out for them Aramaic from the Greek," is quite inapplicable to Onḳelos, and ought to be taken as referring to the Peshito Syriac, which is admittedly dependent on the LXX. In a Jewish writing "for them"—set absolutely—means "for the Christians." The view now accepted by most critics is that the word Onḳelos is a Babylonian corruption of Akylas, but that the name "Targum Onḳelos" originally meant no more than "Targum in the style of Aquila," *i.e.*, bearing to the freer Palestinian Targums a similar relation to that of Aquila's version to the Septuagint.[4] On this view there never was a real person called Onḳelos. But how Akylas (עקילס; in *Ber. Rab.*, i. middle, אקילוס or אקילין, *i.e.*, אקילין) could be corrupted into Onkelos has not been satisfactorily explained; and, besides the traditions about Onḳelos which resemble what is known about Aquila, there are others, and these older than either *Gemara*, which have no such resemblance, and assign to him an earlier date, associating him with R. Gamliel the elder, the teacher of St Paul (*Tosephto, Shab.*, vii. [viii.] 18; *Hag.*, iii. 2, 3; *Kel. Bab. Bath.*, ii. 4; *Mikv.*, vi. 3; Talmud B., '*Ab. Zar.*, 11*a*; *Mas. Semaḥ.*, viii. init.). The *Zohar* (iii. leaf 73*a* of the small ed.) ascribes his being circumcised to Hillel (R. Gamliel's grandfather) and Shammai. These notices, it is true, do not speak of Onḳelos as a targumist; and, indeed, the Targum being a representative piece of the oral law was certainly not written down, private notes (*megilloth setharim*) excepted, before the *Mishnah*, *Tosephto*, &c., *i.e.*, till about the end of the 6th or the beginning of the 7th century. But in the opinion of the present writer this need not prevent us from recognizing Onḳelos as a corrector and compiler of oral Targum in the 1st century. As regards the name, it may be suggested that Onḳelos is a deliberate perversion of Evangelus, a Greek proper name which exactly translates the Jewish (and especially Babylonian-Jewish) name Mebasser. As the Christian writings are called *Aven* (iniquity, idolatry), and as the pre-Mishnic teacher R. Meir calls the gospel (*evangelion*) *ongillayon* (iniquity of the roll; T. B., *Shab.*, leaf 116, Amst. ed. of 1645), or, by inversion, *gilyon-aven* (roll of iniquity), the name Evangelus, which suggested associations with the gospel, might be perverted into Onḳelos *quasi* On-ḳelea (iniquity of disgrace). And, while a Babylonian Jew coming to Palestine might find it convenient to translate his Hebrew name into Evangelus, this good Greek name was enough to suggest in after times that he was of heathen origin and so to facilitate the confusion with Aquila. The idiom of the Targum Onḳelos, which is held to be Palestinian with some Babylonian features, points to Babylonia as the country of its final redactor, if to Palestine as its source. It must be remembered that Hillel and other great fountains of Palestinian learning were of Babylonian origin.[5]

(*β*) Certain Targumic fragments on the Pentateuch go under the name of *Targum Yerushalmi*, or, rather, *Palestinian Targum*. These are the remains of a much larger *Jerusalem Targum*, once current in Palestine. But, the Palestinian rabbis not having approved of it, perhaps because it accorded in various of its interpretations and phrases with interpretations and phrases to be found in the Gospels,[1] it gradually lost its authority and the greater portion of its original matter, and is now in our hands what it is. It certainly never was part of the *T. Onkelos*, nor was the *T. Onkelos* part of it, though the two are closely related. As regards its age, several of the pieces formerly found in it (now in *T. Yonathan*) were in the 2d and 3d centuries distinctly quoted[2] with disapprobation. But like *Onkelos* it cannot have been written down before the *Mishnah* and other parts of the oral Law.[3]

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[1] In Yemen the Targum is publicly recited to this day, and, strange to say, by boys of nine years of age or so in turn. See J. Saphir, *Eben Sappir*, i. (Lyck, 1866, 8vo) leaves 53*b*, 61*a*. Saphir once told the present writer that a youth, eighteen years of age (*ut supra*, 61*b*), who carried his travelling-bag and served as his guide over the mountains, Saïd, *i.e.*, Se'adyah, by name and a shoemaker by trade, could translate to him in Aramaic from memory any passage Saphir recited in Hebrew.

[2] For the connexion of Aquila with R. Elî'ezer and R. Yehoshua', see also *Beresh. Rab.*, lxx.; *Bemidb. Rab.*, viii. end; *Kohel. Rab.*, vii. 8.

[3] *I.e.*, "min Haadummim." The Adummim are supposed to be one of the four noble families carried to Rome by Titus.

[4] The Jerusalem Talmud repeatedly cites Aquila's renderings and never names Onḳelos. But it does show acquaintance with renderings found in Onḳelos (*e.g.*, *Megil.*, iv. 11; *cf.* Onk. on Exod. xxxii. 35) In the *Midrash Rabbah*, besides many citations from Aquila, we find one of Onḳelos by name (in *Bem. R.*, ix. *in fine*; Onk. on Deut. xxxii. 24) and various allusions (without name) to renderings found in him. He is also cited by name in the Palestinian Pirḳe de-R. Elî'ezer, xxxviii.

[5] *Bibliography of the Targum* אונקלוס.—(A) There are very fine MSS. of this Targum at Parma, Oxford, Cambridge (Dd. 11, 26, Add. 446, 1053), the British Museum, Kissingen (Rabbin Bamberger), &c. (B) A Massoreth on our Targum by an anonymous author, who must have lived in or before the 12th century, has been published—(1) by Luzzatto (*Oẓar Neḥmad*, iv.); (2) by Adler (Vilna edition of the Pentateuch of 1874); and (3) by Berliner (with a German translation, &c., Leipsic, 1877, 8vo). (C) Leading editions:—(1) Bologna, 1482, *editio princeps*, without vowel-points; (2) the Complutensian polyglott; (3) the Bomberg Rabbinic Bible of 1517; (4) Sabbioneta, 1557, 16mo (reprinted, not without mistakes, at Berlin, 1884, imp. 8vo); and (5) Vilna edition of the Pentateuch of 1874, the Targum being pointed according to a Bodleian MS. (Canon. Orient. 91). (D) Translations:—(*a*) into Latin—(1) by Alphonsus Zamorensis (*Polygl.*, 1517, &c.); (2) by P. Fagius (Strasburg, 1546, folio); (*b*) into English by Etheridge (*Targums*, London, 1862-65, 8vo). (E) Commentaries, all in Hebrew:—(1) '*Pathshegen*, by an anonymous Provençal rabbi of the 12th century (see MAḤZOR), in the Vilna Pentateuch of 1874; (2) by R. Mordekhai b. Naphtali (Amsterdam, 1671–77, fol.); (3) *Leḥem Vesimlah* (double commentary) by R. Bensiyyon Berkowitz (Vilna, 1846-56); (4) by Dr Nathan M. Adler (Vilna Pentateuch of 1874, *ut supra*). (F) Other literature (also for the other Targums):—(*a*) in Hebrew—*Meor 'Enayim*, by R. 'Azaryah m. Haadummim (cheapest and best edition, Vilna, 1863; *Mine Targumo*, by R. Y. Berlin or Pick (Breslau, 1851, 4to); *Oheb Ger*, by S. D. Luzzatto (Vienna, 1830); '*Oteh Or*, by the before-named B. Berkowitz (Vilna, 1843); *Iggereth Bikkoreth*, by R. Z. H. Hayyuth (Chajes), ed. Brüll, Presburg (1853, 8vo); Rapoport, '*Erekh Millin*, (Prague, 1852, 4to); Löwy, *Biḳḳoreth Hattalmud*, i. (Vienna, 1863, 8vo); (*b*) in Latin—Morinus, *Exercitationes*, ii. viii. 6 (Paris, 1660); Winer, *De Onkeloso* (Leipsic, 1820, 4to); R. Anger, *De Onkelo* (Leipsic, 1845–46); (*c*) in German—Zunz, *Gottesd. Vorträge* (Berlin, 1832); Geiger, *Urschrift* (Breslau, 1857); Hamburger, *Real-Encyklopädie*; *Targum Onkelos*, by Dr A. Berliner (Berlin, 1884, imp. 8vo). On this work, see Nöldeke, in Zarncke's *Centralbl.*, 1884, No. 39, and Lagarde in *Gött. Gel. Anzeig.*, November 1886 (No. 22); (*d*) in English: E. Deutsch, in his *Literary Remains*—to be used with caution. (G) Lexicons to this and other Targums:—(1) as for the Talmuds and Midrashim, so also for the Targum, R. Nathan b. Yehiel's '*Arukh* (see TALMUD, p. 37, note 7) stands first; (2) next to it is Elias Levita's *Methurgeman* (Isny, 1541, fol.); (3) Buxtorf's *Lexicon Chaldaicum, Talmudicum, et Rabbinicum* (cheap and new, though by no means best, edition, Leipsic, 1869-75); (4) Levy's *Chald. Wörterb.* (1866–68); (5) Jastrow's *Dictionary*, i. (New York, 1886). (H) Grammars:—(1) Juda Jeitteles's *Mebo Hallashon* (Prague, 1813, 4to); (2) Blücher's *Marpe Leshon Arammi* (Vienna, 1838); (3) Fürst's *Lehrgeb. d. Aram. Idiome* (Leipsic, 1855); (4) Lerner's *Diḳduḳ Lashon Arammith* (Warsaw, 1875); all in 8vo.

(γ) The *Targum Yonathan, or T. of Jonathan, on the Pentateuch* is also Palestinian. This Targum was no doubt undertaken, as Dr Bacher has shown (*Z. D. M. G.*, xxviii. p. 69), to combine the finest parts of what early *T. Onkelos* and *T. Yerushalmi* contained. This attempt could not have been made without both these Targums lying in writing before the compiler of the third Targum. The *Targum Yonathan* on the Pentateuch is a product, at the earliest, of the 7th century, to which conclusion internal evidence also points.[4] The author is, of course, not the Yonathan b. 'Uzziel, principal of the eighty disciples of Hillel (T. B., *Sukkah*, 28*a*), who, according to T. Bab., *Megill.*, 3*a*, composed a Targum on the Prophets from the traditions of Haggai, Zechariah, and Malachi.[5]

II. *Targum Yonathan on the Prophets.*—It has been known from early quotations, as from Rashi (*q.v.*) and others, but notably from Kimhi (*q.v.*), that, in addition to the complete extant Targum on the Prophets, there existed other Targums or fragments of them. These are now known from the marginal additions to the Reuchlinian Codex of the Targum on the Prophets published by Lagarde (Leipsic, 1872), and have been discussed by Bacher (*ut sup.*). As regards the complete Targum on the Prophets, no mistake can be greater than to believe that Rab Yoseph, a teacher of the 3d and 4th centuries, and head of the academy of Pumbaditha (see Rabbah), was the author of this Targum in whole or in part. This mistake has its origin in the repeated phrase of the Babylonian Talmud, כדמתרגם רב יוסף ("as Rab Yoseph targumizes"); but then a similar phrase exists with regard to Rab Shesheth, כדמתרגם רב ששת ("as Rab Shesheth[6] targumizes"). And in like manner the expression כדמתרגמינן ("as we targumize") is of frequent occurrence. In this last instance the words mean "as we are in the habit of translating certain passages in Holy Writ according to a Targum we have received." As applied to Rab Yoseph and Rab Shesheth the phrase may certainly mean more and yet not imply that these teachers were in any way authors of the Targum on the Law, the Prophets, or Hagiographa. Rab Yoseph and Rab Shesheth were both blind, and as such were not allowed to quote *in extenso* the written word of the Law, which it was forbidden to recite orally. They therefore committed to memory the oral Targum, and so were, of course, appealed to as Targumic authorities, &c.[7] That Rab Yoseph was not the author of the Targum on the Prophets will be clearly seen from the following Talmudic passage (B., *Megillah*, 3*a*; *Mo'ed Katan*, 28*b*):—"Were it not for the Targum of that verse [Zechar. xii. 11] I should not know the meaning of the prophet." This verse is from the last but one of all the Prophets;[8] and we see that Rab Yoseph must have had the Targum on the Prophets before him. In the opinion of the present writer this Targum was composed by Yonathan; and, not being on books of the Law, there was no reason why it should not have been there and then written down.[9] Although the traditions it embodies came originally from Babylonia and returned to Babylonia, its language has yet a more marked colouring of the Palestinian idiom than that of Onkelos, because it was not studied so much and therefore not so much modified and interpolated. Some of the Agadoth occurring in this Targum are ascribed in the Talmud and Midrash to later men, but this is no conclusive argument against an early date. It can be shown that many laws and sayings supposed to be of the 2d, 3d, and 4th centuries of the Christian era are actually of pre-Christian times, and, indeed, certain explanations, figures of speech, &c., had been, so to say, floating in the air for centuries. Certain passages in the Septuagint contain Agadoth which reappear, seemingly for the first time, in the Talmudic literature. The Prophets themselves knew Agadoth which only reappear in what are believed to be late Midrashim (comp., *e.g.*, Isaiah xxix. 22 with T. B., *Synh.*, 19*b*; Isa. xxx. 26 with Targum on Judges v. 31, *Ber. Rab.*, xii.; Ezek. xxii. 24, &c., with *Ber. Rab.*, xxxiii.).[10]

III. *Targum on the Hagiographa.*—No author's name is attached to this Targum in whole or in part. The Psalms must have had one[11] or two[12] Targums; the book of Proverbs at least two;[13] the book of Job at least three.[14] There must have been two Targums on Canticles,[15] Ruth,[16] Ecclesiastes,[17] and Esther,[18] and probably three on Lamentations,[19] the earliest of which was, no doubt, simultaneously coming into existence with the earliest on the book of Job. For Ezra-Nehemiah no Targum exists. Daniel only in part wanted a Targum, and it is supposed to have had one;[20] and the books (or rather the book) of Chronicles have a by no means late one,[21] although it is not by Rab Yoseph, of the 4th century.[22]

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[1] See T. Yer., *Berakhoth*, v. 3, and compare with it Luke vi. 36. Compare Berliner, *ut supra*, pp. 85, 86.

[2] Compare last note.

[3] *Bibliography of the Targum Yerushalmi on the Pentateuch.*—(A) There is a MS. of this Targum preserved in the Vatican library (ccccxl.). (B) The first edition of this Targum is in the so-called Christian Rabbinic Bible of 1517. It is to be found also in most polyglott and Rabbinic Bibles, including the Polish editions (Warsaw, &c.). (C) Translations:—(*a*) Latin—(1) by Taylerus (London, 1649, 4to); (2) by Chevalier (in the *Polyglott*, London, 1653–57). (*b*) In English by Etheridge (*Targums*, London, 1862–65, 8vo). (D) There are two commentaries on this Targum in Hebrew:—(1) by R. David b. Ya'akob (Prague, 1609, 4to); (2) by R. Mordekhai b. Naphtali (Amsterdam, 1671–77, fol.).

[4] See our Targum on Gen. xxi. 21, where Mohammed's first wife (Khadidja) and their youngest daughter (Fâtima) are mentioned by name.

[5] *Bibliography.*—(A) There certainly exists, somewhere in Italy, a MS. of this Targum, although the owner is at present unknown. (B) This Targum appeared for the first time in the Pentateuch edition of Venice (1590–91, 8vo). (C) Translations:—(*a*) Latin by Chevalier (London, 1653–57); (*b*) in English by Etheridge (*op. cit.*). (D) Commentaries:—(1) by R. David b. Ya'akob (Prague, 1609, 4to); (2) by R. Mordekhai b. Naphtali (Amst., 1671–77, fol.); (3) by an anonymous author in the Warsaw edition.

[6] In the editions before us (T. B., *Sotah*, 48*b*) *Yoseph* stands on the margin instead of *Shesheth*; but in the edition before R. 'Azaryah m. Haadummim the reading was absolutely *Shesheth*; see *Meor 'Enayim*, cap. xlv.

[7] See *Tosaphoth* on *B. Kam.*, leaf 3*a*, catchword כדמתרגם.

[8] This is by no means an isolated phrase; in T. B., *Synhedrin*, 94*b*, a similar one occurs, referring to Isa. viii. 6.

[9] See, however, vol. xxi. p. 648.

[10] *Bibliography.*—(A) There are MSS. of the Targum on the Prophets in the Bodleian (Opp. Add., 4to, 75 and 76, Uri 4 and Kennicott 5). (B) The earliest edition is in the Rabbinic Bible of 1517. (C) Translations:—(*a*) in Latin—(1) by Alphonsus Zamorensis (revised by Arias Montanus and afterwards by Clericus); (2) Jeremiah, by Ghislerus, 1623; (3) Minor Prophets, by Mercerus, 1559, Tremellius, 1567, and Figueiro, 1615; (4) Hosea, Joel, and Amos, by Quinquarboreus, 1556; (5) Obadiah, by Bedwell, 1601, and Leusden, 1656; (*b*) in English—Isaiah, by Pauli (London, 1871, 8vo). (D) Besides the general literature mentioned under "*Onkelos*" (*in fine*), we must mention Frankel, *Zum Targum der Propheten* (Breslau, 1872, 4to), which must be used with caution.

[11] See T. B., *Megillah*, 21*a*, and also Rashi on T. B., *Ta'anith*, leaf 18*a*. Zunz is greatly mistaken when he says (*Gott. Vortr.*, p. 64) that the Targums on Psalms, Job, and Proverbs have one and the same linguistic character. The Targum on Proverbs is almost pure Syriac.

[12] See the Targum itself on Psalm lxxvi. 11.

[13] There, no doubt, existed another Targum on this book, older than that now in our hands; see *Ber. Rab.*, xciii.

[14] See the extant Targum on Job xxiv. 19, and comp. note 19 *infra*.

[15] See R. Nathan b. Yehiel's *'Arukh*, s.v. פלמ״א. A "Yerushalmi Targum" presupposes at least one other.

[16] The Targum on the Five Megilloth has all one character, and is therefore wholly Yerushalmi.

[17] The Targum itself repeatedly quotes another Targum.

[18] See Rashi on T. B., *Megillah*, leaf 13*b*, catchword זכה. We have still two Targums on Esther. It ought to be mentioned here that in the post-Talmudic *Massekheth Sopherim*, xiii. 6, an Aramaic translation of Esther iii. 1 is given with the introductory words: רב יוסף תרגם ("Rab Yoseph targumized"). This somewhat lengthy translation is found (the quotation from the Targum on Proverbs excepted) almost verbatim in the *Targum Sheni in loc.*

[19] The book of Lamentations, and consequently a Targum thereon, was no doubt used along with the book of Job and the Targum thereon, by mourners. See Schiller-Szinessy, *Catalogue*, i. p. 27.

[20] See Munk, "Notice sur Saadia" (Cahen, *La Bible: Isaïe*, Paris, 1838), p. 159. His ingenious remarks are scarcely borne out by fact.

[21] From a late name occurring in a book no conclusions must be drawn, as isolated words may be a mere interpolation. The internal character of a work must decide the age in which it was composed.

[22] *Bibliography.*—(A) There are MSS. of the Targum—(1) on the Psalms, in Parma (De-Rossi, 31, 32, 732) and Paris (110); (2) on Proverbs, in Parma (31, 32) and Paris (as before); (3) on Job, in Parma (31, 32) and Paris (as before); (4) on the Five Megilloth, in the Court Library of Vienna (xxix.), Parma (31, 32), the Bodleian (Uri 1, 44), Cambridge (Add., 436); and (5) on Chronicles in the Vatican (Urb. 1.), the Erfurt ministerial library, Cambridge (E 5, 9), and the Bodleian (Uri 35, 36). (B) The earliest editions of the Targum on the Hagiographa (except on Daniel, Ezra-Nehemiah, and Chronicles) are the Rabbinic Bibles, and on Chronicles those of 1680–83 by Beck and 1714 by Wilkins. (C) Translations:—(*a*) in Hebrew—the *Targum Sheni*—(1) *Leshon Zahab* (Const., 1732), and (2) *Pathshegen hakkethab* (Amst., 1770, repr. at Czernowitz, 1838),—all 8vo; (*b*) in Latin—(1) on the Psalms, by Aug. Justinianus, and again by Arias Montanus; (2) on Proverbs, by Alphonsus Zamorensis; (3) on Job, by the same; (4) on Canticles, by the same, and again by Schreckenfuchs (Basel, 1553, 8vo); (5) on Ruth, by Arias Montanus.

State of Text.—The Targum text is, taken as a whole, in a very corrupt state The causes of this corruption are many, but chiefly the following:—(1) mistakes ordinarily made by scribes through carelessness, or ignorance, or both; (2) the Targums had passed from century to century and from country to country without having been written down; (3) when written down they were probably not provided with vowel-points at once; (4) when provided with vowel-points most of them were first provided with Babylonian (or Assyrian), which afterwards were changed into Palestinian ones; this change was a fertile source of fresh mistakes; (5) the loss of the general knowledge of the Targumic idiom contingent on the decline and final fall of the institution of publicly reciting the Targum was an additional source from which mistakes arose; (6) conjectural emendations contributed their quota to the corruption of the text; (7) Buxtorf's emendations founded on the diction of the Biblical Targum (as suggested in the *Methurgeman*) are a gross mistake, inasmuch as they lack the criticism of history; (8) printers' mistakes, increasing in every new edition, have all but ruined the text. The remedies for this corruption are:—(1) good Targum MSS. in private hands and public libraries, notably in Italy, Germany, and England; (2) Targum MSS., according to the Babylonico-Assyrian system of punctuation, chiefly preserved in South Arabia, Russia, and England; (3) some early and comparatively good printed editions; (4) the *Massoreth* of the Targum.

Value of the Targums.—The idea so long entertained, even by the learned, that these old versions were valuable chiefly as guides to the original readings of the sacred text must be given up. All of them contain more or less, whether visible at first sight or not, certain paraphrastic elements, which give no absolute security for the exact reading of the pristine Hebrew text But besides their importance as linguistic monuments they have the highest value as historical records—(1) of the exegesis which obtained at the time of their composition, and (2) of the then current manners, thoughts, and aspirations both of the Jews and of the surrounding nations.[1] (S. M. S.-S.)

TARIFA, a seaport of Spain, in the province of Cadiz, at the extreme south point of the Peninsula, 59 miles south-east from Cadiz and (by land) 21 miles west-south-west from Gibraltar. The town is nearly quadrangular, with narrow crooked streets, and is still surrounded by its old Moorish walls. On its east side, just within these, stands the alcazar. The rocky island in front of the town, connected with the mainland by a causeway, is strongly fortified, and in some sense commands the Strait of Gibraltar It has a lighthouse, 135 feet high, which has a range of 30 miles. The population within the municipal limits was 12,234 in 1877. Anchovy and tunny fishing is carried on, and there is some coasting trade. The manufactures (leather and earthenware) are unimportant. The oranges of Tarifa are famed for their sweetness.

Tarifa is the *Julia Josa* of Strabo, between Gades and Belon, which, according to that writer, was colonized by Romans and the removed inhabitants of Zelis in Mauretania Tingitana The *Julia Transducta* or *Traducta* of coins and of Ptolemy appears to be the same place. Its present name (Arabic *Jazîrat Ṭarîf*) is derived from Ṭarif, the forerunner of Ṭarik (see vol. xvi. p. 573). After a long siege it was taken from the Moors in 1292 by Sancho IV. of Castile, who entrusted it to the keeping of Alonzo Perez de Guzman; the heroic defence by the latter, commemorated in the *Romancero*, earned for him the name of Guzman "el Bueno." It was in the defence of Tarifa that Alfonso XI. gained the battle of Salado, a short distance to the westward, in 1340. The place was successfully defended against the French by Gough in 1812.

TARN, a department of southern France, formed in 1790 of the three dioceses of Albi, Castres, and Lavaur, all belonging to the province of Languedoc, lies between 42° 23′ and 44° 12′ N. lat. and 1° 32′ and 2° 56′ E. long. It is bounded N. and E. by Aveyron, S.E. by Hérault, S. by Aude, S.W. and W. by Haute-Garonne, N.W. by Tarn-et-Garonne. The slope of the department is from east to west, and its general character is mountainous or hilly; its three principal ranges, the Mountains of Lacaune (peak of Montalet, 4154 feet), the Sidobre, and the Montagne Noire, belonging to the Cevennes, lie on the south-east. The stony and wind-blown slopes of the first-named are used for pasturage. The highest point of the range and of the department is the Pic de Montalet (4154 feet); several other summits are not much short of this. The granite-strewn plateaus of the Sidobre, from 1600 to 2000 feet high, separate the valley of the Agoût from that of the Thoré. The Montagne Noire derives its name from the forests on its northern slope, and some of its peaks are from 3000 to 3500 feet high. The limestone and sandstone foot-hills are clothed with vines and fruit trees, and are broken by deep alluvial valleys of extraordinary fertility. With the exception of a small portion of the Montagne Noire, which drains into the Aude, the whole department belongs to the basin of the Garonne,—indeed, if the rivulet Giron be excepted, to that of the Tarn, which flows in a westerly direction past Albi, Gaillac, Lisle, and Rabastens, receiving on the left the Agoût at St Sulpice. Northern Tarn is drained by the Aveyron and its tributary the Viaur. The eastern portion of the department has the climate of Auvergne, the severest in France, but that of the plain is Girondin. At Albi the mean temperature is 55°, and the rainfall 29·5 inches. The population of the department in 1886 was 358,757.

Of the total area of 2217 square miles, or 1,418,969 acres, there are 887,709 acres of arable land, 118,071 of meadows, 118,934 of vineyards, 186,594 under wood, and 52,408 of moorland. By last returns there were 11,360 horses, 3280 mules, 5430 asses, 20,550 bulls and oxen, 53,900 cows and heifers, 13,240 calves, 455,500 sheep (wool-clip in 1878 1209 tons), 87,700 pigs, 5350 goats, and 17,190 bee-hives. In 1878 37 tons 14 cwt. of silk cocoons were produced. Oxen and sheep are fattened; ewes' milk cheese like that of Roquefort is made; and geese and turkeys are reared. The crops in 1881 were—wheat, 3,429,112 bushels; meslin, 53,113; rye, 1,371,040; barley, 37,730; buckwheat, 8448; maize and millet, 1,566,873; oats, 538,422; potatoes, 2,554,860; dry vegetables, 374,715; chestnuts, 268,125; beetroot, 196,625; 782 tons of hemp; 476 of flax; 9,676,476 gallons of wine (only half the quantity of the previous year, owing to the phylloxera). Both common and good table wines are produced.

The mineral products include marble, porphyry, granite, lime, manganese, sulphate of baryta, alum, iron lignite, and tourmaline. In 1881 335,430 tons of coal were taken from seven pits, and other mines are about to be opened. There are iron, alkaline, thermal, and carbonate of lime springs. The chief centre for the manufacture of woollen stuffs (in 1875 287 mills, 6457 workmen, and 98,615 spindles) and for wool-spinning and weaving (4893 machine and hand looms) is at MAZAMET (*q.v.*), but all sorts of woollen and cotton stuffs are produced in other localities. Other industrial products are woollen hosiery, cotton, silk, and linen thread, morocco, hats, earthenware, glass, soap; and there are tanneries, distilleries, flour-mills, breweries, dye-works, sawmills, printing-works, and numerous limekilns. In 1881 929 tons of steel and 1947 tons of iron of various kinds were produced. The Tarn is navigable for 43 miles; there are 208 miles of national roads, 4274 of other roads, and 120 of railway. The department forms the diocese of Albi, and belongs to the 16th corps d'armée (Montpellier), and the court of appeal is at Toulouse. The chef-lieu is Albi. There are 4 arrondissements (Albi, Castres, Gaillac, Lavaur), 35 cantons, and 318 communes.

TARN-ET-GARONNE, a department of south-western France, was formed in 1808 of districts formerly belonging to Guienne and Gascony (Quercy, Lomagne, Armagnac,

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Quinquarboreus (Paris, 1556, 4to), Mercerus (Paris, 1564-65; revised 1657); (6) on Lamentations, by Alph. Zam., by Quinquarboreus (Paris, 1549, 4to), by Ghislerus (Leyd., 1623, fol.), and again by Taylerus (Lond. 1651, 4to); on Ecclesiastes, by Ar. Mont., by Schreckenfuchs (Basel, 1555, 8vo), and again by Costus (Leyden, 1554, 4to); (7) on Esther, by Ar. Mont. (1572, folio); (8) Chronicles by Beck from the Erfurt MS. (imperfect, Augsb., 1680-83), and by Wilkins from the Cambridge MS. (Amst. 1715); (*c*) in German—(1) on the Five Megilloth, by R. Ya'akob b. Shemuel (Breisgau, 1584, 4to); (2) on the *Targum Sheni*, by David Ottensosser (Sulzbach, 1820, 8vo). (D) Commentaries:—(*a*) in Hebrew—(1) on the Targum of the Five Megilloth, by R. Elyaḳim Rothenburg (Prague, 1618); (2) on Esther alone, by R. Shemuel Makshan (Prague, 1601, 4to); (3) on the same Targum, by R. David b. Yehudah Melammed (Cracow, 1644, 4to); on the *Targum Sheni*, by R. David b. Ya'akob (Prague, 1609, 4to); (*b*) in Spanish—on Canticles, by R. Mosheh Laniado (Venice, 1619, 4to).

[1] R. Yehudah Ibn Ḳoreish fully understood the value of the Targums. See his interesting epistle, addressed to the Jewish community of Fez, published at Paris (1857, 8vo), under the name of *Epistola de Studii Targum Utilitate*. A translation of the introductory part (by Wetzstein) is given in the *L. B. O.*, iii. col. 22 (reprinted by Dr Berliner, *T. O.*, p. 168 *sq.*) Ibn Ḳoreish belonged to the 9th century, and not, as Berliner says, to the 10th or 11th; nor was he a Karaite as Graetz (v. p. 293) half believes.

Rouergue, Agenais), with the addition of a small piece of Languedoc. From 1790 to 1808 it was divided between the departments of Lot, Haute-Garonne, Tarn, Aveyron, Gers, and Lot-et-Garonne. Lying between 43° 47′ and 44° 25′ N. lat. and 0° 55′ and 1° 58′ E. long., it is bounded on the N. by Lot, on the E. by Aveyron, on the S. by Tarn and Haute-Garonne, and on the W. by Gers and Lot-et-Garonne. The Garonne and its tributary the Tarn unite a few miles below Moissac, and separate the elevated lands to the north, which belong to the Cevennes and the central plateau, from those to the south, which are a continuation of the plateau of Lannemezan. The principal tributary of the Tarn on the right is the Aveyron, the affluents of which run through remarkably parallel valleys from north-east to south-west. The general slope of the department is from east to west; the highest point (1634 feet) is on the border of Aveyron, the lowest (164 feet) where the Garonne leaves it. The winter temperature is 37° F., that of spring and autumn 54° F., and that of summer 72° F. Rain falls seldom, but heavily, especially in spring, the annual rainfall being 28·9 inches.

Of a total area of about 1436 square miles, or 919,265 acres, arable land occupies 552,708 acres, meadows and grass 45,073, vineyards 102,849, woods 115,429, moorland and pasturage 41,819. The returns in 1883 showed 2,167,000 bushels of wheat, 35,062 of meslin, 62,975 of rye, 77,000 of barley, 2,722,500 of oats, 759,000 of maize, 1,867,250 of potatoes, 35,468 tons of beetroot, 172 tons 8 cwt. of colza seed, 399 tons of hemp, 894 tons of flax, 250,788 tons of fodder, 12 tons 15 cwt. of silk cocoons, 20,048,380 gallons of wine. The live stock in 1881 included 14,336 horses, 1680 mules, 2120 asses, 89,295 cattle of various descriptions, 116,349 sheep, 1358 goats, 32,375 pigs; 6347 beehives gave 25 tons 18 cwt. of honey and 8 tons 2 cwt. of wax. There are 57 quarries, employing 426 workmen, where phosphates of lime, lithographic stone, freestone, potters' clay, gypsum, and schist for slating are worked, as are also iron and copper. The manufacturing industry is represented by flour-mills, various kinds of silk-mills (1317 workmen), and manufactories of linen, wool, and paper. Much fruit is grown, and the principal exports are fresh fruit, wine, flour, phosphates, lithographic stone. There are 83 miles of waterway, including 48 of canal, 156 miles of national roads, 3515 of other roads, 127 of railway lines, the centre of which is Montauban. Tarn-et-Garonne is one of the least densely peopled departments of France: in 1886 there were 214,046 inhabitants, and their number is decreasing. Except some 10,000 Calvinists, all are Roman Catholics. The department forms the diocese of Montauban, and belongs to the jurisdiction of the Toulouse court of appeal and to the district of the 17th corps d'armée (Toulouse). It has 3 arrondissements (Montauban, Moissac, and Castel-Sarrasin), 24 cantons, and 194 communes.

TARNOPOL, a market-town in Galicia, Austria, on the Sereth. It was formerly a fortress, and rendered valuable services to Polish kings, who, in their turn, conferred upon it important privileges. The town enjoys a brisk trade in grain and wine, and has some sugar factories. Its yearly horse fairs are famous throughout the country. The population in 1885 was 27,000, about half of them Jews.

TARPAULIN is a waterproof sheeting consisting of a stout canvas cloth impregnated and coated with tar. It is employed for covering hatchways and other openings into the holds of vessels, for making covers for railway and other waggons and farm ricks, and generally for protecting bulky goods and structures from weather and damp. Many waterproof compositions other than tar are used for similar purposes, the principal ingredients being solutions of india-rubber, gutta-percha, and various resinous bodies combined with pigments. See Waterproofing.

TARQUINII. See Etruria, vol. viii. p. 634.

TARQUINIUS PRISCUS, Lucius, fifth legendary king of Rome, is represented as the son of a Greek refugee who removed from Tarquinii in Etruria to Rome, by the advice of his wife, the prophetess Tanaquil. Appointed guardian to the sons of Ancus Marcius, he succeeded in supplanting them on the throne on their father's death. It was he who first established the Circus Maximus, built the great cloacæ, and founded the triple temple on the Capitol,—the expense of these vast works being defrayed by plunder seized from the Latins and Sabines. Many of the ensigns both of war and of civil office are assigned to his reign, and he was the first to celebrate a Roman triumph, after the Etruscan fashion, in a robe of purple and gold, and borne on a chariot drawn by four horses. After a reign of thirty-eight years he was assassinated by the contrivance of the sons of Ancus Marcius, but Tanaquil had influence enough to secure the succession to Servius Tullius, his son-in-law. See vol. xx. p. 733.

TARQUINIUS SUPERBUS, Lucius, son of the preceding, and son-in-law of Servius Tullius, immediately succeeded the latter without any of the forms of election, and proceeded at once to repeal the recent reforms in the constitution, seeking to establish a pure despotism in their place. Wars were waged with the Latins and Etruscans, but the lower classes were deprived of their arms, and employed in erecting monuments of regal magnificence, while the sovereign recruited his armies from his own retainers and from the forces of foreign allies. The completion of the fortress temple on the Capitoline confirmed his authority over the city, and a fortunate marriage of his son to the daughter of Octavius Manilius of Tusculum secured him powerful assistance in the field. His reign was characterized by bloodshed and violence; the outrage of his son Sextus upon Lucretia precipitated a revolt, which led to the expulsion of the entire family, after Tarquin had reigned twenty-five years. All efforts to force his way back to the throne were vain, and he died a lonely and childless old man at Cumæ. See vol. xx. p. 734.

TARRAGONA, a maritime province in the north-east of Spain, with an area of 2451 square miles and a population in 1877 of 330,105, was formerly part of the province of Catalonia. It is bounded on the S.E. by the Mediterranean, on the N.E. by Barcelona, on the N. by Lerida (the Sierra de Almenar), on the W. by Saragossa and Teruel, and on the S.W. by Castellon-de-la-Plana. The Ebro flows through the southern portion of the province, and the other chief streams are the Gaya and the Francoli. The district, although mountainous, is the richest in Catalonia. The hills are clothed with vineyards, which produce excellent wines, and in the valleys are cultivated all kinds of grain, vegetables, rice, hemp, flax, and silk. Olive, orange, filbert, and almond trees reach great perfection, and the mountains yield rich pastures and timber trees of various kinds. Manufactures are well advanced, and comprise all textile fabrics, soap, leather, and spirits. There are also several potteries and cooperages, and flour, paper, and oil mills. Silver, copper, lead, and barytes are plentiful, and quarries of marble and jasper are worked in the hills. The military government of the province is dependent on the captaincy-general of Catalonia. For administrative purposes the district is divided into eight partidos judiciales, containing 186 ayuntamientos, and returns three senators and eight deputies to the cortes. Besides the capital, the towns in the province with more than 10,000 inhabitants are Reus (27,691), Tortosa (23,808), and Valls (13,256).

TARRAGONA, the capital of the above province, is a flourishing seaport, the seat of an archbishopric, at the mouth of the Francoli, 63 miles by rail west-south-west of Barcelona, in 41° 10′ N. lat. and 0° 20′ E. long., with a population of 23,046 in 1877. The picturesque but badly built older portion of the town stands on the steep slope of a hill 760 feet high, and is still surrounded by walls of Roman (in parts Cyclopean) origin. Below the walls a broad street, the Rambla, divides the upper from the lower town, which has been more regularly built in modern times along the low promontory which stretches out into the Mediterranean. The city is most beautifully situated, and gains considerably in effect from its magnificent cathedral, one of the noblest examples of early Spanish art. It is 300 feet in length and 100 feet in breadth, and consisted originally of a nave, aisles, transepts with an octagonal lantern at the crossing, and an apsidal chancel. Several exterior chapels have been added in later times, and on the south-east stands a 14th-century steeple raised on a Romanesque tower. The east end was probably begun in 1131 on the ruins of an earlier church, but the main body of the building dates from the end of the 12th century and the first half of the 13th, and is of transitional character,—the exuberant richness of the sculptured capitals being admirably kept in subordination by the Romanesque simplicity of the masses. Considerable changes were introduced at a later date; and the present west end of the nave cannot have been completed till late in the 14th century. On the north-east side is a cloister contemporary with the church, with which it communicates by a very fine doorway. The cloister contains much remarkable work, and the tracery of the windows bears interesting marks of Moorish influence. Two other noteworthy churches in the city are San Pablo and Santa Tecla la Vieja, both of the 12th century. The mole, begun in 1491, was chiefly constructed out of the Roman amphitheatre, of which a few rows of seats can still be seen on the sea-shore. The remains of a Roman aqueduct form a picturesque feature in the landscape. The Carcel de Pilatos is said to have been the palace of Augustus Cæsar; it was partly destroyed by Suchet, and now serves as a prison. The museum contains a collection of the Roman antiquities which are continually being discovered during excavations.

The trade is steadily increasing. During 1885 the vessels cleared amounted to 377,250 tons (45,795 tons British, 47,181 French, and 42,617 Swedish and Norwegian). The exports were valued at £1,299,633 (wine £1,023,847), and the imports at £1,237,012. The exports were mostly to France, Great Britain, and the River Plate; the imports were chiefly from Germany, Russia, France, and Sweden. There is communication by rail with Barcelona, Valencia, and Lerida, and by steamer with other ports of Spain.

Tarraco was one of the earliest strongholds of the Romans in Spain, and became a colony (of Julius Cæsar), the capital of Hispania Citerior, and the richest town on the coast. To the Romans the Visigoths under Euric succeeded in 467, but on their expulsion by the Moors in 710 the city was razed to the ground. It was long before the ruins were again inhabited, but by 1089, when the Moors were driven out by Raymond IV. of Barcelona, there must have been a certain revival of prosperity, for the primacy, which had been removed to Vich, was in that year restored to Tarragona. In 1118 a grant of the fief was made to the Norman Robert Burdet, who converted the town into a frontier fortress against the Moors. In 1705 the city was taken and burned by the English, and a century later, after being partly fortified by them, it was captured and sacked by the French in 1811 under Suchet.

TARSHISH. See Phœnicia, vol. xviii. p. 806.

TARSUS, now Tarsûs, an ancient city in the fertile plain of Cilicia, lay on both sides of the Cydnus, whose cool and swift waters were the pride of the city (Dio Chrys., vol. ii. p. 2, Reiske's ed.; *Vita Apollon.*, i. 7), and bore traffic to and from the port of Rhegma. In the time of Xenophon (*Anab.*, i. 2. 23) Tarsus was already great and flourishing, and was the residence of the vassal king of Cilicia. Its civilization at this time seems to have been mainly Semitic, as was to be expected from the geographical relations of Cilicia, which have generally associated its history with that of Syria. We have coins of Tarsus (תרז) of the Persian period, bearing Aramaic inscriptions; and the deities of the town, known in later times as Heracles, Perseus, Apollo, Athena (Dio Chr., ii. 22), seem to have been akin to those of the Phœnicians and Syrians (see below). The Semitic influence was doubtless very ancient; indeed, the Assyrians invaded Cilicia in the 9th century B.C., at which date Tarsus is perhaps mentioned on the monuments under the name of Tarzi (Schrader, *Keilinschr. und Gesch.*, 1878, p. 240; the reading is not certain). After Tarsus was Hellenized the citizens learned to boast that they were Argives sprung from the companions of Triptolemus (Strabo, xiv. 5. 12; Dio Chr., ii. 20), and the town became the seat of a famous school of philosophy which was frequented almost exclusively by natives, but sent forth teachers as far as Rome itself.[1] More than one of these philosophers, notably Athenodorus the teacher of Augustus, and Nestor the teacher of Marcellus, held the chief magistracy of the city. Athenodorus and his predecessors were Stoics, but Nestor was an Academic (Strabo, xiv. 5. 14),[2] so that the Platonic philosophy is that with which Paul would probably have come in contact if he gave heed to the Greek wisdom of his native city. Presumably, however, he formed a higher opinion of the culture of Tarsus than did his contemporary Apollonius of Tyana, whose testimony as to the character of the citizens (*Vit. Ap.*, i. 7) is confirmed by Dio Chrysostom. Tarsus had made rapid material progress since Cilicia became Roman (66 B.C.). It was the capital of a rich province, and had received freedom from Antony, and from Augustus the dignity of a metropolis and important immunities for its commerce (Dio Chr., ii. 36). The inhabitants were vain, effeminate, and luxurious, more like Phœnicians than Greeks. Their sensuous Eastern religion in these golden days of affluence had more attraction for them than the grave philosophy of the Porch; and the legend supposed to be graven on the statue of Sardanapalus, at the neighbour city of Anchiale, "let us eat and drink, for to morrow we die," which Paul quotes in 1 Cor. xv. 32, might have been the motto of the mass of the townsmen.[3] At Tarsus the emperor Tacitus died, and Julian was buried. The city was deserted and lay waste during the frontier wars of Greeks and Arabs in the first century of Islam; a Moslem general, who saw the ruins, estimated its former population at 100,000 (Beladhorí, p. 169). It was rebuilt and settled as a military colony and frontier post by Hárún al-Rashíd in 787 A.D., and became a starting point of forays against the Christians. On such a campaign the caliph Ma'mún died, and was buried at Tarsus (833), having caught a fever, like Alexander the Great, by bathing in the cold Cilician waters. Tarsus was temporarily recovered to Christendom by Nicephorus Phocas, and again by the crusaders under Baldwin. Finally it remained in the hands of the Turks.

The Heracles of Tarsus was the Cilician god Sandan. Dio Chrysostom calls him the *ἀρχηγός* of the Tarsians (ii. 23), and he may be identified with the Baal of Tarsus named on the coins already spoken of. He was worshipped by the periodical erection of "a very fair pyre" (*ibid.*), a rite presumably analogous to that described in the *De Dea Syria*, ch. 49; and the remarkable ruin of Donuk-tash, a vast court with massive walls enclosing two lofty platforms of concrete, probably marks the site of his sanctuary (see Perrot and Chipiez, *Hist. de l'Art*, iv. 536 *sq.*, and Langlois, *Voyage dans la Cilicie*, p. 265 *sq.*). A tradition making Sandan the founder of Tarsus is given by Ammianus (xiv. 8. 3); and, as the Greeks appear to have taken elements of the myth of Sandan (including the pyre) into their legend of Sardanapalus, this explains the current story that Sardanapalus founded Anchiale and Tarsus in one day (Arrian, ii. 5, 2; Athen., xii. p. 529 *sq.*). On Sandan, see K. O. Muller, in *Rhein. Mus.*, 1829, and E. Meyer, in *Z. D. M. G.*, 1877, p. 736 *sq.* Another account in Ammianus makes Perseus the founder of Tarsus, and it appears from Dio Chr. that he was almost or quite as much honoured. The footprint of Pegasus was shown at Tarsus (Avienus, 1031 *sq.*; comp. Dio, ii. 24), and his *ταρσός* (wing?) was said to have fallen there (Alex. Polyh. in Steph. Byz., *s.v.*). This worship reappears at Joppa. Apollo "with the trident" had a sacred sword at Tarsus, which could be cleansed only by the water of the Cydnus (Plut., *Def. Orac.*, 41), and is probably the same as the *harpe* shown on coins of Hadrian's time; if so, he is presumably a differentiated form of Perseus.

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[1] To Strabo's list must be added Zeno, the successor of Chrysippus.

[2] Lucian, *Macrob.*, 21, makes him a Stoic and teacher of Tiberius.

[3] Athenæus, v. p. 215, tells of an Epicurean philosopher, Lysias, who, becoming priest of Heracles, became tyrant of the city, taxing the rich to provide largesses for the poor. The fact is probable, the date quite uncertain.

The worship of Athena may be connected with the statement of Athenodorus (the famous philosopher of Tarsus) that the ancient name of the city was Parthenia (*Fr. Hist. Gr.*, iii. 487); Abydenus in Eusb., *Chron.*, p. 35, ed. Schöne) ascribes the foundation of her temple with its brazen columns and of the city itself to Sennacherib. Thus with the Baal of Tyre there was worshipped an unmarried goddess, as in so many shrines of Syria and Asia Minor. Dio Chr., ii. 2, speaks also of Titans as lords of the city. The reference is to Japetus (Japhet?), grandfather of Cydnus (Athenodorus, *ut sup.*).

TARTAGLIA, Niccolò (*c.* 1500–1557), a self-taught mathematician, was born at Brescia about 1500. His father, Michele Fontana, was a postal messenger between Brescia and the neighbouring towns, who, dying in 1506, left two sons and a daughter to the care of their penniless mother. Niccolò's childhood was accordingly passed under the stress of dire poverty, and was marked by a cruel misfortune. During the sack of Brescia in 1512 he was, in the cathedral where he had vainly sought a refuge, horribly mutilated by some infuriated French soldiers. His skull was laid open in three places, his palate cloven, both jawbones fractured. Yet he recovered with no further assistance than his mother's patient care. He, however, long continued to stammer in his speech, whence the nickname, adopted by himself, of "Tartaglia." His education remains a mystery. Save for the barest rudiments of reading and writing, he tells us that he had no master; yet we find him at Verona in 1521 an esteemed teacher of mathematics. In 1534 he transferred his residence to Venice, and was there met by Antonio del Fiore with a challenge to one of the intellectual duels then customary. Del Fiore relied on his possession of an undivulged formula by Scipione del Ferro for the solution of a particular case of cubic equations. But Tartaglia had attained in 1530 a similar result, which he now, in February 1535, greatly extended. His consequent triumph over his adversary gave him a high reputation, and his house became the resort of the learned of all grades and nations. The mystery in which he chose to shroud his method of dealing with cubic equations promised him a highly effective weapon in future contests, as well as leisure to perfect, before publishing, the coveted rules. But in 1539 Cardan enticed him to Milan, and there, by unremitting solicitations, procured from him the rude verses in which he had enshrined his discovery (see **Algebra**, vol. i. p. 513). The Milanese physician's breach of his oath of secrecy gave rise to a bitter and lifelong quarrel, the most conspicuous incident in which was a public disputation at Milan, August 10, 1548, at which Cardan shrank from appearing. In 1548 Tartaglia accepted a situation as professor of Euclid at Brescia, but returned to Venice at the end of eighteen months. He died at Venice December 13, 1557. Acrid and emulous in disposition, he incurred abundant enmities; yet his honesty, uprightness, and the morality of his life remain unimpeached. He was keen-witted, diligent, and ingenious, and by his discoveries in the solution of equations helped to initiate the rapid progress of modern mathematics.

Tartaglia's first printed work, entitled *Nova Scientia* (Venice, 1537), dealt with the theory and practice of gunnery, to which his attention had been drawn in 1531 by the question of a bombardier at Verona as to the elevation giving the greatest range. He easily found it to be 45° (true only *in vacuo*), but failed to demonstrate the correctness of his intuition. Indeed, he never shook off the erroneous ideas of his time regarding the paths of projectiles, further than to see that no part of them could be a straight line. He nevertheless inaugurated the scientific treatment of the subject, and his propositions reappeared in most ballistical treatises down to Blondel's in 1683. The publication of the *Nova Scientia* was determined by the menacing attitude of Soliman II. Unless in the interests of Christendom, Tartaglia regarded it as a crime to promote arts of destruction. Inquiries rendered lawful by necessity were, however, resumed in his *Quesiti et Invenzioni Diverse*, a collection of the author's replies to questions addressed to him by persons of the most varied conditions, published in 1546, with a dedication to Henry VIII. of England. Problems in artillery occupy two out of nine books; the sixth treats of fortification; the ninth gives several examples of the solution of equations of the third degree. His last years were full of activity. He published in 1551 *Regola Generale per sollevare ogni affondata Nave, intitolata la Travagliata Invenzione* (an allusion to his personal troubles at Brescia), setting forth a method for raising sunken ships, and describing the diving-bell, then little known in western Europe. He pursued the subject in *Ragionamenti sopra la Travagliata Invenzione* (May 1551), adding a table of specific gravities. Of his largest work, entitled *General Trattato di Numeri e Misure*, two parts appeared at Venice in 1556, the remaining four posthumously in 1560. This is a comprehensive mathematical treatise, including arithmetic, geometry, mensuration, and algebra as far as quadratic equations. He designed to embody the results of his original investigations in a separate form; but his *Algebra Nova* remained unwritten. He published the first Italian translation of Euclid (1543) and the earliest version from the Greek of some of the principal works of Archimedes (1543). These included the tract *De Insidentibus Aquæ*, of which his Latin now holds the place of the lost Greek text. An Italian version of it is appended to his *Ragionamenti*. Tartaglia was the first Italian writer on fortification, and claimed the invention of the gunner's quadrant.

Tartaglia's own account of his early life is contained in his *Quesiti*, lib. vi. p. 74. See also Bittanti's *Discorso di Niccolò Tartaglia*, Brescia, 1871; Buoncompagni, *Intorno ad un Testamento inedito di N. Tartaglia*, Milan, 1881; Libri, *Hist. des Sciences Mathématiques*, t. iii. p. 149; Montucla, *Hist. des Math.*, vol. i. p. 567; Marie, *Hist. des Sciences*, t. ii. p. 242; Hankel, *Zur Gesch. d. Math.*, 1874, p. 360; Rossi, *Elogi di Bresciani Illustri*, p. 386. Tartaglia's writings on gunnery were translated into English by Lucar in 1588, and into French by Rieffel in 1845. Thos. Salusbury published (London, 1664) an English version of his *Travagliata Invenzione*, and a selection from his writings appeared at Venice in 1606 with the title *Opere del Famosissimo Niccolò Tartaglia*, 1 vol. 8vo.

TARTAN is a worsted cloth woven with alternate stripes or bands of coloured warp and weft, so as to form a chequered pattern in which the colours alternate in "sets" of definite width and sequence. The weaving of particoloured and striped cloth cannot be claimed as peculiar to any special race or country, for indeed such checks are the simplest ornamental form into which dyed yarns can be combined in the loom. But the term tartan is specially applied to the variegated cloth used for the principal portions of the distinctive costume of the Highlanders of Scotland. For this costume, and the tartan of which it is composed, great antiquity is claimed, and it is asserted that the numerous clans into which the Highland population were divided had each from time to time a special tartan by which it was distinguished. After the rebellion of 1745 various Acts of Parliament were passed for disarming the Scottish Highlanders and for prohibiting the use of the Highland dress in Scotland, under severe penalties. These Acts remained nominally in force till 1782, when they were formally repealed, and since that time clan tartan has, with varying fluctuations of fashion, been a highly popular article of dress, by no means confined in its use to Scotland alone; and many new and imaginary "sets" have been invented by manufacturers, with the result of introducing confusion in the heraldry of tartans, and of throwing doubt on the reality of the distinctive "sets" which at one time undoubtedly were more or less recognized as the badge of various clans. The manufacture has long been carried on at Bannockburn, in the neighbourhood of Stirling, and it still continues to be a feature of the local industries there.

Undoubtedly the term tartan was known, and the material was woven, "of one or two colours for the poor and more varied for the rich," as early as the middle of the 15th century. In the accounts of John, bishop of Glasgow, treasurer to King James III. in 1471, there occurs, with other mention of the material, the following:—"Ane elne and ane halve of blue Tartane to lyne his gowne of cloth of Gold." It is here obvious that the term is not restricted to particoloured chequered textures.[1] In 1538 accounts were incurred for a Highland dress for King James V. on the occasion of a hunting excursion in the Highlands, in which there are charges for "variant cullorit velvet," for "ane schort Heland coit," and for "Heland tartane to be hose to the kinge's grace." Bishop Lesley, in his *De Origine, Moribus, et Rebus Gestis Scotorum*, published in 1578, says of the ancient and still-used dress of the Highlanders and islanders, "all, both noble and common people, wore mantles of one sort (except that the nobles preferred those of several colours)." George Buchanan, in his *Rerum Scoticarum*

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[1] Neither so is it in the French *tiretaine* or in the Spanish *tiritaña*.

Historia (1582), as translated by Menypenny (1612), says of the Highlanders, "they delight in marled clothes, specially that have any long stripes of sundry colours; they love chiefly purple and blue. Their predecessors used short mantles or plaids of divers colours sundry ways divided; and amongst some the same custom is observed to this day." A hint of clan tartan distinctions is given by Martin in his *Western Isles of Scotland* (1703), which work also contains a minute description of the dress of the Highlanders and the manufacture of tartan. "Every isle," he observes, "differs from each other in their fancy of making plaids, as to the stripes in breadth and colours. This humour is as different through the mainland of the Highlands, in so far that they who have seen those places is able at the first view of a man's plaid to guess the place of his residence."

See W. and A. Smith, *Tartans of the Clans of Scotland*, 1850; J. Sobieski Stuart, *Vestiarium Scoticum*, 1842; R. R. M'Ian, *Clans of the Scottish Highlands*, 1845-46; J. Grant, *Tartans of the Clans of Scotland*, Edinburgh, 1885.

TARTARIC ACID, in its ordinary acceptation, refers to one acid, $(C_4H_4O_6)H_2$, which occurs in most acid fruit juices, in association generally with malic or citric, or both. Grape-juice owes its sourness almost entirely to acid tartrate of potash. While the juice ferments into wine, the greater part of the acid tartrate separates out, along with tartrate of lime, colouring matter, and other impurities, as a hard crust adhering to the sides of the cask. Such impure acid tartrate of potash is known commercially as "argol." It was known to the Greeks as τρύξ, to the Romans as *fæx vini*. The alchemists from the 11th century called it *tartarus*, which name has survived in familiar chemical parlance to this day. The true constitution of *tartarus vini* was discovered by Scheele in 1769. He was the first to isolate the acid from its acid potash salt by a method which is still used for its industrial extraction.

Manufacture.—Crude tartar (10 to 14 cwts.) is placed in a tank, and dissolved in sufficient water with the help of steam. The surplus acid is then neutralized by addition of powdered chalk, and precipitated as lime salt:—

$$2(C_4H_4O_6)KH = \underset{\text{normal salt.}}{(C_4H_4O_6)K_2} + \underset{\text{acid}}{(C_4H_4O_6)H_2};$$

$$(C_4H_4O_6)H_2 + Ca\,CO_3 = (C_4H_4O_6)Ca + H_2O + CO_2.$$

The other half of the tartaric acid which remains dissolved as normal potash salt is then precipitated in the same form by addition of chloride of calcium:—

$$(C_4H_4O_6)K_2 + CaCl_2 = 2KCl + (C_4H_4O_6)Ca.$$

The tartrate of lime precipitate is collected, washed, and decomposed by an excess of sulphuric acid at 75° C.:—

$$(C_4H_4O_6)Ca + H_2SO_4 = CaSO_4 + (C_4H_4O_6)H_2.$$

The sulphate of lime is removed by decanting and filtering, and the acid solution evaporated in leaden pans to a sufficient degree to deposit crystals on standing in the cold. The crystals are purified by redissolving them in hot water, decolorizing the solution with animal charcoal, and causing the acid to crystallize a second time after addition of sulphuric acid, which promotes the formation of large crystals. The crystals contain a little sulphuric acid and a trace of lead; if intended for internal use, they must be recrystallized from pure water.

Tartaric acid forms hard colourless transparent monoclinic prisms of 1·764 spec. grav., easily soluble in cold and abundantly in hot water. It has a strong but agreeable sour taste. At 15° C. 100 parts of water dissolve 138 parts of the acid, 100 of alcohol (absolute) 20·4, and 100 of ether 0·39. It fuses at 135° C. and passes into an amorphous modification known as meta-tartaric acid; when heated more strongly it loses water, and passes into the forms of anhydrides. At high temperatures it is decomposed with formation of charcoal and volatile products, which smell pretty much like those formed from sugar in the same circumstances. Most oxidizing agents produce formic from the aqueous acid. Boiling with oxide of silver and excess of caustic alkali produces oxalate.

Tartaric acid is used largely in calico printing as a discharge. In pharmacy and households it serves, conjointly with bicarbonate of soda or potash, for the extemporaneous preparation of effervescing drinks. The so-called German effervescing powders are a combination of weighed-out doses of tartaric acid and of bicarbonate of soda. In the so-called "seltzogènes" (glass apparatus in which carbonic acid is produced in one compartment, to be forced by its own pressure into a mass of water, wine, &c., in the other) the gas is similarly produced.

Tartrates.—The *acid potash salt*, $(C_4H_4O_6)HK$, "cream of tartar," is prepared from crude tartar (argol) by dissolving it in hot water, filtering off what remains of tartrate of lime and other impurities, and allowing the filtrate to crystallize. The crystals are generally contaminated with a little of the lime-salt, for the removal of which the best method is to treat the powdered crystals with cold dilute hydrochloric acid and then wash them with cold water by displacement. The lime passes into the filtrate. Cream of tartar forms small colourless hard crystals which dissolve in about 200 parts of cold and in 15 parts of boiling water. In alcohol the salt is even less soluble than in water.

The *normal* (neutral) *potash salt*, $(C_4H_4O_6)K_2 + \frac{1}{2}H_2O$, is prepared by dissolving powdered cream of tartar in hot solution of carbonate of potash until a neutral or slightly alkaline solution is produced. The salt, being extremely soluble in water, does not crystallize very readily. In former times the carbonate of potash required used to be made by igniting one half of the cream of tartar to be operated upon in a crucible. Hence the name of *tartarus tartarisatus*, which is still familiar in pharmacy. The salt is used medicinally, and also for removing free acid from excessively sour wine by formation of relatively insoluble bitartrate (Liebig's method).

Rochelle salt, $(C_4H_4O_6)KNa + 4H_2O$, is prepared by not quite neutralizing hot solution of carbonate of soda with powdered cream of tartar. The (filtered) hot solution deposits on cooling magnificent crystals, readily soluble in water, though less so than the unmixed potash salt. Rochelle salt is used as a mild purgative. The so-called Seidlitz powders are effervescing powders with a considerable addition of Rochelle salt to the bicarbonate.

The normal tartrates of lime, baryta, &c., are insoluble precipitates producible by double decompositions.

Tartar emetic, $(C_4H_4O_6)K(SbO) + \frac{1}{2}H_2O$, is produced by boiling 4 parts of oxide of antimony, Sb_2O_3, and 5 of powdered cream of tartar with 50 of water for about an hour. The filtered solution, on cooling, deposits crystals of the above composition soluble in 15 parts of cold and 2·8 of boiling hot water. The crystals generally exhibit the appearance of tetrahedra; yet they are rhombic prisms combined with pyramids. The process going on in the formation of the salt is easily understood if we remember that Sb_2O_3 often acts on aqueous acids as if it were the monoxide, $(SbO)_2O$, of a radical (SbO) antimonyl. $(SbO)_2O + H_2O$ is equivalent to $2(SbO)OH$, and

$$(C_4H_4O_6)KH + OH(SbO) = H_2O + (C_4H_4O_6)K(SbO).$$

Tartar emetic has long had a standing in medicine. In doses of 1–3 grains it acts as a powerful emetic; very small doses ($\frac{1}{16}$ to $\frac{1}{6}$ grain) induce perspiration. Large doses produce poisonous effects.

Analysis.—Tartaric acid is characterized chiefly by the relative insolubility of its acid potash salt. To produce it from a solution of a neutral tartrate, add acetic acid and acetate of potash, and stir vigorously; the salt gradually separates out as a crystalline precipitate. Neutral tartrate solutions, with chloride of calcium, give a precipitate of tartrate of lime, which is at first amorphous, and in this condition dissolves pretty readily in excess of reagent or tartrate, but in general re-separates in the crystalline form (the undissolved tartrate likewise becomes crystalline) on standing.

Anhydrides.—Tartaric acid, when kept at 135°, fuses and becomes meta-tartaric acid without change of weight, and on continued application of 140–150° C., ditartrylic acid, $C_8H_{10}O_{11} = 2C_4H_6O_6 - H_2O$; and at 180° tartrelic acid, $C_8H_8O_{10} = 2C_4H_6O_6 - 2H_2O$, is produced. All these three acids form salts of their own, which, however, tend to become tartrates in the presence of water. At 180° real tartaric anhydride (like tartrelic, $C_8H_8O_{10} = 2C_4H_4O_5$) is produced, in addition to tartrelic acid, as an infusible yellowish mass, insoluble in water and in ether. By continued contact with water it is converted finally into tartaric acid solution.

Isomeric Modifications.—Among these *racemic acid* has long been known as an occasional bye-product in the manufacture of tartaric acid. It used to be believed that racemic acid is present ready formed in certain grape-juices, and thus comes to make its appearance occasionally; but it is well known now that the bulk of it at any rate is produced from what was originally tartaric acid, by the continued action of high temperatures and water. Racemic acid is almost identical with tartaric acid; the only purely chemical point of difference is that corresponding salts of the two acids often crystallize with different proportions of water. The two acids, however, are easily distinguished by their action on polarized light (see POLARITY, vol. xix. p. 314). A solution of tartaric acid turns the plane of polarization to the right; racemic acid is, in this sense, optically inactive. These long-known facts led Pasteur to the discovery of the true relations of the two acids. If the double racemate, $(C_4H_4O_6)Na(NH_4)$, is allowed to crystallize slowly, two kinds of crystals are produced, both bearing hemiedric faces, but differing from each other in the situation of these, exactly as the right hand differs from the left. Pasteur separated the two kinds of crystals, and found that one kind is identical with the ordinary (dextro-) tartrate of soda and ammonia, while the other contains a new kind of tartaric acid, which he called lævo-tartaric acid because it turns the plane of polarization to the left. Equal weights of the two acids, when dissolved separately in water and mixed, unite, with perceptible evolution of heat, into optically neutral racemic acid. Racemic acid, then, is lævo- and dextro-tartaric united (loosely) into one molecule. There are a number of optically inactive tartaric acids, not susceptible of decomposition in the sense in which racemic acid is. (W. D.)

TARTARS (more correctly TATARS, but Tartars is the form generally current), a name given to nearly three million inhabitants of the Russian empire, chiefly Moslem and of Turkish origin. The majority—in European Russia—are remnants of the Mongol invasion of the 13th century (see MONGOLS), while those who inhabit Siberia are survivals of the once much more numerous Turkish population of the Ural-Altaic region, mixed to some extent with Finnish and Samoyedic stems, as also with Mongols. The name is derived from that of the Ta-ta Mongols, who in the 5th century inhabited the north-eastern Gobi, and, after subjugation in the 9th century by the Tungus Kidañs, migrated southward, there founding the Mongolian empire under JENGHIZ KHAN (*q.v.*). Under the leadership of his grandson (Batu) they moved westwards, driving with them many stems of the Turkish Ural-Altaians towards the plains of Russia. The ethnographical features of the present Tartar inhabitants of European Russia, as well as their language, shew that they contain no admixture (or very little) of Mongolian blood, but belong to the Turkish branch of the Ural-Altaic stock, necessitating the conclusion that only Batu, his warriors, and a limited number of his followers were Mongolians, while the great bulk of the 13th-century invaders were Turks. On the Volga they mingled with remnants of the old Bulgarian Turkish empire, and elsewhere with Finnish stems, as well as with remnants of the ancient Italian and Greek colonies in Crimea and Caucasians in Caucasus. The name of Tatars, or Tartars, given to the invaders, was afterwards extended so as to include different stems of the same Turkish branch in Siberia, and even the bulk of the then little known inhabitants of the high plateau of Asia and its north-western slopes, which was described under the general name of Tartary. This last name has almost disappeared from geographical literature, but the name Tartars, in the above limited sense, remains in full use.

The present Tartar inhabitants of the Russian empire form three large groups,—those of European Russia and Poland, those of Caucasus, and those of Siberia. The discrimination of the separate stems included under the name is still far from completion. The following subdivisions, however, may be regarded as established. (1) The Kazañ Tartars, descendants of the Kiptchaks settled on the Volga in the 13th century, where they mingled with survivors of the Bulgar Turks and partly with Finnish stems. They number about half a million in the government of Kazañ, about 100,000 in each of the governments of Ufa, Samara, and Simbirsk, and about 300,000 in Vyatka, Saratoff, Tamboff, Penza, Nijni-Novgorod, Perm, and Orenburg; some 15,000 belonging to the same stem have migrated to Ryazañ, or have been settled as prisoners in the 16th and 17th centuries in Lithuania (Vilna, Grodno, and Podolia); and there are some 2000 in St Petersburg. In Poland they constitute 1 per cent. of the population of the district of Ptock. The Kazañ Tartars speak a pure Turkish dialect; they are middle-sized, broad-shouldered, and strong, and mostly have black eyes, a straight nose, and salient cheek bones. They are Mohammedans; polygamy is practised only by the wealthier classes and is a waning institution. Excellent agriculturists and gardeners, very laborious, and having a good reputation for honesty, they live on the best terms with their Russian peasant neighbours. It may be added that, according to M. Yuféroff (*Étude ethn. sur les Bachkirs*, 1881), those Bashkirs who live between the Kama, Ural, and Volga are not of Finnish origin, but in virtue of their history, language, anthropological features, and customs must be regarded as Tartars. (2) The Astrakhan Tartars (about 10,000) are, with the Mongol Kalmucks, all that now remains of the once so powerful Astrakhan empire. They also are agriculturists and gardeners; while some 12,000 Kundrovsk Tartars still continue the nomadic life of their ancestors. (3) The Crimean Tartars, who occupied the Crimea in the 13th century, have preserved the name of their leader, Nogai. During the 15th, 16th, and 17th centuries they constituted a rich empire, which prospered until it fell under Turkish rule, when it had to suffer much from the wars fought between Turkey and Russia for the possession of the peninsula. The war of 1853 and the laws of 1860-63 and 1874 caused an exodus of the Crimean Tartars; they abandoned their admirably irrigated fields and gardens and moved to Turkey, so that now their number falls below 100,000. Those of the south coast, mixed with Greeks and Italians, are well known for their skill in gardening, their honesty, and their laborious habits, as well as for their fine features, presenting the Tartar type at its best. The mountain Tartars closely resemble those of Caucasus, while those of the steppes—the Nogais—are decidedly of a mixed origin from Turks and Mongolians.

The Tartars of Caucasus, who inhabit the upper Kubañ, the steppes of the lower Kuma and the Kura, and the Araxes, number about 1,350,000. Of these (4) the Nogais on the Kuma show traces of an intimate mixture with Kalmucks. They are nomads, supporting themselves by cattle-breeding and fishing; few are agriculturists. (5) The Karatchais (18,500) in the upper valleys about Elburz live by agriculture. (6) The mountain Tartars (about 850,000), divided into many tribes and of an origin still undetermined, are scattered throughout the provinces of Baku, Erivan, Tiflis, Kutais, Daghestan, and partly also of Batum. They are certainly of a mixed origin, and present a variety of ethnological types, all the more so as all who are neither Armenians nor Russians, nor belong to any distinct Caucasian tribe, are often called Tartars. As a rule they are well built and little behind their Caucasian brethren. They are celebrated for their excellence as gardeners, agriculturists, cattle-tenders, and artisans. Although most fervent Shiites, they are on very good terms both with their Sunnite and with their Russian neighbours. Polygamy is rare with them, and their women go to work unveiled.

The Siberian Tartars, mostly mixed with Finnish stems, are the most difficult to classify. They occupy three distinct regions,—a strip running west to east from Tobolsk to Tomsk, the Altai and its spurs, and South Yeniseisk. They originated in the agglomerations of Turkish stems which in the region north of the Altai succeeded the Ugro-Samoyedic civilization (see SIBERIA), and reached a relatively high degree of culture between the 4th and the 8th centuries, but were subdued and enslaved by the Mongols. In the meantime the following subdivisions of the Siberian Tartars may be accepted. (7) The Baraba Tartars, who take their name from one of their stems (Barama), number about 50,000 in the government of Tobolsk and about 5000 in Tomsk. After a strenuous resistance to Russian conquest, and much suffering at a later period from Kirghiz and Kalmuck raids, they now live by agriculture, either in separate villages or along with Russians. (8) The Tcholym or Tchulym Tartars on the Tcholym and both the rivers Yus speak a Turkish language with many Mongolian and Yakut words, and are more like Mongols than Turks. In last century they paid a tribute for 2550 arbaletes, but they now are rapidly becoming fused with Russians. (9) The Abakan or Minusinsk Tartars occupied the steppes on the Abakan and Yus in the 17th century, after the withdrawal of the Kirghizes, and represent a mixture with Koibals (whom Castrén considers as partly of Ostiak and partly Samoyedic origin) and Beltirs—also of Finnish origin. Their language is also mixed. They are known under the name of Sagais, who numbered 11,720 in 1864, and are the purer Turkish stem of the Minusinsk Tartars, Koibals, and Kyzyl or Red Tartars. Formerly Shamanists, they now are, nominally at least, adherents of the Greek Orthodox Church, and support themselves mostly by cattle-breeding. Agriculture is spreading but slowly among them; they still prefer to plunder the stores of bulbs of *Lilium Martagon*, *Pæonia*, and *Erythronium Dens canis* laid up by the steppe mouse (*Mus socialis*). The Soyotes, or Soyons, of the Sayan Mountains, who are Finns mixed with Turks, the Uryankhes of north-west Mongolia, who are of Turkish origin but follow Buddhism, and the Karagasses, also of Turkish origin but much like the Kirghizes, and reduced now to a *few* hundreds, are akin to the above. (10) The Tartars of the northern slopes of the Altai (nearly 20,000 in number) are of Finnish origin. They comprise some hundreds of Kumandintses, the Lebed Tartars, the Tchernevyie or Black-Forest Tartars, and the Shors (11,000), descendants of the Kuznetsk or Iron-Smith Tartars. They are chiefly hunters, passionately loving their *taiga*, or wild forests, and have maintained their Shaman religion and tribal organization into *uluks*. They live partly also on cedar-nuts and honey collected in the forests. Their dress is that of their former rulers, the Kalmucks, and their language contains many Mongolian words. (11) The Altai Tartars, or "Altaians," comprise—(*a*) the Mountain Kalmucks (12,000), to whom this name has been given by mistake, and who have nothing in common with the Kalmucks except their dress and mode of life, while they speak a Turkish dialect, and (*b*) the Teleutes, or Telenghites (5800), a remainder of a formerly numerous and warlike nation who have migrated from the mountains to the lowlands, where they now live along with Russian peasants.

Finally, there are a number of Tartars in Turkestan and Central Asia. Without including under this name the Sarts and the Kuramintses of Turkestan, still less the Kirghiz-Kazaks, it may be reckoned that there are still nearly 30,000 survivors of the Uigurs in the valley of the Ili, about Kuldja, and in the Khami oasis.

As is evident from the above, although the name Tartars originated in an indiscriminate application of the word to the Turkish and Mongolian stems which invaded Europe six centuries ago, and its gradual extension to the Turkish stems mixed with Mongolian or Finnish blood in Siberia, it still represents an aggregate of characters which warrant at least a provisional use of this genetic name, if those to whom it is given are properly subdivided. It embodies stems which, although widely distinct, still have some common ethnographical and philological features, besides being to some extent of like origin and history.

The literature of the subject is very extensive, and bibliographical indexes may be found in the *Geographical Dictionary* of P. Semenoff, appended to the articles devoted respectively to the names given above, as also in the yearly *Indexes* by M. Mezhoff. Besides the well-known works of Castrén, which are a very rich source of information on the subject, Schiefner (St Petersburg academy of science), Donner, Ahlqvist, and other explorers of the Ural-Altaians, as also those of the Russian historians Solovieff, Kostomaroff, Bestuzheff-Riumin, Schapoff, and Ilovaiskiy, the following containing valuable information may be mentioned:—the publications of the Russian Geographical Society and its branches; the Russian *Etnographicheskiy Sbornik*; the *Isvestia* of the Moscow society of the amateurs of natural science; the works of the Russian ethnographical congresses; Kostroff's researches on the Siberian Tartars in the memoirs of the Siberian branch of the geogr. soc.; Radloff's *Reise durch den Altai*, *Aus Sibirien*; "Picturesque Russia" (*Jivopisnaya Rossiya*); Semenoff's and Potanin's "Supplements" to Ritter's *Asien*; Harkavi's report to the congress at Kazan; Hartakhai's "Hist. of Crimean Tatars," in *Vyestnik Evropy*, 1866 and 1867; "Katchinsk Tartars," in *Isvestia Russ. Geogr. Soc.*, xx., 1884. (P. A. K.)

TARTARUS, in the *Iliad* (viii. 13 *sq.*, 481), is a dark underground prison with iron gates, as far below Hades as earth is below heaven, whither Cronus and the Titans were thrust down by Zeus (vol. xxi. p. 321), and to which the sovereign of Olympus threatens to consign other gods who may disobey his behests. Later writers make Tartarus the place of punishment of the wicked after death: Æneas, in his visit to the abode of the shades, comes to a point where the road divides, the branch to the right leading to Elysium and that on the left to the prison-house of Tartarus, girt about by a triple wall, with the fiery Phlegethon as a moat, and guarded by the fury Tisiphone (*Æn.*, vi. 540 *sq.*). Tartarus is personified as the son of Æther and Ge, and father of the giants Typhoeus and Echidna.

TARTINI, GIUSEPPE (1692–1770), violinist, composer, and musical theorist, was born at Pirano, April 12, 1692, and in early life studied, with equal want of success, for the church, the law courts, and the profession of arms. His life as a young man was wild and irregular, and his temper extremely violent and impulsive. His unfitness for an ecclesiastical career was manifest; and, after failing in jurisprudence, he crowned his improprieties by clandestinely marrying the niece of Cardinal Cornaro, archbishop of Padua. Though the family of Tartini had been legally ennobled, the cardinal resented the marriage as a disgraceful mésalliance, and denounced it so violently that the unhappy bridegroom, thinking his life in danger, fled for safety to a monastery at Assisi, where, calmed by the soothing influence of the religious life, his character underwent a complete change. Docile and obedient, as he had before been passionate and headstrong, he studied the theory of music under Padre Boemo, the organist of the monastery, and, without any assistance whatever, taught himself to play the violin in so masterly a style that his performances in the church became the wonder of the neighbourhood. For more than two years his identity remained undiscovered, but one day the wind blew aside a curtain behind which he was playing, and one of his hearers recognized him and betrayed his retreat to the cardinal, who, hearing of his changed character, readmitted him to favour and restored him to his wife.

Tartini next removed to Venice, where the fine violin-playing of Veracini excited his admiration and prompted him to repair, by the aid of good instruction, the shortcomings of his own self-taught method. After this he studied for some time at Ancona; and here, about 1714, he made the curious acoustical discovery on which his fame as a theorist chiefly rests. He observed that, when two notes are sounded together on the violin with sufficient intensity, a third sound, distinct from both, is simultaneously produced. For the production of this "third sound," as he called it, Tartini failed to account on strict mathematical principles. When the two primary notes form an impure consonance, the "third sound" of Tartini (now known as a difference tone of the first order) is accompanied by beats due to the presence of different tones of higher orders, the existence of which, unknown of course to Tartini, has been established by Helmholtz. Tartini made his observations the basis of a theoretical system which he set forth in his *Trattato di Musica, secondo la vera scienzia dell' Armonia* (Padua, 1754) and *Dei Principij dell' Armonia Musicale* (Padua, 1767). In 1721 he returned to Padua, where he was appointed solo violinist at the church of San Antonio. From 1723 to 1726 he acted as conductor of Count Kinsky's private band, but afterwards returned to his old post at Padua, where he died on February 16, 1770.

Tartini's compositions are very numerous, and faithfully illustrate his passionate and masterly style of execution, which surpassed in brilliancy and refined taste that of all his contemporaries. He frequently headed his pieces with an explanatory poetical motto, such as "Ombra cara," or "Volgete il riso in pianto o mie pupille." Concerning that known as *Il Trillo del Diavolo*, or *The Devil's Sonata*, he told a curious story to Lalande, in 1766. He dreamed that the devil had become his slave, and that he one day asked him if he could play the violin. The devil replied that he believed he could pick out a tune, and thereupon he played a sonata so exquisite that Tartini thought he had never heard any music to equal it. On awaking, he tried to note down the composition, but succeeded very imperfectly, though the resulting *Devil's Sonata* is one of his best and most celebrated productions.

Besides the theoretical works we have mentioned, Tartini wrote a *Trattato delle Appogiature*, posthumously printed in French, and an unpublished work, *Delle Ragioni e delle Proporzioni*, the MS. of which has been lost.

TARUDANT. See MOROCCO, vol. xvi. p. 834.

TASHKEND, or TASHKENT, one of the largest and most important cities of Central Asia, now the capital of Russian Turkestan, is situated in the valley of the Tchirtchik, some 50 miles above its junction with the Syr-Daria, in 41° 20′ N. lat. and 69° 18′ E. long. The city, formerly enclosed by walls which are now ruinous, is surrounded by rich gardens, and its houses are buried among the fruit and other trees which grow all along the numberless ramifications of the irrigation canals. The buildings, which are of stone and sun-dried bricks, are mostly low, on account of the earthquakes which frequently disturb the region. Like all old cities of Asia, Tashkend is subdivided into sections (*yurts*), which are characterized by the special trades carried on in each. Asiatic Tashkend in 1871 had 78,130 inhabitants, mostly Sarts (75,176), with a few Uzbegs, Kirghizes, Jews, Russians, and Germans. A depression in the south-east is occupied by Russian Tashkend, dating from 1865, which has clean, broad streets lined with poplars, the low nice-looking houses being surrounded by gardens. In 1875 its population, exclusive of the military, was 4860, mostly Russians. It has a public library containing a rich collection of works on Central Asia, an observatory, a museum, two gymnasia, a seminary, and the buildings occupied by the administration. A branch of the Russian Geographical Society has been opened at Tashkend, and its publications, as also those of the statistical committee and the *Turkestan Gazette*, contain most valuable information about Turkestan. According to the most recent estimates, the population of

Tashkend, with its suburbs, is reckoned at 100,000. In consequence of the chequered history of the town (see **Turkestan**), few old buildings have been preserved, and only the madrasah Beklar Bek, with its fifty students, and the graves of Sheikh Zenedjin-baba and Zenghi-ata are worthy of mention. The former is four centuries old, and that of Zenghi-ata, a saint held in high veneration throughout Central Asia, yearly attracts thousands of pilgrims.

A variety of petty trades are carried on in numerous small workshops,—weaving and dyeing of cottons and the manufacture of small brass and iron wares, of harness, and especially of boots, being the chief. Most of the inhabitants are also engaged in raising corn, rice, oil-plants, cotton, wine, and lucerne, and in gardening. The trade of Tashkend has lost its former importance, but corn, cattle, silk, cotton, and fruits are still exported, and all kinds of manufactured wares are imported from the countries to the south.

TASMAN, Abel Janszen (*c.* 1602–1659), a distinguished Dutch navigator, born at Hoorn, North Holland, probably in 1602 or 1603. He is known to have made two important voyages of discovery in the Pacific and Southern Oceans; only of the second of them have we a full account. In June 1639 Tasman, along with Matthew Quast, was despatched by Van Diemen, governor-general of the Dutch East Indies, on a voyage to the Western Pacific, which was first directed to the Philippine Islands; part of the coast of Luzon was explored. Sailing east and north Tasman and Quast touched at several of the Bonin Islands, which they were probably the first to discover. Sailing still farther north, in quest of what were then known as the "islands of gold and silver," they reached the latitude of 38° 40′ N., about 600 miles east of Japan, and continued east for other 300 miles on the parallel without discovering anything. On October 15 the navigators decided to return, and, after touching at Japan, anchored at Taiwan-fu, Formosa, November 21. After this, Tasman was engaged in operations in the Indian seas until 1642, when he set out on his first great expedition.[1] Several Dutch navigators had already discovered various portions of the west coast of Australia, and the Dutch East India Company were anxious to obtain a more accurate and extended survey of that land. Sailing from Batavia on August 14, 1642, with two vessels, the "Heemskirk" and "Zeehaan," Tasman on November 24 sighted the land to which he gave the name of Van Diemen, in honour of the governor-general, but which is now named Tasmania. He doubled the land, which he evidently did not know was an island, and, running up Storm Bay, anchored on December 1 in the bay to which he gave the name of Frederick Henry. There he set up a post on which he hoisted the Dutch flag. Quitting Van Diemen's Land on December 5, Tasman steered eastwards with a vague idea of reaching the Solomon Islands, and on December 13 he discovered a "high mountainous country," which he called "Staatenland" (New Zealand). Cruising along the west coast of the South Island, he anchored on the 18th in 40° 50′ S. lat., at the entrance of a "wide opening," which he took to be a "fine bay," but which was no doubt Cook's Strait. He gave the name of Moordenaars (Massacre) Bay to the bay, at which he attempted to land, and where several of his men were killed by the natives. Leaving New Zealand, and pursuing an irregularly north direction, but never coming in sight of Australia, he discovered, on January 21, 1643, two islands belonging to the Friendly group, to which he gave the names of Middelburg (Eova) and Amsterdam (Tongatabu). After discovering several other islands in the Friendly group and their neighbourhood, Tasman steered north and west, reaching the neighbourhood of New Britain on March 22. On the 24th he passed Morghen Islands, and, sailing round New Ireland and along the north coast of New Guinea, he cleared the straits between New Guinea and Jilolo, arriving at Batavia on June 15, after a ten months' voyage.[2] The materials for an account of Tasman's important second voyage in 1644 are extremely scanty; they consist of Tasman's own chart and some fragmentary notes by Burgomaster Witsen in his work (1705) on the migrations of the human race (translated in Dalrymple's collection). Further information as to authorities[3] will be found in Mr R. H. Major's Hakluyt Society volume on *Early Voyages to Australia*, where also will be found the "Instructions" given to Tasman for his voyage to New Guinea. He is instructed to obtain a thorough knowledge of Staten and Van Diemen's Land, and "whether New Guinea is a continent with the great Zuidland, or separated by channels and islands," and also "whether the new Van Diemen's Land is the same continent with these two great countries or with one of them." In this voyage Tasman had three vessels under his command. His discoveries were confined to the north and north-west coasts of Australia, and his chart gives the soundings for the whole of this line of coast. He discovered the Gulf of Carpentaria, and established the continuity of the north-west coast of the land designated generally "the great known south continent," as far south as about the 22d degree. The fullest details as to maps of the voyage and other authorities will be found in Mr Major's Hakluyt Society volume referred to above. Tasman rightly ranks as one of the greatest navigators of the 17th century. He died at Batavia in October 1659.

For personal details, see paper on Tasman by Ch. M. Dozy in *Bijdragen tot de Taal-, Land-, en Volkenkunde van Nederlandsch-Indië*, 5th series, vol. ii. p. 308.

TASMANIA, formerly **Van Diemen's Land**, is a compact island, forming a British colony, which lies to the south of Australia, in the Southern Ocean. It has an area of 24,600 square miles (about three-fourths of the size of Ireland), and some fifty islets belong to it. Most of these lie between it and the southern shore of Victoria, in Bass's Strait. It is a land of mountain and flood, with picturesque scenery. The centre is a mass of hills, generally covered with forest, with large lakes nearly 4000 feet above the sea; and this high land is continued to the west and north-west, while southward are other elevations. Ben Lomond in the east rises to a height of 5020 feet; in the north-west are Dry's Bluff (4257 feet) and Quamby (4000); while westward are Cradle (5069), Hugel (4700), Frenchman's Cap (4760), and Bischoff (2500). Wellington, near Hobart, is 4170 feet. Among the rivers flowing northward to Bass's Strait are the Tamar, Inglis, Cam, Emu, Blyth, Forth, Don, Mersey, Piper, and Ringarooma. The Macquarie, receiving the Elizabeth and Lake, falls into the South Esk, which unites with the North Esk to form the Tamar at Launceston. Westward, falling into the ocean, are the Hellyer, Arthur, and Pieman. The King and Gordon gain Macquarie Harbour; the Davey and Spring, Port Davey. The central and southern districts are drained by the Derwent from Lake St Clair,—its tributaries being the Nive, Dee, Clyde, Ouse, and Jordan. The Huon falls into D'Entrecasteaux Channel. The chief mountain lakes

Pla

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[1] See Siebold's paper in *Le Moniteur des Indes-Orientales et Occidentales*, 1848–49, pt. i. p. 390.

[2] The best English translation of Tasman's *Journal* is in Burney's *Collection*, vol. iii. The Dutch original was published at Amsterdam in 1860, edited by Jacob Swart, and contains the chart of the second voyage.

[3] The subject is thoroughly discussed by P. H. Leupe in the *Bijdragen van het kon. Inst. voor Taal-, Land-, en Volkenkunde v. d. Ind. Archipel*, ser. i. pt. iv. pp. 123–140; in *Bijd. voor Vaderlandsche Geschiedenis en Oudheid Kunde*, by R. Fruin, new series, pt. vii. p. 254; and in the same writer's work *De Reizen der Nederlanders naar Nieuw Guinea* (The Hague, 1875); also Col. A. Haga, *Nederlandsch Nieuw Guinea* (The Hague, 1884).

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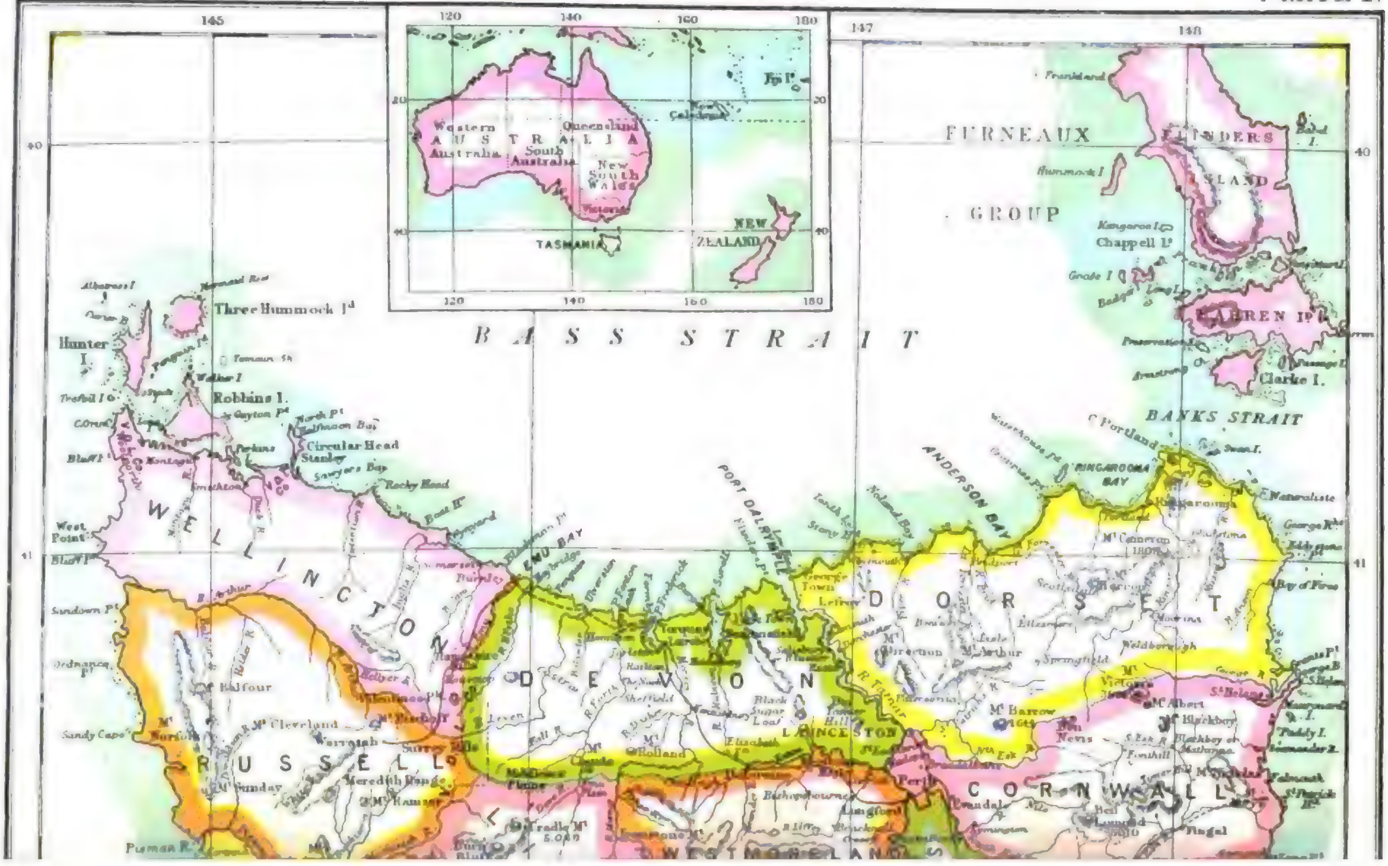

BASS STRAIT
FURNEAUX GROUP
FLINDERS ISLAND
BARREN Iˢ
Clarke I.
BANKS STRAIT
Chappell Iˢ
Hummock I.
Three Hummock Iᵈ
Hunter I.
Robbins I.
Circular Head
Stanley
Rocky Head
West Point
C. Portland
RINGAROOMA BAY
ANDERSON BAY
PORT DALRYMPLE
EMU BAY
George Town
WELLINGTON
DEVON
DORSET
CORNWALL
RUSSELL
LAUNCESTON
WESTMORELAND
Mᵗ Barrow
Mᵗ Victoria
Ben Nevis
Mᵗ Cameron
Perth
Evandale
Sandy Cape
Ordnance Pᵗ
Sandown Pᵗ
Mᵗ Cleveland
Waratah
Balfour
Meredith Range
Cradle Mᵗ
AUSTRALIA
Western Australia
Queensland
South Australia
New South Wales
Victoria
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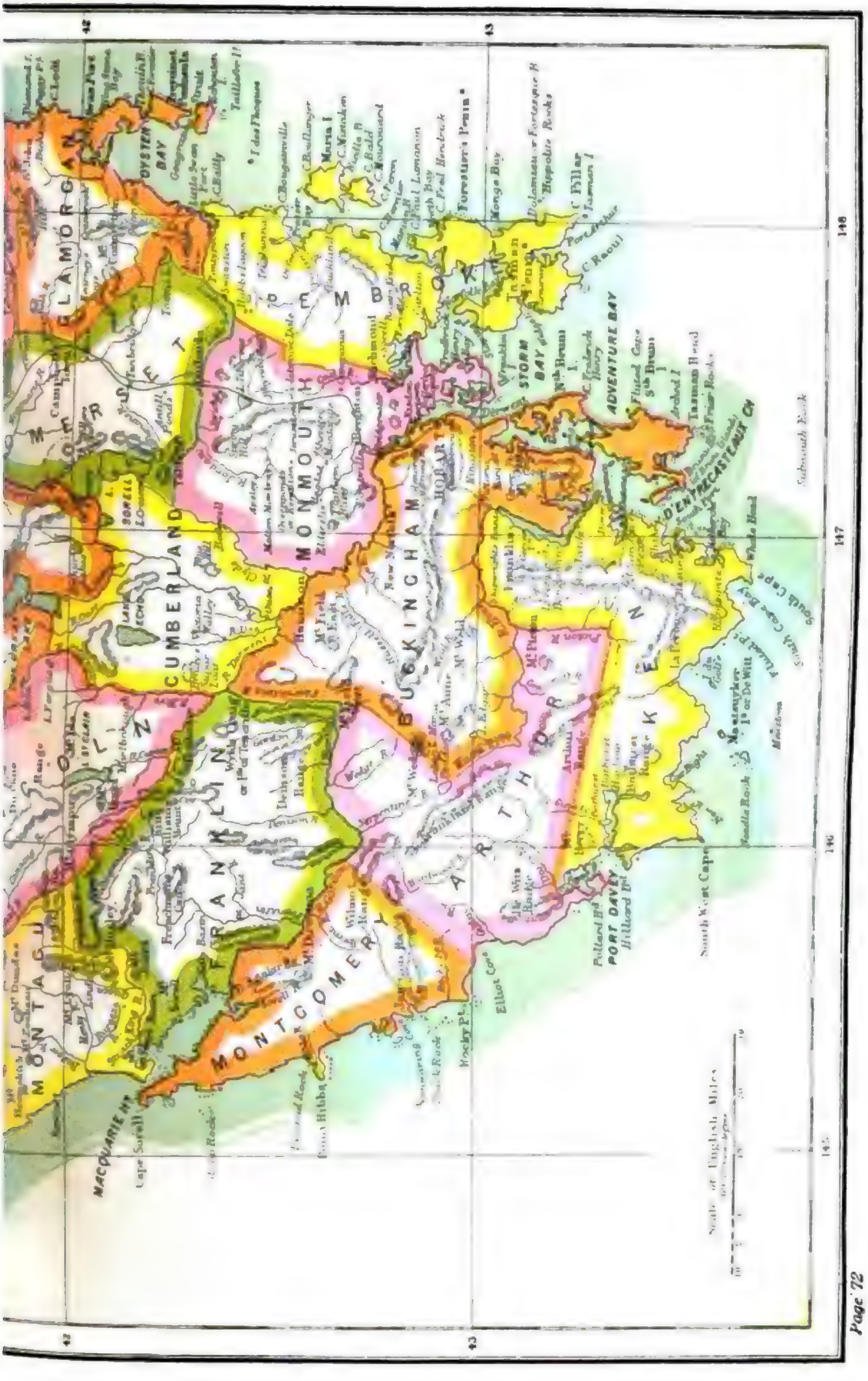
MONTAGU
MONTGOMERY
FRANKLIN
CUMBERLAND
BUCKINGHAM
MONMOUTH
SOMERSET
GLAMORGAN
PEMBROKE
ARTHUR
KENT
HOBART
MACQUARIE HR
PORT DAVEY
STORM BAY
ADVENTURE BAY
D'ENTRECASTEAUX CH
OYSTER BAY
Forestier's Penin.
South Cape Bay
South Cape
South West Cape
Cape Sorell
Elliot Cove
Lake St Clair
Maatsuyker
Mewstone
Pedra Branca
Eddystone
Tasman Head
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are the Great Lake (50 miles in circuit), Sorell, St Clair, Crescent, and Echo. The colony is divided into eighteen counties. The principal towns are Hobart, the capital, on the Derwent, with a population of 21,118 in 1881 (25,044 in 1886), and Launceston (12,752 in 1881; 19,379 in 1886), at the head of the Tamar. The rugged western half of the island has only a few small settlements, while the eastern country is increasing in population on account of the mines.

Climate.—This small colony has a far greater range of climate than can be experienced throughout the Australian continent. The eastern side is dry; the western is very wet. Tin and gold miners are partially arrested in their work during summer from want of water in the north-east. Dense forests and impracticable scrubs result in the west from deposition of a hundred or more inches of rain in the year, while other parts to the east occasionally suffer from drought. Tasmania does not escape the summer visit of an Australian hot wind. Hobart and Launceston, being near the sea, have greater equability of temperature, with rare frosts. The mean temperature of Hobart is 54°, of Waratah in the north-west 44°. Hobart averages 22 inches of rain, less than Melbourne, Sydney, and Brisbane. Inland, in the settled parts, cold is severe in winter, but only for a short period. The wooded north-west shore has no cold and no excessive heat, but plenty of showers. Up in the lake country the climate rather resembles the Highlands of Scotland. On the west and southern coasts the winds are usually strong, and often tempestuous.

Like New Zealand, Tasmania is very healthy. No miasma is retained in its forests. Rheumatism and colds may prevail, but little fever or dysentery occurs. Perhaps no part of the world can show relatively so many aged people. Children generally display the robustness of English village life. As a retreat for Australians, Tasmania in the summer has strong claims. Cool and strengthening airs, magnificent forest solitudes, and secluded fern-tree vales may be enjoyed along with all the comforts of modern civilization.

Geology.—The comparatively recent connexion of Tasmania with Victoria is evidenced not less by rocks than by flora and fauna. The granitic islands of Bass's Strait are as so many stepping-stones across, a depression having converted the loftier districts into islands. The want of similarity, however, between the tufted-haired Tasmanians and their Australian neighbours would indicate that the disruption took place before the advent of the younger race on the northern side. While doubts exist as to the presence of rocks older than the Silurian, a Palæozoic floor exists north, east, south, and west, though often thrown up into irregular ranges, sometimes over 5000 feet, by igneous irruptions. Convulsions have distinguished the history of the little island from one end to the other. Not only is granite in all its varieties very prevalent, but there is an immense amount of metamorphism in different directions. Then, at another period, not merely porphyries, but basalts and greenstones, were widespread in their ravages. They consumed or deranged beds of coal, and overflowed enormous tracts. Earthquakes were busy, and tremendous deluges denuded great areas to depths of thousands of feet, leaving mountains of Primary rock, with peaked or plateau summits of basalt or greenstone. There are prismatic walls several hundreds of feet in height, and 4000 feet above the sea-level, as at Mount Wellington, looking down upon "ploughed fields" of greenstone blocks. Still, unlike Victoria, there are not the extinct craters to tell the tale of more modern lava flows. The lake district, up to over 4000 feet, is a tangled mass of granitic and metamorphic rocks. Quartz is so common a feature that the western storm-bound cliffs reflect a white light to passing ships; while mica, talcose, dolerite, and siliceous schists are common over the island. Contorted slate and the tesselated pavement of Tasman's Peninsula are effects of that transmuting period. Granite is strong at eastern and northern points, at western localities, in the interior, and in the straits. Greenstone is exhibited southward in enormous fields, as well as in the western and lake districts, and alternates often with basalt. Silicified trees are seen standing upright in the floor of igneous rock. The Primary rocks have more casts of former life than fossils in ordinary condition. The Hobart clay-slate abounds in *Fenestella* or lace coral, and trilobites occur in limestone. Slate is abundant on the north-west coast, the South Esk, and westward. New Red Sandstone near Hobart is marked by the presence of salt-beds. The Carboniferous formations are not much exhibited on the western half of the island, but are prominent along the Mersey and other northern rivers. The southern fields are torn by igneous invaders. Anthracitic forms are conspicuous on Tasman's Peninsula. Inland, on the eastern side, the formations spread from near Hobart northward for scores of miles, and even to a thousand feet in thickness. The Fingal and Ben Lomond north-eastern districts are remarkably favoured with Carboniferous sandstones and crinoidal limestones, bearing excellent seams, and like strata are noticed in islands off the east coast. Carbonaceous non-coal-bearing beds by the Mersey are 500 feet thick. Tertiary rocks are not extensive, save in the breccia and coarse sandstone south of Launceston, over Norfolk plains, and along some river valleys. Alluvial gold deposits belong mainly to the Pliocene formations,—the ancient Primaries containing the auriferous quartz veins. Greenstone and basalt belong to various periods, the latter being specially apparent in the Tertiary epoch. Travertine, near Hobart and Richmond, is from freshwater action. The Pleistocene development was characterized by overwhelming denuding forces. Raised beaches are noticed along some of the larger rivers, and westerly moraines would imply a greater elevation of the country formerly. Caves and recent beds exhibit marsupial forms analogous to existing ones. Not far from Deloraine are limestone caves, with passages two miles in extent. The density and intricacy of the island scrubs have interfered with the investigation of its geology.

Minerals.—Tasmania has failed to take a very important position as a gold producer. Still, when the crushing of 1300 tons in one mine produced £11,528, adventurers may well be hopeful. From Beaconsfield mine, west of the Tamar, gold was obtained to the value of £615,330 from July 1878 to January 1, 1887. In 1885 there were five districts under commissioners of mines. Westward, gold is found from Arthur river to Point Hibbs; north-westward, from Blyth river to Cape Grim. In the north-east are Scottsdale, Ringarooma, Mount Victoria, and Waterhouse fields; east, Fingal and St George river. Arsenic and silver are found with gold in the north-east; and iron, arsenic, copper, and lead with it at Beaconsfield. For 1885 the gold export was 37,498 oz., worth £141,319. Silver occurs at Penguin, Mount Ramsey, and Waratah (Mount Bischoff), combined with lead. Copper is met with at Mount Maurice, &c., but not in paying quantities. Bismuth at Mount Ramsey is rich, but the country is difficult to reach. Antimony, zinc, manganese, copper, plumbago, and galena are known west of the Tamar, where also asbestos in serpentine hills is plentiful. Tin is well distributed in Tasmanian granite. Mount Bischoff, in the scrubby, rocky, damp west, has the richest lodes; other mines are in the north-east and west. In ten years the product came to two and a half million pounds sterling. Bischoff district in 1885 gave 2871 tons of ore, much being found in huge blocks. Want of water in the north-east prevents much hydraulic working. Anthracite coal is pretty abundant at Port Arthur. Near Hobart are workings of poor quality. Around Ben Lomond are bituminous seams, but difficult of access. Fingal district has coal equal to that of Newcastle, with a seam of 14 feet, but carriage is difficult. Mersey river coal mines yielded 60,000 tons in the course of over a dozen years. Iron was worked near the Tamar, but did not pay, excess of chromium making it brittle; its steel was very malleable. All varieties of iron ores are known. Hobart freestone is largely exported to other colonies. Tasmanite or dysodile in the Mersey district is an inflammable resinous substance. During 1884 there were raised 41,240 oz. of gold, 5461 tons of tin, and 5334 tons of coal. The total export of gold and tin during the five years 1880 to 1885 was of the value of £2,591,320,—being £642,230 more than for the ten years preceding. The export of tin averaged 79,682 cwt.

Agriculture.—The island has not a large area fit for cultivation. A great part is very mountainous; and dense scrubs, with heavy forests, are impediments to the farmer. The west side is too wet, stormy, and sterile for settlement. Almost all the farms lie in the line between Hobart and Launceston and between Launceston and Circular Head. The climate being cooler and moister than in most parts of Australia, the productions are of an English character, hops, barley, and oats being freely raised. Cropping land for many successive years with wheat has lessened the produce of what was fertile country, as little manure had been used. In later times there has been a great improvement in agriculture. For some time Tasmanian growers did well, supplying Australia and New Zealand with flour, potatoes, and fruit; but, as their customers became in their turn producers, the old markets failed in all but apples and stone fruit. Fresh and preserved fruit, with jams, together with excellent hops, continue to afford the islanders a good trade. In 1885–86 there were 417,777 acres in cultivation; in crop, 144,761; in grasses, 181,203. Wheat occupied 30,266 acres, barley 6833, oats 29,247, pease 7147, potatoes 11,073, hay 41,693, turnips 3680, and gardens and orchards 8198.

So large a part of the island is covered with thicket, rock, and marsh that it appears less pastoral than eastern Australia. The total number of sheep in 1886 amounted to 1,648,627, the horses to 28,610, and the cattle to 138,642. Of 16,778,000 acres only 4,403,888 have been sold or granted.

Flora.—This differs but little from that of south-eastern Australia, with which it was formerly connected. Over a thousand species are represented. The eucalypts are gums, stringy bark, box, peppermint, ironwood, &c. The celebrated blue gum (*Eucalyptus Globulus*), so eagerly sought for pestilential places in southern Europe, Africa, and America, flourishes best in the southern districts of the island. For shipbuilding purposes the timber, which grows to a large size, is much prized. Acacias are abundant, and manna trees are very productive. Sassafras (*Atherosperma moschata*) is a tall and handsome tree. Pines are numerous. The Huon pine (*Dacrydium cupressinum*), whose satin-like wood is so sought after, flourishes in Huon and Gordon river districts. The celery pine is a *Phyllocladus*, and the pencil cedar an *Athrotaxis*. The pepper tree is *Tasmania fragrans*. The *Myrtaceæ* are noble trees. The lakes cider tree is *Eucalyptus resinifera*, whose treacle-like sap was formerly made into a drink by bushmen. Xanthorrœas or grass trees throw up a flowering spike. The charming red flowers of the Tasmanian tulip tree (*Telopea*) are seen from a great distance on the sides of mountains. The so-called rice plant, with rice-like grains on a stalk, is the grass *Richea*. Of *Boronia*, *Epacris*, and *Orchis* there are numerous species. The *Blandfordia*, a Liliaceous plant, has a head of brilliant crimson flowers. The *Casuarina*, *Elæocarpus*, *Banksia*, and tree fern resemble those of Australia. Tasmanian evergreen forests are very aromatic. At one time the island had an extensive timber trade with Sydney, Melbourne, and Adelaide, and it still exports £50,000 to £80,000 worth annually of planks, shingles, paling, &c.

Fauna.—Animal life in Tasmania is similar to that in Australia. The dingo or dog of the latter is wanting; and the Tasmanian devil and tiger, or wolf, are peculiar to the island. The Marsupials include the *Macropus* or kangaroo, *Didelphys* or opossum, *Petaurus* or flying phalanger, *Perameles* or bandicoot, *Hypsiprymnus* or kangaroo rat, *Phascolomys* or wombat; while of *Monotremata* there are the *Echidna* or porcupine anteater and the duck-billed platypus. The marsupial tiger or Tasmanian wolf (*Thylacinus cynocephalus*), 5 feet long, is yellowish brown, with several stripes across the back, having short stiff hair and very short legs (see vol. xv. p. 380). Very few of these nocturnal carnivores are now alive to trouble flocks. The tiger cat of the colonists, with weasel legs, white spots, and nocturnal habits, is a large species of the untameable native cats. The devil (*Dasyurus* or *Sarcophilus ursinus*) is black, with white bands on neck and haunches. The covering of this savage but cowardly little night-prowler is a sort of short hair, not fur. The tail is thick, and the bull-dog mouth is formidable. Among the birds of the island are the eagle, hawk, petrel, owl, finch, peewit, diamond bird, firetail, robin, emu-wren, crow, swallow, magpie, blackcap, goatsucker, quail, ground dove, jay, parrot, lark, mountain thrush, cuckoo, wattlebird, whistling duck, honeybird, Cape Barren goose, penguin duck, waterhen, snipe, albatross, and laughing jackass. Snakes are pretty plentiful in scrubs; the lizards are harmless. Insects, though similar to Australian ones, are far less troublesome; many are to be admired for their great beauty.

Fisheries.—In the early years of occupation the island was the resort of whalers from the United Kingdom, the United States, and France. Both sperm and black oil, with whalebone, were important articles of export till the retreat of the whales to other seas. Sealing was carried on successfully for many years in Bass's Strait, until the seals were utterly destroyed. There has recently been a revival of whaling, the product of the island fishery for 1885 being £12,600. The bays contain some excellent fish, much esteemed in the neighbouring colonies, particularly the trumpeter, found on the southern side of the island. Of nearly 200 sorts of fishes a third can be considered good for food. The outer fisheries extend to 16 miles from shore, being from 20 to 80 fathoms deep. The species include the trumpeter (*Latris*, found up to 60 lb weight), the "salmon" of the old settlers (*Arripis*), the flathead (*Platycephalus*), trevally (*Neptonemus*), garfish (*Hemirhamphus*), barracouta and kingfish (both *Thyrsites*). There are thirteen sorts of perch, and five of bream. The anchovy is migratory. English mackerel have been seen off the east coast; and some of the herrings are much like the English. Rock cod and bull-kelp cod are favourites. Mud oysters are nearly worked out; artificial oyster-beds are being formed. English trout (*Salmo fario*) are more certainly found than the true salmon (*Salmo salar*); the last are doubtful, though numbers have been raised in hatcheries on the Derwent. Among freshwater fish are a so-called freshwater herring (*Prototroctes*), various kinds of what the old settlers called trout (*Galaxias*), blackfish (*Gadopsis*), and fine perch.

Commerce.—Soon after the colony was founded there was a great trade in whale oil, as well as in the oil and skins of seals. When this declined, merchants did well in the exportation of breadstuffs, fruits, and vegetables to the neighbouring and more recently established colonies, not less than to New South Wales. Timber was also freely sent to places less favoured with forests or too busy with other employments. When the trade with England in oil fell off, the export in wool and then of metals succeeded. Tasmania has now an active commerce with Victoria, but has a competitor rather than a customer in New Zealand. The shipping during 1885 was 342,745 tons inward, 335,061 outward. The imports for that year came to £1,757,486; the exports to £1,313,693. Of the exports, £1,299,011 were of Tasmanian products and manufactures,—including wool, £260,480; tin, £357,587; gold, £141,319; fruit, £105,368. The banks of the colony at the end of 1885 showed assets £3,754,226 and liabilities £3,814,631. The savings banks early in 1886 declared £455,774 to the credit of depositors. Attempts have been recently made to draw Tasmania into closer commercial and fiscal relations with Victoria.

Manufactures.—Numerous industries are practised, though not to the extent of exportation, excepting from the working of 28 tanneries, 63 sawmills, 13 breweries, 7 manufactories of jam, and a rising wool factory.

Roads and Railways.—No colony, for its area, was ever so favoured with excellent roads as Tasmania has been. There are now about 5000 miles of good roads. The principal line of railway is that from Hobart to Launceston. Altogether, 260 miles of railway were open in 1887.

Post-Office.—In early years letters were carried by runners on foot across the island. In 1885 there were 246 post offices, and the telegraph had 1579 miles of wire. A submarine line connects Tasmania with Victoria.

Administration.—The governor is appointed by the British crown. The legislative council has eighteen members, and the assembly thirty-six. The revenue for 1885–86 was £571,396, the expenditure £585,766. The public debt, contracted for public works, amounts to three and a third millions. The customs provided £276,100. The official machinery is as extensive as for a colony with seven or eight times the population.

Education.—At first the state made grants in aid to schools established by private persons and religious denominations, but ultimately, as in Victoria and New Zealand, education was made secular and compulsory, religious teaching being out of school hours, or dependent on Sunday schools, which are to be found all over the island. There are 204 public schools, maintained out of a fund of £32,793. In eight grammar and collegiate schools a higher standard of instruction is reached. The degree of Associate of Arts is conferred on deserving scholars in the state schools; and exhibitions (up to £200 a year for four years) enable pupils to study at the higher schools or colonial or European universities. No state grant is now made for the support of any religious denomination.

Population.—The whites have entirely displaced the blacks. Outrages and cruelties led to conflicts; and now the last individual of the tribes has passed away. There are, however, some half-castes on islands in the Straits. The colonists in Tasmania are more concentrated than in other settlements. In 1818 there were 2320 men, 432 women, and only 489 children. At the census of 1881 the population numbered 115,705 (61,162 males, 54,543 females); in 1886 it was estimated at 133,791. The births in 1886 averaged 34·6 per thousand, the deaths 15·2.

History.—The Dutch navigator TASMAN (*q.v.*) sighted the island November 24, 1642, and named it Van Diemen's Land, after the Dutch governor of Java. He took possession at Frederick Henry Bay in the name of the stadtholder of Holland, and then passed on to the discovery of New Zealand. The French Captain Marion in 1772 came to blows with the natives. Captain Cook was at

Adventure Bay, to the south, in 1777. His companion, Captain Furneaux, had entered the bay four years previously, assuring Cook that Van Diemen's Land was joined to New Holland. Admiral Bruni d'Entrecasteaux, with the naturalist La Billardière, entered the Derwent, calling it North River, in 1792. Two years after, Captain Hayes named it Derwent. Mr Bass and Lieutenant Flinders passed through Bass's Strait, and first sailed round the island, in 1798. The high terms in which they spoke of Sullivan's cove, at the mouth of the Derwent, afterwards led to the settlement of Hobart there. The French discovery ships, "Géographe" and "Naturaliste," under Commodore Baudin, were off the coast in 1801–2. The island was settled from Sydney. A small party was sent to the Derwent, under Lieutenant Bowen, in 1803, and another to Port Dalrymple next year under Colonel Paterson, who was removed to Launceston in 1806. Captain Collins, who had been sent with a large number of convicts from England to form a penal colony in Port Philip, thought proper to remove thence after three months, and establish himself at Hobart Town, February 1804. The early days were trying, from want of supplies and of good government; and conflicts arose with the natives, which led to the celebrated Black War. In 1830 nearly all the settlers, with 4000 soldiers and armed constables, attempted to drive the aborigines into a peninsula, but caught only one lad. Mr George Robinson afterwards succeeded in inducing the few hunted ones to surrender and be taken to Flinders Island. Deaths rapidly followed. The last man died in 1862, the last female in 1872. Bushranging was common for years in this scrubby land. The colony was subject to New South Wales till 1825, when independence was declared. On free settlers being permitted to go to Van Diemen's Land, they endeavoured to get freedom of the press, trial by jury, and a popular form of rule. After long struggles, the liberties they sought for were gradually granted. A responsible government was the last boon received. Oppressed by the number of convicts thrown into the country, the free inhabitants petitioned again and again for the cessation of transportation, which was eventually allowed. Among the governors was Sir John Franklin, of polar celebrity. The first newspaper, *The Derwent Star*, came out in 1810. Literature advanced from that humble beginning. At first the Government entirely supported schools and churches, and for many years state aid was afforded to the Church of England, Presbyterian, Wesleyan, and Roman Catholic churches, but this aid is now withdrawn. The island proving too small for a large population, numbers swarmed off to the neighbouring settlements, and Port Philip, now Victoria, received its first inhabitants from Tasmania. Though not so prosperous as Victoria, the little island enjoys an amount of ease and comfort which few, if any, settlements elsewhere have been known to experience. (J. BO.)

TASSIE, James (1735–1799), gem-engraver and modeller, was born of humble parentage at Pollokshaws, near Glasgow, in 1735. During his earlier years he worked as a stone-mason, but, having visited Glasgow on a fair-holiday, and seen the collection of paintings brought together in that city by Robert and Andrew Foulis, the celebrated printers, he was seized with an irresistible desire to become an artist. He removed to Glasgow, attended the academy which had been established there by the brothers Foulis, and, applying himself to drawing with indomitable perseverance, seconded by great natural aptitude, he eventually became one of the most distinguished pupils of the school. When his training was completed he visited Dublin in search of commissions, and there became acquainted with Dr Quin, who had been experimenting, as an amateur, in imitating antique engraved gems in coloured pastes. He engaged Tassie as an assistant, and together they perfected the discovery of a vitreous paste composition, styled "enamel," a substance admirably adapted, by its hardness and beauty of texture, for the formation of gems and medallions. Dr Quin encouraged his assistant to try his fortune in London, and thither he repaired in 1766. At first he had a hard struggle to make his way, for he was modest and diffident in the extreme, and without influential introductions to amateurs and collectors. But he worked on steadily with the greatest care and accuracy, scrupulously destroying all impressions of his gems which were in the slightest degree inferior or defective. Gradually the beauty and artistic character of his productions came to be known. He received a commission from the empress of Russia for a collection of about 15,000 examples; all the richest cabinets in Europe were thrown open to him for purposes of study and reproduction; and his copies were frequently sold by fraudulent dealers as the original gems. He exhibited in the Royal Academy from 1769 to 1791. In 1775 he published the first catalogue of his works, a thin pamphlet detailing 2856 items. This was followed in 1791 by a large catalogue, in two volumes quarto, with illustrations etched by David Allan, and descriptive text in English and French by Rudolph Eric Raspe, F.S.A., enumerating nearly 16,000 pieces Materials exist in MS., in the possession of a descendant of Tassie's, for a list of more than 3000 further items.

In addition to his impressions from antique gems, Tassie executed many large profile medallion portraits of his contemporaries, and these form the most original and definitely artistic class of his works. They were modelled in wax from the life or from drawings done from the life, and—when this was impossible—from other authentic sources. They were then cast in white enamel paste, the whole medallion being sometimes executed in this material; while in other cases the head only appears in enamel, relieved against a background of ground-glass tinted of a subdued colour by paper placed behind. His first large enamel portrait was that of John Dolbon, son of Sir William Dolbon, Bart., modelled in 1793 or 1794; and the series possesses great historic interest, as well as artistic value, including as it does portraits of Adam Smith, Sir Henry Raeburn, Drs James Beattie, Blair, Black, and Cullen, and many other celebrated men of the latter half of the 18th century.

At the time of his death, in 1799, the collection of Tassie's works numbered about 20,000 pieces. (J. M. G.)

TASSIE, William (1777–1860), gem-engraver and medeller, nephew of the above, was born in London on the 4th of December 1777. He succeeded to the business of his uncle, to whose collection of casts and medallions he added largely. His portrait of Pitt, in particular, was very popular, and circulated widely. When the Shakespeare Gallery, formed by Alderman Boydel was disposed of by lottery in 1805, William Tassie was the winner of the prize, and in the same year he sold the pictures by auction for a sum of over £6000. He died at Kensington on the 26th of October 1860, and bequeathed to the Board of Manufactures, Edinburgh, an extensive and valuable collection of casts and medallions by his uncle and himself, along with portraits of James Tassie and his wife by David Allan, and a series of water-colour studies by George Sanders from pictures of the Dutch and Flemish schools. (J. M. G.)

TASSO, Torquato (1544–1595), who ranks with Dante, Petrarch, and Ariosto among the first four poets of Italy, was the son of Bernardo Tasso, a nobleman of Bergamo, and his wife Porzia de Rossi. He was born at Sorrento in 1544. His father had for many years been secretary in the service of the prince of Salerno, and his mother was closely connected with the most illustrious Neapolitan families. The prince of Salerno came into collision with the Spanish Government of Naples, was outlawed, and was deprived of his hereditary fiefs In this disaster of his patron Tasso's father shared. He was proclaimed a rebel to the state, together with his son Torquato, and his patrimony was sequestered. These things happened during the boy's childhood. In 1552 he was living with his mother and his only sister Cornelia at Naples, pursuing his education under the Jesuits, who had recently opened a school there. The precocity of intellect and the religious fervour of the boy attracted general admiration. At the age of eight he was already famous. Soon after this date he joined his father, who then resided in great indigence, an exile and without occupation, in

Rome. News reached them in 1556 that Porzia Tasso had died suddenly and mysteriously at Naples. Her husband was firmly convinced that she had been poisoned by her brother with the object of getting control over her property. As it subsequently happened, Porzia's estate never descended to her son; and the daughter Cornelia married below her birth, at the instigation of her maternal relatives. Tasso's father was a poet by predilection and a professional courtier of some distinction. In those days an Italian gentleman of modest fortunes had no congenial sphere of society or occupation outside the courts of petty ecclesiastical and secular princes. When, therefore, an opening at the court of Urbino offered in 1557, Bernardo Tasso gladly accepted it. The young Torquato, a handsome and brilliant lad, became the companion in sports and studies of Francesco Maria della Rovere, heir to the dukedom of Urbino. The fate which condemned him for life to be a poet and a courtier like his father was sealed by this early entrance into princely palaces. At Urbino a society of cultivated men pursued the æsthetical and literary studies which were then in vogue. Bernardo Tasso read cantos of his *Amadigi* to the duchess and her ladies, or discussed the merits of Homer and Virgil, Trissino and Ariosto, with the duke's librarians and secretaries. Torquato grew up in an atmosphere of refined luxury and somewhat pedantic criticism, both of which gave a permanent tone to his character. At Venice, whither his father went to superintend the printing of the *Amadigi*, these influences continued. He found himself the pet and prodigy of a distinguished literary circle. But Bernardo had suffered in his own career so seriously from addiction to the Muses and a prince that he now determined on a lucrative profession for his son. Torquato was sent to study law at Padua. Instead of applying himself to law, the young man bestowed all his attention upon philosophy and poetry. Before the end of 1562 he had produced a narrative poem called *Rinaldo*, which was meant to combine the regularity of the Virgilian with the attractions of the romantic epic In the attainment of this object, and in all the minor qualities of style and handling, *Rinaldo* showed such marked originality that its author was proclaimed the most promising poet of his time. The flattered father allowed it to be printed; and, after a short period of study at Bologna, he consented to his son's entering the service of Cardinal Luigi d'Este. In 1565, then, Torquato for the first time set foot in that castle at Ferrara which was destined for him to be the scene of so many glories and such cruel sufferings. After the publication of *Rinaldo* he had expressed his views upon the epic in some *Discourses on the Art of Poetry*, which committed him to a distinct theory and gained for him the additional celebrity of a philosophical critic. The age was nothing if not critical; but it may be esteemed a misfortune for the future author of the *Gerusalemme* that he should have started with pronounced opinions upon art. Essentially a poet of impulse and instinct, he was hampered in production by his own rules.

The five years between 1565 and 1570 seem to have been the happiest of Tasso's life, although his father's death in 1569 caused his affectionate nature profound pain. Young, handsome, accomplished in all the exercises of a well-bred gentleman, accustomed to the society of the great and learned, illustrious by his published works in verse and prose, he became the idol of the most brilliant court in Italy. The princesses Lucrezia and Leonora d'Este, both unmarried, both his seniors by about ten years, took him under their protection. He was admitted to their familiarity, and there is some reason to think that neither of them was indifferent to him personally. Of the celebrated story of his love for Leonora this is not the place to speak. It is enough at present to observe that he owed much to the constant kindness of both sisters. In 1570 he travelled to Paris with the cardinal. Frankness of speech and a certain habitual want of tact caused a disagreement with his worldly patron. He left France next year, and took service under Duke Alfonso II. of Ferrara. The most important events in Tasso's biography during the following four years are the publication of the *Aminta* in 1573 and the completion of the *Gerusalemme Liberata* in 1574. The *Aminta* is a pastoral drama of very simple plot, but of exquisite lyrical charm. It appeared at the critical moment when modern music, under Palestrina's impulse, was becoming the main art of Italy. The honeyed melodies and sensuous melancholy of *Aminta* exactly suited and interpreted the spirit of its age. We may regard it as the most decisively important of Tasso's compositions, for its influence, in opera and cantata, was felt through two successive centuries. The *Gerusalemme Liberata* occupies a larger space in the history of European literature, and is a more considerable work. Yet the commanding qualities of this epic poem, those which revealed Tasso's individuality, and which made it immediately pass into the rank of classics, beloved by the people no less than by persons of culture, are akin to the lyrical graces of *Aminta*. It was finished in Tasso's thirty-first year; and when the MS. lay before him the best part of his life was over, his best work had been already accomplished. Troubles immediately began to gather round him. Instead of having the courage to obey his own instinct, and to publish the *Gerusalemme* as he had conceived it, he yielded to the critical scrupulosity which formed a secondary feature of his character. The poem was sent in manuscript to several literary men of eminence, Tasso expressing his willingness to hear their strictures and to adopt their suggestions unless he could convert them to his own views. The result was that each of these candid friends, while expressing in general high admiration for the epic, took some exception to its plot, its title, its moral tone, its episodes, or its diction, in detail. One wished it to be more regularly classical; another wanted more romance. One hinted that the Inquisition would not tolerate its supernatural machinery; another demanded the excision of its most charming passages—the loves of Armida, Clorinda, and Erminia. Tasso had to defend himself against all these ineptitudes and pedantries, and to accommodate his practice to the theories he had rashly expressed. As in the *Rinaldo*, so also in the *Jerusalem Delivered*, he aimed at ennobling the Italian epic style by preserving strict unity of plot and heightening poetic diction. He chose Virgil for his model, took the first crusade for subject, infused the fervour of religion into his conception of the hero Godfrey. But his own natural bias was for romance. In spite of the poet's ingenuity and industry the stately main theme evinced less spontaneity of genius than the romantic episodes with which, as also in *Rinaldo*, he adorned it. Godfrey, a mixture of pious Æneas and Tridentine Catholicism, is not the real hero of the *Gerusalemme*. Fiery and passionate Rinaldo, Ruggiero, melancholy impulsive Tancredi, and the chivalrous Saracens with whom they clash in love and war, divide our interest and divert it from Goffredo. On Armida, beautiful witch, sent forth by the infernal senate to sow discord in the Christian camp, turns the action of the epic. She is converted to the true faith by her adoration for a crusading knight, and quits the scene with a phrase of the Virgin Mary on her lips. Brave Clorinda, donning armour like Marfisa, fighting in duel with her devoted lover, and receiving baptism from his hands in her pathetic death; Erminia seeking refuge in the shepherd's hut,—these lovely pagan women, so touching in their sorrows, so romantic in their adventures, so tender in their emotions, rivet our attention, while we skip the battles, religious ceremonies, conclaves, and stratagems of the campaign. The truth is that Tasso's great invention as an artist was the poetry of sentiment. Sentiment, not sentimentality, gives value to what is immortal in the *Gerusalemme.* It was a new thing in the 16th century, something concordant with a growing feeling for woman and with the ascendant art of music. This sentiment, refined, noble, natural, steeped in melancholy, exquisitely graceful, pathetically touching, breathes throughout the episodes of the *Gerusalemme*, finds metrical expression in the languishing cadence of its mellifluous verse, and sustains the ideal life of those seductive heroines whose names were familiar as household words to all Europe in the 17th and 18th centuries.

Tasso's self-chosen critics were not men to admit what the public has since accepted as incontrovertible. They vaguely felt that a great and beautiful romantic poem was embedded in a dull and not very correct epic. In their uneasiness they suggested every course but the right one, which was to publish the *Gerusalemme* without further dispute. Tasso, already overworked by his precocious studies, by exciting court-life and exhausting literary industry, now grew almost mad with worry. His health began to fail him. He complained of headache, suffered from malarious fevers, and wished to leave Ferrara. The *Gerusalemme* was laid in manuscript upon a shelf. He opened negotiations with the court of Florence for an exchange of service. This irritated the duke of Ferrara. Alfonso hated nothing more than his courtiers leaving him for a rival duchy. He thought, moreover, that, if Tasso were allowed to go, the Medici would get the coveted dedication of that already famous epic. Therefore he bore with the poet's humours, and so contrived that the latter should have no excuse for quitting Ferrara. Meanwhile, through the years 1575, 1576, 1577, Tasso's health grew worse. Jealousy inspired the courtiers to calumniate and insult him. His irritable and suspicious temper, vain and sensitive to slights, rendered him only too easy a prey to their malevolence. He became the subject of delusions,—thought that his servants betrayed his confidence, fancied he had been denounced to the Inquisition, expected daily to be poisoned. In the autumn of 1576 he quarrelled with a Ferrarese gentleman, Maddalo, who had talked too freely about some love affair; in the summer of 1577 he drew his knife upon a servant in the presence of Lucrezia d'Este, duchess of Urbino. For this excess he was arrested; but the duke released him, and took him for change of air to his country seat of Belriguardo. What happened there is not known. Some biographers have surmised that a compromising *liaison* with Leonora d'Este came to light, and that Tasso agreed to feign madness in order to cover her honour. But of this there is no proof. It is only certain that from Belriguardo he returned to a Franciscan convent at Ferrara, for the express purpose of attending to his health. There the dread of being murdered by the duke took firm hold on his mind. He escaped at the end of July, disguised himself as a peasant, and went on foot to his sister at Sorrento.

The truth seems to be that Tasso, after the beginning of 1575, became the victim of a mental malady, which, without amounting to actual insanity, rendered him fantastical and insupportable, a misery to himself and a cause of anxiety to his patrons. There is no evidence whatsoever that this state of things was due to an overwhelming passion for Leonora. The duke, instead of acting like a tyrant, showed considerable forbearance. He was a rigid and not sympathetic man, as egotistical as a princeling of that age was wont to be. But to Tasso he was never cruel,—hard and unintelligent perhaps, but far from being that monster of ferocity which has been painted. The subsequent history of his connexion with the poet, over which we may pass rapidly, will corroborate this view. While at Sorrento, Tasso hankered after Ferrara. The court-made man could not breathe freely outside its charmed circle. He wrote humbly requesting to be taken back. Alfonso consented, provided Tasso would agree to undergo a medical course of treatment for his melancholy. When he returned, which he did with alacrity under those conditions, he was well received by the ducal family. All might have gone well if his old maladies had not revived. Scene followed scene of irritability, moodiness, suspicion, wounded vanity, and violent outbursts. In the summer of 1578 he ran away again; travelled through Mantua, Padua, Venice, Urbino, Lombardy. In September he reached the gates of Turin on foot, and was courteously entertained by the duke of Savoy. Wherever he went, "wandering like the world's rejected guest," he met with the honour due to his illustrious name. Great folk opened their houses to him gladly, partly in compassion, partly in admiration of his genius. But he soon wearied of their society, and wore their kindness out by his querulous peevishness. It seemed, moreover, that life was intolerable to him outside Ferrara. Accordingly he once more opened negotiations with the duke; and in February 1579 he again set foot in the castle. Alfonso was about to contract his third marriage, this time with a princess of the house of Mantua. He had no children; and, unless he got an heir, there was a probability that his state would fall, as it did subsequently, to the Holy See. The nuptial festivals, on the eve of which Tasso arrived, were not therefore the occasion of great rejoicing to the elderly bridegroom. As a forlorn hope he had to wed a third wife; but his heart was not engaged and his expectations were far from sanguine. Tasso, preoccupied as always with his own sorrows and his own sense of dignity, made no allowance for the troubles of his master. Rooms below his rank, he thought, had been assigned him. The princesses did not want to see him. The duke was engaged. Without exercising common patience, or giving his old friends the benefit of a doubt, he broke into terms of open abuse, behaved like a lunatic, and was sent off without ceremony to the madhouse of St Anna. This happened in March 1579; and there he remained until July 1586. Duke Alfonso's long-sufferance at last had given way. He firmly believed that Tasso was insane, and he felt that if he were so St Anna was the safest place for him. Tasso had put himself in the wrong by his intemperate conduct, but far more by that incomprehensible yearning after the Ferrarese court which made him return to it again and yet again. It would be pleasant to assume that an unconquerable love for Leonora led him back. Unfortunately, there is no proof of this. His relations to her sister Lucrezia were not less intimate and affectionate than to Leonora. The lyrics he addressed to numerous ladies are not less respectful and less passionate than those which bear her name. Had he compromised her honour, the duke would certainly have had him murdered. Custom demanded this retaliation, and society approved of it. If therefore Tasso really cherished a secret lifelong devotion to Leonora, it remains buried in impenetrable mystery. He did certainly not behave like a loyal lover, for both when he returned to Ferrara in 1578 and in 1579 he showed no capacity for curbing his peevish humours in the hope of access to her society.

It was no doubt very irksome for a man of Tasso's pleasure-loving, restless, and self-conscious spirit to be kept for more than seven years in confinement. Yet we must weigh the facts of the case rather than the fancies which have been indulged regarding them. After the first few months of his incarceration he obtained spacious apartments, received the visits of friends, went abroad attended by responsible persons of his acquaintance, and corresponded freely with whomsoever he chose to address. The letters written from St Anna to the princes and cities of Italy, to warm well-wishers, and to men of the highest reputation in the world of art and learning, form our most valuable source of information, not only on his then condition, but also on his temperament at large. It is singular that he spoke always respectfully, even affectionately, of the duke. Some critics have attempted to make it appear that he was hypocritically kissing the hand which had chastised him, with the view of being released from prison. But no one who has impartially considered the whole tone and tenor of his epistles will adopt this opinion. What emerges clearly from them is that he laboured under a serious mental disease, and that he was conscious of it. He complains that his disorder at times amounted to frenzy, after which his memory was weakened and his intellectual faculties enfeebled. He saw visions and heard phantom voices. Puck-like spirits made away with his books and papers. The old dread of poison, the old terror of the Inquisition, returned with greater violence. His bodily condition grew gradually worse; and, though he does not seem to have suffered from acute attacks of illness, the intellectual and physical constitution of the man was out of gear. Meanwhile he occupied his uneasy leisure with copious compositions. The mass of his prose dialogues on philosophical and ethical themes, which is very considerable, we owe to the years of imprisonment in St Anna. Except for occasional odes or sonnets—some written at request and only rhetorically interesting, a few inspired by his keen sense of suffering and therefore poignant—he neglected poetry. But everything which fell from his pen during this period was carefully preserved by the Italians, who, while they regarded him as a lunatic, somewhat illogically scrambled for the very offscourings of his wit. Nor can it be said that society was wrong. Tasso had proved himself an impracticable human being; but he remained a man of genius, the most interesting personality in Italy. Long ago his papers had been sequestered. Now, in the year 1580, he heard that part of the *Gerusalemme* was being published without his permission and without his corrections. Next year the whole poem was given to the world, and in the following six months seven editions issued from the press. The prisoner of St Anna had no control over his editors; and from the masterpiece which placed him on the level of Petrarch and Ariosto he never derived one penny of pecuniary profit. A rival poet at the court of Ferrara undertook to revise and re-edit his lyrics in 1582. This was Battista Guarini; and Tasso, in his cell, had to allow odes and sonnets, poems of personal feeling, occasional pieces of compliment, to be collected and emended, without lifting a voice in the matter. A few years later, in 1585, two Florentine pedants of the Della Crusca academy declared war against the *Gerusalemme*. They loaded it with insults, which seem to those who read their pamphlets now mere parodies of criticism. Yet Tasso felt bound to reply; and he did so with a moderation and urbanity which prove him to have been not only in full possession of his reasoning faculties, but a gentleman of noble manners also. Certainly the history of Tasso's incarceration at St Anna is one to make us pause and wonder. The man, like Hamlet, was distraught through ill-accommodation to his circumstances and his age; brain-sick he was undoubtedly; and this is the duke of Ferrara's justification for the treatment he endured. In the prison he bore himself pathetically, peevishly, but never ignobly. He showed a singular indifference to the fate of his great poem, a rare magnanimity in dealing with its detractors. His own personal distress, that terrible *malaise* of imperfect insanity, absorbed him. What remained over, untouched by the malady, unoppressed by his consciousness thereof, displayed a sweet and gravely-toned humanity. The oddest thing about his life in prison is that he was always trying to place his two nephews, the sons of his sister Cornelia, in court-service. One of them he attached to the duke of Mantua, the other to the duke of Parma. After all his father's and his own lessons of life, he had not learned that the court was to be shunned like Circe by an honest man. In estimating Duke Alfonso's share of blame, this wilful idealization of the court by Tasso must be taken into account. That man is not a tyrant's victim who moves heaven and earth to place his sister's sons with tyrants.

In 1586 Tasso left St Anna at the solicitation of Vincenzo Gonzaga, prince of Mantua. He followed his young deliverer to the city by the Mincio, basked awhile in liberty and courtly pleasures, enjoyed a splendid reception from his paternal town of Bergamo, and produced a meritorious tragedy called *Torrismondo*. But only a few months had passed when he grew discontented. Vincenzo Gonzaga, succeeding to his father's dukedom of Mantua, had scanty leisure to bestow upon the poet. Tasso felt neglected. In the autumn of 1587 we find him journeying through Bologna and Loreto to Rome, and taking up his quarters there with an old friend, Scipione Gonzaga, now patriarch of Jerusalem. Next year he wandered off to Naples, where he wrote a dull poem on *Monte Oliveto*. In 1589 he returned to Rome, and took up his quarters again with the patriarch of Jerusalem. The servants found him insufferable, and turned him out of doors. He fell ill, and went to a hospital. The patriarch in 1590 again received him. But Tasso's restless spirit drove him forth to Florence. The Florentines said, "Actum est de eo." Rome once more, then Mantua, then Florence, then Rome, then Naples, then Rome, then Naples—such is the weary record of the years 1590-94. We have to study a veritable Odyssey of malady, indigence, and misfortune. To Tasso everything came amiss. He had the palaces of princes, cardinals, patriarchs, nay popes, always open to him. Yet he could rest in none. To rest would have been so easy, had he possessed the temperament of Berni or of Horace. But he was out of joint with the world. No sensuous comforts, no tranquillity of living, soothed his vexed soul. Gradually, in spite of all veneration for the *sacer vates*, he made himself the laughing-stock and bore of Italy.

His health grew ever feebler and his genius dimmer. In 1592 he gave to the public a revised version of the *Gerusalemme*. It was called the *Gerusalemme Conquistata*. All that made the poem of his early manhood charming he rigidly erased. The versification was degraded; the heavier elements of the plot underwent a dull rhetorical development. During the same year a prosaic composition in Italian blank verse, called *Le Sette Giornate*, saw the light. Nobody reads it now. We only mention it as one of Tasso's dotages—a dreary amplification of the first chapter of Genesis.

It is singular that just in these years, when mental disorder, physical weakness, and decay of inspiration seemed dooming Tasso to oblivion, his old age was cheered with brighter rays of hope. Clement VIII. ascended the papal chair in 1592. He and his nephew, Cardinal Aldobrandini of St Giorgio, determined to befriend our poet. In 1594 they invited him to Rome. There he was to assume the crown of bays, as Petrarch had assumed it, on the Capitol. Lean and worn out with sickness, ready to totter into the tomb, where rest might possibly be found, Tasso reached Rome in November. The ceremony of his coronation was deferred because Cardinal Aldobrandini had fallen ill. But the pope assigned him a pension; and, under the pressure of pontifical remonstrance, Prince Avellino, who held Tasso's maternal estate, agreed to discharge a portion of his claims by payment of a yearly rent-charge. At no time since Tasso left St Anna had the heavens apparently so smiled upon him. Capitolian honours and money were now at his disposal. Yet this good fortune came too late. It seemed as though fate had decided that this man, in all his weakness of character and pathetic grace of genius, should win the stern fame of martyrdom. Both laurel wreath and wealth must be withdrawn from him. Before the crown was worn or the pensions paid he ascended to the convent of St Onofrio, on a stormy 1st day of April in 1595. Seeing a cardinal's coach toil up the steep Trasteverine Hill, those good monks came to the door to greet it. From the carriage stepped Tasso, the Odysseus of many wanderings and miseries, the singer of sweetest strains still vocal, and told the prior he was come to die with him.

In St Onofrio he died, on the 25th of April of that year 1595. He was just past fifty-one; and the last twenty years of his existence had been practically and artistically ineffectual. At the age of thirty-one the *Gerusalemme*, as we have it, was accomplished. The world too was already ringing with the music of *Aminta*. More than this Tasso had not to give to literature. But those succeeding years of derangement, exile, imprisonment, poverty, and hope deferred endear the man to us. Elegiac and querulous as he must always appear, we yet love Tasso better because he suffered through nearly a quarter of a century of slow decline and unexplained misfortune.

Taken altogether, the best complete edition of Tasso's writings is that of Rosini (Pisa), in 33 vols. The prose works (in 2 vols., Florence, Le Monnier, 1875) and the letters (in 5 vols., same publishers, 1853) have been admirably edited by Cesare Guasti. This edition of Tasso's *Letters* forms by far the most valuable source for his biography. No student can, however, omit to use the romantic memoir attributed to Tasso's friend Marchese Manso (printed in Rosini's edition of Tasso's works above cited), and the important *Vita di Torquato Tasso* by Serassi (Bergamo, 1790). To give anything like a complete account of more recent critical and biographical Tasso literature is impossible within the limits of this article. (J. A. S.)

TASSONI, ALESSANDRO, Italian poet, was a native of Modena, where he was born in 1565, and where he died in 1635. From 1599 till 1608 he was secretary to Cardinal Ascanio Colonna, and in this capacity saw some diplomatic service; he was afterwards employed for some time in similar occupations by Charles Emmanuel, duke of Savoy. His best-known literary work is a burlesque epic entitled *La Secchia Rapita*, or "The Rape of the Bucket" (1622), the reference being to a raid of the Modenese upon the people of Bologna in 1325, when a bucket was carried off as a trophy. As in Butler's *Hudibras*, many of the personal and local allusions in this poem are now very obscure, and are apt to seem somewhat pointless to the general reader, but, in spite of Voltaire's contempt, it cannot be neglected by any systematic student of Italian literature (compare vol. xii. p. 512). Other characteristic works of Tassoni are his *Pensieri Diversi* (1612), in which he treats philosophical, literary, historical, and scientific questions with unusual freedom, and his *Considerazioni sopra il Petrarcha* (1609), a piece of criticism showing great independence of traditional views.

TASTE is the sensation referred to the mouth when certain soluble substances are brought into contact with the mucous membrane of that cavity. The sense is located almost entirely in the tongue. Three distinct sensations are referable to the tongue—(1) taste, (2) touch, and (3) temperature. The posterior part of its surface, where there is a Λ-shaped group of large papillæ, called circumvallate papillæ, supplied by the glosso-pharyngeal nerve, and the tip and margins of the tongue, covered with filiform (touch) papillæ and fungiform papillæ, are the chief localities where taste is manifested, but it also exists in the glosso-palatine arch and the lateral part of the soft palate. The middle of the tongue and the surface of the hard palate are devoid of taste. The terminal organs of taste consist of peculiar bodies named taste-bulbs or taste-goblets, discovered by Schwalbe and Lovèn in 1867. They can be most easily demonstrated in the *papillæ foliatæ*, large oval prominences found on each side near the base of the tongue in the rabbit. Each papilla consists of a series of laminæ or folds, in the sides of which the taste-bodies are readily displayed in a transverse section. Taste-bodies are also found on the lateral aspects of the circumvallate papillæ (see fig. 1), in the fungiform papillæ, in the papillæ of the soft palate and uvula, the under surface of the epiglottis, the upper part of the posterior surface of the epiglottis, the inner sides of the arytenoid cartilages, and even in the vocal cords.

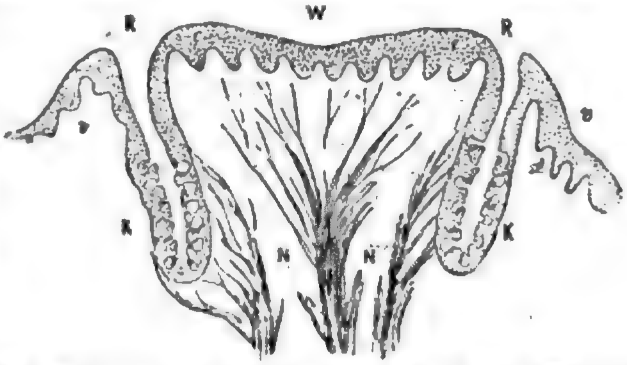

FIG. 1.—Transverse section of a circumvallate papilla: W, the papilla; e, e, the wall in section; R, R, the circular slit or fossa; K, K, the taste-bulbs in position; N, N, the nerves. The figures are from Landois and Stirling's *Physiology*.

The taste-bulbs are minute oval bodies, somewhat like an old-fashioned Florence flask, about $\frac{1}{300}$ inch in length by $\frac{1}{500}$ in breadth. Each consists of two sets of cells,—an *outer* set, nucleated, fusiform, bent like the staves of a barrel, and arranged side by side so as to leave a small opening at the apex (the mouth of the barrel), called the gustatory pore; and an *inner* set, five to ten in number, lying in the centre, pointed at the end next the gustatory pore, and branched at the other extremity. The branched ends are continuous with non-medullated nerve fibres from the gustatory nerve. These taste-bodies are found in immense numbers: as many as 1760 have been counted on one circumvallate papilla in the ox. They are absent in reptiles and birds. F. E. Schultze states that they exist in the mouth of the tadpole, whilst the tongue of the frog is covered with epithelium resembling that of the gustatory bodies. Leydig has described organs having a similar structure in the skins of freshwater fishes and the tadpole: these may possibly be widely distributed taste-organs. The proofs that these are the terminal organs of taste rest on careful observations which have shown (1) that taste is only experienced when the sapid substance is allowed to come into contact with the taste-body, and that the sense

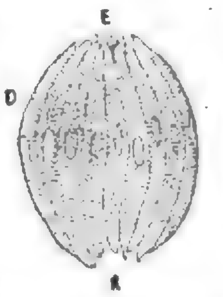

Fig. 2.

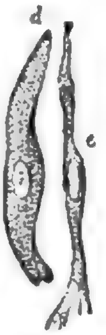

Fig. 3.

FIG. 2.—Isolated taste-bulb: D, supporting or protective cells; K, under end; E free end, open, with the projecting apices of the taste-cells.

FIG. 3.—*d*, Isolated protective cell; *e*, taste-cell.

is absent or much weakened in those areas of mucous membrane where these are deficient; (2) that they are most abundant where the sense is most acute; and (3) that section of the glosso-pharyngeal nerve which is known to be distributed to the areas of mucous membrane where taste is present is followed by degeneration of the taste-bodies. At the same time it cannot be asserted that they are absolutely essential to taste, as we can hardly suppose that those animals which have no special taste-bodies are devoid of the sense.

Taste is no doubt closely allied to smell; hence in invertebrates organs are found that may be referred to either of the senses (see Smell). Tastes have been variously classified. One of the most useful classifications is into sweet, bitter, acid, and saline tastes. To excite the sensation, substances must be soluble in the fluid of the mouth. Insoluble substances, when brought into contact with the tongue, give rise to feelings of touch or of temperature, but excite no taste. The specific mode of action of sapid substances is quite unknown. The extent of surface acted on increases the massiveness of the sensation, whilst the intensity is affected by the degree of concentration of the solution of the sapid substance. If solutions of various substances are gradually diluted with water until no taste is experienced, Valentine found that the sensations of taste disappeared in the following order—syrup, sugar, common salt, aloes, quinine, sulphuric acid; and Camerer found that the taste of quinine still continued although diluted with twenty times more water than common salt. Von Vintschgau found that the time required to excite taste after the sapid substance was placed on the tongue varied. Thus saline matters are tasted most rapidly (·17 second), then sweet, acid, and bitter (·258 second). This is probably due to the activity of diffusion of the substance. No relation between the chemical constitution of the substance and the nature of the taste excited by it has yet been discovered, and there are many curious examples of substances of very different chemical constitutions having similar tastes. For example, sugar, acetate of lead, and the vapour of chloroform have all a sweetish taste. A temperature of from 50° to 90° F. is the most favourable to the sense, water above or below this temperature either masking or temporarily paralysing it. Taste is often associated with smell, giving rise to a sensation of flavour, and we are frequently in the habit of confounding the one sensation with the other. Chloroform excites taste alone, whilst garlic, asafœtida, and vanilla excite only smell. This is illustrated by the familiar experiment of blindfolding a person and touching the tongue successively with slices of an apple and of an onion. In these circumstances the one cannot be distinguished from the other when the nose is firmly closed. No doubt also experience aids in detecting slight differences of taste by suggesting to the mind what may be expected; it is not easy, for instance, to distinguish the tastes of red and white wine when the eyes are blindfolded. Taste may be educated to a remarkable extent; and careful observation—along with the practice of avoiding all substances having a very pronounced taste or having an irritating effect—enables tea-tasters and wine-tasters to detect slight differences of taste, more especially when combined with odour so as to produce flavour, which would be quite inappreciable to an ordinary palate. As to the action of electrical currents on taste, observers have arrived at uncertain results. So long ago as 1752 Sulzer stated that a constant current caused, more especially at the moments of opening and of closing the current, a sensation of acidity at the anode (+ pole) and of alkalinity at the katode (− pole). This is in all probability due to electrolysis, the decomposition products exciting the taste-bodies. Grünhagen found that rapidly interrupted currents fail to excite the sense; Von Vintschgau, who has directed much attention to the sense of taste, says that when the tip of his tongue is traversed by a current there is only a tactile sensation. Again Hönigschmied, on the contrary, found that a current excited the metallic or acid taste at the anode placed on the tip of the tongue, whilst the alkaline taste of the katode was absent. The writer of this article has found that this is the experience of most persons examined by him.

Disease of the tongue causing unnatural dryness may interfere with taste. Substances circulating in the blood may give rise to subjective sensations of taste Thus santonine, morphia, and biliary products (as in jaundice) usually cause a bitter sensation, whilst the sufferer from diabetes is distressed by a persistent sweetish taste. The insane frequently have subjective tastes, which are real to the patient, and frequently cause much distress. In such cases, the sensation is excited by changes in the taste-centres of the brain. Increase in the sense of taste is called *hypergeusia*, diminution of it *hypogeusia*, and its entire loss *ageusia*. Rare cases occur where there is a subjective taste not associated with insanity nor with the circulation of any known sweetish matters in the blood, possibly caused by irritation of the gustatory nerves or by changes in the nerve centres.

As to the comparative anatomy of the tongue, see Owen's *Comparative Anatomy and Physiology of Vertebrates* (London, 1868). For a full account of the physiology of taste, see Von Vintschgau's article "Geschmacksinn," in *Hermann's Handbuch der Physiologie*, vol. iii. part ii. (J. G. M.)

TATARS. See Tartars.

TATE, Nahum (1652-1715), poet-laureate, was born in 1652 in Dublin, and was educated at Trinity College there. He afterwards removed to London, and adopted literature as a profession, succeeding Shadwell as poet-laureate in 1692. He died within the precincts of the Mint, Southwark (whither he had taken refuge from his debtors), August 12, 1715.

His name is still remembered in connexion with the *New Version of the Psalms of David*, which, in conjunction with Nicholas Brady (*q.v.*), he published in 1696 (see Hymns, vol. xii. p. 590). Tate was also the author of some ten dramatic pieces (see *Biogr. Dramatica*, i. 703) and a great number of poems, including one entitled *The Innocent Epicure, or The Art of Angling* (1697).

TATIAN, one of the earliest Christian apologists, whose personality and work had an important influence on the history of the church during the period of the Antonines. He was by birth an Assyrian (according to Zahn of Semitic descent), but received a Greek education, and, after acquiring a very extensive knowledge of Greek literature, began to travel about the Roman empire as a wandering teacher or "sophist." But his inquiring disposition and his earnest spirit remained unsatisfied alike with the religions and the philosophies he encountered, while the doings of men, their greed for amusement and pleasure, their vanity and treachery, disgusted him. In this temper, about 150 A.D., he reached Rome, where the Old Testament fell into his hands, and at the same time he came into closer relations with the Christians; their firm faith, chaste morals, fearless courage, and close fellowship deeply impressed him, and in the end the spectacle of their life and their monotheistic doctrine founded upon prophetic revelation completely conquered him. Henceforward the whole unchristian world, with all its philosophy and culture, presented itself to him as mere darkness and the deception of demons, but the "barbarian philosophy" (for so he called Christianity) as the wisdom of God. He became a convert, and soon afterwards (152-153) wrote (most probably in Greece, where he stayed for some time) his *Oratio ad Græcos*, which gained him great repute among the Christians, and is still extant. This discourse is distinguished from the other apologies of that century by the brusqueness with which its author repudiates the culture of the Greeks; his scorn, however, does not forget to avail itself of the resources of Greek philosophy and rhetoric. His polemic often reminds the reader of the Cynics and of such scoffers as Lucian; his view of things, however, is very different from that of the last-named writer, for with Tatian the "barbarian philosophy," on behalf of which he speaks, which teaches a monotheistic cosmology and inculcates rigid asceticism and renunciation of the world, is indisputably certain. In many details, and even in the general outline of his philosophy, Tatian the Christian continued without knowing it to be a Platonizing philosopher; but that he had undergone a radical change is shown by his views of history and civilization, his faith in one living God, his conviction that truth is contained nowhere else than in the Christian Scriptures, his attitude of trust towards the Logos, made man in Jesus Christ, and finally by his earnest and world-forsaking expectation of judgment to come. The *Oratio*, which is polemical rather than apologetic in its character, has a special importance in the history of Christian dogma, inasmuch as it gives an elaborated exposition of the doctrine of the Logos; it was also read by subsequent writers, as, for example, by Julius Africanus, for its chronological data. Tatian was the first apologist to undertake, on behalf of Christianity, a work of the class which afterwards developed into the numerous "world-histories" written from the Christian point of view. Tatian's diction is often rough, harsh, and abrupt, his sentences involved and inelegant. He has the art, indeed, of expressing himself with uncommon freedom and independence, and can put things also in a very graphic way, but at the same time he is a careless stylist, or rather, as an apostate from the Greek view of things, he has tried to accentuate his breach with classical traditions by elaborate carelessness and deliberate eccentricity.

Tatian soon returned from Greece to Rome, and came into close relations with the famous apologist Justin, whom he reverenced greatly. He himself established a school, to which the afterwards celebrated ecclesiastical writer Rhodon belonged for a time. So long as Justin lived (*i.e.*, till 166) Tatian's doctrines excited no feelings of offence in the Christian community, although even in his *Oratio* there are germs of questionable and unorthodox views. These germs, however, he continued to develop until about 172; and, as about this very time the Roman church became severely opposed to everything Gnostic and heretical, a rupture was inevitable; the date of the breach is given by Eusebius (doubtless following Julius Africanus) as having been 172. But the teaching of Tatian had really become open to challenge. He drew a distinction between the supreme God and the demiurge, considering the latter to be good in his nature indeed, but quite a subordinate being; he accepted the doctrine of a variety of æons; he utterly rejected marriage and the use of animal food; he denied the blessedness of Adam; he began to abandon the allegorical interpretation of the Scriptures and to see genuine difficulties and contradictions in them; he sought to demonstrate from the epistles of Paul the indispensableness of the most rigid asceticism; but indeed all his "heresies" (and he has also been charged with docetism) have their explanation in this desire of his to establish a theoretical basis for his doctrine of the Christian duty of complete world-renunciation. He joined the "Encratites," a sect which indeed had existed before this time, but which received new life from his presence. Of his numerous writings belonging to this period nothing has survived the hostility which sought their repression save a few titles (*βιβλίον προβλημάτων, περὶ τοῦ κατὰ τὸν σωτῆρα καταρτισμοῦ*, &c.) and one or two very interesting fragments in the works of Clement of Alexandria, Origen, and Jerome. Clement of Alexandria seems personally to have known Tatian, and even to have been his pupil for a time. Soon Tatian began also to be assailed in writing by the teachers of the church, and to be set aside as a very prodigy among heretics, and as a man who united the errors of Marcion with those of Valentine. Musanus, Rhodon, Irenæus, the author of the Muratorian fragment (see below), Tertullian, Hippolytus, Clement of Alexandria, and Origen all took part in refuting him.

Towards the end of his life, or perhaps even between 152 and 172, Tatian went from Rome to Mesopotamia, and there—probably in Edessa—wrought a great deal. It is probable that he was in Rome about the year 172, but whether he died there or in his native country is not ascertained. It is very possible that in Syria, where ecclesiastical matters had not been developed so far as in the West, the doctrines of Tatian met with toleration within the Christian communities, but neither of this can we be certain.[1] But this we do know, that a work of Tatian's not yet mentioned, the *Diatessaron*, held its ground in the Syrian churches and even in ecclesiastical use for two whole centuries.

The *Diatessaron* is a gospel very freely and boldly constructed by Tatian out of the four Gospels known to us. It cannot have been produced during his latter years, for all traces of dualism are absent. On the other hand, however, it exhibits certain peculiarities of the theology of its compiler. Probably one would not be far wrong in assigning it to the first years of the reign of Marcus Aurelius. It was written by Tatian in Greek, not in Syriac as Zahn has tried to make out; this is shown—(1) by the title, it being known even among the Syrians as *Diatessaron*; (2) by a few Greek fragments which still survive; (3) by the Latin redaction which it received in the 6th century; (4) by its rejection in the Muratorian fragment—for that the word "m-tia-i," carelessly corrected by the transcriber, stood originally "tatiani" may be regarded as certain.[2] In estimating the work scholars were formerly entirely dependent on certain meagre notices in Eusebius, Theodoret, Ephraem Syrus, Epiphanius, and the later Syrians,[3] but we have recently become possessed of large portions of it, and are now in a position to form for ourselves an idea of its character and plan. In 1877 there was published[4] a Latin translation, by Aucher the Mechitarist, of Ephraem's gospel commentary, which had been preserved in Armenian, and it then became apparent that Ephraem had taken the *Diatessaron* as his basis. This led to further research.[5] Recognizing with other scholars that other Syrian writers also, down to the middle of the 4th century, had used the *Diatessaron* (Theodoret tells us that in his diocese alone he caused more than 800 copies to be withdrawn from use), Zahn undertook the laborious task of restoring the work with the help of Ephraem's commentary and other sources.[6] In details much of what Zahn has given as belonging to the text of the *Diatessaron* remains problematical,—in particular he has not been sufficiently careful in his examination of the work of Aphraates,—but in all the main points his restoration has been successful. The rediscovery of such a work is in a variety of ways of the very highest importance for the early history of Christianity. (1) It is of interest for the history of the canon. It shows that in Tatian's time there was still no recognized New Testament canon, and that the texts of the Gospels were not regarded as inspired. He could not possibly have treated them with such freedom had they been held to be otherwise. But the ecclesiastical use made of his work in Syria shows that Tatian intended it for the church, and, as we are informed further by Eusebius that Tatian also edited the Pauline epistles, we are entitled to conclude that, like Marcion, he wished to frame a special New Testament canon. (2) It is of importance for the Gospels as we now have them. We learn from the *Diatessaron* that about 160 A.D. our four Gospels had already taken a place of prominence in the church and that no others had done so; that in particular the Fourth Gospel had taken a fixed place alongside of the three synoptics. (3) As regards the text of the Gospels, we can conclude from the *Diatessaron* that the texts of our Gospels about the year 160 already ran essentially as we now read them, but that intentional changes were not wanting about the middle of the 2d century. Thus, for example, Tatian in his Gospel according to Matthew found nothing about the "church" and about the building of the church upon Peter the rock. Those sentences therefore are very probably of later interpolation. (4) It is of importance for the light it throws on Tatian's Christianity. The Syriac translation of the *Diatessaron* still falls within the 2d century, but Zahn was mistaken in assuming it to presuppose a prior Syriac translation of the separate Gospels (the so-called *Syrus Curetonianus*); Baethgen[1] has shown the latter to be the later. It was only gradually that the "evangelium der Getrennten" superseded the "evangelium der Gemischten."[2]

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[1] The author of the *Acta Archelai* treats him as a heretic.

[2] See *Zeitschr. f. d. luth. Theol.*, 1874 and 1875; *Zeitschr. f. wiss. Theol.*, 1877; *Zeitschr. f. Kirchengesch.*, iii. p. 400.

[3] See Credner, *Einl.*, i. 437 *sq.*; Semisch, *Tatiani Diatessaron*, 1856.

[4] *Evangelii Concordantis Expositio facta a S. Ephraemo*, Venice.

[5] See Harnack, *Ztschr. f. Kirchengesch.*, iv. p. 471 *sq.*

[6] Zahn, *Tatian's Diatessaron*, 1881.

The best editions of the *Oratio ad Græcos* are those of Worth (Oxford, 1700), Maranus (Paris, 1742), and Otto (Jena, 1851). See Daniel, *Tatian der Apologet*, 1837; Zahn, *Tatian's Diatessaron*, Erlangen, 1881 (compare also his *Evang.-Comm. des Theophilus*, Erlangen, 1883, p. 286 *sq.*); Harnack, *Texte u. Untersuchungen z. Gesch. d. altchr. Lit.*, i. 1; Id., *Ztschr. f. Kirchengesch.*, iv. 471 *sq.*; and *Tatian's Rede an die Griechen übersetzt u. eingeleitet*, Giessen, 1884; Hilgenfeld, *Ketzergesch.*, Leipsic, 1884; Möller, art. "Tatian," in Herzog-Plitt's *Encykl.*, vol. xv.; and Donaldson, *Hist. of Christ. Lit.*, iii. p. 3-62. (A. HA.)

TATIUS, ACHILLES. See ROMANCE, vol. xx. p. 635 *sq.*

TAULER, JOHANN (*c.* 1300-1361), was born about the year 1300 in Strasburg, where his father was a wealthy burgher. It is probable that he entered the Dominican convent in his native city about the year 1313, while Meister Eckhart was still professor of theology (1312-1320) in the monastery school. From Strasburg he went to the Dominican college of Cologne, and some believe that his superiors sent him a few years later to St James's College, Paris. After his theological education was finished he returned to Strasburg. In 1324 the pope placed under an interdict these parts of Germany, including Strasburg, which supported the excommunicated emperor Louis of Bavaria. It was one of the privileges of the Dominican and Franciscan orders to be allowed to perform religious services when the secular and all other regular clergy were silenced by an interdict. The Dominican order, however, had taken the side of Frederick, and in most places refused to say mass; but in Strasburg they remained in the deserted city, kept their churches open, and administered to the citizens the consolations of religion. It is supposed that this conduct of the Strasburg Dominicans was due to the influence of Tauler. In 1339 the heads of the order interfered, and commanded the monks to close their churches. The town council in return banished the Dominicans from the city. Tauler, with some of his brethren, found refuge in Basel, although that city, like Strasburg, sided with the emperor. During these years Basel was the headquarters of the "Friends of God" (*Gottesfreunde*, see MYSTICISM, vol. xvii. p. 133), and Tauler was brought into intimate relations with the members of that pious mystical fellowship. He returned to Strasburg probably in the year 1346. It is somewhat difficult to trace his later life. The Black Death came to Strasburg in 1348, and it is more than probable that, when the city was deserted by all who could leave it, Tauler remained at his post, encouraging by sermons and personal visitations his terror-stricken fellow-citizens. His correspondence with distinguished members of the *Gottesfreunde*, especially with Margaretha Ebner, and the fame of his preaching and other work in Strasburg, had made him known throughout a wide circle of pious people. He seems to have made preaching journeys, in the later years of his life, to Cologne and to other places in the Rhineland. He died in the year 1361.

It is somewhat difficult to form an estimate of the religious life and opinions of Tauler. For many years the chief modern authority upon the subject was the late Prof. C. Schmidt of Strasburg, whose views had been introduced into England in Miss Winkworth's book upon Tauler. According to Schmidt, Tauler's religious life divides into two parts, before and after what may be called his second conversion. In the first period Eckhart rules his religious life; in the second he is under the influence of the mysterious "Friend of God in the Oberland," whom Schmidt asserts to be Nicholas of Basel. Denifle doubts the historical character of this episode and the genuineness of the book, while Preger admits the fact of the conversion, but refuses to identify the mysterious stranger with Nicholas of Basel.

It is still more difficult to determine the precise nature of the theological opinions of Tauler. Denifle maintains that the only genuine remains of Tauler are the eighty well-known *Sermons* included in the earliest edition and four others in two manuscripts, all of which bear Tauler's name; Preger seems inclined to admit in addition the *Sermons* in the account of Tauler's conversion; both critics exclude the famous *Book of Spiritual Poverty*. Schmidt, on the other hand, while admitting the authenticity of all the above-named sermons, calls the *Book of Spiritual Poverty* Tauler's masterpiece.

If we take the *Sermons* by themselves, then Tauler's teachers in theology were the Pseudo-Dionysius, Augustine, Gregory, Bernard, the two abbots of St Victor, Thomas Aquinas, and, above all, Theodoric of Freiburg and Meister Eckhart. His theology will represent the purest and highest type of German mysticism (see MYSTICISM), and, by insisting upon personal relationship to God, freedom from the thraldom of authority, and the worthlessness of mere good works without the renewal of the inward life, will represent a tendency in theology which found full expression in the reformation of the 16th century. If, on the other hand, the *Book of Spiritual Poverty* be included among the genuine writings of Tauler, then undoubtedly his views have more distinct connexion with that doctrine of the appropriation of the benefits of Christ's work of redemption by an *imitatio Christi* finding expression in a life of evangelical poverty which is such a characteristic of the religious life of the century to which he belonged. The problem is a very difficult one, and it may be questioned whether we are yet in a position to solve it. Denifle is undoubtedly correct in his statement that we need critical texts of 14th-century mystical writers, and that very great uncertainty exists with reference to the authors of the individual mystical writings of that period. It may be added that it is very probable, when the organization and method of work among the "Friends of God" are taken into consideration, that many mystical books of devotion were the work, not of one, but of several authors, and that the conditions of the problem concerning the authenticity of Tauler's writings are not unlike those which exist among the books and tracts ascribed to Wickliffe. This at all events may be safely asserted, that Tauler's sermons are among the noblest in the German language. They are not so emotional as Suso's, nor so speculative as Eckhart's, but they are intensely practical, and touch on all sides the deeper problems of the moral and spiritual life.

Tauler's *Sermons* were printed first at Leipsic in 1498, and reprinted with additions from Eckhart and others at Basel (1521, 1522) and at Cologne (1543). There is a recent edition by Julius Hamberger, Frankfort, 1864. See Denifle, *Das Buch von geistlicher Armuth*, 1877; Carl Schmidt, *Johann Tauler von Strassburg*, Hamburg, 1841; Miss Winkworth, *Tauler's Life and Sermons*; R. A. Vaughan, *Hours with the Mystics*, 3d ed., vol. i. pp. 214-307. The third volume of Preger's *Gesch. der deutschen Mystik im Mittelalter*, which will treat of Tauler, is in the press.

TAUNTON, a municipal borough and market-town of Somerset, England, is situated in the beautiful and fertile vale of Taunton Dene, on the river Tone, on the Taunton and Bridgwater Canal, and on several branches of the Great Western Railway, 45 miles south-south-west of Bristol, 31 north-east of Exeter, and 163 west-south-west of London. The river is crossed by a stone bridge of three arches. The town is well built, the three main streets being wide and regular, and meeting in a triangular space in the centre called the Parade, where there is a market cross. The castle, now occupied by the museum of the Somerset Archæological and Natural History Society, is reputed to have been founded by Ine, king of the West Saxons. The earliest portion of the present building was erected by Walter Giffard, bishop of Winchester, in the time of Henry I., but the whole building was repaired in 1496, and an embattled gateway erected by Bishop Langton. The church of St Mary Magdalene, a spacious building with double aisles both north and south of the nave is chiefly Perpendicular, but has remains of Norman work in the chancel arch, and of Early English in the north aisles and transepts. It possesses one of the finest of the characteristic towers of Somerset, but only a facsimile reproduction (erected 1857-62) of the old one. There are still some remains of the Augustinian priory founded by Bishop Giffard, and there are also two modern convents. Taunton is an important centre of education, the principal institutions being the grammar school (founded in 1522 by Richard Fox, bishop of Winchester), Huish's schools, the Independent college (1841), and the Wesleyan collegiate institution (1847). The other principal public buildings are the old market-house, the assembly rooms, the new market in the Ionic style, and the shire hall in the Elizabethan style, opened in 1858 at a cost of £28,000. The charitable institutions include the Taunton and Somerset hospital (opened in 1809 and extended in 1870 and 1873), the eye infirmary (1816), Gray's almshouses and chapel (1635), St Saviour's home for boys (1870), and the servants' training home (1882). The town possesses manufactories of silk, collars and cuffs, and gloves, iron and brass foundries, coach-building works, and breweries. There is also a considerable agricultural trade. The population of the municipal and parliamentary borough (area 1249 acres) in 1881 was 16,614. The population of the same area in 1871 was 15,466.

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[1] *Evangelienfragmente: Der Griechische Text des Cureton'schen Syrers*, Leipsic, 1885.

[2] On the *Diatessaron*, its later history and various editions, see (besides Zahn, as cited above) the *Codex Fuldensis*, ed. Ranke, 1868; Schmeller, *Ammonii Alex. quæ et Tatiani dicitur Harmonia Evang.*, 1841; Sievers, *Tatian*, Lat. and Ger., Paderborn, 1872; Martin, "De Tatiani Diatessaron Arabica Versione," in Pitra's *Analecta Sacra*, vol. iv. (1883), pp. 465. 487.

Taunton has played a prominent part during the troubled periods of English history. Various Roman remains prove it to have been occupied by the Romans; but it first obtained historical notice when Ine, king of the West-Saxons, made it the border fortress of his kingdom. It takes the name Taunton, or Thoneton, from its situation on the Tone or Thone. The castle was razed by Ethelburg after expelling Edbricht, king of the South-Saxons. About the time of William the Conqueror the town and castle were granted to the bishop of Winchester, and for many years the castle was the bishop's principal residence. In the reign of William it possessed a mint. In 1497 the town and castle were seized by the impostor Perkin Warbeck. Taunton was made the seat of the suffragan see of Taunton and Bridgwater in 1538, but, on the death of William Finch, the first bishop, in 1559, the Act had no further operation in reference to Taunton. Like the other towns of Somerset, Taunton was strongly Puritan in its sympathies. Situated at a point where the main roads of the county met, it was during the Civil War almost constantly in a state of siege by one or other of the rival parties. Having been garrisoned by the Parliamentary forces, it was captured by the Royalists in the summer of 1643, but on 8th July 1644 it was, after a long siege, taken by Blake, who held it with heroic pertinacity till relieved by Fairfax on the 11th May 1645, and again after it was invested by 10,000 troops under Goring till the siege was finally raised on the 3d July. Still constant to its Puritan traditions, Taunton welcomed Monmouth in 1685 with acclamation, and he was proclaimed king there on the 20th June, the maidens of the town presenting him with a standard. As a consequence, Taunton was made the chief example of the fearful vengeance of Jeffreys, who, at the assizes held in the castle, condemned no fewer than 134 inhabitants of the town and neighbourhood to death, and a much larger number to transportation. Taunton obtained a municipal charter from Charles I. in 1627, which was revoked in 1660. A second charter, granted by Charles II. in 1677, was permitted to lapse in 1792 owing to the corporation allowing a majority of their number to die without filling up the vacancies. From this time until it again received municipal government, 17th April 1877, it was under the care of two bailiffs appointed at the court leet of the lord of the manor. Formerly the town returned two members to parliament, but in 1885 the number was reduced to one.

See Toulmin's *History of Taunton*, edited by Savage, 1822; and several papers in the *Proceedings* of the Somerset Archæological Society for 1872.

TAUNTON, a city of the United States, the county seat of Bristol county, Massachusetts, lies some 31 miles nearly south from Boston. The town proper, sometimes called Taunton Green, stands on the right bank of the Taunton river, at the head of navigation, about 17 miles above its mouth. The entire area enclosed within the corporate limits is 37 square miles. Taunton is traversed by the main line of the Old Colony Railway, which connects it with Boston and Fall River, Mass., and Providence, R.I. Owing to its situation and its connexions by rail and sea, Taunton has become a supply point for the greater part of south-eastern Massachusetts. The population of the city was 18,629 in 1870, 21,213 in 1880, and 23,674 in 1885, showing an increase somewhat in excess of that of the State at large. Fully one-fourth of the population are of foreign birth, and the proportion is increasing. The State lunatic asylum is in Taunton. The leading industries are the manufacture of cotton goods, iron and steel products (particularly locomotives, machinery, nails and spikes), and silver-plated table ware. Taunton was incorporated as a town in 1639, and received a city charter in 1864.

TAURIDA, a government of southern Russia, includes the peninsula of CRIMEA (*q.v.*) and a tract of mainland situated between the lower Dnieper and the coasts of the Black Sea and the Sea of Azoff, and is bounded by these two seas on the S., while it has on the N. the governments of Kherson and Ekaterinoslaff. The area is 24,540 square miles, of which 6990 square miles belong to the Crimea; its continental part consists of a gently undulating steppe of black earth, with only a few patches of salt clay on the banks of the Sivash or Putrid Sea, and sands in the lower course of the Dnieper. It is watered by the Dnieper, which flows along the frontier for 180 miles, and by two small rivers, the Molotchnaya and Berda. Many small lakes and ponds occur in the north, especially among the Dnieper sands, as well as on the Kinburn peninsula, at the mouth of the Dnieper, where salt is made. There are no forests except the artificial plantations in the colonies of the Mennonites. The climate is continental, and resembles that of central Crimea and Kherson. The population in 1883 was 940,530 (247,780 in Crimea). The continental portion, although less mixed than that of the peninsula, consists of Russians (Great, Little, and White Russians), who constitute 83 per cent. of the population, Germans (11 per cent.), Bulgarians (5 per cent.), and Jews (1 per cent.).

Agriculture and cattle-breeding are the leading occupations. Wheat is the chief product, and by the Germans and Russian Nonconformists on the Molotchnaya agriculture is carried to a high degree of perfection. In 1882 there were within the government 356,270 horses, 485,800 cattle, and 3,985,300 sheep (2,891,700 merinos). Salt is made both on the mainland and in the Crimea, and the fisheries along the coast supply an export trade. Manufactures are insignificant, but there is a brisk export trade in grain, salt, fish, wool, and tallow. The main centres of trade are the Kakhovka port on the Dnieper, Berdyansk on the Sea of Azoff, and the seaports of Eupatoria, Sebastopol, Sudak, and Theodosia. The government is divided into eight districts, the chief towns of which (with populations in 1881) are Simferopol (29,030), capital of the government, Eupatoria (13,420), and Theodosia (10,800) in Crimea, and Aleshki (8915), Berdyansk (18,180), Melitopol (13,310), Perekop (4280), and Yalta (3000) on the continent. Several villages, such as Bolshoy Tokmak (8000) and Andreevka (7300), have each a population of more than 5000.

TAUROMENIUM. See TAORMINA.

TAURUS. See ASIA MINOR, vol. ii. p. 704-5.

TAVERNIER, JEAN BAPTISTE (1605-1689), the celebrated traveller and pioneer of French trade with India, was born (1605) at Paris, where his father Gabriel and uncle Melchior, Protestants from Antwerp, pursued with reputation and success the profession of geographers and engravers. The conversations he heard in his father's house inspired Jean Baptiste with an early desire to travel, and in his sixteenth year he had already visited England, the Low Countries, and Germany, and seen something of war with the imperialist Colonel Hans Brenner, whom he met at Nuremberg. Four and a half years in the household of Brenner's uncle, the viceroy of Hungary (1624-29), and a briefer connexion in 1629 with the duke of Rethel and his father the duke of Nevers, prince of Mantua, gave him the habit of courts, which was invaluable to him in later years, and at the defence of Mantua in 1629, and in Germany in the following year with Colonel Walter Butler (afterwards notorious through the death of Wallenstein), he gained some military experience. When he left Butler to view the diet of Ratisbon in 1630, he had seen Italy, Switzerland, Germany, Poland, and Hungary, as well as France, England, and the Low Countries, and spoke the principal languages of these regions. He was now eager to visit the East, and at Ratisbon he found the opportunity to join two French fathers, M. de Chapes and M. de St Liebau, who had received a mission to the Levant. In their company he reached Constantinople early in 1631, and here he spent eleven months, and then proceeded by Tokat, Erzerum, and Erivan to Persia. His farthest point in this first journey was Ispahan; he returned by Baghdad, Aleppo, Alexandretta, Malta, and Italy, and was again in Paris in 1633. Of the next five years of his life nothing is known with certainty, but it is probable that it was during this period that he became controller of the household of the duke of Orleans. In September 1638 he began a second journey (1638–43) by Aleppo to Persia and thence to India as far as Agra and Golconda. His visit to the court of the Great Mogul and to the famous diamond mines was, of course, connected with the plans realized more fully in his later voyages, in which Tavernier travelled as a merchant of the highest rank, trading in costly jewels and other precious wares, and finding his chief customers among the greatest princes of the East. The second journey was followed up by four others. In his third journey (1643–49) he went as far as Java and returned by the Cape; but his relations with the Dutch proved not wholly satisfactory, and a long lawsuit on his return yielded but imperfect redress. In his last three journeys (1651–55, 1657–62, 1664–68) he did not proceed beyond India. The details of these voyages need not detain us here, and indeed are often obscure: but they completed an extraordinary knowledge of the routes of overland Eastern trade, and brought the now famous merchant into close and friendly communication with the greatest Oriental potentates. They also secured for him a large fortune and great reputation at home. He was presented to Louis XIV., "in whose service he had travelled sixty thousand leagues by land," received letters of nobility (16th February 1669), and in the following year purchased the barony of Aubonne, near Geneva. In 1662 he had married Madeleine Goisse, daughter of a Parisian jeweller.

Thus settled in ease and affluence, Tavernier occupied himself, as it would seem at the desire of the king, in publishing the account of his journeys. He had neither the equipment nor the tastes of a scientific traveller, but in all that referred to commerce his knowledge was vast and could not fail to be of much public service. He set to work therefore with the aid of Samuel Chappuzeau, a French Protestant littérateur, and produced a *Nouvelle Relation de l'Intérieur du Sérail du Grand Seigneur* (4to, Paris, 1675), based on two visits to Constantinople in his first and sixth journeys. This was followed by *Les Six Voyages de J. B. Tavernier* (2 vols. 4to, Paris, 1676) and by a supplementary *Recueil de Plusieurs Relations* (4to, Paris, 1679), in which he was assisted by a certain La Chapelle. This last contains an account of Japan, gathered from merchants and others, and one of Tong-king, derived from the observations of his brother Daniel, who had shared his second voyage and settled at Batavia; it contained also a violent attack on the agents of the Dutch East India Company, at whose hands Tavernier had suffered more than one wrong. This attack was elaborately answered in Dutch by H. van Quellenburgh (*Vindiciæ Batavicæ*, Amst., 1684), but made more noise because Arnauld drew from it some material unfavourable to Protestantism for his *Apologie pour les Catholiques* (1681), and so brought on the traveller a ferocious onslaught in Jurieu's *Esprit de M. Arnauld* (1684). Tavernier made no reply to Jurieu; he was in fact engaged in weightier matters, for in 1684 he travelled to Berlin at the invitation of the Great Elector, who commissioned him to organize an Eastern trading company,—a project never realized. The closing years of Tavernier's life are obscure; the time was not favourable for a Protestant, and it has even been supposed that he passed some time in the Bastille. What is certain is that he left Paris for Switzerland in 1687, that in 1689 he passed through Copenhagen on his way to Persia through Muscovy, and that in the same year he died at Moscow. It appears that he had still business relations in the East, and that the neglect of these by his nephew, to whom they were intrusted, had determined the indefatigable old man to a fresh journey.

Tavernier's travels, though often reprinted and translated, have two defects: the author uses other men's material without distinguishing it from his own observations; and the narrative is much confused by his plan of often deserting the chronological order and giving instead notes from various journeys about certain routes. The latter defect, it is true, while it embarrasses the biographer, is hardly a blemish in view of the object of the writer, who sought mainly to furnish a guide to other merchants. A careful attempt to disentangle the thread of a life still in many parts obscure has been made by Charles Joret, *Jean Baptiste Tavernier d'après des Documents Nouveaux*, 8vo, Paris, 1886, where the literature of the subject is fully given.

TAVIRA, a seaport of Portugal, in the province of Algarves, at the mouth of the Seca, 21 miles east-north-east of Faro. It is regularly built, and has an alcazar, used as an official residence, besides other public buildings. It has sardine and tunny fisheries, and carries on a considerable coasting trade. Excellent fruit is grown in the neighbourhood. The population in 1878 was 11,459.

TAVISTOCK, a town of Devonshire, England, is finely situated in the valley of the Tavy, on the western border of Dartmoor, and on the South Devon Railway, 15 miles north of Plymouth, 14 south-east of Launceston, and 213 west-south-west of London. The town has been greatly improved since 1845, chiefly at the expense of the duke of Bedford, by the construction of a system of sewage and the erection of many new dwellings suitable for the working classes. There are some remains (including a portion in the square, now used as a public library established in 1799) of the magnificent abbey of Sts Mary and Rumon, first founded in 961 by Orgar, earl of Devon. After destruction by the Danes in 997 it was restored, and among its famous abbots were Lyfing, friend of Canute, and Aldred, who crowned Harold II. and William, and died archbishop of York. The abbey church was rebuilt in 1285, and the greater part of the abbey in 1457–58. The church of St Eustachius possesses a lofty tower supported on four open arches. Among the principal public buildings are the guildhall (1848), the corn market (1838), the market buildings (1858), and the new hall for concerts and public entertainments. Near the town is Kelly College, opened in 1877, founded by Admiral Benedictus Marwood Kelly, with a preference for the founder's kin. Mines of copper, manganese, lead, silver, and tin are in the neighbourhood, and the town possesses a considerable trade in cattle and corn, as well as a brewery. The population of the township in 1881 was 6914. The parliamentary borough (area 11,450 acres), which had a population in 1871 of 7725 and in 1881 of 6879, was merged in the county in 1885.

The town owes its origin to the foundation of the abbey in 961. From Henry I. the abbots obtained the entire jurisdiction of the hundred of Tavistock, with a weekly market. A school for Saxon literature was established by the monks, which flourished till the Reformation. The Royalists were quartered at Tavistock after the defeat of the Parliamentarians on Bradock Down in 1643, and Charles I. visited it on his way to Cornwall. It returned members to parliament from the time of Edward I. till 1885, among its representatives having been John Pym, the great opposer of the policy of Charles I., and William, Lord Russell, beheaded in the reign of Charles II. Among the famous natives of Tavistock are Sir John Glanville, judge under James I., William Brown, the author of *Britannia's Pastorals*, and Sir Francis Drake, of whom a colossal statue by Boehm was presented to the town by the duke of Bedford in 1883.

TAVOY, a British district in the Tenasserim division of Burmah, lying between 13° 15′ and 15° 11′ N. lat. and between 97° 48′ and 98° 44′ E. long. It has an area of 7200 square miles, and is bounded on the N. by Amherst district, E. by the Yoma Mountains, S. by Mergui district, and W. by the Bay of Bengal. The district is enclosed by mountains on three sides, viz., the main chain of the Yomas on the east, rising in places to 5000 feet, which, with its densely wooded spurs, forms an almost impassable barrier between British and Siamese territory; the Nwahlabo in the centre, which takes its name from its loftiest peak (5000 feet); and a third range, under the name of Thinmaw, between the Nwahlabo and the sea-coast. The chief rivers are the Tenasserim and Tavoy, the former being formed by the junction of two streams which unite near Met-ta; for the greater part of its course it is dangerous to navigation. The Tavoy is navigable for vessels of any burden. It is interspersed with many islands, and with its numerous smaller tributaries affords easy and rapid communication over the country. The climate is on the whole pleasant. The rainfall averages about 190 inches a year.

The census of 1881 returned the population of Tavoy at 84,988 (males 41,785, females 43,203), of whom 82,187 were Buddhists, 828 were Mohammedans, and 1368 were Christians. The headquarters and capital is Tavoy town, which is situated on the left bank of the river of the same name, and contained a population of 13,372 in 1881. Of the total area, only 83,740 acres are (1885–86) cultivated. Rice is the principal product; the betel-nut is extensively grown for home consumption; and the district is particularly rich in fruit trees. With its only port difficult of access, and with no means of internal communication, the trade of Tavoy district has always been small and almost entirely confined to Siam and the Straits Settlements. The principal imports are piece goods and other cotton manufactures, raw silk, tea, crockery, wines and spirits, metals, and provisions The chief manufactures are salt and earthen pots. The gross revenue of the district in 1885–86 was £20,235, of which the land contributed £12,663. Tavoy was handed over to the British at the end of the first Burmese war in 1824. A revolt broke out in 1829, headed by Moung Da, the former governor, which was at once quelled, and since then the district has remained in undisturbed possession of the British.

TAWING. See Leather.

TAXATION, With regard to taxes in general Adam Smith lays down four maxims which have been briefly described as the maxims of *equality*, *certainty*, *convenience*, and *economy*. The treatment of the general principles of taxation by subsequent writers consists in the main of the development and criticism of these celebrated canons.

Equality. *Equality of Taxation.*—The subjoined passage from Adam Smith contains the germs of several distinct theories of what constitutes just or equal taxation:—

> "The subjects of every state ought to contribute towards the support of its government as nearly as possible in proportion to their respective abilities, that is, in proportion to the revenue which they respectively enjoy under the protection of the state. The expense of government to the individuals of a great nation is like the expense of management to the joint tenants of a great estate, who are all obliged to contribute in proportion to their respective interests in the estate. In the observation or neglect of this maxim consists what is called the equality or inequality of taxation. Every tax, it must be observed once for all, which falls finally upon one only of the three sorts of revenue above-mentioned [viz., rent, wages, profits] is necessarily unequal in so far as it does not affect the other two. In the following examination of different taxes I shall seldom take much further notice of this sort of inequality, but shall in most cases confine my observations to that inequality which is occasioned by a particular tax falling unequally upon that particular sort of private revenue which is affected by it."

The first sentence implies (*a*) that every Government has the *right* to exact contributions for its support from all its subjects. According to this view. the right of taxation is derived directly from the conception of sovereignty. It was the determination to insist on this principle which led to the retention of the 3d. per ℔ duty on tea, that "figment of a tax, that peppercorn rent," which lost the British their American colonies. The Americans opposed to this absolute doctrine the maxim that taxation ought to be coincident with *representation*,—that only those who shared in the powers should have the burdens of government. If the latter opinion is strictly construed it would follow that all taxes on articles of universal consumption are unjust except in a country where all who have the natural have also the legal capacity of voting. The doctrine of sovereignty as the basis of taxation, pushed to its logical extreme, results in the maxim that a Government should impose such taxes as are "most easily assessed and collected, and are at the same time most conducive to the public interests" (M'Culloch). Just as a general looks to the efficiency of his army as a whole, and is prepared to sacrifice any portion if necessary, so, it may be said, the state should not regard the particular interests of individuals, but should rather consider the nation as an organism, or, to adopt older phraseology, a leviathan. So far as the political *existence* of a state is concerned, this view seems to meet with general acquiescence even in modern times, when patriotism is often classed amongst the doubtful virtues, but no ideal of a perfect state has yet met with such acceptance in any nation as to render popular a complete neglect of private interests.

Accordingly, a second basis of taxation (*b*) is found in the expansion of the term "abilities" used by Adam Smith, which leads to the position that taxes ought to be levied so as to involve *equality of sacrifice* on the part of the contributors. This is the ideal of taxation which was advocated by Mill and Fawcett. "Equality of taxation as a maxim of politics," says the former, "means equality of sacrifice. It means the apportioning the contribution of each person towards the expenses of government, so that he shall feel neither more nor less inconvenience from his share of the payment than every other person experiences from his." It is admitted that this standard cannot be completely realized, but it is thought to furnish a proper foundation of remission in some cases and of proportional increase of taxation in others. It is generally on this ground that it is proposed to leave incomes below a certain amount untaxed,—a plan which, so far as direct taxes are concerned, has been adopted in the United Kingdom. It is clear, however, that any taxes on commodities in general use must infringe this canon, whilst the distinction between "necessaries" and "luxuries," as Adam Smith pointed out, is difficult to draw in communities advancing in civilization; and certainly a considerable portion of the taxes on stimulants is, as a matter of fact, derived from persons whose incomes are below what is generally considered a reasonable minimum for the standard of comfort, and such persons would probably consider enforced abstinence a greater sacrifice than the payment of a direct tax. It is also principally on the ground of equality of sacrifice that the proposal for graduated or progressive taxation rests. It is argued that a person with £10,000 a year can pay 10 per cent. (for example) as easily as a person with £1000 can pay 5 per cent. It is to be observed that the principle of equality of sacrifice regards the payment of taxes as duty imposed on the subjects of a state independently of the advantages they may derive individually from the expenditure of the amount levied.

A third basis of taxation, however, is found in the principle (*c*) that taxes ought to be considered as *payment for valuable services* rendered by the state to individuals, and this seems to be the position Adam Smith had in view in introducing the clause "under the protection of the state," and in comparing the individuals of a great nation to the joint tenants of a great estate. It is easy to show, as Mill does, that, if protection is taken in its narrowest signification, as a matter of fact the poor need more protection than the rich, but the argument becomes more plausible, and more consonant with the general teaching of Mill, if stress is laid on the protection and assistance afforded by the state in the process of acquisition of individual fortunes—a view of taxation sometimes called the *social dividend theory* (*cf.* Walker, Helferich). It is really on this ground that Mill proposes that the "unearned increment" from land should be taken by the state, and, as has often been pointed out, "unearned increments" are by no means confined to land. Without much exaggeration the state may be regarded as a partner in all industrial undertakings, and is therefore entitled to a share in the proceeds. In a somewhat similar manner, poor rates, education rates, &c., have been regarded as of the nature of insurance paid by the rich against the carelessness of the poor. The principle under consideration has been generally applied in cases in which the service rendered by the state and the benefit accruing to individuals are easily discovered and estimated, especially in connexion with local taxation.

The object of taxation is in general to provide the state with an adequate revenue, but in all cases the indirect effects are important, and sometimes provision of revenue is considered of secondary importance. Accordingly it has been maintained (*d*) that the state ought to use its powers of taxation for the promotion of various *social ends.* Adam Smith remarks that "it has for some time past been the policy of Great Britain to discourage the consumption of spirituous liquors, on account of their supposed tendency to ruin the health and corrupt the morals of the common people," and in our own times the falling off in the revenue from alcoholic drinks often furnishes a subject for apparent congratulation in "budget" speeches. German writers with socialistic tendencies (*e.g.*, Wagner) have emphasized this social point of taxation; and Mill, although disapproving of graduated taxation of income, advocated the imposition of extremely heavy succession duties, with the object of promoting a better distribution of national wealth and compelling individuals to rely on themselves. Many nations again have imposed duties on imports with the view of protecting and encouraging home industries, and most of the import duties levied in England before the great reforms of Peel were of this nature. Accordingly, both theoretically and practically, the promotion of social or moral ends may be considered as a fourth basis of taxation. It is worth noticing that in early times the fines received in the courts of justice were an important source of revenue.

Whatever basis of taxation be adopted, the elementary principle of justice noticed in the conclusion of A. Smith's first canon must be considered. If it is just to tax A, it is just to tax B under precisely similar circumstances. Thus stated, the principle seems almost formal, but for practical purposes small differences in circumstances may be neglected, and it is clear that in any great nation the taxpayers may be arranged in a limited number of groups, within each of which the constituent individuals may be regarded as similarly situated. A tax on rent, or wages, or profits would be obviously unequal if those in one place or employment were taxed while those in another were left free. The practical difficulty is to discover what cases may fairly be regarded as similar, especially if equality of sacrifice be taken as the ideal.

As a matter of fact, in every civilized community a complex system of taxation is adopted, the different parts of which rest in different degrees upon the various principles just noticed. Some taxes are justified on the grounds of their convenience to the sovereign power, and others are increased or diminished in certain cases in accordance with the principle of equality of sacrifice; some are regarded as payments for services rendered by the state, others partake of the nature of sumptuary regulations or are approved on various social or moral grounds; and sometimes the imposition of one productive tax involves, on the ground of simple equality, the adoption of similar taxes which are hardly worth collecting.

Cer-
tainty

The remaining canons of Adam Smith are partly, like the first, ethical in character partly purely economic. Of the second—the canon of *certainty*—Adam Smith remarks:—"The time of payment, the manner of payment, the quantity to be paid, ought all to be clear and plain to the contributor and to every other person [on the ground of the otherwise arbitrary powers which are given to the tax-gatherer] . . . . The certainty of what each individual ought to pay is in taxation a matter of so great importance that a very considerable degree of inequality, it appears, I believe, from the experience of all nations, is not near so great an evil as a very small degree of uncertainty." Perhaps the best example of the infringement of this canon is furnished by the taxes levied from the miserable provincials by their Roman governors.

Con-
venie

The third rule—the canon of *convenience*—which enjoins that "every tax ought to be levied at the time or in the manner to which it is most likely to be convenient for the contributor to pay it," may be justified, not merely on general grounds of good government, but also on the special economic ground of the increase in the productiveness of taxes which satisfy the condition. It has been found possible to raise a considerable revenue by taxes on commodities, the payments of which by the consumers are made in insensible portions, when it would have been impossible to collect the same amount by direct taxation at comparatively long intervals Taxation is in this respect like bleeding.

Econ

The fourth rule—the canon of *economy*—states as its general principle that "every tax ought to be so contrived as both to take out and to keep out of the pockets of the people as little as possible over and above what it brings into the public treasury of the state." Taxes may, according to Adam Smith, break this rule by requiring a large number of officials for their collection, by restraint of trade and production, by encouraging smuggling, and by causing unnecessary vexation; "and, though vexation is not, strictly speaking, expense, it is certainly equivalent to the expense at which every man would be willing to redeem himself from it." On smuggling Adam Smith elsewhere remarks that "to pretend to have any scruple about buying smuggled goods would in most countries be regarded as one of those pedantic pieces of hypocrisy which serve only to expose the person who affects to practise them to the suspicion of being a greater knave than his neighbours." It may be observed that in practical politics it is generally taken for granted that a tax which can be evaded will be evaded, and indirect methods of taxation are to a great extent devices by which possibilities of evasion are restricted.

Ot
gen
pri
cip

To these general rules of taxation explicitly given by Adam Smith, the following may be added, most of which are implied in different passages of his treatment of taxation, but have been expounded and emphasized by subsequent writers. A convenient summary is given by Helferich in Schönberg's *Handbuch der Politischen Oekonomie* (vol. ii. p. 138). (*a*) A given amount of revenue is, as a rule, both from the point of view of the Government and its subjects, more conveniently raised from a small number of very productive taxes than from a larger number with smaller returns per unit. This was one of the principal financial reforms advocated by Adam Smith with reference to the customs duties, and has been carried out in the United Kingdom by Sir Robert Peel and his successors. The inextricable confusion of the customs duties levied before these reforms were effected can only be realized by those who study the details of the history of taxation. A similar process of simplification has been partially applied to the direct taxes, but in many cases (especially in local taxation) the rule is more honoured in the breach than in the observance. (*b*) A good system of taxation ought to provide for a self acting increase in the revenue in proportion as the population and the consequent demands for governmental expenditure increase. It has been found by experience that an old tax causes less inconvenience than a new tax of smaller amount, a fact which is so striking in some cases as to have given rise to the saying that an old tax is no tax. (*c*) Those taxes are best which yield a steady and calculable return, instead of a return fluctuating in character and difficult to estimate. (*d*) Those taxes are best which in case of need can be most conveniently increased in amount. It is this characteristic of the income tax which renders it so popular with chancellors of the exchequer, and it was partly on this ground that Mr Gladstone substituted a tax on beer for the tax on malt. (*e*) Regard must always be paid to the real incidence of taxation, and care taken that the real burden of the tax falls on those aimed at by the legislature. No part of the theory or practice of taxation has given rise to so much controversy as the incidence of particular taxes, a subject indeed of so much difficulty and importance as to occupy the greater portion of the treatment by systematic writers.

INCIDENCE OF TAXATION.—Taxes are generally divided into *direct* and *indirect*. A direct tax is defined by Mill as one "demanded from the very persons who it is intended or desired should pay it." Others (*e.g.*, M'Culloch) define it as a tax taken directly from income or capital. In the former definition non-transferable taxes on expenditure would be included (*e.g.*, a tax on livery servants), but not in the latter. Mill's definition has been generally adopted (*e.g.*, by Wagner, in the German *Handbuch*, vol. ii. p. 152); but in any case the most important direct taxes practically are those levied on income or capital directly, and the most important indirect the customs and excise duties. In examining the incidence of taxation the order of arrangement adopted by Adam Smith seems best. He discusses separately taxes on the three great species of income,—rent, profits, and wages (appending to the articles on the first two an examination of taxes upon the capital value of land, houses, and stock), and taxes intended to fall indifferently upon every species of revenue, viz., capitation taxes and taxes upon consumable commodities.

Taxes on Rent.—What is commonly known as rent consists in general of two parts, which may be termed economic rent and profit rent. Economic rent arises from the superiority of advantage of any source in the production of a certain amount of utility over the least productive source which the conditions of demand and supply (including transmission to market) render it possible to employ. Thus, in the production of food, some lands have an advantage in fertility or situation; again, in furnishing amenities of accommodation or facilities for business, some houses have from their situation a similar advantage; and again, different processes in the arts and manufactures are superior to others (giving rise to patents). In all these cases where the amount of the superior sources is limited (naturally or artificially), and recourse must be made to inferior sources of supply, economic rent is paid for the superior advantage Any tax imposed on this species of revenue falls on the owner. If levied in the first instance from the lessee, he will pay so much less rent, and any new taxes imposed during the currency of leases ought, if intended to fall on the owner, to be taken directly from him. It may be assumed that every owner of a superior source has exacted the highest price obtainable for its use, so that he cannot transfer the tax to the tenant, nor through the tenant to the consumer. If, for example, a tax is imposed on the economic rent of agricultural land, the landlord cannot exact it from the tenant (for if the tenant could afford more rent, why under competition was he not forced to do so before?) nor from the consumer of the produce, for the price is obviously determined independently of rent. Similarly a tax on the ground rent of houses, if it be assumed that the land is useless for other purposes, must fall on the owners; although a certain portion will be transferred to the occupier if the landlord could use it otherwise and escape the tax (*cf.* Mill, bk. v. ch. iii. § 6). Taxes on economic rent of various kinds, so heavy as to absorb the whole amount, have been advocated by some theorists on grounds noticed under Adam Smith's first canon. It is said they would impose no burden on the state as a whole, that they would not affect production or accumulation, and even that the substitution of the state for private owners—who are simply *nati consumere fruges*—would really increase the wealth and power of the nation by compelling these unproductive consumers to work, and by lightening the pressure of taxation on industry. It is, however, obvious that the confiscation of rent would, seeing that land has for generations been in the circle of exchangeable commodities, strike at the roots of the institution of private property. Apart from this general objection, there would in the case of agricultural land be great difficulty in separating economic from profit rent, and any exceptional tax on the latter would obviously tend to check agricultural improvements.

Taxes
profits

Taxes on Profits.—Profits, as commonly used, is a term embracing three elements which, from an economic and financial point of view, are quite distinct in character, viz., interest (pure and simple), insurance against risk, and earnings of management. The interest on capital in any industrial area, lent on the same security, tends to equality. If, then, a tax is imposed on *interest in every form*, the incidence in the first place will be on the owners of capital. But two indirect consequences will follow. (1) As Adam Smith remarks, "the proprietor of stock is properly a citizen of the world, and is not necessarily attached to any particular country. He would be apt to abandon the country in which he was exposed to a vexatious inquisition in order to be assessed to a burdensome tax, and would remove his stock to some other country, where he could either carry on his business or enjoy his fortune more at his ease." In this case the ultimate result would be that the country in which the tax was imposed would possess less capital, and thus would yield a higher rate of interest sufficient to counterbalance the burden of the tax. (2) The tax would tend to check the accumulation of capital within the country, so far as the interest received is a cause of accumulation, with the same ultimate result as in the former case. It must, however, be observed that the rate of interest is only one of the causes affecting the accumulation of capital.

A tax on some *particular form of interest* (security still being supposed perfect), for example on mortgages on land, would obviously fall on the borrowers. In the same way a tax on that part of the profit rent of houses which is interest on capital tends to fall on the occupier. In general, however, the security is more or less imperfect, and the insurance against risk is allowed for in the rate of interest charged on borrowed capital. Thus a tax which took equal percentages from all species of interest would be in part a tax on insurance against risk, and the tendency must be for such a tax to fall on the borrowers of capital. Suppose at any time a perfect security yields 3 per cent. and one with greater risk 6 per cent., then 3 per cent. represents the estimated value of the insurance against risk. A tax which reduces the net yield on the first to 2 per cent. would reduce the net yield on the latter to 4 per cent. In order, then, for the insurance against risk to remain the same, the rate yielded by the latter must rise from 6 to 7½ per cent. It follows, then, that a tax levied on all forms of interest (no allowance being made for risk) would tend to check investment in proportion as risk was involved, and would thus check industrial enterprise. This result would follow even although the rate of interest on perfect security, owing to the causes mentioned above, were raised in proportion to the tax.

A tax on that part of profits known as earnings of management would, if imposed generally, fall in the first instance on the *entrepreneurs* or employers of capital, and with similar indirect consequences to those just noticed in regard to interest. Capital would tend to flow abroad, and accumulation would be checked, since in general the employers of capital are also to a large extent the owners. So far as profits, in this sense, are of the nature of rent (a view recently advocated as regards all profits by Prof. Walker), a tax on profits would be analogous to a tax on rent. If the differences in the net advantages of different methods of employing capital are supposed to remain constant (according to Prof. Marshall's view of earnings of management), a proportional tax on profits must be in part transferred to the consumers of the articles produced, in the same way as a tax on interest with risk was shown to fall on the borrower. It will be seen from this general survey that the incidence and effects of a tax on profits (taking the term in its common acceptation without analysis) are extremely difficult to determine, and the practical difficulty is still greater than the theoretical. For, as M'Culloch and others have shown, profits are always fluctuating and difficult to estimate. So great, for example, is this difficulty felt to be as regards farmers' profits that in the income tax it is assumed that such profits bear a certain proportion to the rent paid for land on a purely empirical rule, which may happen to hit the mark in a majority of cases, but is much more likely to be unequal and unjust in its operation.

A tax on some particular form of profits (as distinct from a general tax on profits) will, it is generally said, fall on the consumer of the article produced, on the ground of the tendency of profits to equality. This view will be noticed below under taxes on consumable commodities.

Taxes on capital.

Taxes on Capital.—In early English history taxes upon capital of a very simple kind played an important part. A grant, for example, of certain fractional parts of movables, commencing with the famous Saladin tithe (on both rent and movables) in 1188, and gradually settling down to a fifteenth for the counties and a tenth for the towns, prevailed for more than three centuries. In 1334 a fifteenth and tenth was fixed at a certain sum for each township, and after this date a grant of one or more "fifteenths and tenths" meant simply a grant according to the scale then fixed (Dowell, vol. iii. p. 75). But in our own times taxes on capital are levied principally when property changes hands, and may be divided, as they are by Adam Smith, according as they are levied when property passes (*a*) from the dead to the living, (*b*) from the living to the living.

It is obvious, as regards incidence, that taxes of the first class (*a*) are the most direct of all taxes, in the sense that they cannot be transferred to other persons by the beneficiaries. The principal difficulties connected with the "death duties," as they are often called, arise in connexion with the canon of equality of taxation. Opinion is still divided on the proportions which ought to be paid by personal and real estate respectively, as well as on the advisability of the taxes being made progressive according to the value of the property, and there are still greater difficulties in connexion with life interests in settled property. Mill was strongly in favour of making the death duties very heavy and also graduated. "I conceive," he says (*Pol. Econ.*, bk. v. ch. ii. § 3), "that inheritances and legacies exceeding a certain amount are highly proper subjects for taxation, and that the revenue from these should be made as great as it can be made without giving rise to evasions by donation during life, or concealment of property, such as it would be impossible adequately to check. The principle of graduation, that is, of levying a larger percentage on a larger sum, though its application to general taxation would be in my opinion objectionable, seems to me both just and expedient as applied to legacy and inheritance duties." The principal objections urged against such taxation are, that a stimulus would be given to personal extravagance and a check placed on accumulation, and that in consequence indirect production would be lessened, partly by want of capital and partly by the check placed on production on a large scale. As regards the want of capital, apart from the check placed on saving, there would be a tendency to send it abroad. A heavy tax on large capitals at home will place a premium on investments abroad, in which evasion would be easy. Perhaps, with the present rate of accumulation, the objection may be made light of, as it is by Mill; but the second, if less obvious, is more important. All our great staple manufactures are necessarily conducted on a large scale, and in many respects also large agricultural capitals are most productive. In manufactures, as a rule, the larger the scale of operations the more extended will be the division of labour in production, and the greater the facilities for ready sale in foreign markets. Of all the causes which contribute to our commercial prosperity, perhaps the most important is the large scale on which our operations are conducted. We are able to employ machinery where the foreigner, working on a smaller scale, is obliged to use manual labour. There can be little doubt that graduated taxation, even on the modified form proposed by Mill, would tend to check production on a large scale. Indirectly it might artificially foster joint-stock companies. (*b*) Taxes on the transference of property from the living to the living cannot, as Adam Smith points out, be very easily taken directly, as such transactions for the most part actually are or might be secret. This has led to the invention of stamp and registration duties. The penalty of invalidity attaching to unstamped documents of various kinds has proved a very effective deterrent to evasion. A tax on sales will vary in its incidence according to the nature of the commodity and the degree of competition or monopoly (*cf.* H. Sidgwick's *Principles of Pol. Econ.*, bk. ii. ch. x.). The most important case is that of taxes on the transfer of land. Theoretically it seems that, just as the farmer who takes land on rent offers more or less rent according to the burdens imposed on the land by rates, &c., so the purchaser of land will consider any expenses connected with its acquisition as part of the capital value, and thus any taxes on transfer will really fall on the sellers. If, however, the taxes are imposed in such a way as to fall less heavily on land when sold in larger than in small quantities, it is clear that the tendency will be for the differential portion of the tax at least to fall on the purchaser of a small amount; and practically at present this feature is characteristic of the English system. A tax on the transfer of stocks and shares is generally held to fall on the seller, as in case of repeal he would obtain so much more; but in this case the same considerations apply as in the case of interest noticed above. A curious example of legal evasion is furnished by time-bargains; and the imposition of the tax directly on the contracts of sale, instead of as at present on the actual transfer, has been strongly urged.

Taxes on Wages.—It is clear that the treatment of taxes on wages will depend on the general view taken of the determination of the rate of wages. Adam Smith appears to lay undue stress on the price of provisions, and to think that in most cases taxes on wages must fall on the employer of labour (bk. v. ch. ii. art. iii.). There seems, however, to be no sufficient reason why a tax on labour should be transferred to the employer, except in the case where the wages are really at a minimum below which the supply of efficient labour could not be kept up. Even in this case, as Prof. Walker shows, there would probably be a degradation of labour before the rise in wages was effected. Certainly no practical statesman at the present time would venture to propose a direct tax on wages, under the idea that it would be transferred to the employer. In Germany it was found necessary to abandon the system, owing to the hardship inflicted on the poor. At any rate, in all cases in which the rate of wages is above the "necessary" minimum, a tax on wages must fall on the labourer. A differential tax on some particular species of employment would, unless it partook of the nature of a monopoly, tend to fall on the consumer of the article produced or the person who enjoys the service rendered. In every case, speaking generally, the incidence of the tax will depend on the conditions of the demand and supply of the labour in question, and no further analysis can be given without entering into the general principles governing wages. See WAGES.

Capitation taxes are chiefly of interest historically, as illustrated in England by the poll-taxes imposed at various times. The income tax as at present levied is in reality not a single uniform tax, as might at first sight appear, but a tax on the various species of rent, interest, profits, and wages. The anomalies which arise from practically taking income as uniform have often been pointed out and acknowledged, but the authority of Mr Gladstone may be quoted in support of the view that the practical difficulties in the way of a readjustment more in accordance with theoretical principles are insuperable. The objections noted above to a graduated property tax apply, *mutatis mutandis*, to a graduated income tax, which appears, however, to find increasing favour on the Continent. A full discussion of the anomalies of the income tax would involve a repetition of the analysis of the taxes on the various species of income.

Taxes on Commodities.—The general principles applicable in this case are that, where production takes place under free competition, the tax will, owing to the tendency of profits to equality, be transferred to the consumer, but that, when the article is practically monopolized, a tax must fall on the monopolist, on the assumption that he has already fixed such a price for the article as will, considering the law of demand and the expenses of production, yield him a maximum revenue. The practical difficulties connected with the assumption of equality of profits have been well exposed by Cliffe Leslie (*Financial Reform: Cobden Club Essays*, 2d series, 1871-72).

The incidence of export and import duties is peculiarly difficult to ascertain even theoretically. The prevailing opinion that an import duty necessarily falls on the consumer of the import necessarily involves as its counterpart the position that an export duty must fall on the consumer of the export. If the latter view is upheld it is curious that export duties find such little favour with practical statesmen. It is clear, however, that the real incidence of export and import duties will depend partly on the conditions of production in various countries, partly on the variations in demand due to changes in price, partly on the indirect influence on the general balance of trade, and partly on the possibility of using substitutes for the article taxed (*cf.* H. Sidgwick's *Principles of Pol. Econ.*, bk. iii. ch. v.; Cournot, *Revue Sommaire des Doctrines Économiques*, sects. 5 and 6). A fuller examination is not possible in the limits assigned to this article. In conclusion, it may be pointed out that a thorough investigation of the general principles of taxation must presuppose the principles of political philosophy, whilst a full inquiry into the incidence of particular species of taxes must presuppose the principles of political economy. (J. S. N†.)

TAXIDERMY, the art of preserving the integument, together with the scales, feathers, or fur, of animals. Little is known of the beginnings of the practice of the "stuffing" or "setting up" of animals for ornament or for scientific purposes; and it is highly probable, from what we gather from old works of travel or natural history, that the art is not more than some three hundred years old. It was practised in England towards the end of the 17th century, as is proved by the Sloane collection, which in 1725 formed the nucleus of the collection of natural history now lodged in the galleries at South Kensington.

It was not until the middle of last century that any treatise devoted to the principles of the then little understood art was published in France, Réaumur's treatise (1749) being probably the first. This was followed at intervals by others in France and Germany, until the beginning of the present century, when the English began to move in the matter, and several works were published, notably those by E. Donovan,[1] W. Swainson,[2] Capt. Thomas Brown,[3] and others. These works, however, are now inadequate; and since the Great Exhibition of 1851, when the Germans and French taught British taxidermists the rudiments of scientific treatment of natural objects, several works have appeared upon the subject from the pens of American and English authors, such as J. H. Batty,[4] R. Ward,[5] and Montagu Browne.[6]

The first principle governing the art is that, after the specimen has been procured, in as fresh and clean a state as may be, it should have the skin stripped from the body in such a manner as not to disturb the scales if a fish or a reptile, the feathers if a bird, or the fur or hair if a mammal. To do this correctly requires a small stock of tools, as well as a great amount of patience and perseverance. The appliances comprise several sharp knives (some pointed and some obtuse), a pair of scissors, a pair of pliers, a pair of nippers or "cutting-pliers," some tow, wadding, needles and thread, also a "stuffing-iron," some crooked awls, a pair of fine long flat-nosed pliers, and a camel-hair brush. The preservative compound is often the original (Bécœur's) "arsenical soap," made by cutting up and boiling 2 ℔ of white soap, to which 12 oz. of salt of tartar and 4 oz. of powdered lime (or whiting) are added when dissolved; to this mixture, when nearly cold, 2 ℔ of powdered arsenic and 5 oz. of camphor (the latter previously triturated in a mortar with spirits of wine) are added. The mixture is put away in small jars or pots for use. Like all arsenical preparations, this is exceedingly dangerous in the hands of unskilled persons, often causing shortness of breath, sores, brittleness of the nails, and other symptoms; and, as arsenic is really no protection against the attacks of insects, an efficient substitute has been invented by Browne, composed of 1 ℔ of white curd soap and 3 ℔ of whiting boiled together, to which is added, whilst hot, 1½ oz. of chloride of lime, and, when cold, 1 oz. of tincture of musk. This mixture is perfectly safe to use when cold (although when hot the fumes should not be inhaled, owing to the chlorine given off), and is spoken of as doing its work efficiently. Solutions of corrosive sublimate, often recommended, are, even if efficient, dangerous in the extreme. Powders consisting of tannin, pepper, camphor, and burnt alum are sometimes used for "making skins," but they dry them too rapidly for the purposes of "mounting." Mammals are best preserved by a mixture of 1 ℔ of burnt alum to ¼ ℔ of saltpetre; this, when intimately mixed, should be well rubbed into the skin. Fishes and reptiles, when not cast and modelled, are best preserved in rectified spirits of wine; but this, when economy is desired, can be replaced by "Möller's solution" (bichromate of potash 2 oz., sulphate of soda 1 oz., distilled water 3 pints) or by a nearly saturated solution of chloride of zinc. The cleaning of feathers and furs is performed by rubbing them lightly with wadding soaked in benzoline, afterwards dusting on plaster of Paris, which is beaten out, when dry, with a bunch of feathers.

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[1] *Instructions for Collecting and Preserving Various Subjects of Natural History*, London, 1794.

[2] *The Naturalist's Guide for Collecting and Preserving Subjects of Natural History and Botany*, London, 1822.

[3] *Taxidermist's Manual*, Glasgow, 1833.

[4] *Practical Taxidermy and Home Decoration*, New York, 1880.

[5] *Sportsman's Handbook of Practical Collecting and Preserving*, London, 1880.

[6] *Practical Taxidermy*, London, 1879; 2d edition, 1884.

The preparation and mounting of bird specimens, the objects most usually selected by the amateur, are performed in the following manner. The specimen to be operated upon should have its nostrils and throat closed by plugs of cotton wool or tow; both wing-bones should be broken close to the body, and the bird laid upon a table on its back; and, as birds—especially white-breasted ones—should seldom, if ever, be opened on the breast, an incision should be made in the skin under the wing on the side most damaged, from which the thigh protrudes when pushed up slightly; this is cut through at its junction with the body, when the knife is gently used to separate the skin from this, until the wing-bone is seen on the open side. This is then cut through by scissors, and by careful manipulation the skin is further freed from the back and breast until the neck can be cut off. The other side now remains to be dealt with; from this the wing is cut by travelling downwards, the remaining leg is cut away, and very careful skinning over the stomach and upon the lower back brings the operator to the tail, which is cut off, leaving a small portion of the bone (the coccyx) in the skin. The body now falls off, and nothing remains in the skin but the neck and head. To skin these out properly without unduly stretching the integument, is a task trying to the patience, but it can be accomplished by gradually working the skin away from the back of the head forward, taking care to avoid cutting the eyes or the eyelids, but, by cautious management, to cut the membranous skin over those parts, so that the eyes are easily extracted from the orbits without bursting. The skin should be freed down nearly to the beak, and then the back of the head, with neck attached, should be cut off, the brains extracted, all the flesh cleared from the skull and from the bones of the wings, legs, and tail, the skin painted with the preservative, and ultimately turned into its proper position. When "skins" only are to be made for the cabinet, it is sufficient to fill the head and neck with chopped tow, the body with a false one made of tow, lightly packed or loose according to the genius of the preparer, to sew up the skin of the stomach, and to place a band of paper lightly pinned around the body over the breast and wings, and allow it to remain in a warm position, free from dust, for several days or weeks, according to the size of the specimen. It should then be labelled with name, sex, locality, and date, and put away with insect powder around it.

When, however, the specimen is to be "mounted," the operations should be carried up to the point of returning the skin, and then a false body of tightly wrapped tow is made upon a wire pointed at its upper end. This is inserted through the incision under the wing, the pointed end going up the neck and through the skull to the outside. When the imitation body rests within the skin, pointed wires are thrust through the soles of the feet, up the skin of the back of the legs, and are finally clenched in the body. Wires are also thrust into the butts of the wings, following the skin of the under surface, and also clenched through into the body. A stand or perch is provided, and the bird, being fixed upon this, is, after the eyes have been inserted, arranged in the most natural attitude which the skill of the taxidermist can give it.

Mammals are cut along the stomach from nearly the middle to the breast, and are skinned by working out the hind legs first, cutting them off under the skin at the junction of the femur with the tibia, and carefully stripping the skin off the lower back and front until the tail is reached, the flesh and bones of which are pulled out of the skin, leaving the operator free to follow on up the back and chest until the fore legs are reached, which are cut off in like manner. The neck and head are skinned out down to the inner edges of the lips and nose, great care being exercised not to cut the outer portions of the ears, the eyelids, the nose, or the lips. The flesh being cleared off, and the brain and eyes extracted, the skull should adhere to the skin by the inner edges of the lips. All the flesh should be trimmed from the bones of the legs. The head, being shaped, where the flesh was removed, by tow and clay, is returned into the skin. A long wire of sufficient strength is tightly bound with tow, making a long, narrow body, through which wires are thrust by the skin of the soles of the feet. The leg wires and bones being wrapped with tow and clay into shape, the points of the wires are pushed through the tow body and clenched. They and the body are then bent into the desired position, and modelled up by the addition of more tow and clay, until the contours of the natural body are imitated, when the stomach is sewn up. A board is provided upon which to fix the specimen, artificial eyes are inserted, the lips, nose, and eyelids fixed by means of pins or "needle-points," and the specimen is then placed in a warm situation to dry.

Reptiles, when small, have their skin removed by cutting away the attachment of the skull to the cervical vertebræ, and by turning the decapitated trunk out at the mouth by delicate manipulation. When large, they are cut along their median line, and treated in the same manner as mammals.

Fishes, after being covered on their best side with paper or muslin to protect the scales, are cut along the other side from the tail to the gills, and are skinned out by removing "cutlets," as large as is possible without cracking the skin, which, indeed, should be kept damp during work. After being cured with a preservative, they are filled with sawdust or dry plaster of Paris, sewn up, turned over on a board, the fins pinned out, and the mouth adjusted, and, when perfectly dry, the plaster may be shaken out.

A new school of taxidermists, with new methods, whose aim is to combine knowledge of anatomy and modelling with taxidermic technique, are now coming to the front, and the next generation will discard all processes of "stuffing" in favour of modelling. Within the limits of an article like the present it is impossible to do more than glance at the intricate processes involved in this. In the case of mammals, after the skin has been completely removed, even to the toes, a copy is made of the body, posed as in life, and from this an accurate representation of form, including delineation of muscles, &c., is built up in light materials; the model is then covered with the skin, which is damped, and pinned in to follow every depression and prominence; the study is then suffered to dry; and, models having been made, in the case of large animals, of the mucous membrane of the jaws, palate, tongue, and lips, these are truthfully reproduced in a plastic material. The ordinary glass eyes are discarded, and hollow globes, specially made, are hand-painted from nature, and are fixed in the head so as to convey the exact expression which the pose of the body demands. Birds, if of any size, can be modelled in like manner, and fishes are treated by a nearly identical process, being finally coloured as in a "still life" painting.

To give a life-like representation, attention is also paid to artistic "mounting." By this is meant the surrounding of specimens with appropriate accessories, and it is well exemplified by the new work shown in the natural history museum at South Kensington, where, for example, birds are arranged as in a state of nature, feeding or flying to their young, sitting on their eggs, swimming in miniature pools, or preening their feathers whilst perched lovingly side by side, and surrounded by exquisitely modelled foliage and flowers. This, with correct modelling of the specimens, which, except in rare instances, is not quite so striking in the new groups, indicates the future of the art, the hope of which lies in the better education of taxidermists as designers, artists, and modellers. (M. B.)

TAXILA. See Rawal Pindi.

TAY, The, the longest river in Scotland, has its source on the northern side of Ben Lui, on the borders of Argyllshire and Perthshire, being known in its earlier course as the Fillan, and, after forming Loch Dochart, as the Dochart, until entering Loch Tay, 25 miles from its source, at an elevation above sea-level of 553 feet. Its course through Perthshire is described in the article on that county. Its total length to the town of Perth is about 95 miles, and it drains a total area of about 2400 square miles, while its estuary extends for about other 25 miles. The navigation of the estuary is somewhat impeded by sandbanks. The only important port is Dundee, but vessels of 100 tons can pass up to Perth, the river being tidal to 2 miles above it. The salmon fisheries on the river and its estuary are among the most valuable in Scotland. A railway bridge over the Tay at Dundee, designed by Sir Thomas Bouch (see Bridges, vol. iv. p. 340), was opened for traffic 31st May 1878, but was blown down during the crossing of a passenger train 28th December 1879. Some distance to the west a new bridge, designed by W. H. Barlow, was commenced in 1882, and was opened for general traffic 20th June 1887.

TAYLOR, Bayard (1825-1878), one of the most prolific among American authors, was born at Kennett Square in Chester county, Pennsylvania, on January 25, 1825. The son of a well-to-do farmer, he received his early instruction in an academy at West Chester, and, later, at Unionville. At the age of seventeen he was apprenticed to a printer in West Chester. A little volume, published in 1844 under the title *Ximena, or the Battle of the Sierra Morena, and other Poems*, brought its author a little cash; and indirectly it did him better service as the means of his introduction to *The New York Tribune*. With the money thus obtained, and with an advance made to him on account of some journalistic work to be done in Europe, "J. B. Taylor" (as he had up to this time signed himself, though he bore no other Christian name than Bayard) set sail for the East. The young poet spent a happy time in roaming through certain districts of England, France, Germany, and Italy; that he was a born traveller is evident from the fact that this pedestrian tour of almost two years cost him only £100. The graphic accounts which he sent from Europe to *The New York Tribune*, *The Saturday Evening Post*, and *The United States Gazette* were so highly appreciated that on Taylor's return to America he was advised to throw his articles into book form. In 1846, accordingly, appeared his *Views Afoot, or Europe seen with Knapsack and Staff*. This pleasant book had considerable popularity, and its author now found himself a recognized man of letters; moreover, Horace Greeley, then editor of the *Tribune*, placed Taylor on the staff of that journal, thus securing him a certain if a moderate income. His next journey, made when the gold-fever was at its height, was to California, as correspondent for the *Tribune*: from this expedition he returned by way of Mexico, and, seeing his opportunity, published (1850) a highly successful book of travels, entitled *Eldorado, or Adventures in the Path of Empire*. Ten thousand copies were said to have been sold in America, and thirty thousand in Great Britain, within a fortnight from the date of issue. Bayard Taylor always considered himself native to the East, and it was with great delight that in 1851 he found himself on the banks of the Nile. He ascended as far as 12° 30′ N. lat., and stored his memory with countless sights and delights, to many of which he afterwards gave expression in metrical form. From England, towards the end of 1852, he sailed for Calcutta, proceeding thence to China, where he joined the expedition of Commodore Perry to Japan. The results of these journeys (besides his poetical memorials, to which reference will be afterwards made) were *A Journey to Central Africa, or Life and Landscapes from Egypt to the Negro Kingdoms of the Nile* (1854); *The Land of the Saracens, or Pictures of Palestine, Asia Minor, Sicily, and Spain* (1854); and *A Visit to India, China, and Japan in the Year 1853* (1855). On his return (1854) from these various journeyings he entered, with marked success, upon the career of a public lecturer, delivering addresses in every town of importance from Maine to Wisconsin. After two years' experience of this lucrative profession, he again started on his travels, on this occasion for northern Europe, his special object being the study of Swedish life, language, and literature. The most noteworthy result was the long narrative poem *Lars*, but his "Swedish Letters" to the *Tribune* were also republished, under the title *Northern Travel* (1857). In October 1857 he married Maria Hansen, the daughter of the well known German astronomer. The ensuing winter was spent in Greece. In 1859 Taylor once more traversed the whole extent of the western American gold region, the primary cause of the journey lying in an invitation to lecture at San Francisco. About three years later he entered the diplomatic service as secretary of legation at St Petersburg, and the following year (1863) became chargé d'affaires at the Russian capital. In 1864 he returned to the United States and resumed his active literary labours, and it was at this period that *Hannah Thurston*, the first of his four novels, was published. This book had a moderate success, but neither in it nor in its successors did Bayard Taylor betray any special talent as a novelist: some of his characters are faithful studies from life, and he could describe well the aspects of nature,—but a good deal more than this is necessary for the creation of noteworthy romances. In 1874 he went to Iceland, to take part in the centennial celebration which was held in that year. In June 1878 he was accredited United States minister at Berlin. Notwithstanding the resistless passion for travel which had always possessed him, Bayard Taylor was (when not actually *en route*) sedentary in his habits, especially in the later years of his life; and at Berlin he aggravated a constitutional liver affection by too sedulous devotion to literary studies and pursuits, in the intervals of leisure from his diplomatic duties. His death occurred on the 17th of December, only a few months after his arrival in Berlin.

The main drawback to the widespread acceptance of Bayard Taylor's poetry as a whole is its perpetual diffuseness. His most ambitious productions—his *Masque of the Gods* (1872), *Prince Deukalion* (1877), *The Picture of St John* (1865), *Lars* (1873), and *The Prophet* (1874)—are marred by a ceaseless effort to overstrain his power. *Lars* is the least likely of his longer poems to survive any length of time: it lacks the grandiose eloquence and impressive "adjuncts" of the *Masque* or *Prince Deukalion*, while in theme and treatment it is, at most, only sedately agreeable. *The Poems of the Orient* contains his most genuinely satisfactory poetic writings. But probably long after even the most familiar of the poems just mentioned have ceased to be popular, when even the *Views Afoot* and *Eldorado* no longer hold the attention of the numerous public interested in vividly narrated experiences of travel, Bayard Taylor will be remembered by his poetic and excellent translation of *Faust*. Taylor felt, in all truth, "the torment and the ecstasy of verse"; but, as a critical friend has written of him, "his nature was so ardent, so full-blooded, that slight and common sensations intoxicated him, and he estimated their effect, and his power to transmit it to others, beyond the true value." He felt life as perhaps only the poetic temperament can experience the beauty of the world; single words thus became for him so charged with poetry that he overlooked the fact that to most people these were, simply in themselves, mere abstract terms—sunshine, sea, spring, morning, night, and so forth. Thus a stanza having absolutely nothing original or striking or even poetic in it would, because born of him, seem to be poetry unadulterate: to *his* mind, each line, each word, was charged with delightful significance, therefore—so he felt—would be so also to the sympathetic reader. He had, from the earliest period at which he began to compose, a distinct lyrical faculty: so keen indeed was his ear that he became too insistently haunted by the music of others, pre-eminently of Tennyson. But he had often a true and fine note of his own. His best short poems are "The Metempsychosis of the Pine" and the well-known Bedouin love-song, the latter a stirring lyric that ought assuredly to endure. In his critical essays Bayard Taylor had himself in no inconsiderable degree what he wrote of as "that pure poetic insight which is the vital spirit of criticism.' The most valuable of these prose dissertations are the *Studies in German Literature.*

TAYLOR, BROOK (1685-1731), a distinguished mathematician of Newton's school, was the son of John Taylor, of Bifrons House, Kent, by Olivia, daughter of Sir Nicholas Tempest, Bart., of Durham, and was born at Edmonton in Middlesex, August 18, 1685. He entered St John's College, Cambridge, as a fellow-commoner in 1701, and took degrees of LL.B. and LL.D. respectively in 1709 and 1714. Having studied mathematics with applause under Machin and Keill, he obtained in 1708 a remarkable solution of the problem of the "centre of oscillation," which, however, remaining unpublished until May 1714 (*Phil. Trans.*, vol. xxviii. p. 11), his claim to priority was unjustly disputed by John Bernoulli Taylor's *Methodus Incrementorum Directa et Inversa* (London, 1715) added a new branch to the higher mathematics, now designated the "calculus of finite differences." Among other ingenious applications, he used it to determine the form of movement of a vibrating string, by him first successfully reduced to mechanical principles. The same work contained (p. 23) the celebrated formula known as "Taylor's theorem." It is of extensive use in almost every analytical inquiry; but its full importance remained unrecognized until pointed out in 1772 (Berlin *Memoirs*) by Lagrange, who later termed it "le principal fondement du calcul différentiel."

In his essay on *Linear Perspective* (London, 1715) Taylor set forth the true principles of the art with much originality, and in a more general form than any of his predecessors. The little work suffered, however, from the brevity and obscurity which affected most of his writings, and needed the elucidation bestowed on it in the treatises of Joshua Kirby (1754) and Daniel Fournier (1761).

Taylor was elected a fellow of the Royal Society early in 1712, sat in the same year on the committee for adjudicating the claims of Newton and Leibnitz, and acted as secretary to the society January 13, 1714, to October 21, 1718. During a visit to Paris in 1716 he made acquaintance with Bossuet and the Comte de Caylus, and knit a warm friendship with Bolingbroke, whom he visited at La Source in 1720 From 1715 his studies took a philosophical and religious bent. He corresponded, in that year, with the Comte de Montmort on the subject of Malebranche's tenets; and unfinished treatises, "On the Jewish Sacrifices" and "On the Lawfulness of Eating Blood," written on his return from Aix-la-Chapelle in 1719, were afterwards found among his papers. His marriage in 1721 with Miss Brydges of Wallington, Surrey, led to an estrangement from his father, a person of somewhat morose temper, which terminated in 1723 after the death of the lady in giving birth to a son. The ensuing two years were spent by him with his family at Bifrons, and in 1725 he married, with the paternal approbation, Sabetta, daughter of Mr Sawbridge of Olantigh, Kent, who, by a strange fatality, died also in childbed in 1730; in this case, however, the infant, a daughter, survived. Weighed down by repeated sorrows, Taylor's fragile health gave way; he fell into a decline, died December 29, 1731, at Somerset House, and was buried at St Ann's, Soho. By his father's death in 1729 he had inherited the Bifrons estate. Socially as well as intellectually gifted, he possessed a handsome person and engaging manners, and was accomplished to an uncommon degree in music and painting. As a mathematician, he was the only Englishman after Newton and Cotes capable of holding his own with the Bernoullis; but a great part of the effect of his demonstrations was lost through his failure to express his ideas fully and clearly.

A posthumous work entitled *Contemplatio Philosophica* was printed for private circulation in 1793 by his grandson, Sir William Young, Bart., prefaced by a life of the author, and with an appendix containing letters addressed to him by Bolingbroke, Bossuet, &c. Several short papers by him were published in *Phil. Trans.*, vols. xxvii. to xxxii., including accounts of some interesting experiments in magnetism and capillary attraction. He issued in 1719 an improved version of his work on perspective, with the title *New Principles of Linear Perspective*, revised by Colson in 1749, and printed again, with portrait and life of the author, in 1811. A French translation appeared in 1753 at Lyons. Taylor gave (*Methodus Incrementorum*, p. 108) the first satisfactory investigation of astronomical refraction.

See Watt, *Bibliotheca Britannica*; Hutton, *Phil. and Math. Dictionary*; Fétis *Biog. des Musiciens*; Th. Thomson, *Hist. of the R. Society*, p. 302; Grant, *Hist. Phys. Astronomy*, p. 377; Marie, *Hist. des Sciences*, vii. p. 231.

TAYLOR, SIR HENRY (1800-1886), poet and colonial statesman, was born October 18, 1800, at Bishop-Middleham, in the county of Durham. His ancestors had been small landowners for some generations, and both his studious father, who late in life emerged for a time from a recluse existence to make an efficient secretary to the Poor Law Commission, and his original warm-hearted mother were interesting persons. His mother died while he was yet an infant, and he was chiefly educated by his father, who, finding him less quick and deeming him less intelligent than his two elder brothers, allowed him to go to sea as a midshipman. Eight months summed up his naval career: it had taken much less to disgust him with it. After obtaining his discharge he was appointed to a clerkship in the storekeeper's office, and had scarcely entered upon his duties ere he was attacked by typhus fever, which carried off both his brothers, then living with him in London. In three or four years more his office was abolished while he was on duty in the West Indies. On his return he found his father happily married to a lady whose interest and sympathy proved of priceless value to him. Through her he became acquainted with her cousin Isabella Fenwick, the neighbour and intimate friend of Wordsworth, who introduced him to Wordsworth and Southey. Under these influences he lost his early admiration for Byron, whose school, whatever its merits, he at least was in no way calculated to adorn, and his intellectual powers developed rapidly. In October 1822 an article from his pen on Moore's *Irish Melodies* appeared in the *Quarterly Review*. A year later he departed for London to seek his fortune as a man of letters, and met with such rapid success, though not precisely in this capacity, as has but rarely attended an unknown young man. He became editor of the *London Magazine*, to which he had already contributed, and in January 1824 obtained, through the influence of Sir Henry Holland, an appointment in the Colonial Office, insuring him, not only an ample salary, but considerable influence in this department of public affairs. The general standard of the office was probably at that time low; at all events Taylor was immediately entrusted with the preparation of confidential state papers, and his opinion soon exercised an important influence on the decisions of the secretary of state. He visited Wordsworth and Southey, travelled on the Continent with the latter, and at the same time, mainly through his friend and official colleague, the Hon. Hyde Villiers, became intimate with a very different set, the younger followers of Bentham, without, however, adopting their opinions,—"young men," he afterwards reminded

Stuart Mill, "who every one said would be ruined by their independence, but who ended by obtaining all their hearts' desires, except one who fell by the way." The reference is to Hyde Villiers, who died prematurely, and for whose sister, afterwards Lady Theresa Lewis, Taylor was an unsuccessful suitor. He actively promoted the emancipation of the slaves in 1833, and became an intimate ally of Sir James Stephen, then counsel to the Colonial Office, afterwards under-secretary, by whom the Act of Emancipation was principally framed. His first drama, *Isaac Comnenus*, was published anonymously in 1827. Though highly praised by Southey, it made little impression on the public. *Philip van Artevelde*, the subject of which had been recommended to him by Southey, was begun in 1828, published in 1834, and, aided by a laudatory criticism from Lockhart's pen, achieved extraordinary success. *Edwin the Fair* (1842) was less warmly received. In the interim he had married (1839) the daughter of his former chief Lord Monteagle, and, in conjunction with Stephen, had taken a leading part in the abolition of negro apprenticeship in the West Indies. *The Statesman*, a volume of essays suggested by his official position, had been published in 1836, and about the same time he had written in the *Quarterly* the friendly advertisements of Wordsworth and Southey, subsequently published under the somewhat misleading title of *Notes from Books*. In 1847 he was offered the under-secretaryship of state, which he declined. *Notes from Life* and *The Eve of the Conquest* appeared in this year, and *Notes from Books* in 1849. An experiment in romantic comedy, *The Virgin Widow*, afterwards entitled *A Sicilian Summer*, was published in 1850. "The pleasantest play I had written," says the author; "and I never could tell why people would not be pleased with it." His last dramatic work was *St Clement's Eve*, published in 1862. In 1869 he was made K.C.M.G. He retired from the Colonial Office in 1872, though continuing to be consulted by Government. His last days were spent at Bournemouth in the enjoyment of universal respect; and the public, to whom he had hitherto been an almost impersonal existence, became familiarized with the extreme picturesqueness of his appearance in old age, as represented in the photographs of his friend Mrs Cameron. He died on March 27, 1886.

Sir Henry Taylor is pre-eminently the statesman among English poets. When he can speak poetically in this character he is impressive, almost great; when he deals with the more prosaic aspects of policy he is dignified and weighty, without being altogether a poet; when his theme is entirely unrelated to the conduct of public affairs or private life he is usually little more than an accomplished man of letters. An exception must be made for the interesting character of Elena in *Philip van Artevelde*, and for Artevelde's early love experience, which reproduces and transfigures the writer's own. The circumstance of *Philip van Artevelde* being to a great extent the vehicle of his own ideas and feelings explains its great superiority to his other works. It is subjective as well as objective, and to a certain extent lyrical in feeling, though not in form. Though more elaborate than any of his other dramas, it seems to smell less of the lamp. He has thoroughly identified himself with his hero, and the only fault to be found with this noble picture of a consummate leader and statesman is the absence of the shadow required for a tragic portrait. The blame allotted to Artevelde is felt to be merely conventional, and the delineation of uniform excellence becomes monotonous. The hero of *Edwin the Fair*, Dunstan, the ecclesiastical statesman, the man of two worlds, is less sympathetic to the author and less attractive to the reader. The character is nevertheless a fine psychological study, and the play is full of historical if not of dramatic interest. *Isaac Comnenus* is more Elizabethan in tone than his other dramas. Comnenus is like a preliminary sketch for Van Artevelde; and the picture of the Byzantine court and people is exceedingly lively. The idea of the revival of romantic comedy in *The Virgin Widow* is excellent, but the play lacks the humour which might have made it a success. The length of the speeches, even when not set speeches, is a drawback to all these dramas. Taylor's lyrical work is in general laboriously artificial. It is therefore extraordinary that he should have produced two songs ("Quoth tongue of neither maid nor wife" and "If I had the wings of a dove") which it would hardly be an exaggeration to call worthy of Shakespeare. His character as an essayist repeats his character as a dramatist. The essays published under the title of *The Statesman* occupy a peculiar place in literature. They have serious faults, especially the too obvious imitation of Bacon, but they nevertheless are original in their point of view, and their wisdom is the result of a different kind of observation from that which qualifies the bulk of essayists on human life. When writing as one of these Taylor is less removed from the commonplace, though many of his remarks are admirable. As a literary critic he seems unable to get beyond Wordsworth and the select circle of poets admired by the latter. His essays on Wordsworth did much to dispel the conventional prejudices of the day, but will not advance the study of the poet where his greatness is already recognized. His strictures on Byron and Shelley are narrow and not a little presumptuous. Presumption, indeed, the last fault to have been expected in so grave and measured a writer, is one of those of which he most freely accuses himself in the autobiography published a year before his death. It is not otherwise apparent in this highly interesting book, which, sinning a little by the egotism pardonable in a poet and the garrulity natural to a veteran, is in the main a pleasing and faithful picture of an aspiring youth, an active maturity, and a happy and honoured old age. (R. G.)

TAYLOR, Isaac (1787–1865), a voluminous writer on philosophical and theological subjects, was born at Lavenham, Suffolk, in 1787, and was trained by his father to be an artist, but early adopted literature as a profession. From 1824, the year of his marriage, he lived a busy but uneventful life at Ongar, in the parish of Stanford Rivers, Essex, where he died on June 28, 1865.

He early became a contributor to the *Eclectic Review*, when it was conducted by Robert Hall and John Foster, and in 1822 he published a small volume entitled *Elements of Thought*. This was followed by a translation of Theophrastus with original etchings, a *History of the Transmission of Ancient Books to Modern Times*, *Memoirs and Correspondence of Jane Taylor* (his sister, who died in 1824), and a translation of Herodotus. None of these works attained very great popularity; but in 1829 he published anonymously a work bearing upon the religious and political problems of the day, entitled *The Natural History of Enthusiasm*, which was eagerly read and speedily ran through eight or nine editions. The success of this publication encouraged him to produce, also anonymously, *The Natural History of Fanaticism*, *Spiritual Despotism*, *Saturday Evening*, and *The Physical Theory of Another Life*, all of which commanded a large circulation. Among his subsequent works may be mentioned *Ancient Christianity*, a series of dissertations in reply to the "Tracts for the Times," a volume entitled *The Restoration of Belief*, and a course of lectures on *The Spirit of Hebrew Poetry*.

TAYLOR, Jeremy (1613–1667), was a native of Cambridge, and was baptized on the 15th August 1613. His father, Nathaniel, though a barber, was a man of some education, respected by his townsmen, and lineally descended from Dr Rowland Taylor, Cranmer's chaplain, who suffered martyrdom under Mary. Jeremy, after passing through the grammar school, was entered at Caius College as a sizar in 1626, eighteen months after Milton had entered Christ's, and while George Herbert was public orator and Edmund Waller and Thomas Fuller were undergraduates of the university. He was elected a fellow of his college in 1633, but the best evidence of his diligence as a student is the enormous learning of which he showed so easy a command in after years. Accepting the invitation of Risden, a fellow-student, to supply his place for a short time as lecturer in St Paul's, he at once attracted attention by his remarkable eloquence as well as by his handsome face and youthful appearance. Archbishop Laud, ever on the outlook for men of capacity, sent for Taylor to preach before him at Lambeth, and, discerning that his genius was worth fostering, dismissed him from the overpressure of the metropolis to the quiet of a fellowship in All Souls, Oxford, and at the same time, by making him one of his own chaplains, showed his desire to keep him in permanent connexion with himself. At Oxford Chillingworth was then busy with his great work, the *Religion of Protestants*, and it is possible that by intercourse with him Taylor's mind may have been turned towards the liberal movement of his age. After two years in Oxford, in March 1638 he was presented by Juxon, bishop of London, to the rectory of Uppingham, in Rutlandshire. In the autumn of the same year he was appointed to preach in St Mary's on the anniversary of the Gunpowder Plot, and apparently used the occasion to clear himself of a suspicion, which, however, haunted him through life, of a secret leaning to the Romish communion. This suspicion seems to have arisen chiefly from his intimacy with Christopher Davenport, better known as Francis a Sancta Clara, a learned Franciscan friar who became chaplain to Queen Henrietta; but it may have been strengthened by his known connexion with Laud, as well as by his ascetic habits and ritualistic propensities. More serious consequences followed his attachment to the Royalist cause, when in 1642 the livings of the loyal clergy were sequestered by decree of parliament. The author of *Episcopacy Asserted against the Aerians and Acephali New and Old*, ineffective as that work seems in the light of modern research, could scarcely hope to retain his parish. Along with Fuller, Chillingworth, and others, he found temporary refuge with the king at Oxford. His two little boys must have been cared for by friends, for his wife, Phœbe Langsdale, whom he had married the year after his settlement at Uppingham, had died with her third child in that disastrous year 1642.

During the next fifteen years Taylor's movements are not easily traced. Sometimes he appears with the king, from whom at his last interview he received, in token of his regard, his watch and some jewels which had ornamented the ebony case in which he kept his Bible. He is supposed to be the Dr Taylor who was taken prisoner with other Royalists while besieging Cardigan castle. In 1646 he is found in partnership with two other deprived clergymen keeping a school at Newton Hall, in the parish of Llanvihangel. It was while resident here that he attracted the friendship of one of his kindest patrons, Richard Vaughan, earl of Carbery, whose hospitable mansion, Golden Grove, is immortalized in the title of Taylor's still popular manual of devotion, and whose countess had the greater distinction of being the original of the "Lady" in Milton's *Comus*. It was also while resident in Wales that Taylor married his second wife, Joanna Bridges, who was generally understood to be a natural daughter of Charles I., and who owned a good estate, though probably impoverished by Parliamentarian exactions, at Mandinam, in Carmarthenshire. From time to time he appears in London in the company of his friend Evelyn, at whose table he met such men as Boyle, Berkeley, and Wilkins. Thrice he was imprisoned: in 1653-4 for a well-intended but injudicious preface to his *Golden Grove*; again in Chepstow castle, from May to October 1655, on what charge does not appear; and a third time in the Tower in 1657-8, on account of the indiscretion of his publisher, Royston, who had adorned his "Collection of Offices" with a print representing Christ in the attitude of prayer. This unsettled life, with its interruptions, harassments, and privations, would seem rather to have stimulated than to have stinted the productiveness of his genius. In 1647 appeared his most important work, *The Liberty of Prophesying*, and in the following year the complete edition of his *Apology for Authorized and Set Forms of Liturgy against the Pretence of the Spirit*, as well as his *Life of Christ, or the Great Exemplar*, a book which at once won a popularity it still in large measure retains. Then followed in rapid succession the *Twenty-seven Sermons*, "for the summer half-year," and the *Twenty-five* "for the winter half year," *Holy Living*, *Holy Dying*, a controversial treatise on the Real Presence, the *Golden Grove*, and the *Unum Necessarium*, which by its Pelagianism gave great offence. During these years he was also busy with his *Ductor Dubitantium* (published in 1660), which he intended to be the standard manual of casuistry and ethics for the Christian people.

In 1658 settlement was at length reached through the kind offices of the earl of Carbery, who obtained for Taylor a lectureship in Lisburn. At first he declined a post in which the duty was to be shared with a Presbyterian, or, as he expressed it, "where a Presbyterian and myself shall be like Castor and Pollux, the one up and the other down," and to which also a very meagre salary was attached. He was, however, induced to take it, and found, near his patron's mansion on Lough Neagh, so congenial a retirement that even after he was raised to a bishopric he continued to make it his home. At the Restoration, instead of being recalled to England, as he probably expected and certainly desired, he was appointed to the see of Down and Connor, to which was shortly added the small and adjacent diocese of Dromore. He was also made a member of the Irish privy council and vice-chancellor of the university of Dublin. None of these honours were sinecures. Of the university he writes, "I found all things in a perfect disorder . . . . a heap of men and boys, but no body of a college, no one member, either fellow or scholar, having any legal title to his place, but thrust in by tyranny or chance." Accordingly he set himself vigorously to the task of framing and enforcing regulations for the admission and conduct of members of the university, and also of establishing lectureships. His episcopal labours were still more arduous. There were, at the date of the Restoration, about seventy Presbyterian ministers in the north of Ireland, and most of these were from the west of Scotland, and were imbued with the dislike of Episcopacy which distinguished the Covenanting party. No wonder that Taylor, writing to the duke of Ormonde shortly after his consecration, should have said, "I perceive myself thrown into a place of torment." His letters perhaps somewhat exaggerate the danger in which he lived, but there is no doubt that his authority was resisted and his overtures rejected. His writings also were ransacked for matter of accusation against him, "a committee of Scotch spiders being appointed to see if they can gather or make poison out of them." Here, then, was Taylor's opportunity for exemplifying the wise toleration he had in other days inculcated. These Presbyterians had, like himself, suffered under Cromwell for their loyalty, and might have been expected to evoke his sympathy; but the new bishop had nothing to offer them but the bare alternative—submission to episcopal ordination and jurisdiction or deprivation. Consequently in his first visitation, he declared thirty-six churches vacant; and of these forcible possession was taken by his orders. At the same time many of the gentry were won by his undoubted sincerity and devotedness as well as by his eloquence. With the Romanist element of the population he was less successful. Ignorant of the English language, and firmly attached to their ancestral forms of worship, they were yet compelled to attend a service they considered profane, conducted in a language they could not understand. As Heber says, "No part of the administration of Ireland by the English crown has been more extraordinary and more unfortunate than the system pursued for the introduction of the Reformed religion." At the instance of the Irish bishops Taylor undertook his last great work, the *Dissuasive from Popery* (in two parts, 1664 and 1667), but, as he himself seemed partly conscious, he might have more effectually gained his end by adopting the methods of Ussher and Bedell, and inducing his clergy to acquire the Irish tongue.

Nor were domestic sorrows awanting in these later years.

In 1661 he buried, at Lisburn, Edward, the only surviving son of his second marriage. His oldest son, an officer in the army, was killed in a duel; and his second son, Charles, intended for the church, left Trinity College and became companion and secretary to the duke of Buckingham, at whose house he died. The day after his son's funeral Taylor sickened, and, after a ten days' illness, he died at Lisburn on the 13th August 1667, in the fifty-fifth year of his life and the seventh of his episcopate.

Taylor's fame has been maintained by the popularity of his sermons and devotional writings rather than by his influence as a theologian or his importance as an ecclesiastic. His mind was neither scientific nor speculative, and he was attracted rather to questions of casuistry than to the deeper problems of pure theology. His wide reading and capacious memory enabled him to carry in his mind the materials of a sound historical theology, but these materials were unsifted by criticism. His immense learning served him rather as a storehouse of illustrations, or as an armoury out of which he could choose the fittest weapon for discomfiting an opponent, than as a quarry furnishing him with material for building up a completely designed and enduring edifice of systematized truth. Indeed, he had very limited faith in the human mind as an instrument of truth. "Theology," he says, "is rather a divine life than a divine knowledge." His great plea for toleration is based on the impossibility of erecting theology into a demonstrable science. "It is impossible all should be of one mind. And what is impossible to be done is not necessary it should be done." Differences of opinion there must be; but "heresy is not an error of the understanding but an error of the will." His aim in life was practical; his interests were in men rather than in ideas, and his sympathies were evoked rather by the experiences of individuals than by great movements. Of a decidedly poetic temperament, fervid and mobile in feeling, and of a prolific fancy, he had also the sense and wit that come of varied contact with men. All his gifts were made available for influencing other men by his easy command of a style rarely matched in dignity and colour. With all the majesty and stately elaboration and musical rhythm of Milton's finest prose, Taylor's style is relieved and brightened by an astonishing variety of felicitous illustrations, ranging from the most homely and terse to the most dignified and elaborate. His sermons especially abound in quotations and allusions, which have the air of spontaneously suggesting themselves, but which must sometimes have baffled his hearers. This seeming pedantry is, however, atoned for by the clear practical aim of his sermons, the noble ideal he keeps before his hearers, and the skill with which he handles spiritual experience and urges incentives to virtue. But, through all his gorgeous eloquence and genial interest in human nature, there breaks from time to time some dead and laboured irrelevancy, the growth of his training in scholastic dialectics; for "like some other writers of the 17th century he seems almost to have two minds,—one tender, sweet, luxuriant to excess, the other hard, subtle, formal, prone to definition and logomachy."

The first collected edition of his works was published by Bishop Heber (with a life) in 1822, reissued after careful revision by Charles Page Eden, 1852-61. (M. D.)

TAYLOR, John (1580–1654), commonly called "The Water Poet," was born at Gloucester in August 1580 Of his parentage and early boyhood very little is known, and that little is mainly to be gleaned from various scattered personal allusions in the numerous short writings of this prolific wit and rhymster. After fulfilling his apprenticeship to a waterman, he seems to have served (1596) in the fleet under the earl of Essex, and to have been present at the naval attack upon Cadiz. On his return to England he took up the trade of Thames waterman, and for a time at any rate was a collector of the dues exacted by the lieutenant of the Tower on all wines destined for London. The title of "Water Poet," which he owes to his occupation on the river, is a misnomer. Taylor was no poet, though he could string rhymes together with facility; his wit, which was vigorous and vulgar, found best expression in rollicking prose. He shows a broad sense of rough fun, occasionally of humour; but for the most part his comicalities would now meet with scanty appreciation. He had a very good opinion of himself, his writings, and his importance; and it was he himself who set forth that he was the "king's water poet" and the "queen's waterman." His literary performances can most easily and most satisfactorily be studied in the handsome quarto, containing all his productions, edited by Mr C. Hindley, and published in 1872. His "works," sixty-three in number, first appeared in one large volume—now a rarity sought after by collectors—in 1630. He delighted in eccentric freaks, calculated in narration to astound both the sober countryfolk and the somewhat sceptical Londoners. Thus, with a companion as feather-brained as himself, he once started on a voyage from London to Queensborough in a paper boat, with two stockfish tied to two canes for oars; before the journey's end was reached the frail boat collapsed, as might have been expected, though a qualified success finally met Taylor's efforts. The spirit of the bargee was in him, and he delighted in rough give-and-take; a rude lampoon was one of his favourite verbal weapons. Thus Thomas Coryat, the author of *Crudities*, having excited the literary waterman's ridicule, was rewarded with a ludicrous dedication in the production entitled *Taylor's Travels in Germanie*; again, the "water poet" indulged in abusive satire to his heart's content in an "effusion" which he called *A Kicksey-Winsey, or a Lerry Come-Twang*—a literary castigation which he inflicted upon those subscribers to a certain "work" of his who omitted to substantiate their promises. This production was entitled *The Penniless Pilgrimage, or the Moneyless Perambulation of John Taylor*, and consisted of an account of its author's pedestrian tour from London to Edinburgh; and to this work some sixteen hundred persons are said to have promised their support. Another wagering venture was a journey to Prague, where he is said to have been received and entertained by the queen of Bohemia in 1620. Two years later Taylor made "a very merry, wherry ferry voyage, or Yorke for my money," and in the ensuing year another water-journey, which he subsequently described in prose and verse as *A New Discovery by Sea with a Wherry from London to Salisbury*. At the outbreak of the Civil War Taylor forsook the river and retired to Oxford, where he tempted fortune by keeping a public-house. His sympathies were wholly with the Royalists,—the Roysterists, as he called them once; and, when the town surrendered, the "water poet" returned to London and kept a public-house under the sign of The Crown, in Phœnix Alley, Long Acre. He incurred some odium from his loyal observance of the king's death in the placement above his door of the sign of The Mourning Crown, and he was forced to take the latter down. With characteristic readiness he substituted for it his own portrait, with some doggerel lines underneath. It was here that in December 1654 he died, and in the neighbouring churchyard of St Martin's-in-the-Fields his remains were laid.

At the most, Taylor can only be called an amusing and vulgarly clever pamphleteer; he wrote nothing worthy of remembrance save by the historian of the period in which he lived, by the antiquary, and by the enthusiastic student of the many straggling little byways of literature.

TAYLOR, Tom (1817–1880), dramatist and art critic, was born at Sunderland in 1817. After attending school there, and studying for two sessions at Glasgow university, he in 1837 entered Trinity College, Cambridge, of which he became a fellow. Subsequently he held for two years the professorship of English literature at University College, London. He was called to the bar (Middle Temple) in November 1845, and went on the northern circuit until, in 1850, he became assistant secretary of the Board of Health. On the reconstruction of the board in 1854 he was made secretary, and on its abolition his services were transferred to the Local Government Act Office, a department of the Home Office created by the Sanitary Act of 1866. In his very early years Tom Taylor showed a predilection for the drama, and was in the habit of performing dramatic pieces along with a number of children in a loft over a brewer's stable. His first dramatic composition was a rhymed fairy tale or extravaganza, written in conjunction with Albert Smith and Charles Kenny, and performed in 1846. From this time he wrote for the stage continuously till the close of his life, his dramatic compositions or adaptations numbering in all over 100, amongst the best known of which are *Still Water Runs Deep*, *Victims*, the *Contested Election*, the *Overland Route*, the *Ticket of Leave Man*, *Anne Boleyn*, and *Joan of Arc*. He may perhaps be regarded as the first dramatist of his time, so far as general appreciation goes; and, if his chief concern was the construction of a popular acting play, his dramas possess at the same time considerable literary excellence, while the characters are clearly and consistently drawn, and the dialogue is natural, yet nervous and pointed. In his blank verse historical dramas, such as *Anne Boleyn* and *Joan of Arc*, he was not so successful. Taylor was also a very frequent contributor to the light magazine literature of the day. In 1872 he withdrew from public life, and, on the death of Shirley Brooks in 1873, he became editor of *Punch*. He occasionally appeared with success in amateur theatricals, more especially in the character of Adam in *As You Like It* and of Jasper in *A Sheep in Wolf's Clothing*. He had some talent for painting, and for many years was art critic to the *Times*. He died at Lavender Sweep, Wandsworth, 12th July 1880.

Apart from the drama, his chief contributions to literature are his biographies of painters, viz., *Autobiography of B. R. Haydon* (1853); *Autobiography and Correspondence of C. R. Leslie, R.A.* (1859); and *Life and Times of Sir Joshua Reynolds* (1865), which had been left in a very incomplete state by Mr Leslie. His *Historical Dramas* appeared in one volume in 1877. He also edited, with a memorial preface, *Pen Sketches from a Vanished Hand, selected from Papers of the late Mortimer Collins.*

TAYLOR, Zachary (1784–1850), president of the United States, was born in Orange county, Virginia, November 24, 1784. He entered the army as lieutenant in 1808, and rose to the rank of major in the war with Great Britain which followed. At the outbreak of the Mexican War he was in command of the American forces in Louisiana and Texas, and was directed to make the advance into the disputed territory which brought on the war. Beating the Mexicans in two battles, he followed them into Mexico, and there defeated Santa Anna in the crowning battle of his campaign, Buena Vista (1847). Dissatisfied with his treatment by the administration, he resigned and returned to the United States, where the Whig party nominated him and elected him president (1848). The struggle over the question of the admission of slavery to the territory taken from Mexico occupied his term of office, and he died at Washington, July 9, 1850.

TCHAD, Tsad, or Chad, Lake. See Africa, vol. i. p. 255, and Soudan.

TCHEREMISSES, or Cheremisses. See Finland, vol. ix. p. 219, and Russia, vol. xxi. pp. 79–80.

TCHERKASY (Polish *Czerkasy*), a district town of Russia, in the government of Kieff, and 190 miles by rail to the south-east of Kieff, on the right bank of the Dnieper. It is poorly built, mostly of wood; the population has rapidly increased lately, and has doubled since 1846, reaching 15,740 in 1883. There are now two gymnasiums for boys and girls, and several lower schools. The inhabitants (Little Russian) are mostly employed in agriculture and gardening. There is a brisk export trade in corn, refined sugar, tobacco, salt, and timber; raw sugar and manufactured goods are imported, principally by Jewish merchants.

Tcherkasy, formerly Tcherkassk, was an important town of the Ukraine in the 15th century, and remained so, under Polish rule, until the revolt of Hmelnitski, when it became free. When West Ukraine was taken again by Poland, most of its inhabitants migrated to the left bank of the Dnieper. It was annexed by Russia in 1795.

TCHERNIGOFF, a government of Little Russia, on the left bank of the Dnieper, bounded by Moghileff and Smolensk on the N., Orel and Kursk on the E., Poltava on the S., and Kieff and Minsk on the W., has an area of 20,233 square miles. Its surface is an undulating plain, 650 to 750 feet high in the north, and from 370 to 600 feet in the south, deeply grooved by ravines and the valleys of the rivers. In the north, "beyond the Desna," about one-third of the area is under wood (which is rapidly disappearing), and marshes occur along the courses of the rivers; while to the south of the Desna the soil is dry, sometimes sandy, and assumes the characters of a steppe-land as one proceeds southward. Chalk deposits prevail in the north, and Eocene in the south. The government is watered by the Dnieper (which forms its western boundary for 178 miles) and its tributaries the Soj and the Desna. The latter, which flows through Tchernigoff for nearly 350 miles, is navigable, and timber is brought down its tributaries. Corn, linseed, timber, brandy, hemp, and sugar are shipped on the Dnieper, Soj, and Desna, and salt imported. The climate is much colder in the woody tracts of the north than in the south; the average yearly temperature at the town of Tchernigoff is 44°·4 (January, 23°; July, 68°·5).

The population, which is rapidly increasing, reached 1,996,250 in 1883. It is chiefly Little Russian (85·6 per cent.); Great Russians (6·1 per cent.), mostly Raskolniks, and White Russians (5·6 per cent.) inhabit the northern districts. Jews have spread rapidly since last century, and now number more than 45,000. There are, besides, some 20,000 Germans as well as Greeks at Nyezhin. Agriculture is the principal occupation; in the north, however, many of the inhabitants are engaged in the timber trade and various domestic industries. Cattle-breeding is carried on in the central districts, and there were in 1883 572,200 horses, 515,300 cattle, and 948,000 sheep. Beet is extensively cultivated, and in 1884 2 million cwts. of beet-root were delivered to the thirteen sugar-works within the government. The culture of tobacco is also increasing, upwards of 500,000 cwts. being produced annually. Hemp is widely cultivated in the north, and the milder climate of the south encourages gardening. Bee-keeping is extensively carried on by the Raskolniks. Tar, pitch, and a large variety of wooden manufactures are largely produced in the forest districts, as also are woven fabrics, felts, and leather wares. Limestone, grindstones, china-clay, and building stone are quarried. Manufactures have begun to develop rapidly of late; by 1881 their yearly production reached £1,340,000 (£860,000 from sugar-works and distilleries). Trade is active, especially since the opening of the railway between Kieff and Kursk, which runs through Tchernigoff. The government is divided into fifteen districts, the chief towns (with populations in 1885) being Tchernigoff (19,000), Borzna (13,700), Glukhoff (16,450), Gorodnya (3550), Konotop (16,420), Kozelets (4430), Krolevets (9190), Mglin (10,880), Novgorod-Syeversk (8020), Novozybkoff (11,920), Nyezhin (43,020), Oster (3550), Sosnitsa (5650), Starodub (23,890 in 1880), and Surazh (3770). A number of unimportant towns (14 *posads* and 49 *myestechki*) possess municipal institutions.

TCHERNIGOFF, capital of the above government, stands on the right bank of the Desna, nearly half a mile from the river, 476 miles from Moscow. Far removed from the great channels of trade, its sole importance is as an administrative centre. Its houses are poorly built, and the streets are unpaved. The population (19,000 in 1885, one-third being Jews) is almost stationary. The ruins of its fortress, and the old cathedrals of Preobrazhenie and Borisoglebsk, founded in the 11th and 12th centuries, bear witness to the former importance of the town. Numerous graves scattered about, and now partly explored, speak of the battles which caused its decay.

Tchernigoff is known to have existed before the introduction of Christianity into Russia. In 907 it is mentioned in the treaty of Oleg as next to Kieff, and in the 11th century it became the capital of the principality of Syeversk and an important commercial city. The Mongolian invasion put an end to its growth. Lithuania annexed it in the 14th century, but it was soon seized by Poland, which held it until the 17th century. The great rising in 1648 rendered it independent until 1654, when the Cossacks accepted the protectorate of the czars of Moscow. In 1686 it was definitely annexed to Russia.

TCHERNOMORSK, a government of Caucasia, Russia, consisting of a narrow strip of land between the main Caucasus chain and the Black Sea, formerly inhabited by the Adyghe mountaineers of Caucasus. This strip, protected by the mountains from the cold winds of the north, is in respect of climate one of the most favoured parts of the Black Sea littoral. Owing to extensive emigrations of its inhabitants to Turkey since the Russian conquest of 1864, it is very thinly peopled, the population numbering but 25,980, mostly Russians, on an area of 2824 square miles. The steep slopes of the Caucasus, whose summits range from 2000 to 10,000 feet, are furrowed by narrow gorges, and bear a luxuriant vegetation. The wild vine—a relic of former gardens—grows freely in the forests, which are almost impassable on account of the underwood and decaying trees. The moistness of the atmosphere contributes to the spread of the Caucasian fever, which is characteristic of the littoral. Notwithstanding the proximity of the mountains to the sea, a road is now being constructed along the coast,—for military reasons.

Agriculture is carried on, but only in the south,—gardening and the culture of the vine and tobacco being the chief occupations besides fishing and hunting. Some manufactures are rising up at Novorossiyak (3330 inhabitants) and Anapa (5360), the two principal towns, which also have some foreign trade. The region is a separate province under a military governor residing at Novorossiyak, where a new harbour is being constructed.

TCHISTOPOL, a district town of Russia, in the government of Kazañ, 90 miles to the south-east of that town, on the left bank of the Kama. Before 1781 it was a mere village (Tchistoye Pole), founded by runaway serfs; at present it is extending rapidly and becoming an industrial town, with flour-mills, distilleries, and a few cotton-mills. The merchants carry on a brisk trade in corn brought in from the fertile tracts of Ufa, and shipped down the Kama; manufactured wares are imported. The population in 1883 was 18,200.

TCHITA, capital of Transbaikalia, Eastern Siberia, stands 585 miles east of Irkutsk, on the Tchita river, half a mile above its junction with the Ingoda. It was founded in 1851; and military considerations led to the selection of this very small village to be the capital of Transbaikalia. Steamers on the Amur and Shilka do not penetrate so far as the upper Ingoda; they usually stay at Sryetensk, 320 miles distant. But the military supplies sent every year from Transbaikalia to the Amur region usually start from Tchita,—the forest-covered hills on the banks of the Ingoda supplying material for the construction of the barges (from 100 to 200 in number) on which these supplies are carried as soon as the melting of the snows in the mountains temporarily raises the water in the river to a sufficient height. Tchita is built of wood, with unpaved streets and wide open spaces. The dryness of the Buriat steppe close by prevents snow from accumulating to any depth, even when the cold is extreme; the merchandise accordingly which is forwarded from Irkutsk to the Nertchinsk district is brought to Tchita on carts, and is there loaded on sledges for the continuation of the journey down the frozen rivers. The population of Tchita in 1883 was 12,600. The inhabitants support themselves by agriculture, by trade in furs, cattle, hides, and tallow, which are bought from the Buriats, and in all kind of manufactured wares imported from Russia and Western Siberia.

TEA. This important food auxiliary, now in daily use as a beverage by probably one-half of the population of the world, is prepared from the leaves of one or more plants belonging to the natural order *Ternströmiaceæ*. The order includes the well-known ornamental genus of shrubs *Camellia*, to which indeed the tea-plants are so closely allied that by many systematic writers they are included in the same genus. The tea-plants have been cultivated in China for at least a thousand years.

Botany.

As is commonly the case with plants which have been long under cultivation, there is much doubt as to specific distinctions among the varieties of tea. Under the name of *Thea sinensis*, Linnæus originally described tea as a single species; but with fuller knowledge of the Chinese plants he established two species, *Thea Bohea* and *Thea viridis*, and it was assumed that the former was the source of black teas, while *Thea viridis* was held to yield the green varieties. In 1843, however, Mr Robert Fortune found that, although the two varieties of the plant exist in different parts of China, black and green tea are made indifferently from the leaves of the same plant. The tea-plant is cultivated in China as an evergreen shrub, which grows to a height of from 3 to 5 feet. The stem is bushy, with numerous and very leafy branches; the leaves are alternate, large elliptical, obtusely serrated, veined, and placed on short channelled foot-stalks. The calyx is small, smooth, and divided into five obtuse sepals. The flowers are white, axillary, and slightly fragrant,—often two or three together on separate pedicels. The corolla has from five to nine petals, cohering at the base. The filaments are short, numerous, and inserted at the base of the corolla; the anthers are large and yellow, the style trifid, and the capsules three-celled and three-seeded.

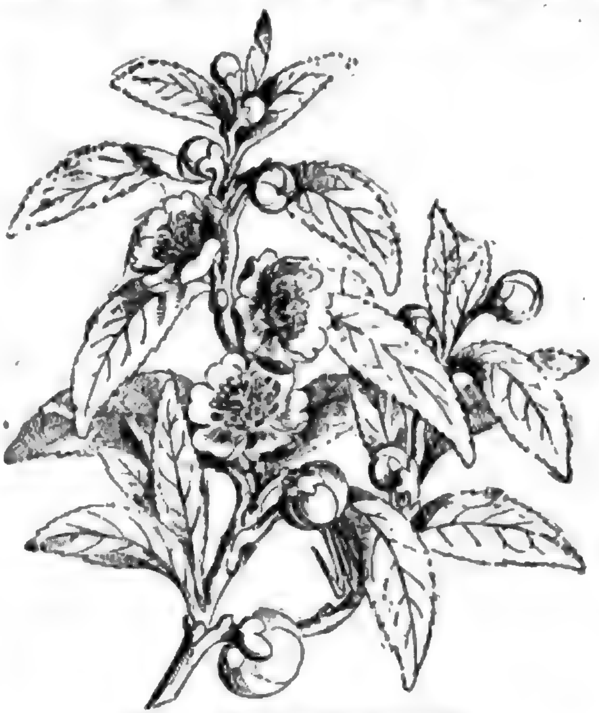

Fig. 1.—Tea-Plant (*Thea sinensis*).

The *viridis* varieties are hardier, and possess larger and brighter green leaves than belong to the *Bohea* variety. No strictly wild tea-plants have been discovered in China, but an indigenous tea-tree (*Thea assamica*) is found in Assam, which botanists now incline to regard as the parent species of all cultivated varieties. It differs in many respects from the Chinese plants. The indigenous Assam tea-plant is a tree attaining a height of from 15 to 20 feet, growing in the midst of dense moist jungle and in shady sheltered situations. Its leaves vary considerably in size, form, and venation, being usually smooth, thick, and leathery, lanceolate, ovate lanceolate, or oblong lanceolate. They are variously dotted with pellucid cells containing essential oil, and the number of such cells shown by the leaf is held to be an indication of the quality of tea it will yield. The leaf of the Chinese plant never exceeds 4 inches in length, while that of the Assam tree reaches

9 inches and upwards. The Chinese plant is hardy, and capable of thriving under many different conditions of climate and situation; while the indigenous plant is tender and difficult of cultivation, requiring for its success a close, hot, moist, and equable climate. The characteristic venation of the leaf of the Chinese tea-plant is delineated in fig. 2. In minute structure the leaf presents highly characteristic appearances. The under side of the young leaf is densely covered with fine one-celled thick-walled hairs, about 1 mm. in length and ·015 mm. in thickness. These hairs entirely disappear with increasing age. The structure of the epidermis of the under side of the leaf, with its contorted cells, is represented (× 160) in fig. 3. A further characteristic feature of the cellular structure of the tea-leaf is the abundance, especially in grown leaves, of large, branching, thick-walled, smooth cells (idioblasts), which, although they occur in other leaves, are not found in such as are likely to be confounded with or substituted for tea. The minute structure of the leaf in section is illustrated in fig. 4.

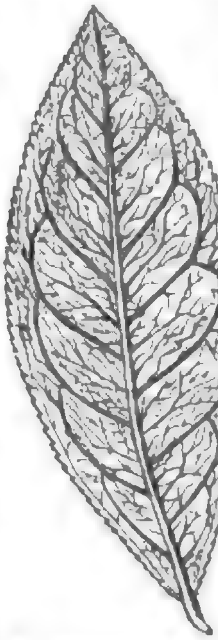
FIG. 2.—Tea-Leaf—full size.

Range of growth.

The cultivated varieties of tea, being comparatively hardy, possess an adaptability to climate excelled among food plants only by the wheat. The limits of actual tea cultivation extend from 39° N. lat. in Japan, through the tropics, to Java, Australia, Natal, and Brazil in the southern hemisphere. The tea-plant will even live in the open air in the south of England, and withstand some amount of frost, when it receives sufficient summer heat to harden its wood. But comparatively few regions are suited for practical tea-growing.

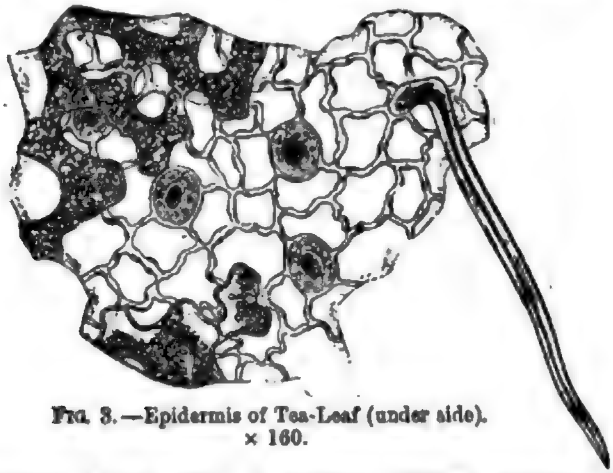
FIG. 3.—Epidermis of Tea-Leaf (under side). × 160.

Climate and soil.

A rich and exuberant growth of the plants is a first essential of successful tea cultivation. This is only obtainable in warm, moist, and comparatively equable climates, where rains are frequent and copious. The climate indeed which favours tropical profusion of jungle growth—still steaming heat—is that most favourable for the cultivation of tea, and such climate, unfortunately, is most prejudicial to the health of Europeans. It was formerly supposed that comparatively temperate latitudes and steep sloping ground afforded the most favourable situations for tea-planting, and much of the disaster which attended the early stages of the tea enterprise in India is traceable to this erroneous conception. Tea thrives best in light friable soils of good depth, through which water percolates freely, the plant being specially impatient of marshy situations and stagnant water. Undulating well-watered tracts, where the rain escapes freely, yet without washing away the soil, are the most valuable for tea gardens. As a matter of fact, many of the Indian plantations are established on hill-sides, after the example of known districts in China, where hill slopes and odd corners are commonly occupied with tea-plants.

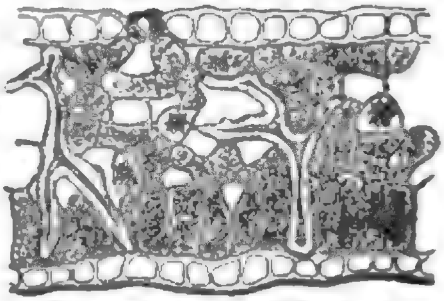
FIG. 4.—Section through Tea-Leaf.

Histor

According to Chinese legend, the virtues of tea (*cha*, pronounced in the Amoy dialect *tê*, whence the English name) were discovered by the mythical emperor Chinnung, 2737 B.C., to whom all agricultural and medicinal knowledge is traced. It is doubtfully referred to in the book of ancient poems edited by Confucius, all of which are previous in date to 550 B.C. A tradition exists in China that a knowledge of tea travelled eastward to and in China, having been introduced 543 A.D. by Bodhidharma, an ascetic who came from India on a missionary expedition, but that legend is also mixed with mythical and supernatural details. But it is quite certain, from the historical narrative of Lo Yu, who lived in the Tang dynasty (618–906 A.D.), that tea was already used as a beverage in the 6th century, and that during the 8th century its use had become so common that a tax was levied on its consumption in the 14th year of Tih Tsung (793). The use of tea in China in the middle of the 9th century is known from Arab sources (Reinaud, *Relation des Voyages*, 1845, p. 40). From China a knowledge of tea was carried into Japan, and there the cultivation was established about the beginning of the 13th century. Seed was brought from China by the priest Miyoye, and planted first in the south island, Kiushiu, whence the cultivation spread northwards till it reached the high limit of 39° N. To the south tea cultivation also spread into Tong-king and Cochin China, but the product in these regions is of inferior quality. Till well into the 19th century it may be said that China and Japan were the only two tea-producing countries, and that the product reached the Western markets only through the narrowest channels and under most oppressive restrictions.

In the year 1826 the Dutch succeeded in establishing tea gardens in Java. At an early period the East India Company of Great Britain, as the principal trade intermediary between China and Europe, became deeply interested in the question of tea cultivation in their Eastern possessions. In 1788 Sir Joseph Banks, at the request of the directors, drew up a memoir on the cultivation of economic plants in Bengal, in which he gave special prominence to tea, pointing out the regions most favourable for its cultivation. About the year 1820 Mr David Scott, one of the Company's servants, sent to Calcutta from the district of Kuch Behar and Rangpur—the very district indicated by Sir Joseph Banks as favourable for tea-growing—certain leaves, with a statement that they were said to belong to the wild tea-plant. The leaves were submitted to Dr Wallich, Government botanist at Calcutta, who pronounced them to belong to a species of *Camellia*, and no result followed on Mr Scott's communication. These very leaves ultimately came into the herbarium of the Linnean Society of London, and have authoritatively been pronounced to belong to the indigenous Assam tea-plant. Dr Wallich's attribution of this and other specimens subsequently sent in to the genus *Camellia*, although scientifically defensible, unfortunately diverted attention from the significance of the discovery. It was not till 1834 that, overcome by the insistance of Captain Francis Jenkins, who maintained and proved that, called by the name *Camellia* or not, the leaves belonged to a tea-plant, Dr Wallich admitted "the fact of the genuine tea-plant being a native of our territories in Upper Assam as incontrovertibly proved." In the meantime a committee had been formed by Lord William Bentinck, the governor-general, for the introduction of tea culture into India, and an official had already been sent to the tea districts of China to procure seed and skilled Chinese workmen to conduct operations in the Himalayan regions. The discovery and reports of Captain Jenkins led to the investigation of the capacities of Assam as a tea-growing country by Lord William Bentinck's committee. Evidence of the abundant existence of the indigenous tea-tree was obtained; and the directors of the East India Company resolved to institute an experimental establishment in Assam for cultivating and manufacturing tea, leaving the industry to be developed by private enterprise should its practicability be demonstrated. In 1836 there was sent to London 1 ℔ of tea made from indigenous leaves; in 1837 5 ℔ of Assam tea was sent; in 1838 the quantity sent was twelve small boxes, and ninety-five boxes reached London in 1839. In January 1840 the Assam Company was formed, and thenceforward the cultivation of tea in India was carried on as a private commercial undertaking. The tea districts of India include, in the order of their priority, Assam, Dehra Dun, Kumaun, Darjiling, Cachar, Kangra, Hazaribagh, Chittagong, Tarai, and the Nilgiris (Madras).

Attempts were repeatedly made to introduce tea culture in Ceylon, under both Dutch and British authority. No permanent success was attained till about 1876, when the disastrous effects of the coffee-leaf disease induced planters to give serious attention to tea. Since that period the tea industry has developed in Ceylon with marvellous rapidity, and it has every prospect of taking the first rank among Singalese productions. Tea-planting has also been successfully established in Natal. But beyond the regions above enumerated the industry has never taken root. It has been tried in the West Indies, the Southern States of America, Brazil, Australia, and the south of Europe; but cheap labour is a *sine qua non* of success. Tea can be picked in China and the British East Indies for two or three pence a day of wages, and it is on such exceedingly moderate outlay that the margin of profit depends.

Tea is more or less cultivated for local consumption in all provinces of China except the extreme north, but the regions from which it is exported are embraced within the provinces in the south-east—Kwang-tung, Fuh-keen, Keang-se, Che-keang, Keang-su, and Gan-hwuy. Black-tea manufacture belongs to the more southerly portion of these regions, the green-tea country lying to the north. The methods employed in cultivating the plants and in making tea in China differ widely in various districts, and the teas retained for native use—especially the high-class fancy teas which are never seen abroad, and would probably not bear exportation—undergo special manipulation. The teas exported are of three principal classes—black tea, green tea, and brick tea.

In cultivation, the young plants are not ready for picking till they are three years old, by which time they should be well established, throwing out young shoots or "flushes" with vigour and profusion. It is these tender shoots, with leaf-buds and expanding leaves, which alone are gathered for tea manufacture, and the younger the leaf-bud the better is the quality of the tea. According to Chinese statements there are four gatherings of leaves in the year. The first is made early in April, when the young leaf-buds are just unfolding, and these, covered below with their fine silky hairs, are taken for making pekoe or young hyson. The second gathering takes place about the beginning of May, another in July, and the fourth in August and September. On each succeeding occasion the product is less fragrant and valuable, and the final gathering is said to consist of large leaves of little value. These statements do not, however, accord with Indian experience.

The following brief outline of the Chinese tea-making processes is given by Mr Ball (*Cultivation and Manufacture of Tea*):—

Black tea.

"The leaves of black tea are exposed to the sun and air on circular trays and treated as hay, during which an incipient saccharine fermentation is supposed to take place in conjunction with a volatile oil. Various modifications of flavour are thus produced by the management of this fermentation; a loss of tannin takes place by the conversion of part of the tannic acid into sugar. During this change the leaves become flaccid, and slightly tinged or spotted with red or brown colouring matter, and give out a peculiar odour, approximating to, or, as some think, identical with, the odour of tea. A certain change in this odour is carefully watched by the workmen, this being an indication that the roasting must not be delayed. It is not necessary to wait till the leaves are spotted with red. They are then roasted in an iron vessel, and afterwards rolled with the hands, to express their juices. The roasting and rolling are repeated so long as any juices can be expressed from the leaves in the act of rolling. Finally, they are dried in sieves placed over a charcoal fire in drying tubes, during which the leaves are occasionally taken from the fire, and turned until completely dried. It is in this last stage of the process that the leaves turn black, though this change of colour is mainly due to the process of manipulation previously to roasting, and not to the action of heat."

Green tea.

"The leaves of green tea are roasted also in an iron vessel, but as soon as gathered, without any previous manipulation, all heating or fermentation of the leaves being studiously avoided; they are then rolled as black tea, and finally dried in the same vessel in which they have been roasted, by constantly stirring and moving them about. They are also fanned to hasten evaporation, and the drying and formation of the peculiar characteristic colour of this tea, which it gradually acquires in this process, and which resembles the bloom on some fruits."

The colour of genuine green tea is entirely due to the rapid drying of the fresh leaves, which prevents the chlorophyll from undergoing any alteration. The green tea sent out of China is almost invariably faced or glazed with artificial colouring matter, principally with a powdered mixture of gypsum and Prussian blue.

Commercial varieties

The names distinguishing commercial qualities of tea are almost entirely of Chinese origin. In general they indicate a gradation of qualities from the fine and delicate product of the young leaf-bud up to the hard and woody expanded and partly-grown leaf. The following list represents the ordinary series of qualities, beginning with the finest:—

Black Tea.—Flowery pekoe, orange pekoe, pekoe, pekoe souchong, souchong, congou, bohea.

Green Tea.—Gunpowder, imperial, hyson, young hyson, hyson skin, caper.

Of these names, pekoe is derived from *pak-ho* (white hairs), the pekoes showing the fine downy tips of the young buds; souchong is from *siaou-chung*, little plant or sort; congou (*kung-fu*), labour; bohea (*wu-i*), the mountains in Fuh-keen, the centre of the black-tea country; and hyson (*yu-tsien*), before the rains, or *tu-chun*, flourishing spring. Many other names occur in the trade denoting teas of special qualities or districts, such as oolong (black dragon) and twankay, from the district of that name in the province of Keang-su. Scented teas also form a special class of Chinese produce. In scenting the finished tea, either black or green is intimately intermixed with odoriferous flowers and left in a heap till the tea is fully impregnated with the odour, when the two substances are separated by sifting, and the tea so scented is immediately packed and excluded from the air.

Brick tea.

Brick tea is the special form in which tea is prepared for use throughout the vast tracts of Central Asia. It is made principally from broken leaves, stalks, and fragments of large leaves, compressed into blocks of various sizes. The bricks are of various degrees of compression, some being lightly squeezed into a loose mass and sewed up in cowhide bags, while others form compact resonant cakes, in which all trace of the original leaf structure is lost, with gilt characters impressed in their surface. Brick tea is much in demand over an area greater than the whole of Europe, and by many tribes it is stewed with milk, salt, and butter or other fat and eaten as a vegetable. The Russian factors established in Hoo-pih prepare two sizes of brick tea, which they send off in great quantities through the Kalgan Gate of the Great Wall.

Tea industry in India.

Under European supervision the cultivation and especially the manufacture of tea have in India undergone remarkable improvements. Indeed, the traditional and empirical teaching and processes of China proved a most serious stumblingblock to the progress of the tea industry under Western auspices. The tea-plants now cultivated in India are of three principal classes—the indigenous Assam, the Chinese, and a hybrid between the two. By much crossing and intermixture the gradations from one extreme to the other are almost imperceptible. The best qualities of black teas are made from indigenous and high-class hybrid plants, but these are comparatively tender and require a close humid climate. The hardiness of the Chinese plants is their most important character, for, favourably situated, the Assam plant gives a larger yield of delicate young leaf during the season than any other.

Picking.

In favourable circumstances the tea-plant "flushes" or sends forth a fresh crop of tender young shoots from twenty to twenty-five times in the course of its growing and picking season of about nine months. The average annual yield per plant is very variable, but may be stated at about one-fifth of a ℔ of finished tea; and, as each acre of a garden holds 1500 to 1600 mature plants, the yield per acre may be from 300 to 350 ℔ per annum. The diagram (fig. 5) from Col. Money's valuable practical treatise on the *Culti-*

vation and Manufacture of Tea illustrates the method in which a flush or shoot is picked, and the portions which go to make special classes of tea. The lines in the diagram show the points at which the shoot may be picked, and it is important that the lowest leaf taken should be so nipped off as to leave the bud in its axil uninjured on the branch, as from it the next flush will then develop. The three leaves at the growing point (*a*, *b*, *c*) yield pekoe, and the whole shoot down to and including *f* gives pekoe souchong. In the order of their age, the individual leaves manufacture into *a* flowery pekoe, *b* orange pekoe, *c* pekoe, *d* pekoe souchong, *e* souchong, and *f* congou. Were the flush further developed another leaf might be taken, which would be classed as bohea, but that is not a quality recognized by Indian growers. It is not, however, the practice to pick or treat leaves separately, the whole flush being manipulated together, and the tea is only separated into qualities by sifting after the manufacturing processes have been completed.

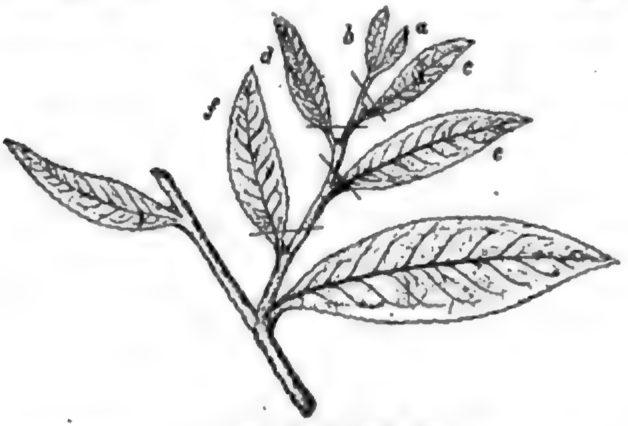

FIG. 5.—Mode of Picking Tea.

Manufacture. Black tea. The manufacture of black tea is found to be an essentially simple matter. Many of the processes employed by the Chinese are quite superfluous, and several of the manual operations which bulk largely in the Chinese manufacture, it is found, can with advantage be supplanted by mechanical agency. The whole object of the black-tea manufacturer is to ferment, roll, and dry the leaf, and for that purpose the leaves undergo—(1) withering, (2) rolling, (3) fermenting, and (4) firing or dholing. Between the fermenting and the firing operations it is desirable to expose the leaves to the direct sunlight for an hour or thereby. This cannot always be done, as it is impossible to keep the fermented leaves after they have attained their proper state; nevertheless the best result is always attained in bright weather, when it is possible to expose the fermented leaves to the sun.

The fresh leaves from the garden, as they are brought in to the factory, are withered by being spread evenly over square wicker-work trays—leaf challanies—thickly or thinly as the weather is hot or cool. Thus they are left exposed to the air till they become quite soft and flaccid, folding together when pressed in the hand into a clammy mass without crackling or rebound. In cloudy or rainy weather it becomes necessary to wither by machine, acting on the leaves with artificially dried and heated air. Withering is a preliminary to rolling, in which the flaccid and velvety leaves are kneaded, twisted, and rolled back and forward over a table till the whole comes into a mashy condition by the exudation of juice. While in Chinese tea-making that juice is squeezed out of the leaves, in India it is most carefully lapped up and absorbed in the spongy mass. In hand-rolling as much as can be worked between two hands is operated on, and passed from man to man along the table till fully worked, when it is made up into a compressed ball and so put aside for fermenting. This process is the distinguishing feature of black-tea making, and on its sufficient accomplishment depends much of the character and quality of the tea made. The progress of the fermentation must be carefully watched, and at the point when by the colour it is known to be sufficiently advanced the tea is in favourable weather sunned by exposure, thinly spread out to the sunlight for about an hour. It is immediately thereafter fired, either by the fumes of burning charcoal or by a current of dried and heated air from one of the numerous machines now in use. With this single firing the process is completed, and the tea so finished is sifted by machinery into commercial qualities according to the size of the leaf.

For the entire range of manufacturing operations numerous forms of machinery and mechanical devices have been adapted and introduced in Indian gardens, so that, apart from picking the leaves, tea-making has become practically a factory industry.

Green tea. The manufacture of green tea is comparatively little prosecuted in India. In Europe the demand has greatly fallen away, and, though the consumption is considerable in the United States, the supply is principally drawn from Japan, where its preparation is extensively practised. The manufacture as carried on in the North-Western Provinces resolves itself into a rapid rolling and drying of the leaf. Without permitting the leaves to wither after gathering, they are, if free from moisture, at once by exposure to a brisk heat sweated and softened for rolling. They are then without delay rolled as in black-tea manufacture, next spread out in the sun till they take a blackish tinge, then again rolled, and this rolling and exposure may be repeated yet a third time. When the rolling is completed the tea is placed in a highly heated pan, in which it is stirred about briskly till the whole mass becomes too hot to be worked by hand. Then it is tightly packed in a strong canvas bag, in which it is beaten by a heavy flat stick to consolidate it, and in this condition left for a night. Next day it is fired off in a pan, beginning with a high heat, which is gradually reduced during the nine hours or thereby of the operation, an incessant stirring and tossing being kept up the whole time. During this firing off the green colour of the tea is developed; and Indian green tea never owes any of its colour to "facing" with foreign substances.

Qualities of tea. The qualities of a sample of tea and its commercial value can only with accuracy be determined by actual infusion and trial by a skilled tea-tastor. Certain general and external appearances which indicate the class of a tea are obvious enough; but, although a pekoe may be readily distinguished from a souchong, the souchong of certain planters or districts may be more valuable than other pekoes. While it is impossible to define the conditions which determine the commercial value of an ordinary black tea, Col. Money lays down the following rules: the darker the liquor the stronger the tea, and the nearer the approach of the infused leaf to a uniform salmony brown the purer the flavour. Black tea of good quality should in infusion yield a clear bright brown liquor emitting a subdued fragrance, and in taste it should be mild, bland, and sweetish, with an agreeable astringency. Green tea yields a light-coloured liquor of high fragrance, but thin, sharp, and somewhat rasping in taste as compared with black tea.

Chemistry. The chemical components of tea leaves are essential oil, theine, tannin, boheic acid, quercetin, quercitannic acid, gallic acid, oxalic acid, gum, chlorophyll, resin, wax, albuminoids, colouring matters, cellulose, and mineral ash. Of these the first three—essential oil, theine, and tannin—are of importance in the infused beverage. The essential oil, on which the flavour of tea depends, is present to the extent of from 0·6 to 1 per cent. Theine $(C_8H_{10}N_4O_2)$ is an alkaloid identical with the caffeine obtained from coffee, and it is remarkable that the same substance is yielded by the maté or Paraguayan tea and the guarana of South America, and by the kola nut of Central Africa. The theobromine of cocoa is also closely allied to theine, and the characteristic components of the extract of meat similarly show certain points of contact with these stimulant bodies. To the tannin of tea infusions is due what is known as the strength of the tea. Prof. Dittmar has recently examined a number of China and Indian teas in regard to the proportions of theine and tannin in their infusions and to the dependence of these proportions on the time of infusion. The general result was that Chinese tea yields more theine and less tannin than Indian tea, and that in both cases 10 minutes' infusion extracts practically all the theine. Longer infusion adds only to the tannin that passes into the solution, and, as excess of tannin impedes digestion, prolonged infusion is hurtful and ought to be avoided.

The quantitative composition of tea is of course subject to great variation. The analyses by Mulder given in the accompanying table furnish a general idea of the proportion of constituents.

	Hyson. Green.	Congou. Black.
Volatile oil	0·79	0·60
Chlorophyll	2·22	1·84
Wax	0·28	0·00
Resin	2·22	3·64
Gum	8·56	7·28
Tannin	17·80	12·88
Theine[1]	0·43	0·46
Extractive matter	22·80	21·36
Colouring matter	23·60	19·12
Albumen	3·00	2·80
Woody fibre	17·08	28·32
	98·78[2]	98·30[2]

A series of investigations into a large number of teas has been carried out by Mr G. W. Wigner (*Pharm. Jour.*, 3d series, vi. 261, 281, 402). In tea as imported he found large proportions of moisture which could be expelled on exposure to a temperature of 212° F. In a range of thirty-five samples the average moisture was equal to 7·67 per cent., the lowest—in a Chinese young hyson—being 4·84, while in several congous it exceeded 10 per cent. The ash in sixty-seven specimens of ordinary and special (undried) teas he found to average 5·78 per cent., the maximum being 7·02 and the minimum 5·17; and of that ash 54·50 per cent. was soluble in water. The proportion of extractive substances in twenty-four teas varied from 26·15 in a congou to 44·85 in Moyune young hyson. The total average nitrogen from sixty green teas, slightly faced, was 3·76, from sixty black teas 3·26, from six Assam teas 3·64, and from exhausted leaves 3·80 per cent.

Adulteration. So long as the Western world remained almost exclusively dependent on China for its tea supply, adulteration was rampant and multiform in the trade. Especially among green and fancy teas there was scarcely such a thing as an unsophisticated sample to be obtained. The Chinese were also expert in fabricating an artificial gunpowder—appropriately known as "lie tea,"—which consisted of the sweepings of tea warehouses artfully made up with a paste of rice water. Paddy husks and many kinds of leaves faced with China clay, soapstone, catechu, and black lead also found their way abundantly into tea. On the European side, exhausted leaves were again dried, impregnated with catechu and gum, and faced up to do duty as fresh tea, and the leaves of numerous plants—sloe-thorn, hawthorn, willow, beech, plane, *Epilobium angustifolium*, &c.—were freely worked up as tea. Adulterated tea is now, however, comparatively rare, largely owing to the watchfulness of the customs authorities. Moreover, as it is nearly as cheap to make tea from the leaves of the tea-plant as from those of any other herb, there is not much incentive to substitute the false for the real.

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[1] The theine is certainly understated; more recent observers obtain from 1·8 to 3 per cent., and occasionally more.

[2] The mineral salts (ash) partly included in these totals amounted to 5·56 and 5·24 respectively.

At a very early period in the European history of tea the probable effects of its use on the health and morals of the population attracted jealous attention, and a great deal was written, mostly in a hostile sense, on the subject. In 1678 we find Mr Henry Savile writing to his uncle, Mr Secretary Coventry, in sharp reproof of certain friends of his "who call for tea, instead of pipes and bottles after dinner,—a base unworthy Indian practice, which I must ever admire your most Christian family for not admitting." And he adds, with an audible sigh, "the truth is, all nations are growing so wicked as to have some of these filthy customs!" Some of the writers, however, although resolute for its banishment from the caddy, were willing to give it a place in the medicine chest. "Among many other novelties," says a medical writer in 1722, "there is one which seems to be particularly the cause of the hypochondriac disorders, and is generally known by the name of thea, or tea. It is a drug which of late years has very much insinuated itself, as well into our diet as regales and entertainments, though its occupation is not less destructive to the animal economy than opium, or some other drugs which we have at present learned to avoid."[1] Dr Lettsom was the first medical writer who gave the public a reasonable and scientific account of the plant; but even he let the fear of its abuse run away with his judgment, asserting that "the first rise of this pernicious custom [that of drinking spirits to excess] is often owing to the weakness and debility of the system brought on by the daily habit of drinking tea; the trembling hand seeks a temporary relief in some cordial, in order to refresh and excite again the enfeebled system, whereby such persons almost necessarily fall into a habit of intemperance."[2] Jonas Hanway (*Essay on Tea*, 1756) was among its most vigorous assailants. "Men," he says, "seem to have lost their stature and comeliness, and women their beauty . . . . . What Shakespeare ascribes to the concealment of love is in this age more frequently occasioned by the use of tea." To these complaints echoes were not wanting, but after a while the tea-drinkers had it all their own way. In the meantime, however, tea was not without its apologists. To say nothing of our own familiar poets and essayists, its praises have been sung by Herrichen and by Francius in Greek verses, by Pechlin in Latin epigrams, by Pierre Petit in a Latin poem of five hundred lines, and by a German versifier, who celebrates, in a fashion of his own, its "burial and happy resurrection."[3] Huet, bishop of Avranches, has also paid his graceful tribute[4] to a stimulant to which, probably, no scholar was ever more indebted, and which he continued to enjoy at the age of ninety. Dr Johnson draws his own portrait as "a hardened and shameless tea-drinker, who for twenty years diluted his meals with only the infusion of this fascinating plant; whose kettle had scarcely time to cool; who with tea amused the evening, with tea solaced the midnight, and with tea welcomed the morning."[5]

Authorities are not yet by any means agreed as to the exact physiological influence and value of tea. The very striking fact that theine is precisely the characteristic constituent of coffee, maté, guarana, and the kola nut, all substances eagerly sought after in different quarters of the globe, serves to show that the alkaloid satisfies some craving of the human system, although what its effect is has not yet been certainly determined. The quantity of theine consumed even by the most hardened tea-drinker is exceedingly minute, and there are not wanting authorities who assert that it is practically inert, an assertion surely contradicted by the general instinct of the race. What is indisputable about tea drinking is that it forms an agreeable means of imbibing the proportion of water necessary in human nutrition, which, being taken hot, communicates to the system a diffused warm glow. Further, as used by Western communities, it is a medium of taking, in the form of sugar and cream, no inconsiderable amount of real nutriment. The other effects of tea are more a matter of general impression than of ascertained scientific reality. Its virtues have nowhere been better summarized than by the earliest Chinese writer on the subject, the above-mentioned Lo Yu, who says, "It tempers the spirits and harmonizes the mind, dispels lassitude and relieves fatigue, awakens thought and prevents drowsiness, lightens or refreshes the body, and clears the perceptive faculties." The gentle exhilaration which accompanies the moderate use of tea is not followed by the depression which succeeds the use of alcoholic stimuli. Experience has proved that it sustains the frame under severe muscular or mental exercise without causing subsequent exhaustion and collapse. Tea is frequently found to be beneficial to sufferers from nervous headache, and it counteracts to some extent the effects of alcohol and of opiates. Taken in excess it produces cerebral excitement, sleeplessness, and general nervous irritability. The tannin contained in its infusions also interferes with the flow of the saliva, diminishes the digestive activity of the stomach, and impedes the action of the bowels. In this view the large quantity of strong tea used by the poor—and especially by the sedentary poor,—while serving to blunt the keen tooth of hunger, must work incalculable havoc with the digestive and nervous systems of the consumers.

Commerce and statistics.

It is a remarkable fact that no mention of tea is made by Marco Polo, and that no knowledge of the substance appears to have reached Europe till after the establishment of intercourse between Portugal and China in 1517. The Portuguese, however, did little towards the introduction of the herb into Europe, and it was not till the Dutch established themselves at Bantam early in the 17th century that these adventurers learned from the Chinese the habit of tea drinking and brought it to Europe.

The earliest mention of tea by an Englishman is probably that contained in a letter from Mr Wickham, an agent of the East India Company, written from Firando in Japan, on the 27th June 1615, to Mr Eaton, another officer of the company, resident at Macao, and asking for "a pot of the best sort of *chaw*." How the commission was executed does not appear, but in Mr Eaton's subsequent accounts of expenditure occurs this item—"three silver porringers to drink chaw in."

It was not till the middle of the century that the English began to use tea, and they also received their supplies from Java till in 1686 they were driven out of the island by the Dutch. At first the price of tea in England ranged from £6 to £10 per lb. In the *Mercurius Politicus*, No. 435, of September 1658, the following advertisement occurs:—"That excellent and by all Physitians approved China Drink called by the Chineans *Tcha*, by other nations *Tay, alias Tee*, is sold at the Sultaness Head, a cophee-house in Sweetings Rents, by the Royal Exchange, London." Thomas Garway, the first English tea dealer, and founder of the well-known coffee-house, "Garraway's," in a curious broadsheet, *An Exact Description of the Growth, Quality, and Virtues of the Leaf Tea*, issued in 1659 or 1660, writes, "in respect of its scarceness and dearness, it hath been only used as a regalia in high treatments and entertainments, and presents made thereof to princes and grandees." In that year he purchased a quantity of the rare and much-prized commodity, and offered it to the public, in the leaf, at fixed prices varying from 15s. to 50s. the lb, according to quality, and also in the infusion, "made according to the directions of the most knowing merchants and travellers into those eastern countries." In 1660 an Act of the first parliament of the Restoration imposed a tax on "every gallon of chocolate, sherbet, and tea, made and sold, to be paid by the maker thereof, eightpence" (12 Car. II. c. 23).

Pepys's often-quoted mention of the fact that on the 25th September 1660, "I did send for a cup of tee, a China drink, of which I never had drunk before," proves the novelty of tea in England at that date. In 1664 we find that the East India Company presented the king with 2 lb and 2 oz. of "thea," which cost 40s. per lb, and two years afterwards with another parcel containing 22¾ lb, for which the directors paid 50s. per lb. Both parcels appear to have been purchased on the Continent. Not until 1677 is the Company recorded to have taken any steps for the importation of tea. The order then given to their agents was for "teas of the best kind to the amount of 100 dollars." But their instructions were considerably exceeded, for the quantity imported in 1678 was 4713 lb, a quantity which seems to have glutted the market for several years. The annals of the Company record that, in February 1684, the directors wrote thus to Madras:—"In regard thea is grown to be a commodity here, and we have occasion to make presents therein to our great friends at court, we would have you to send us yearly five or six canisters of the very best and freshest thea." Until the Revolution no duty was laid on tea other than that levied on the infusion as sold in the coffee-houses. By 1 William and Mary c. 6, a duty of 5s. per lb and 5 per cent. on the value was imposed. For several years the quantities imported were very small, and consisted exclusively of the finer sorts. The first direct purchase in China was made at Amoy, the teas previously obtained by the Company's factors having been purchased in Madras and Surat, whither it was brought by Chinese junks after the expulsion of the British from Java. During the closing years of the century the amount brought over seems to have been, on the average, about 20,000 lb a year. The instructions of 1700 directed the supercargoes to send home 300 tubs of the finest green teas and 80 tubs of bohea. In 1703 orders were given for "75,000 lb Singlo (green), 10,000 lb imperial, and 20,000 lb bohea." The average price of tea at this period was 16s. per lb.

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[1] *An Essay on the Nature, Use, and Abuse of Tea*, 14, 15.

[2] Lettsom, *Natural History of the Tea-Tree*, 78.

[3] *Der Thee Begräbniss und glückliche Wiederauferstehung* [1690?].

[4] In the verses beginning—

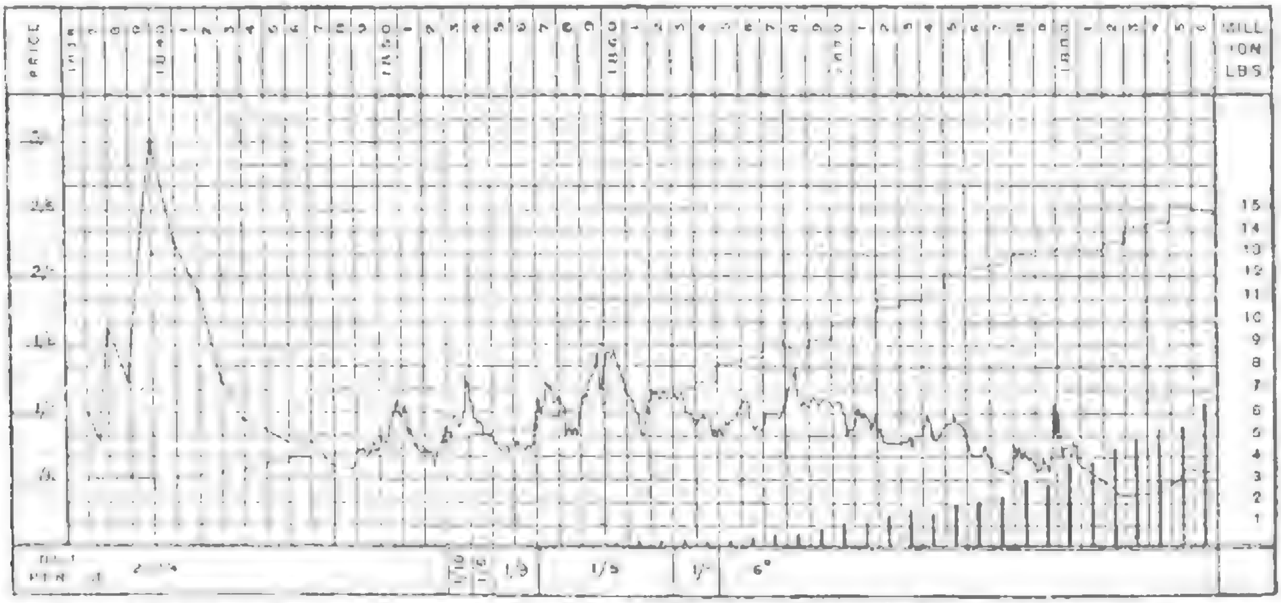
> "I, puer, i, Theam confestim in pocula misce;
> Urget non solitus lumina nostra sopor;
> Mens stupet; obtusae languent in corpore vires;
> Languorem solvet vivida Thea novum."—
> Huetii *Commentarius de rebus ad eum pertinentibus*, 304.

[5] *Literary Magazine*, vol. ii., No. 13 (1757).

During the 100 years from 1710 to 1810 the aggregate sale of tea by the East India Company amounted to 750,219,016 lb, worth £129,804,595, of which 116,470,675 lb was re-exported. The duties during that century (excepting a period of eleven years, 1784-95, when they were only 12½ per cent.) were excessive, amounting to about 200 per cent. on the value of common teas. The results of so enormous a tax were the creation of a gigantic smuggling trade, extensive adulteration of imported teas, and much fabrication of counterfeit tea within the country. Probably the duty-paid tea did not represent more than half what was consumed under the name of tea. The following table exhibits the principal facts connected with the trade during the period of the Company's monopoly, which terminated on the 22d of April 1834, when the trade was thrown open to all, the prices quoted being those of good qualities in the Company's warehouse or in bond:—

	Average Price per lb.	Rates of Duty.	Home Consumption. lb.
1728	13/2 (duty included) ...	4s. per lb, and £10, 18s. 8d. ...	1,496,026
1750		1s. per lb, and £23, 18s. 7d. ...	2,860,976
[illegible]	5/ congou, 9/10 hyson	1s. 1¼ per lb, and £25, 15s. 10d. ...	6,102,257
1783			4,741,522
1784	4/[illegible] hyson	£12, 10s. per cent. ...	[illegible]
1785	4/ congou; 10/ hyson		14,500,952
1786	4/6 congou; 7/ hyson		15,[illegible],547
1795	[illegible] congou; [illegible] hyson	20 per cent. ...	21,342,845
1801	[illegible] congou; 5/6 hyson....	£30 per cent., £20 under 2/6...	[illegible],730,150
1821	3/[illegible] congou; [illegible] hyson	£100 and £96 per cent.	[illegible]
1833	[illegible] congou; 4/2 hyson		31,829,620

The progressive increase in the consumption of tea in the United Kingdom during 50 years from 1836 till 1886 is instructively shown in the accompanying diagram constructed by Messrs J. C. Siller and Co., of London. The dotted line represents the average monthly consumption in each year; the fluctuations in price of good sound congou are traced by the black line; and the years in which reduced customs duty came into operation are indicated along the base. From 1860 onwards the amount of Indian tea entered for home consumption is shown in monthly average by a black column. This column brings out the remarkable fact that the Indian tea consumed in the United Kingdom in a year now exceeds the total consumption of all kinds in 1860, and is more than double the whole quantity used fifty years ago.



The following table shows the growth of the British tea trade for five years ending 1885:—

	India.	Ceylon.	China.	Hong Kong.	Total Imports.	Home Consumption.
1881	48,431,130	171,676	151,742,592	10,445,738	209,801,622	160,225,911
1882	53,576,690	507,031	142,706,457	10,820,915	210,663,133	165,069,339
1883	59,252,433	2,005,510	145 249,136	10,862,695	222,262,431	170,628,431
1884	63,208,309	2,210,993	134,297,091	9,411,477	215,877,759	175,090,675
1885	63,794,025	4,242,244	131,234,354	6,355,529	212,143,820	182,448,215

The consumption of tea in the United Kingdom per head was in 1840 1·22 lb, which increased in 1850 to 1·86 lb; in 1860 it reached 2·67 lb, in 1870 3·31 lb, in 1880 4·06 lb, and now (1887) it is about 5 lb.

Next to the United Kingdom, the greatest tea-importing nation is the United States. Notwithstanding that tea has from 1873 been duty free (duty 25 cents per lb in 1870, 17·72 in 1871, and 15 in 1872), the habit of tea drinking does not grow in America as it is found to do in the British Isles, as is shown by the accompanying table. Of the 72,104,956 lb of tea imported into the United States in the year ended June 1885, 35,895,835 lb was Chinese, 32,156,032 came from Japan, and 3,540,148 lb came from England. Nearly 6,000,000 lb was re-exported, principally to Canada.

Year ending 30th June.	lb entered for Consumption.	Per Head.
1870	40,812,189	1·06
1871	46,972,788	1·19
1872	34,224,494	0·84
1873	106,423,570	2·55
1875	64,708,079	1·47
1880	72,159,266	1·44
1881	81,949,796	1·59
1882	79,030,854	1·50
1883	70,771,225	1·31
1884	65,774,234	1·18
1885	69,820,172	1·22

Next to the English, the Dutch are the greatest consumers of tea outside of China; and the only other considerable tea-using nation is Russia. The following table gives the amount of tea imported in the year 1884 by the principal tea-drinking countries:—

Russia..................	35,600,000 lb	— ·43 lb	per head.
Holland..................	3,900,000 ,,	— ·91	,,
Denmark..................	820,000 ,,	— ·04	,,
New South Wales....	8,437,981 ,,	— 9·15	,,
Victoria..................	11,524,205 ,,	— 11·99	,,
South Australia.......	2,229,993 ,,	— 7·00	,,
Queensland..............	2,757,277 ,,	— 8·75	,,
Cape of Good Hope...	1,295,042 ,,	— 5·00	,,

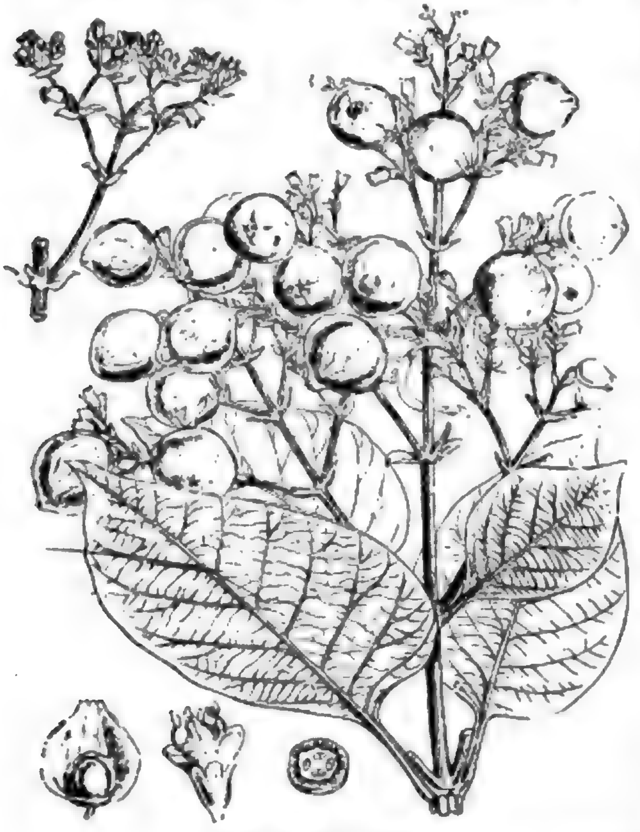
By this table the Australian colonists come out as the most inveterate tea-drinkers in the world. The quantity received by Holland in 1884 was 2,250,000 lb less than the imports of 1883, but the average of recent times has been 4,500,000 lb.

The quantity consumed in China has been estimated as high as 2000 millions of pounds annually, being at the rate of a little more than 5 lb per head of the population; and, considering the tea-drinking habits of the people, the estimate is by no means extravagant. In this light it may be safe to affirm that the amount of tea used yearly throughout the world reaches the gigantic total of 2500 millions of pounds.

Bibliography.—The literature of tea is very copious but much scattered. The following works may be named:—Bontekoe, *Tractat van het excellenste Kruyd Thee*, The Hague, 1679; Sylvestre Dufour, *Traitez Nouveaux et Curieux du Café, du Thé, et du Chocolat*, 2d ed., Lyons, 1688 (translation of 1st edition by John Chamberlayne, London, 1685; translations also in Spanish and Latin); J. G. Houssaye, *Monographie du Thé*, Paris, 1843; Robert Fortune, *Three Years' Wanderings in China*, London, 1847; Id., *A Journey to the Tea Countries of China*, London, 1852; S. Ball, *Tea Cultivation in China*, London, 1848; J. J. L. L. Jacobson, *Handboek voor de Kultuur en Fabrikatie van Thee*, 3 vols., 1843; S. A. Schwarzkopf, *Die narkotischen Genussmittel*—i. *Der Thee*, Halle, 1881; Lieut.-Col. E. Money, *Cultivation and Manufacture of Tea*, 3d ed., London, 1878; F. T. R. Deas, *Young Tea Planter's Companion*, London, 1886. See also parliamentary papers and official publications of Indian Government; *Jour. Roy. Asiatic Soc.*; *Jour. Agri. and Hort. Soc. of India*; *Soc. of Arts Journ.*, &c. (J. PA.)

TEAK[1] may justly be called the most valuable of all known timbers. For use in tropical countries it has no equal, and for certain purposes it is preferable to other woods in temperate climates also. Its price is higher than that of any other timber, except mahogany.[2] Great efforts have been made to find substitutes, but no timber has been brought to market in sufficient quantities combining the many valuable qualities which teak possesses.

The first good figure and description of the tree was given by Rheede.[3] The younger Linnæus called it *Tectona grandis*. It is a large deciduous tree, of the natural order *Verbenaceæ*, with a tall straight stem, a spreading crown, the branchlets four-sided, with large quadrangular pith. It is a native of the two Indian peninsulas, and is also found in the Philippine Islands, Java, and other islands of the Malay Archipelago. In India proper its northern limit is 24° 40′ on the west side of the Aravalli Hills, and in the centre near Jhansi, in 25° 30′ N. lat. In Burmah it extends to the Mogoung district, in lat. 25° 10′. In Bengal or Assam it is not indigenous, but plantations have been formed in Assam as far as the 27th parallel. In the Punjab it is grown in gardens to the 32d.



Teak (*Tectona grandis*).

Teak requires a tropical climate, and the most important forests are found in the moister districts of India, where during the summer months heavy rains are brought by the south-west monsoon, the winter months being rainless. In the interior of the Indian peninsula, where the mean annual rainfall is less than 30 inches, no teak is found, and it thrives best with a mean annual fall of more than 50 inches. The mean annual temperature which suits it best lies between 75° and 81° Fahr. Near the coast the tree is absent, and the most valuable forests are on low hills up to 3000 feet. It grows on a great variety of soils, but there is one indispensable condition—perfect drainage or a dry subsoil. On level ground, with deep alluvial soil, teak does not often form regularly shaped stems, probably because the subsoil drainage is imperfect.

During the dry season the tree is leafless; in hot localities the leaves fall in January, but in moist places the tree remains green till March. At the end of the dry season, when the first monsoon rains fall, the fresh foliage comes out. The leaves, which stand opposite, are from 1 to 2 feet in length and from 6 to 12 inches in breadth. On coppice shoots the leaves are much larger, and not rarely from 2 to 3 feet long. In shape they somewhat resemble those of the tobacco plant, but their substance is hard and the surface rough. The small white flowers are very numerous, on large erect cross-branched panicles, which terminate the branches. They appear during the rains, generally in July and August, and the seed ripens in January and February. On the east side of the Indian peninsula, the teak flowers during the rains in October and November. In Java the forests are leafless in September, while during March and April, after the rains have commenced, they are clothed with foliage and the flowers open. During the rainy season the tree is readily recognized at a considerable distance by the whitish flower panicles, which overtop the green foliage, and during the dry season the feathery seed-bearing panicles distinguish it from all other trees. The small oily seeds are enclosed in a hard bony 1–4 celled nut, which is surrounded by a thick covering, consisting of a dense felt of matted hairs. The fruit is enclosed by the enlarged membranous calyx, in appearance like an irregularly plaited or crumpled bladder. The tree seeds freely every year, but its spread by means of self-sown seed is impeded by the forest fires of the dry season, which in India generally occur in March and April, after the seeds have ripened and have partly fallen. Of the seeds which escape, numbers are washed down the hills by the first heavy rains of the monsoon. These collect in the valleys, and it is here that groups of seedlings and young trees are frequently found. A portion of the seed remains on the tree; this falls gradually after the rains have commenced, and thus escapes the fires of the hot season. The germination of the seed is slow and uncertain; a large amount of moisture is needed to saturate the spongy covering; many seeds do not germinate until the second or third year, and many do not come up at all.

The bark of the stem is about half an inch thick, grey or brownish grey, the sapwood white; the heartwood of the green tree has a pleasant and strong aromatic fragrance and a beautiful golden-yellow colour, which on seasoning soon darkens into brown, mottled with darker streaks. The timber retains its aromatic fragrance to a great age. On a transverse section the wood is marked by large pores, which are more numerous and larger in the spring wood, or the inner belt of each annual ring, while they are less numerous and smaller in the autumn wood or outer belt. In this manner the growth of each successive year is marked in the wood, and the age of a tree may be determined by counting the annual rings.

The principal value of teak timber for use in warm countries is its extraordinary durability. In India and in Burmah beams of the wood in good preservation are often found in buildings several centuries old, and instances are known of teak beams having lasted more than a thousand years.[4] Being one of the few Indian timbers which are really durable, teak has always been used for buildings, particularly for temples, and in India it has been the chief timber employed for shipbuilding. When iron commenced to be extensively used for the last-named purpose, it was supposed that the demand for teak would decrease. This, however, has not been the case, for the wood is still very largely used for the backing of ironclads and for decks of large vessels. It is also used for furniture, for door and window frames, for the construction of railway carriages, and for many other purposes. White ants eat the sapwood, but rarely attack the heartwood of teak. It is not, however, proof against the borings of the teredo, from whose attacks the teak piles of the wharves in the Rangoon river have to be protected by a sheathing of metal.

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[1] The Sanskrit name of teak is *saka*, and it is certain that in India teak has been known and used largely for considerably more than 2000 years. In Persia teak was used nearly 2000 years ago, and the town of Siraf on the Persian Gulf was entirely built of it. *Saj* is the name in Arabic and Persian; and in Hindi, Mahratti, and the other modern languages derived from Sanskrit the tree is called *sag*, *sagwan*. In the Dravidian languages the name is *teka*, and the Portuguese, adopting this, called it *teke*, *teca*, whence the English name.

[2] The rate in the London market since 1860 has fluctuated between £10 and £15 per load of 50 cubic feet.

[3] *Hortus Malabaricus*, vol. iv. tab. 27, 1683.

[4] In one of the oldest buildings among the ruins of the old city of Vijayanagar, on the banks of the Tungabhadra in southern India, the superstructure is supported by planks of teakwood 1½ inches thick. These planks were examined in 1881; they were in a good state of

Once seasoned, teak timber does not split, crack, shrink, or alter its shape. In these qualities it is superior to most timbers. In contact with iron, neither the iron nor the teak suffers, and in this respect it is far superior to oak. It is not very hard, is easily worked, and takes a beautiful polish. It has great elasticity and strength, and is not very heavy. The average weight of perfectly seasoned wood fluctuates between 38 and 46 ℔ per cubic foot.[1] Its weight, therefore, is a little less than that of English oak. Green teak timber, however, is heavier than water, and unless thoroughly seasoned it cannot be floated. In Burmah, therefore, where the rivers are used to float the timber to the seaports, a peculiar mode of seasoning teak by girdling has been practised from time immemorial. Girdling consists in making a deep circular cut through bark and sap into the heartwood, so as completely to sever communication between bark and sapwood above and below the cut. In teak, as in oak and other trees with well-marked heartwood, the circulation of the sap only takes place in the sapwood, and the girdled tree therefore dies after a few days if the operation has been effectually performed. But if even the smallest band of sapwood is left connecting the outer layers of wood above and below the girdle, the tree is not killed, and often recovers completely. The girdled tree is allowed to stand one or two years, and longer if a very large-sized tree. Being exposed to the wind and to the action of the sun, the timber of a girdled tree seasons more rapidly and more completely than that of a tree felled green. The teak produced in the presidencies of Madras and Bombay and in the Central Provinces is as a rule felled green, and even when dry it generally is a little heavier than the timber from Burmah.[2] For a long time to come, the rivers of Burmah and Siam will continue to afford the most convenient and most economical routes for the transport of timber. Indeed the forests drained by the Salwin and its feeders are not likely ever to be worked otherwise than on the present plan, under which the logs are floated singly over the rapids and are caught and rafted lower down, at the kyodan or rope station, 70 miles above Maulmain.

As already mentioned, teakwood contains an aromatic oil, which gives it a peculiarly pleasant smell and an oily surface when fresh cut. To this oil may probably with justice be ascribed its great durability. In Burmah oil is extracted from the timber on a small scale, for medicinal purposes, by filling an earthen pot, which is placed inverted upon another, with chips of wood, and putting fire round it, upon which the oil runs down into the lower vessel.

According to the colour and texture of the wood, several varieties of teak are distinguished in India, Burmah, and Java; in the timber trade, however, these distinctions are of no importance. Teak as well as other trees, when standing isolated, forms side branches far down the stem, and the wood of such trees is more knotty and wavy, and generally heavier and darker-coloured than the timber of trees which have grown close together in a dense forest. Apart from the manner in which the tree had grown up in the forest, soil, elevation, and climate have a great influence upon the grain and the mechanical qualities of teak as of other timbers. Most of the larger logs brought to market have an irregular crack or hollow in the centre, which commences at the butt and often runs up a long way. There is little doubt that this is generally due to the action of the fires, which scorch and often destroy the bark of young trees. Such external injuries are apt to induce decay in the wood. Moreover, most teak seedlings which come up naturally are cut down to the ground by the fires of the hot season; some are killed, but many sprout again during the rains, and this is generally repeated year after year, until a sapling is produced strong enough to outlive the fire. Such saplings have a very large pith, which dries up, causing a hollow in the heart. Or a piece of the old shoot killed by the fire is enclosed by the new wood, and this also is apt to give rise to a hollow.

The leaves of the teak tree contain a red dye, which in Malabar was formerly used to dye silk and cotton. Natives of Burmah use the leaves as plates, to wrap up parcels, and for thatching.

In its youth the tree grows with extreme rapidity. Two-year-old seedlings on good soil are 5 to 10 feet high, and instances of more rapid growth are not uncommon. In the plantations which have been made since 1856 in Burmah, the teak has on good soil attained an average height of 60 feet in 15 years, with a girth, breast high, of 19 inches. This is between 16° and 18° N. lat., with a mean annual temperature of 78° F. and a rainfall of 100 inches. In the Burmah plantations it is estimated that the tree will, under favourable circumstances, attain a diameter of 24 inches (girth 72 inches) at the age of 80. Timber of that size is marketable, but the timber of the natural forests which is at present brought to market in Burmah has grown much more slowly, the chief reason being the annual forest fires, which harden and impoverish the soil. In the natural forests of Burmah and India teak timber with a diameter of 24 inches is never less than 100 and often more than 200 years old. In future, the timber grown in plantations and in forests under regular management may be expected to grow much faster; and there is no ground for anticipating that rapidly grown timber will be less valuable than that of slow growth, which is at present brought to market.

Like the other trees of the dry deciduous forest, teak does not attain any extraordinary size. The trees are not generally more than 100 to 150 feet high, even under the most favourable circumstances, and stems more than 100 feet to the first branch are not often found. Exceptionally tall trees were measured in 1861 in the Gwaythay forest in Pegu, east of the Sitang river, on gneiss. The stems had 106 to 114 feet to the first branch, with a girth, at 6 feet off the ground, from 7 to 16 feet. Larger girths, up to 25 feet, are not uncommon.

The teak tree does not usually form pure forests. It is associated with bamboos and a great variety of other trees, which have little market value, and, as a rule, thrives best in such company. Hence in the plantations established in Burmah, the object has been to raise forests of teak mixed with bamboos and other trees.

Most of the teak timber produced is consumed in India. The produce of the magnificent forests of Travancore, Cochin, the Madras presidency, Coorg, Mysore, Bombay, Berar, and the Central Provinces is all so consumed. Formerly there was a considerable export from the ports of the western coast,—Malabar, Kanara, Surat, and Broach,—but the country at present requires all the teak which its forests can produce; indeed the demand is in excess of the supply, and large quantities are imported from Burmah to Calcutta, Madras, Bombay, and other Indian ports. Small quantities are still exported from the ports of the western coast to Arabia and the coast of Africa. The chief export is from Burmah, principally from Rangoon and Maulmain. Of the other teak-producing countries, Java exports a little; there have also been exports from Saigon; and since 1882 Bankok has sent considerable quantities to Europe. But the Burmah coast is the chief source of supply at present. Rangoon has for a very long time been an important place for shipbuilding, teak being the chief timber used: between 1786 and 1825 111 European vessels were built at Rangoon, aggregating 35,000 tons. At the same time timber was exported, and, when the place was taken by the British in 1852, teak was the chief article of export. Maulmain became British territory at the close of the first Burmese war in 1826. At that time the place was a large fishing village, and it was mainly through the export of teak timber and the shipbuilding trade that it attained its present importance. From 1829 to 1841 upwards of 50,000 loads of teak timber were exported, and, in addition, 68 vessels were built during that period, aggregating 15,680 tons, and estimated to have required for their construction 24,000 loads of teak timber. The forests from which Maulmain first derived its supplies are situated on the Attaran river, a feeder of the Salwin. In 1836, however, timber began to come down from more distant forests, and in 1841 one-fourth only of the supply was brought from the Attaran forests.

The increase in the export of timber from the Burmah ports was slow at first, but has gone on rapidly since Rangoon became a British port. Since that time the timber brought to the Burmah ports has come from the following sources:—(1) from the forests in the British coast provinces, Pegu and Tenasserim; (2) from the forests in the former kingdom of Burmah, floated to Rangoon down the Sitang and Irrawaddy rivers; (3) from the forests in the Shan states formerly tributary to Burmah, from the Karenni country, and from Siam, which is all floated to Maulmain by the Salwin river. Since 1856 the increase of the supply derived from these three sources has been large, as will be apparent from the following

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preservation and showed the peculiar structure of teak timber in a very marked manner. They had been in the building for 500 years (*Indian Forester*, vol. vii. p. 260). In the wall of a palace of the Persian kings near Baghdad, which was pillaged in the 7th century, two Americans found in 1811 pieces of Indian teak which were perfectly sound (Ouseley, *Travels in Various Countries of the East*, vol. ii. p. 280, note 67). In the old cave temples of Salsette and elsewhere in western India pieces of teak have been found in good preservation which must have been more than 2000 years old.

[1] At 44·8 ℔ per cubic foot a load of 50 cubic feet weighs a ton (2240 ℔), hence in the Burmah ports a ton of teak timber is taken as equivalent to a load of 50 cubic feet.

[2] It has been erroneously stated that the tree in Burmah is tapped for its oil before felling.

averages for the eight years 1856–57 to 1863–64 and for the two years 1883–84 and 1884–85 :—

	1856-7 to 1863-4.	1883-4, 1884-5.
	Loads.	Loads.
From the British coast provinces, Pegu and Tenasserim	22,675	44,228
From Burmah by Sitang and Irrawaddy rivers	6,890	66,668
From Shan states, Karenni, and Siam, by Salwin river	55,491	163,751
Total supplies	85,056	274,648
Exports by sea	76,763	153,198
Local consumption in Rangoon and Maulmain	8,293	121,450

Of the quantities exported, between 38,000 and 65,000 loads[1] have gone beyond India during this period, the balance having been sent to Calcutta, Bombay, and other Indian ports. The quantities here stated do not include the timber consumed in Upper Burmah, nor that brought from the forests drained by the Menam and Mekhong rivers on the east side of the Indo-Chinese Peninsula, nor the teak produced in Java and the other islands of the Malay Archipelago, and in the extensive forests of the western peninsula of India. No data are yet available for a precise estimate; but the total amount yielded by these forests, and consumed locally or exported, appears to be not less than 500,000 loads or tons a year.

In British India a large portion of the teak-producing tracts have since 1856 been placed under conservancy management, and similar measures will doubtless be extended to the forests in Upper Burmah, now annexed to the British empire, as well as to the forests of the feudatory native states. In British India, the area of state forests demarcated in order to be permanently conserved[2] was in 1885 (in round figures) 33,000 square miles, and the teak-producing tracts included in this area may be estimated to cover about 12,000 square miles, or 7,680,000 acres. Large additions will be made to this area, especially in Upper Burmah. Of teak plantations, 12,000 acres have been formed in Burmah, 563 acres in Coorg, 3436 at Nilambur in Malabar, and about 2000 acres in other districts. There are good grounds for estimating the future yield of plantations at the rate of 50 cubic feet (one ton) per acre annually. The natural forests will, in their present impoverished condition, not furnish more than one cubic foot per acre annually, but, as protection against fire is gradually extending, the proportion of teak is everywhere being increased by cultural operations in the forests, and the effect of these measures will eventually manifest itself by a considerable increase in the yield. In their present condition, the natural forests demarcated in India up to 1887 may be expected to yield 150,000 tons a year, while the produce of the plantations will eventually add 18,000 tons more. The teak forests in Java were surveyed in 1871, and their area was found to be 2280 square miles, while the plantations in that island in 1880 amounted to 24,710 acres. These figures will serve to show that, if the system commenced in India and Java is maintained, there is no reason to apprehend a diminution of the teak supply. (D. BR.)

TEAL (Old English Tele), a word of uncertain origin, but doubtless cognate with the Dutch *Taling* (formerly *Talingh* and *Telingh*), and this apparently with the Scandinavian *Atteling-And* (Brünnich, *Ornithol. Borealis*, p. 18) and *Atling*, which it seems impossible not to connect with the Scottish *Atteile* or *Atteal*, to be found in many old records, though this last word (however it be spelt) is generally used in conjunction with Teal, as if to mean a different kind of bird; and commentators have shewn a marvellous ineptitude in surmising what that bird was.

The Teal is the *Anas crecca* of Linnæus, and the smallest of the European *Anatidæ*, as well as one of the most abundant and highly esteemed for the table. It breeds in many parts of the British Islands, making its nest in places very like those chosen by the Wild Duck, *A. boscas*; but there is no doubt that by far the greater number of those that are taken in decoys, or are shot, during the autumn and winter are of foreign origin. While the female presents the usual inconspicuous mottled plumage of the same sex in most species of *Anatinæ*, the male is one of the handsomest of his kind. His deep chestnut head and throat are diversified on either side by a line of buff, which, springing from the gape, runs upward to the eye, in front of which it forms a fork, one prong passing backward above and the other below, enclosing a dark glossy-green patch, and both losing themselves in the elongated feathers of the hind-head and nape. The back and sides of the body appear to be grey, an effect produced by delicate transverse pencillings of black on a dull white ground. The outer lanceolate scapulars have one-half of their webs pure white, forming a conspicuous stripe along the side of the back. The breast is of a pale salmon or peach-blossom colour, each feather in front bearing a roundish dark spot, but these spots lessen in number and size lower down, and the warm tint passes into white on the belly. The tail-coverts above and below are velvety black, but those at the side are pale orange.

The Teal inhabits almost the whole of Europe and Asia,—from Iceland to Japan,—in winter visiting Northern Africa and India. It occasionally occurs on the western shores of the Atlantic; but its place in North America is taken by its representative, *A. carolinensis*, the male of which is easily to be recognized by the absence of the upper buff line on the side of the head and of the white scapular stripe, while he presents a whitish crescentic bar on the sides of the lower neck just in front of the wings.

Species more or less allied to these two are found in most other parts of the world, and among such species are some (for instance, the *A. gibberifrons* of the Australian Region and the *A. eatoni* of Kerguelen Island) in which the male wears almost the same inconspicuous plumage as the female. But the determination of the birds which should be technically considered "Teals," and belong to the subgenus *Nettium* (generally misspelt *Nettion*), as distinguished from other groups of *Anatinæ*, is a task not yet successfully attempted, and much confusion has been caused by associating with them such species as the Garganey (vol. x. p. 80) and its allies of the group *Querquedula*. Others again have not yet been discriminated from the Wigeons (*q.v.*), the Pintail-Ducks, *Dafila*, or even from the typical form of *Anas* (*cf.* Duck, vol. vii. p. 505), into each of which subgenera the Teals, *Nettium*, seem to pass without any great break. In ordinary talk "Teal" seems to stand for any Duck-like bird of small size, and in that sense the word is often applied to the members of the genus *Nettopus*, though systematists will have it that they are properly Geese. In the same loose sense the word is often applied to the two most beautiful of the Family *Anatidæ*, belonging to the genus *Æx* (commonly misspelt *Aix*)—the Carolina Duck of North America, *Æ. sponsa* (not to be confounded with the above-named *Anas carolinensis* or *Nettium carolinense*), and the Mandarin-Duck of China, *Æ. galericulata*. Hardly less showy than these are the two species of the subgenus *Eunetta*,—the Falcated Duck, *E. falcata*, and the Baikal Teal, *E. formosa*,—both from eastern Asia, but occasionally appearing in Europe. Some British authors have referred to the latter of these well-marked species certain Ducks that from time to time occur, but they are doubtless hybrids, though the secret of their parentage may be unknown; and in this way a so-called Bimaculated Duck, *Anas bimaculata*, was for many years erroneously admitted as a good species to the British list, but of late this has been properly discarded. (A. N.)

TECHNICAL EDUCATION. The special education, the object of which is to train persons in the arts and sciences that underlie the practice of some trade or profession, is technical education. Schools in which this training is provided are known as technical schools. In its widest sense, technical education embraces all kinds of instruction that have direct reference to the career a person is following or preparing to follow; but it is usual and convenient to restrict the term to the special training which helps to qualify a person to engage in some branch of productive industry. This education may consist of the explanation of the processes concerned in production, or of instruction in art or science in its relation to industry, but it may also include the acquisition of the manual skill which production necessitates. The term technical, as applied to education, arose from the necessity of finding a word to indicate the special training which was needed in consequence of the altered conditions of production during the present century. Whilst the changed conditions of production, consequent mainly on the application of steam power to machinery, demanded a special training for those who were to be engaged in productive industry, the prevalent system of education was not adapted to the requirements of these persons, and schools were wanted in which the necessary instruction could be obtained. Other circumstances resulting mainly from the application of steam power to machinery have rendered technical education necessary. Production on a large scale led to a great extension of the principle of the division of labour, in consequence of which it was found economical to keep a man constantly engaged at the same kind of work, since the more he practised it the quicker and more skilful he became. Thus employed, the workman learned little or nothing of the process of the manufacture at which he assisted, or of other departments of the work than the particular one in which he was engaged, and his only opportunity of acquiring such knowledge was outside the workshop or factory in a technical school. The economy effected by the division of labour led to the extension of the principle to other industries than those in which machinery is largely employed. There are many trades in which manual skill is as necessary now as ever, but even in these the methods of instruction prevailing under the system of apprenticeship are now almost obsolete.

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[1] Of the teak exported to foreign countries from India in 1883–84, 27,356 tons went to Great Britain, 8594 tons to Egypt, 2056 tons to Ceylon, 1984 tons to Japan, and 1823 tons to the Cape of Good Hope. The total quantity exported was 46,471 tons.

[2] Not including 16,000 square miles of second class reserves in the Central Provinces.

In many industries, including trades in which machinery is not as yet extensively employed, production on a large scale has increased the demand for unskilled labour, numbers of hands being required to prepare the work to be finished by a few artisans. Rapidity of execution is attained by keeping a workman at the same work, which after a time he succeeds in mechanically performing, and continues to do until some machine is invented to take his place. In most trades, as formerly practised, the master employed a few apprentices who assisted him in his work, and who learnt from him to understand the details of their craft, so that, when the term of their apprenticeship was over, they were competent to practise as journeymen. But now the master has neither time nor opportunity to instruct young lads, and the old relation of master and apprentice is changed into that of capitalist and workman. In consequence of these altered relations between employer and employed, there is an acknowledged want of properly trained workmen in a number of trades in which skilful hand work is still needed; and in these trades a demand has arisen for technical schools, or some other substitute for apprenticeship, as a means of suitably training workmen and foremen. The ever-increasing competition in production has led to the employment, in many trades, of children to do work of a mechanical kind requiring little skill; but, whilst thus employed, these young people have little opportunity of learning those parts of their trade in which skill and special knowledge are needed; and when they are grown up, and seek higher wages, they are dismissed to make room for other children. Numbers of young men are thus thrown upon the labour market, competent to do nothing more than children's work, and to earn children's wages, and knowing no trade to which they can apply their hands. To remedy this, by creating some substitute for the old apprenticeship, is one of the objects of a system of technical education.

A complete system of technical education should provide necessary instruction for the different classes of persons engaged in productive industry. It is usual to divide these persons into three classes:—(1) workmen or journeymen; (2) foremen or overseers; (3) managers or masters.

The industries in which they are employed may be grouped under four heads:—(1) those involving the use of extensive machinery, such as iron and steel manufacture, machine making, the textile industries, and some of the chemical trades; (2) those which mainly require the use of hand tools, as cabinet-making, brick-work, plumbing, and tailoring; (3) those depending on artistic skill, as wood and stone carving, metal-chasing, decorative work, and industrial designing generally; (4) agriculture in all its branches. These industries will be referred to as manufactures, handicrafts, art industries, and agriculture. The foregoing classification comprises groups which necessarily, to some extent, overlap one another. Every factory contains a carpenter's and smith's shop, and handicraftsmen of group (2) are required in every manufacturing concern. Whilst the industries in which hand labour is exclusively employed are becoming fewer and fewer, there are many trades which, owing to the frequent invention of labour-saving appliances, are passing gradually from the class of handicrafts to that of manufactures. In these trades, of which watch and clock making and boot and shoe making may be taken as examples, there is still a demand for goods largely if not entirely produced by hand work. In such trades, owing to the absence of facilities for instruction in the ordinary shops, there is a want of skilled hand labour which there is an increasing difficulty in satisfying, and to supply this want technical schools of different kinds have been established. Then, again, there are many branches of manufacturing industry which greatly depend for their success upon the designer's art, and it is necessary that the industrial designer should possess a knowledge of the processes of the manufacture in which his designs will be utilized, as well as of the properties and capabilities of the material to which they will be applied. Indeed, it is the possession of this knowledge which mainly distinguishes the industrial designer from the ordinary artist. To determine the best training for such designers is one of the problems of technical education. There are many trades, too, in which the handicraftsman and the designer should be united. This is the case in such industries as wood-engraving, metal-chasing, and silversmith's work. In these and other trades the true artisan is the artist and handicraftsman combined.

In order to reconcile some of the different views which are held as to the objects of technical education, it is necessary to keep in mind the broad distinction, above referred to, between the conditions of production on a large scale, as in those industries in which goods are manufactured by the use of extensive labour-saving machinery, and in those trades in which hand work is chiefly employed. Much of the diversity of opinion regarding the objects of technical education is due to the difference of standpoint from which the problem is regarded. The volume of the trade and commerce of Britain depends mainly on the progress of its manufacturing industries. It is these which chiefly affect the exports and imports. The aim of manufacturers is to produce cheaper and better goods than can be produced by other manufacturers at home or abroad; and technical education is valuable to them, in so far as it enables them to do so. But the artisan engaged in hand industries looks to technical education for the means by which he may acquire a knowledge of the principles of his trade, which the absence of the system of apprenticeship prevents him from acquiring in the shop. Hence the artisan and the manufacturer approach the consideration of the question from different sides. To the spinner or weaver who almost exclusively employs women to tend his machinery, or to the manufacturing chemist whose workpeople are little more than labourers employed in carrying to and fro materials, knowing little or nothing of the scientific principles underlying the complicated processes in which they are engaged, the technical education of the workpeople may seem to be a matter of little moment. What such manufacturers require are the services of a few skilled engineers, artistic designers, or scientific chemists. From the manufacturer's point of view, therefore, technical instruction is not so much needed for the *hands* he employs in his work as for the *heads* that direct it. But in trades in which machinery plays a subsidiary part, technical teaching supplies the place of that instruction which, in former times, the master gave to his apprentice, and the workman looks to it to supply him with the knowledge of the principles and practice of his trade, on the acquisition of which his individual success greatly depends. In the former class of industries, technical education is needed mainly for the training of managers; in the latter, for the training of workmen. Hence has arisen a double cry,—for the teaching of art and of the higher branches of science, with a view to their application to manufacturing industry, and for the teaching of trades, and of the scientific facts which help to explain the processes and methods connected with the practice of these trades. This double cry has led to the establishment of technical universities and of trade schools.

Owing to the conditions under which manufacturing industry is now carried on, it is difficult to select competent foremen from the rank and file of the workmen. The ordinary hands gain a very limited and circumscribed acquaintance with the details of the manufacture in which they are engaged, and have little opportunity of acquiring that general knowledge of various departments of work, and of the structure of the machinery in use, which is essential to the foreman or overseer. It is in evening technical classes that this supplementary instruction, which it is the workman's interest to acquire and the master's to encourage, can be obtained. The history of invention shows how frequently important improvements in machinery are made by the workman or minder in charge of it, and adds weight to the arguments already adduced for giving technical instruction to persons of all grades employed in manufacturing industry. To these advantages of technical education, as affecting the workmen themselves as well as the progress of the industry in which they are engaged, must be added the general improvement in the character of the work produced, resulting from the superior and better-trained intelligence of those who have had the benefit of such instruction.

In order that the different classes of persons who are to be engaged in productive industry may receive a fitting preparatory training, the programme of elementary and secondary as well as of the higher education must be organized with reference to their special requirements. If the demand for technical instruction is to be fully satisfied, a great part of our existing system of education must be reconstructed, and the training provided in our several schools must be made a more fitting preparation for industrial work than it is at present.

Schools in which the course of instruction is not specialized with a view to any particular industry, but is so arranged as to form a general preparation for manufacturing or other trade pursuits, are often spoken of as professional, technical, or trade schools; but such schools must be distinguished from apprenticeship schools, the object of which is to teach trades. Of the former class of schools there are excellent examples in the different countries of Europe as well as in the United States, and some few have recently been established in the United Kingdom. Of the latter class the best examples are found in France and Austria. The study of these schools, and of the means of providing fitting education for the different classes of producers, may be simplified by a statement of the following propositions:—

1. The ordinary education of all persons who are likely to be engaged in productive industry should be determined by the general requirements of their future work. This proposition affects the curriculum of all schools in which different classes of producers are to be trained, *i.e.*, of primary, secondary, and higher schools, and involves the consideration of the extent to which, in such schools, modern languages, science, drawing, and manual instruction should take the place of literary and classical studies.

2. Special schools or classes should be established (*a*) for instruction in art, and in those sciences which serve to explain the processes of productive industry, including agriculture, manufactures, and engineering, as well as in the application of art and science to these departments of industry; (*b*) for the teaching of, and in certain cases for practice in, various handicrafts or trades.

3. The special schools should be adapted to the requirements of the different grades of workers, and to the different kinds of work in which they are or are likely to be engaged.

A survey of the technical schools in different countries shows how these different requirements are met. Owing to the complexity of the problem, a complete or an ideal system of technical education is nowhere to be found. Schools have been established to meet local and present wants, and the greatest variety exists in the attempts that have been made to establish schools in accordance with the foregoing propositions.

1. *Workmen.*—Many attempts have been made to provide a substitute for apprenticeship, but hitherto with no great success. Two classes of workpeople have to be considered—(1) those engaged in manufacturing industries, and (2) those engaged in handicraft industries. The education of all classes of workpeople begins in the public elementary schools; and, in view of the future occupation of the children, it may be taken for granted that primary instruction should be practical, and should include drawing and elementary science, with some amount of manual training for boys, and with needlework, cookery, and domestic economy for girls. In nearly every country of Europe, and in the United States, primary instruction includes drawing, in addition to reading, writing, and reckoning. In England this is not yet the case, drawing being taught in very few schools outside of the jurisdiction of the London school board. In France, Belgium, Holland, and Sweden handicraft instruction is generally included in the curriculum of elementary schools. Rudimentary science is also taught in nearly all the primary schools of Europe. Modelling is taught both to boys and girls in many Continental schools; and in Sweden "slojd," or elementary woodwork, in which simple and useful articles are constructed with the fewest possible tools, is taught with considerable success to children of both sexes.

In Germany and Switzerland there exists an excellent system of evening continuation schools, known as *Fortbildungs-* or *Ergänzungs-Schulen*, in which the instruction of the children who leave school before fourteen, and of those who leave at that age, is continued. In most of these schools drawing is taught with special reference to local industries. In England an attempt is being made to attract children to evening schools by means of recreative classes. These classes are intended to continue the child's general education, and to supplement it by some amount of practical teaching between the time that he leaves the elementary school and is prepared to take advantage of evening technical instruction. The training of most workpeople, and of nearly all those who are engaged in manufacturing industry, consists of—(1) primary teaching in elementary schools; (2) practice in the factory or shop; (3) evening technical instruction.

In all the principal towns throughout Europe evening classes have been established for teaching drawing, painting, and designing, and the elements of science in their application to special industries. On the Continent these classes are mainly supported by the municipalities, by the chambers of commerce, by industrial or trade societies, by county boards, and in some cases by the fees of the pupils. They receive little or no support from the state. They are well attended by workpeople of all grades, who are encouraged by their employers to profit by these opportunities of instruction. In England evening technical instruction is more systematically organized than in any other country. It is under the direction of the committee of the council of education known as the Science and Art Department, and of the City and Guilds of London Institute for the advancement of technical education, an institute founded and supported by the corporation and by a large-number of the livery companies of London. The department encourages instruction in pure science and in art; the institute in the application of science, and to some extent of art also, to different trades.

Both the department and the institute make grants on behalf of properly registered teachers on the results of the examination of their pupils. The directory of the department contains a detailed syllabus of the twenty-five different subjects on the teaching of which grants are paid, and in the programme of the institute are found syllabuses of instruction in the technology of fifty different trade subjects. In the evening classes organized by the department, as well as in those in connexion with the institute, the workman or foreman engaged in any manufacturing industry has the opportunity, by payment of a very small fee, of studying art in all its branches, science theoretically and practically, and the technology of any particular industry. Provided his early education enables him to take advantage of this instruction, no better system has been suggested of enabling workmen, whilst earning wages at an early age, to acquire manual skill by continuous practice, and at the same time to gain a knowledge of the principles of science connected with their work and explanatory of the processes of the manufacture in which they are engaged.

For those engaged in handicraft trades this evening instruction is equally valuable, and in many parts of Europe there exist evening trade schools in which the workman is able to supplement the "sectional" practice he acquires in the shop by more general practice in other branches of his trade. In Vienna, for example, and in other parts of Austria, there are found practical evening classes for carpenters, turners, joiners, metal-workers, and others; and similar classes, some of which are subsidized by the City and Guilds Institute, have recently been established in England. Throughout Europe schools for weaving, with practical work at the loom and pattern designing, have existed for many years.

To provide a training more like the old system of apprenticeship, schools have been established in many parts of Europe which are known as professional, trade, or apprenticeship schools (*écoles professionnelles, écoles des apprentis, Fachschulen*). The object is to train workmen: and the pupils, after completing their course of instruction in such a school, are supposed to have learnt a trade. The school is the substitute for the shop. In such a school the pupils have the advantage of being taught their trade systematically and leisurely, and production is made subsidiary to instruction. Under such an artificial system of production, the pupil is less likely to acquire excellence of workmanship and smartness of habit than in the mercantile shop, under the strain of severe competition. Moreover, the cost of maintenance of these schools renders it impossible to look to them as a general substitute for apprenticeship. By sending into the labour market, however, a few highly-trained workmen, who are absorbed in various works and exert a beneficial influence on other workmen, these schools serve a useful purpose. Schools of this kind have been tried with more or less success in different countries. In Paris there is the well-known École Diderot for the training of mechanics, fitters, smiths, &c.; and similar schools have been established in other parts of France. A furniture-trade school of the same category has recently been opened in Paris, and for many years a society of Christian Brethren have directed a large school in which several different trades have been taught. In this establishment, situated in the Rue Vaugirard, all the secular and general instruction is given gratuitously by the brothers, and in the several shops attached to the school skilled workmen are employed, who instruct the pupil apprentices, and utilize their labour. This system combines many of the advantages of shop work and school work, but it depends financially for its success upon the religious spirit which actuates its promoters and supporters. The Artane school, near Dublin, is conducted on somewhat similar principles, but is intended for a lower class of children. In Austria, particularly in the rural districts, there are numerous schools for the training of carpenters, joiners, turners, cabinetmakers, workers in stone and marble, in silver and other metals, &c. Schools of the same class are found in Germany, Italy, and elsewhere. It is only in certain cases, however, that apprenticeship schools can be said to satisfactorily answer the purpose for which they have been established. Where a new industry, especially in rural districts, has to be created; where decaying industries need to be revived; where machinery is superseding hand work, and, owing to the demands for ordinary hands, there is a dearth of skilled workmen; where through the effects of competition and other causes the trade is carried on under conditions in which competent workmen cannot be properly trained in the ordinary shop,—in these cases, and in various art industries, an apprenticeship school may prove to be the best means of training workmen, and of advancing particular trades. Generally, an apprenticeship school should be looked upon as a temporary expedient, as a form of relief applied at the birth or during any temporary depression of a particular industry. The proper training school for workmen is the factory or shop.

2. *Foremen.*—The foreman must be familiar with the various branches of work he is to overlook, and the training which the workman receives in the factory or shop affords him but scanty opportunities of obtaining this general knowledge. The foreman needs also a generally superior education. How then are foremen to be trained? The problem is somewhat easier than that of training workmen, because the number required is fewer. The variety of schools in Europe devoted to this purpose is very great. There are three distinct ways in which foremen are being trained.

(*a*) The evening technical classes in Britain and on the Continent offer to ambitious workmen an opportunity of acquiring a knowledge of other departments of the trade than those in which they are engaged, as well as of the scientific principles underlying their work. These classes serve the double purpose of improving the workpeople and of affording a means of discovering those who are best fitted to occupy higher posts.

(*b*) Special schools have been established for the training of foremen. There are many trade schools of this kind in which selected boys are received after leaving the elementary school. The best known are those at Châlons, Aix, Nevers, Angers, and Lille in France. These schools are intended for the training of foremen in engineering trades. They are state institutions, in which practical mechanical work in the shops is supplemented by theoretical instruction. The first of these schools was founded in 1803. The course lasts three years, and the number of students in each school must not exceed three hundred. The students spend from six to seven hours a day in the workshop, and are trained as fitters, founders, smiths, and pattern-makers. As in all such schools, saleable goods are produced, but, as production is subordinated to instruction, the school does not bind itself to deliver work at a given date, and therefore does not compete with any manufacturing establishment. The students on leaving these schools are competent at once to undertake the duties of foremen, managers, or draughtsmen. At Komotau, Steyr, Klagenfurt, Ferlach, and many other places schools have been established on somewhat similar principles. In Germany there are special schools for the training of foremen in the building trade, which are chiefly frequented in the winter, and numerous schools are found in all parts of the Continent for the training of weavers. At Winterthur in Switzerland a school has been established the main purpose of which is the training of foremen. In Italy there are numerous technical institutes, the object of which is to train young men for intermediate posts in industrial works. In the United States the manual training schools, the number of which is rapidly increasing, have somewhat similar objects. In London, the Finsbury technical college of the City and Guilds of London Institute has a day department, the main purpose of which is the training of youths as foremen, works managers, &c.; but in this school, as well as in those last mentioned, the character of the instruction deviates considerably from that given in French schools, and aims rather at preparing youths to learn, than at teaching them, their trade.

(*c*) A third method adopted for the training of foremen is by encouraging selected children of the ordinary elementary schools to continue their education in schools of a higher grade of a technical character. It is thought that, by developing to a higher degree the intelligence and skill of those children who show aptitude for scientific and practical work, they will be able, when they enter the shop, to learn their trade more quickly and more thoroughly, and to acquire that general knowledge of their work, and to exhibit those special aptitudes, which may qualify them for the position of foreman or manager. The education given in these schools, although having direct reference to the future career of the pupil, is disciplinary in character, and consists of the subjects of primary instruction further pursued,—of drawing, modelling, science, mathematics, and manual exercises. The curriculum is varied to some extent according to local requirements, the technology of the staple industries forming in many cases part of the instruction. Such schools, under varied forms, have been established in most Continental countries, some of the best examples of them being found in Paris, Lyons, Rheims, Rouen, and in other towns of France. The want of similar schools in Britain has been frequently pointed out. One of the oldest of these schools is the École Martinière at Lyons. The school was founded in 1820 by a bequest from Major-General Martin, who had fought against the English under Tippoo Sahib. In this school, in which the education is gratuitous, as in nearly all the higher elementary schools of France, instruction is given in drawing, modelling, chemistry, mechanics, and physics, in the working of wood and iron, and in German and English in addition to the subjects of an ordinary school education. Surveying is also taught to some of the pupils, and the instruction generally is of a very practical character. The students visit factories under the guidance of the masters, and on their return they write out full descriptions of their visits. The school hours are from seven till eleven in the morning and from one till seven in the afternoon. The boys from this school rapidly obtain places in the commercial and industrial houses of Lyons, and many of them, after a time, succeed in obtaining high positions. A very similar school, on more modern lines, has been established at Rheims, and is accommodated in a building especially adapted to the purpose. In this school instruction is directed towards the staple industries of the district, namely, weaving, dyeing, and engineering. There are many other similar schools in France, the object of which is to give the children of artisans and small shopkeepers a higher practical education in order to fit them to occupy the posts of foremen, overseers, and superior clerks in manufacturing and commercial firms. A large number of poor children showing talent are selected from the primary schools and receive scholarships; and the objection sometimes urged against the establishment of higher elementary schools,—that the better classes only are able to benefit by them—is thus obviated. In Germany the real-schools in which Latin is not taught, known as *Ohnelatein Realschulen*, have very nearly the same objects as the higher elementary schools of France. The instruction in these German schools is not yet so practical as in the schools of France. Drawing is always well taught, and the schools generally contain good chemical laboratories, as well as collections of physical apparatus and museums. From the children of these schools the ranks of foremen are largely recruited. They receive no special trade instruction, but the general training is so arranged as to qualify them for higher posts in industrial works. The cost of this higher education seldom exceeds £3 per annum. In Bavaria it is two shillings a month. In most of these schools, as well as in the chief intermediate commercial schools, the exit certificate exempts a lad from two of the three years' compulsory military service, and this regulation, to which nothing corresponds in England, is an incentive to parents to allow their children to receive higher instruction, which operates very forcibly in largely increasing the number of well-educated youths in Germany. In these opportunities for higher education England is still very deficient, and the complaint is generally heard of the difficulties of obtaining competent foremen.

3. *Masters.*—The best special schools for the training of future masters, managers, engineers, manufacturers, and industrial chemists are in Germany, and are known as technical high schools or polytechnic schools. Schools of a similar character are found in other countries, and in England the facilities for higher technical education have within the last few years greatly improved.

In Germany the polytechnic or *technische Hochschule* is an institution of university type in which the education has special reference to industrial purposes. In many respects the teaching coincides with that given in the universities. The chief distinction consists in the arrangement of courses of instruction in the several departments, in the admission of students having a non-classical preliminary training, and in the absence of certain faculties found in the university and the addition of others. It is not correct to say that the polytechnic is a professional school as distinguished from the university; for the faculties of law, medicine, and theology give to the university as distinctly a professional character as the faculty of engineering gives to the polytechnic. Nor can it be said that the scientific studies at the universities are less practical than at the polytechnic. For, whilst workshops for instruction in the use of tools are found in very few of the polytechnic schools, the laboratories, for the practical study of chemistry and physics, are perhaps better fitted and under more eminent professors at some of the German universities than at the polytechnic schools. At the same time, engineers of every description, architects, and builders, besides a great number of manufacturing chemists, find in the polytechnic the scientific and technical training which the lawyer or physician, and in many cases the industrial chemist, seeks in the university.

In some of the large cities—in Berlin, Vienna, and Munich, for instance—the university and polytechnic coexist; and in certain cases, in which a very special training is required to fit a youth for his career, the German student, after spending three or four years at a polytechnic school, passes on to another institution, such as a dyeing school, in which his studies are further specialized with a view to his future work.

Taking the technical high school of Munich as a type of other similar institutions, we find the cost of the building and of the various collections it contains to have amounted to nearly £200,000, and the annual cost of maintenance to be about £20,000. The institution consists of six schools:—(1) the general; (2) the civil engineering; (3) the building; (4) the mechanical engineering; (5) the industrial chemical; and (6) the agricultural. A department for electrical technology is now being built. In other institutions there are architectural, pharmaceutical, and mining schools. The programme of the Munich school gives a list of about 180 different courses of instruction distributed over the several departments. A separate professor is engaged to lecture on that particular subject with which he is specially conversant, and the number of such professors attached to a polytechnic school is very large. In the engineering department there are six or seven distinct courses of lectures under the direction of thirteen professors. The largest and most recently constructed of all these institutions is the polytechnic school of Berlin, which was completed in 1884 at a cost of about £450,000. In France the institutions in which the highest technical instruction is given are concentrated in the capital. There are a large number of provincial colleges where the education is somewhat more practical, but where the mathematical and scientific teaching is not carried to so high a point (the École Centrale at Lyons, the École des Mineurs at St Étienne, and the Institut du Nord at Lille, &c.). The École Centrale of Paris, in which the majority of French engineers who are not employed in the Government service are trained, is a rare instance of an institution for higher technical instruction which is self-supporting and independent of Government aid.

In Switzerland the federal polytechnic of Zurich is similar to the polytechnic schools of Germany and Austria. Italy has three superior technical institutes,—one at Milan, one at Turin, and one at Naples, in which technical education is given on the same lines as in German polytechnic schools. Holland has an excellent institution at Delft, which was opened in 1864; and in Russia the imperial technical school at Moscow is a high-class engineering school, in which the theoretical studies are supplemented, to a greater extent than in the German schools, by workshop practice.

In some of the German schools the fees charged vary according to the number of lectures and to the number of hours of practical work which the student takes per week. Thus at Munich the entrance fee for each student is 10s., and the lecture fee is 2s. 6d. for each hour's lecture per week, including the use of materials. At Zurich the cost of a student in a chemical department, including laboratory practice, does not exceed £12 per annum, and in other departments it does not exceed £4 per annum. At Delft the student pays about £16 per annum for a complete course.

In England there is a growing tendency to associate technical with university education. This is mainly owing to the fact that the colleges which have recently been established to give university education are poorly endowed, and have found it necessary to attract students by meeting the increasing demand for technical instruction. Most of the provincial colleges may indeed be regarded as technical schools with a literary side. In order that they may provide university education in addition to sound technical instruction, it is necessary that they should be placed on a sound and satisfactory footing by means of state endowment. Of the more recently erected English colleges, the Owens College at Manchester is the most important, combining the faculties of a German university with those of a polytechnic school. The Yorkshire College, Leeds, possesses a special school for the teaching of weaving and dyeing. Other somewhat similar institutions are found in Birmingham, Newcastle, Sheffield, Nottingham, Dundee, Cardiff, and elsewhere. The university of Edinburgh has a good school of chemistry, physics, and engineering, and the university of Glasgow has been long distinguished for the excellence of its physical laboratories. In University College and King's College, London, the metropolis possesses two institutions each of which may be likened to a university and a polytechnic combined. In the university of Cambridge there are mechanical workshops in connexion with the chair of engineering. The Royal School of Mines and the normal schools of science and art in South Kensington are the only technical institutions in England supported by state aid. The central institution in London has more in common with the German polytechnic school than any other institution in Britain. This school is designed for the technical teaching of engineers, architects, master builders, and industrial chemists. It was built at a cost of £100,000, and is maintained by an annual grant from the City and Guilds of London Institute of £10,000, in addition to the students' fees.

Such is a brief outline of the means provided for the technical education of masters in different parts of Europe. It will be seen from the foregoing statement that efforts are now being made to bring Britain more nearly on a level with other countries in the provision of those kinds of instruction which are best adapted to the different classes of producers. But as yet only a beginning has been made, and in England technical students can be counted by hundreds, whilst those of Germany are numbered by thousands.

For further information the reader is referred to the *Report* of the royal commissioners on technical instruction, published in 1884. (P. M*.)

TEETH. See MAMMALIA, vol. xv. p. 349; DIGESTIVE ORGANS, vol. vii. p. 232; IVORY; and DENTISTRY.

TEGEA, one of the chief cities of Arcadia, of which its territory occupied the south-eastern corner, being bounded on the S. by Laconia, on the E. by Cynuria and Argolis, on the N. by the territory of Mantinea, and on the W. by Mænalia. Its legendary founder was Tegeates, son of Lycaon. Like many other cities of ancient Greece, Tegea was formed by the union of a population which had previously lived dispersed in villages. The people were divided into four tribes,—the Clareotis, Hippothoetis, Apolloniatis, and Athaneatis. Tegea offered a stubborn resistance to the encroachments of Lacedæmon, and on more than one occasion defeated its ambitious neighbour. About 560 B.C., however, the Lacedæmonians found the bones of Orestes in Tegea and conveyed them to Sparta; and henceforward Spartan valour, backed by this powerful fetich, proved too much for the merely carnal weapons of Tegea. At Platæa (479 B.C.) 3000 Tegeans fought the good fight of freedom, and were the first to enter the breach which the Athenians had made in the Persian redoubt. Between the Persian and Peloponnesian Wars hostilities again broke out between Tegea and Sparta, in the course of which Tegea was twice defeated. However, in the Peloponnesian War (431–404), and afterwards in the Corinthian War (395–387), Tegea sided with Sparta. But after the battle of Leuctra (371), when the star of Sparta began to decline, Tegea concluded an alliance with the victorious Thebans, and fought on their side against Sparta at the great battle of Mantinea (362). In the Macedonian period Tegea joined the Ætolian League, but Cleomenes, king of Sparta, having won it over to his side, the city was besieged and taken by Antigonus Doson, king of Macedonia, the ally of the Achæan League (222). In 218 the city was retaken, except the acropolis, by the Lacedæmonians under Lycurgus. After the defeat of Machanidas, tyrant of Sparta, by Philopœmen in 207, Tegea passed into the hands of the Achæan League. In the time of Strabo it was the only town of any importance in Arcadia. In the 2d century it was visited by Pausanias, who has left a fairly full description of it (viii. 45–53).

Of its buildings much the most famous was the great temple of Athene Alea, which had often afforded sanctuary to fugitives from Sparta. The old temple was burned down in 394 B.C., and Pausanius speaks of the newer temple as by far the finest and largest in the Peloponnesus (that of Zeus at Olympia, however, occupied nearly double the area). The architect was Scopas; and, as the recent German excavations have proved, the temple was a Doric peripteros, with six columns at each end and fourteen at each side. Of the columns which Pausanias mentions in addition to the Doric, the Corinthian may have stood in the pronaos and posticum, the Ionic in "the interior of the temple" (for *ἐκτός* we should probably read *ἐντός* in Pausanius, viii. 45, 5). The ancient image of Athene Alea was carried off by Augustus, and placed at the entrance to his new forum at Rome. The statues of Æsculapius and Health, which in Pausanias's time stood on the two sides of the image of the goddess at Tegea, were by Scopas. On the front pediment of the temple was sculptured the hunt of the Calydonian boar, on the back pediment the combat between Telephus and Achilles. Some fragments of these pedimental sculptures (comprising the head of the boar and two human heads, one helmeted) have been discovered; and, as they are the only existing sculptures which can be referred with some certainty to the hand of Scopas himself, they are of the highest importance for the history of art. The site of the temple, at the modern village of Piali, was partially excavated under the auspices of the German archæological institute in 1879 and 1882. It appears that the foundations of the temple measured 49·90 metres (nearly 164 feet) by 21·30 (70 feet). As Tegea stood on a plain surrounded by mountains and liable to inundations, its site has been covered by an alluvial soil which has been favourable to the preservation of the ruins, and a thorough excavation might yield important results.

On the excavations, see *Mittheilungen des deutschen archäologischen Institutes in Athen*, 1879, p. 131 *sq.*, 168 *sq.*; *ibid.*, 1880, p. 52 *sq.*; *ibid.*, 1883, p. 274 *sq.* On the artistic value of the sculptures, see *ibid.*, 1881, p. 393 *sq*; *Jour. Hell. Stud.*, 1886, p. 115 *sq.*

TEGNÉR, Esaias (1782–1846), the most celebrated of Swedish writers, was born November 13, 1782, at Kyrkerud in Wermland. His father was a pastor, and his grandparents on both sides were peasants. His father, whose name had been Esaias Lucasson, took the surname of Tegnerus—altered by his fifth son, the poet, to Tegnér—from the hamlet of Tegnaby in Småland, where he was born. In 1799 Tegnér, hitherto educated in the country, entered the university of Lund, where he graduated in philosophy in 1802, and continued as tutor until 1810, when he was elected Greek lecturer. In 1812 he was named professor, and continued to work as a lecturer in Lund until 1824, when he was made bishop of Wexiö. At Wexiö he remained until his death, twenty-two years later. Tegnér's early poems have little merit. He was comparatively slow in development. His first great success was a dithyrambic war-song for the army of 1808, which stirred every Swedish heart. In 1811 his patriotic poem *Svea* won the great prize of the Swedish Academy, and made him famous. In the same year was founded in Stockholm the Gothic League (*Götiska förbundet*), a sort of club of young and patriotic men of letters, of whom Tegnér quickly became the chief. The club published a magazine, entitled *Iduna*, in which it printed a great deal of excellent poetry, and ventilated its views, particularly as regards the study of old Icelandic literature and history. Tegnér, Géijer, Afzelius, and Nicander became the most famous members of the Gothic League. Of the very numerous poems written by Tegnér in the little room at Lund which is now shown to visitors as the Tegnér museum, the majority are short, and even occasional lyrics. His celebrated *Song to the Sun* dates from 1817. He completed three poems of a more ambitious character, on which his fame chiefly rests. Of these, two, the romance of *Axel* and the delicately-chiselled idyl of *Nattvardsbarnen* ("The First Communion," 1820), translated by Longfellow, take a secondary place in comparison with Tegnér's masterpiece, of world-wide fame. In 1820 he published in *Iduna* certain fragments of an epic or cycle of epical pieces, on which he was then working, *Frithiofssaga* or the Story of Frithiof. In 1822 he published five more cantos, and in 1825 the entire poem. Before it was completed it was famous throughout Europe; the aged Goethe took up his pen to commend to his countrymen this "alte, kräftige, gigantisch-barbarische Dichtart," and desired Amalie von Imhoff to translate it into German. This romantic paraphrase of an ancient saga was composed in twenty-four cantos, all differing in verse form, modelled somewhat, it is only fair to say, on an earlier Danish masterpiece, the *Helge* of Oehlenschläger. *Frithiofsaga* is the best known of all Swedish productions; it is said to have been translated nineteen times into English, eighteen times into German, and once at least into every European language. It is far from satisfying the demands of more recent antiquarian research, but it still is allowed to give the freshest existing impression, in imaginative form, of life in early Scandinavia. In later years Tegnér began, but left unfinished, two important epical poems, *Gerda* and *Kronbruden*. The period of the publication of *Frithiofssaga* (1825) was the critical epoch of his career. It made him one of the most famous poets of Europe; it transferred him from his study in Lund to the bishop's palace in Wexiö; it marked the first breakdown of his health, which had hitherto been excellent; and it witnessed a singular moral crisis in the inner history of the poet, about which much has been written, but of which little is known. Tegnér was at this time passionately in love with a certain beautiful Euphrosyne Palm, the wife of a town-councillor in Lund, and this unfortunate passion, while it inspired much of his finest poetry, turned the poet's blood to gall. From this time forward the heartlessness of woman is one of Tegnér's principal themes. It is a remarkable sign of the condition of Sweden at that time that a man not in holy orders, and so little in possession of the religious temperament as Tegnér, should be offered and should accept a bishop's crozier. He did not hesitate in accepting it: it was a great honour; he was poor; and he was anxious to get away from Lund. No sooner, however, had he begun to study for his new duties than he began to regret the step he had taken. It was nevertheless too late to go back, and Tegnér made a respectable bishop as long as his health lasted. But he became moody and melancholy; as early as 1836 he complained of fiery heats in his brain, and in 1840, during a visit to Stockholm, he suddenly became insane. He was sent to an asylum in Schleswig, and early in 1841 he was cured, and able to return to Wexiö. It was during his convalescence in Schleswig that he wrote *Kronbruden*. He wrote no more of importance; in 1843 he had a stroke of apoplexy, and on the 2d of November 1846 he died in Wexiö. From 1819 he had been a member of the Swedish Academy, where he was succeeded by his biographer and best imitator Böttiger. In prose Tegnér wrote letters, which have been collected, and which are considered the best of their kind in the Swedish language. As a poet he will scarcely be preferred to Bellman or to Runeberg by Swedish verse amateurs, but he still exceeds these and all other writers in popularity.

See Böttiger, *Teckning af Tegnérs Lefnad*; Georg Brandes, *Esaias Tegnér*; Thomander, *Tankar och Löjen*. (E. W. G.)

TEHERAN, or, more properly, **Tehran** (lat. 35° 40′ N., long. 51° 25′ E.), for about a century the recognized capital of Persia, has little to distinguish it, in general outward appearance, from other large cities of the country, though in quite recent years Parisian streets or boulevards, and even Western architecture for single houses, in the midst of mud-brick palaces or plain mud hovels, have been incongruously introduced. Formerly a kind of polygon some 4 miles in circumference—with its mean "shahr panah" or wall, its clumsy and uneven ditch, and its six gates, two facing north, two south, one east, and one west,—Teheran has now been extended to an outer ditch and wall, thrown out on each side beyond the ancient limit. The bazaars are good, though hardly of the first class; the caravanserais deserve honourable mention; and the telegraph and arsenal are respectable institutions. The streets are for the most part narrow and wretchedly paved. The "Ark," or citadel, contains the royal and better description of public buildings, and connecting its encircling wall with the city gates are four principal thoroughfares, of which the parallel avenues from the Násiriya and Daulat entrances are the more notable. Between these two gates, in a parallelogram extending from one to the other and including both, is the gas-lighted Tôp Maidan, or "Place des Canons," in the centre of which is a large reservoir. European professors are to be found in the king's college, where some 250 students, more or less, are taught mathematics, engineering, military tactics, music, telegraphy, painting, together with the Arabic, English, French, and Russian languages. Among the not very remarkable mosques—to some of which *madrasahs*, or colleges, are attached—may be specially mentioned the Masjid-i-Shah, or king's mosque, with its handsome enamelled front, and the Masjid-i-Mádar-i-Shah, or mosque of the king's mother. Water is freely supplied to the town by means of the underground canals, or *kanáts*, from the near mountain ranges. Public baths abound, but the Europeans use those of the Armenian and not of the Mohammedan community. The British legation stands in a handsome garden of great size, in which are placed the houses of the secretaries, which resemble English villas. In the summer season the representatives of Western powers and other Europeans move out to the slope of the mountain range north of Teheran,—the British residents to Gulhak, a village about 7 miles from the city. A prominent feature in the landscape at Gulhak and the neighbouring summer quarters, as at Teheran itself, is Demavend, the noblest and most graceful of Persian mountains.

The present population of Teheran may be taken at 160,000 at most. According to a late authority (Bassett, 1887) the European inhabitants are reckoned at about 100 only; the Jews number some 2500; and there are 150 Gabrs or Parsis, a sorry remnant of the old fire-worshippers. In 1872 there were said to be 1000 Armenians, mainly traders and artisans. In 1872 there were but four legations in Teheran—those of England, France, Russia, and Turkey. Since that year representatives have been added from Holland, Austria, Germany, and the United States. The French have summer quarters at Tejrísh and the Russians at Zargandah, at no great distance from the English Gulhak.

Morier supposes Teheran to be the Tahors of the Theodosian Tables, and recognizes it also in the account of the journey of the Castilian ambassadors to Timur. Porter, too, relates that in 1637 the secretary of the Holstein ambassadors mentions Teheran as "one of the towns which enjoy the privilege of maintaining no soldiers." Again, in the 17th century, it was visited by Pietro della Valle and by Sir Thomas Herbert,—the latter spelling it "Tyroan." Most writers affirm that Teheran, though not of recent origin, can barely be held of repute till Agha Muhammad made it his residence in about 1788, taking to himself the title of shah, as first of the Kajar kings, in 1796. Yet there is evidence that in the previous century it was a royal resort, if nothing more, in Herbert's statement that "the Toune is most beautified by a vast garden of the kings, succinct with a great towered mud-wall larger than the circuit of the city." Du Pré (who visited it in 1808) states that it had been pillaged and nearly destroyed by the Afghans,—evidently at their invasion of Persia in 1728. Since Agha Muhammad's time Teheran has been the usual seat of the Kajar dynasty, a circumstance to be attributed to the political advantages of its geographical position.

See, besides the authorities cited, *Telegraph and Travel* (1874); Dr Wills's *Land of the Lion and Sun* (1883); and Mr Bassett's *Land of the Imáms* (1887).

TEHUANTEPEC, an isthmus in Mexico, comprising the western extremities of the states of Vera Cruz and Oajaca, and limited eastwards by the states of Tabasco and Chiapas, thus lying between 16° and 18° N. lat. and 94° and 95° W. long. Between the Bay of Campeche on the north or Atlantic side and that of Tehuantepec on the south or Pacific side the distance in a bee line is only 125 miles. Here also the Sierra Madre falls rapidly from over 5000 feet in Chiapas to about 730 feet in the ridge skirting the Pacific coast, and leaving the rest of this district somewhat level, with a rise from the Atlantic of not more than 60 feet in the mile except at the Chivela Pass, where for 8 miles the gradients are about 116 feet per mile.

This favourable condition of the relief, combined with a relatively healthy climate subject only to dangerous insect pests in summer, has naturally attracted attention to the Tehuantepec isthmus, as offering peculiar advantages for interoceanic communication either by a navigable canal, a railway, or a ship railway. A first concession was made in 1841 by the Mexican Government to Don José de Garay, who had the land surveyed with a view to a canal, but who, after the war with the United States, surrendered his rights to Mr P. A. Hargous of New York. The company then organized to give effect to the Garay grant caused a fresh survey for a railway to be made in 1851, under the direction of the late General J. G. Barnard. But nothing came of this or of another railway project in 1857, when a third survey was executed, under the direction of Col. W. H. Sidell. Then the "Tehuantepec Railway Company," formed in 1870 in New York, and reorganized in 1879, obtained a concession from the Mexican Government to construct the "Tehuantepec Railway"; but, after a few miles were made, the work was suspended, and in 1882 the Government contracted with private individuals for the completion of the line, which was to be 190 miles long, and to run from the mouth of the Goatzacoalcos (Coatzacoalcos) river on the Atlantic to the port of Salina Cruz on the Pacific. The work was carried to Minatitlan, a distance of 25 miles, in 1884, and was to have been completed in 1885; but since then operations appear to have been suspended for want of means. A Tehuantepec ship railway is also projected, as it is expected that most of the trade between the Atlantic and Pacific coasts of the United States will be attracted to this route, which shortens the distance between New York and San Francisco by 1477 miles, and between New Orleans and the same place by 2334 miles, as compared with that by the Panama railway and future canal.

Tehuantepec, the town which gives its name to the isthmus, bay, and neighbouring lagoon, stands on the river Tehuantepec, 15 miles above its mouth on the Pacific, where it develops a shallow and somewhat exposed harbour. Of the population, estimated at 14,000, a large number are civilized and industrious Indians engaged in cotton-weaving and on the salt-works. Indigo is grown in the district, and there are productive pearl-fisheries in the bay. Amongst the exports are cochineal and a purple dye extracted from a shellfish abounding on the coast.

TEIGNMOUTH, a seaport and market town of England, in Devonshire, consisting of the parishes of East and West Teignmouth, and situated on the English Channel, at the mouth of the Teign and on the Great Western Railway, 14 miles south of Exeter and 209 west-south-west of London. It is somewhat irregularly built, partly on a projecting peninsula and partly on the acclivities rising behind the river. The Teign is crossed by a bridge 1671 feet in length, built of wood and iron in 1824. St Michael's church, in East Teignmouth, erected in 1822-23 in the Decorated style, was enlarged in 1875. The other buildings include St Scholastica's abbey (erected for Benedictine nuns in 1862), the East Devon and Teignmouth club-house, the mechanics' institute (1840), the temperance hall (1879), the sailors' home (1881), the baths (1883), and the public market (1883). There are two commodious quays and a pier 600 feet in length. Fine pipe and potters' clay (from Kingsteignton) is shipped to Staffordshire. Coal and culm are imported, and there is also a trade with Newfoundland. Fishing is extensively carried on. The town, which is not incorporated, was formerly governed by portreeves. It now forms an urban sanitary district, which was extended on 29th September 1881. The population of the former area (1238 acres) in 1871 was 6751, and in 1881 it was 7120; that of the extended area (2347 acres) in 1881 was 8496.

Teignmouth is of very ancient origin. It received a grant of a market from Henry III. East Teignmouth was formerly called Teignmouth Regis, and West Teignmouth, Teignmouth Episcopi,—the manor having belonged to the see of Exeter until alienated by Bishop Veesy. Teignmouth was burned by French pirates in 1340, and was again devastated by the French on 26th June 1690.

TEINDS. See TITHES.

TELEGRAPH

TELEGRAPH (from τῆλε and γράφω) signifies an instrument to write at a distance. The term is specifically applied to apparatus for communicating intelligence to a distance in unwritten signs addressed to the eye or ear, and has only recently had application to those wonderful combinations of inanimate matter which literally write at a distance the intelligence committed to them. The chief object of the present article is to explain the principles and practice of the electric telegraph, and we shall allude to other telegraphic systems only to illustrate the general principles of signalling.

Signalling generally.

A word expressing an idea may, according to a prearranged plan of signalling, be communicated by voice, by trumpet calls, by gun fire, by gesture or dumb signs, by lamp signals, by flags, by semaphore, or by electric telegraph. The simplest system of word-signalling hitherto practised is that of the nautical flag telegraph, in which each hoist represents a word by a combination of four flags in four distinct positions (see SIGNALS, NAVAL). If n denote the number of flags, supposed all different, out of which the four to be sent up may be selected, the number of different ideas which can be expressed by a single hoist is $n(n-1)(n-2)(n-3)$, since there are n varieties out of which the flag for each of the four positions may be independently chosen. To commit to memory so great a number of combinations, which amount to 358,800 if $n = 26$, would be a vain effort; the operators on each side must therefore have constant recourse to a dictionary, or code, as it is called. For the sake of convenient reference each flag is called by the name of a letter of the alphabet, and all that the operator has to bear in mind is the letter by which each flag is designated. Sometimes the words to be expressed are spelled out by means of the flags as in ordinary language; but, as in most words there are more than four letters, as scarcely any two consecutive words are spelled with four or less than four letters, and as more than four flags at a time cannot be conveniently used, the system of alphabetic signalling frequently requires the use of two hoists for a word, and scarcely ever has the advantage of expressing two words by one hoist. It is therefore much more tedious than code signalling in the nautical telegraph.

In point of simplicity spoken words may be considered as almost on a par with the nautical telegraph, since each word is in reality spoken and heard almost as a single utterance. Next in order comes the system of spelling out words letter by letter, in which—instead of, as in the nautical telegraph, 358,800 single symbols to express the same number of ideas—26 distinct symbols are used to express by their combinations any number whatever of distinct ideas. Next again to this may be ranked the system by which several distinct successive signals are used to express a letter, and letters thus communicated by compound signals are combined into words according to the ordinary method of language. It is to this last class that nearly all practical systems of electro-telegraphic signalling belong. But some of the earliest and latest proposals for electric telegraphs are founded on the idea of making a single signal represent a single letter of the alphabet; as instances we may name those early forms in which separate conductors were used for the different letters; a method suggested by Professor W. Thomson[1] in 1858 in which different strengths of current were to be employed to indicate the letters; and the various forms of printing telegraph now in use.

I. HISTORICAL SKETCH OF EARLY TELEGRAPHS.

Early forms.

Although the history of practical electric telegraphy does not include a period of more than half a century, the idea of using electricity for telegraphic purposes is much older. It was suggested again and again as each new discovery in electricity and magnetism seemed to render it more feasible. Thus the discovery of Stephen Gray and of Wheeler that the electrical influence of a charged Leyden jar may be conveyed to a distance by means of an insulated wire gave rise to various proposals, of which perhaps the earliest was that in an anonymous letter[2] to the *Scots Magazine* (vol. xv. p. 73, 1753), in which the use of as many insulated conductors as there are letters in the alphabet was suggested. Each wire was to be used for the transmission of one letter only, and the message was to be sent by charging the proper wires in succession and received by observing the movements of small pieces of paper marked with the letters of the alphabet and placed under the ends of the wires. A very interesting modification was also proposed in the same letter, viz., to attach to the end of each wire a small light ball which when charged would be attracted towards an adjacent bell and strike it. Some twenty years later Le Sage proposed a similar method, in which each conductor was to be attached to a pith ball electroscope. An important advance on this was proposed in 1797 by Lomond,[3] who used only one line of wire and an alphabet of motions. Besides these we have in the same period the spark telegraph of Reiser, of Don Silva, and of Cavallo, the pith ball telegraph of Ronalds, and several others. Next came the discovery of Galvani and of Volta, and as a consequence a fresh set of proposals, in which voltaic electricity was to be used. The discovery by Nicholson and Carlisle of the decomposition of water and the subsequent researches of Davy on the decomposition of the solutions of salts by the voltaic current were turned to account in the water voltameter telegraph of Sommering and the modification of it proposed by Schweigger, and in a similar method proposed by Coxe, in which a solution of salts was substituted for water. Then came the discovery by Romagnesi and by Oersted of the action of the galvanic current on a magnet. The application of this to telegraphic purposes was suggested by Laplace and taken up by Ampere, and afterwards by Triboaillet and by Schilling, whose work forms the foundation of much of modern telegraphy. Faraday's discovery of the induced current produced by passing a magnet through a helix of wire forming part of a closed circuit was laid hold of in the telegraph of Gauss and Weber, and this application was at the request of Gauss taken up by Steinheil, who brought it to considerable perfection. Steinheil communicated to the Göttingen Academy of Sciences in September 1838 an account of his telegraph, which had been constructed about the middle of the preceding year. The currents were produced by a magneto-electric machine resembling that of Clarke. The receiving apparatus consisted of a multiplier, in the centre of which were pivoted one or two magnetic needles, which either indicated the message by the movement of an index or by striking two bells of different tone or recorded it by making ink dots on a ribbon of paper. Among other workers about this time we may mention Masson, Bréguet, Davy, Deval, Billon, Soudalot, and Vorsselman who proposed to use the physiological effects of electricity in working an electric telegraph.[1]

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[1] See his *Mathematical and Physical Papers*, vol. ii. p. 105.

[2] From correspondence found among Sir David Brewster's papers after his death it seems highly probable that the writer of this letter, which was signed "C. M.", was Charles Morrison, a surgeon and a native of Greenock, but at that time resident in Renfrew.

[3] See Arthur Young, *Travels in France*, p. 3.

Steinheil appears to have been anticipated in the matter of a recording telegraph by Morse of America, who in 1835 constructed a rude working model of an instrument; this within a few years was so perfected that with some modification in detail it has been largely used ever since (see below). In 1836 Cooke, to whom the idea appears to have been suggested by Schilling's method, invented a telegraph in which an alphabet was worked out by the single and combined movement of three needles. Subsequently, in conjunction with Wheatstone, he introduced another form, in which five vertical index needles, each worked by a separate multiplier, were made to point out the letters on a dial. Two needles were acted upon at the same time, and the letter at the point of intersection of the direction of the indexes was read. This telegraph required six wires, and was shortly afterwards displaced by the single-needle system, still to a large extent used on railway and other less important circuits. The single-needle instrument is a vertical needle galvanoscope worked by a battery and reversing key, the motions to right and left of one end of the index corresponding to the dashes and dots of the Morse alphabet. To increase the speed of working, two single-needle instruments were sometimes used (double-needle telegraph). This system required two lines of wire, and, along with all multiple-wire systems, soon passed out of use. Similar instruments to the single and double needle ones of Cooke and Wheatstone were about the same time invented by the Rev. H. Highton and his brother Edward Highton, and were used for a considerable time on some of the railway lines in England. Another series of instruments, introduced by Cooke and Wheatstone in 1840, and generally known as "Wheatstone's step-by-step letter-showing" or "A B C instruments," were worked out with great ingenuity of detail by Wheatstone in Great Britain and by Bréguet and others in France. They are still largely used for private wires, but are being rapidly displaced by the telephone.[2] Wheatstone also described and to some extent worked out an interesting modification of his step-by-step instrument, the object of which was to produce a letter-printing telegraph. But it never came into use; some years later, however, an instrument embodying the same principle, although differing greatly in mechanical detail, was brought into use by Royal E. House of Vermont, U.S., and was very successfully worked on some of the American telegraph lines till 1860, after which it was gradually displaced by the Phelps combination telegraph. The House instrument is not now in use, but various modifications of it are still employed for private lines and for stock telegraphs, such as Calahan's and the universal stock telegraphs, Phelps's stock printer, Gray's automatic printer for private lines, Siemens's and Phelps's automatic type printers, &c. (see *infra*, pp. 120-121).

II. General Description of Electric Telegraphs for Land and Sea.

Essential apparatus.

The first requisite for electro-telegraphic communication between two localities is an insulated conductor extending from one to the other. This, with proper apparatus for originating electric currents at one end and for discovering the effects produced by them at the other end, constitutes an electric telegraph. Faraday's term "electrode," literally a way for electricity to travel along, might be well applied to designate the insulated conductor along which the electric messenger is despatched. It is, however, more commonly and familiarly called "the wire" or "the line."

The apparatus for generating the electric action at one end is commonly called the *transmitting apparatus* or *instrument*, or the *sending apparatus* or *instrument*, or sometimes simply the *transmitter* or *sender*. The apparatus used at the other end of the line to render the effects of this action perceptible to any of the senses—eye, ear, or taste, all of which have been used in actual telegraphic signalling—is called the *receiving apparatus* or *instrument*.

Over-ground lines.

In the aerial or overground system of land telegraphs the main line consists generally of a "galvanized" iron wire from one-sixth to a quarter of an inch in diameter, stretched through the air from pole to pole, at a sufficient height above the ground for security. The supports or insulators, as they are called, by which it is attached to the poles are of very different form and arrangement in different telegraphs, but consist essentially of a stem of glass, porcelain, coarse earthenware, or other non-conducting substance, protected by an overhanging screen or roof. One end of the stem is firmly attached to the pole, and the other bears the wire. The best idea of a single telegraphic insulator may be got from a common umbrella with its stem of insulating substance attached upright to the top of a pole and bearing the wire supported in a notch on the top outside. The umbrella may be either of the same substance as the stem—all glass or all glazed earthenware, for instance—or of a stronger material, such as iron, with an insulating stem fitted to it to support it below. Very good insulators may be made of continuous glass; but well-glazed porcelain is more generally used, or rather earthenware, which is cheaper, less brittle, and less hygroscopic, and insulates well as long as the glazing is sufficient to prevent the porous substance within from absorbing moisture.

One of the best forms—Varley's double cup insulator

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[1] The reader interested in the early history of the electric telegraph may consult Edward Highton, *The Electric Telegraph*, London, 1852; Moigno, *Traité de Télégraphie Électrique*, Paris, 1849; and Sabine, *History of the Electric Telegraph*, London, 1869.

[2] For the different forms see Prescott's *Electricity and the Electric Telegraph*, pp. 562-602.

—is shown in fig. 1. It consists of two distinct cups (*c*, C), which are moulded and fired separately, and afterwards cemented together. The double cup gives great security against loss of insulation due to cracks extending through the insulator, and also gives a high surface insulation. An iron bolt (*b*) cemented into the centre of the inner cup is used for fixing the insulator to the pole or bracket.

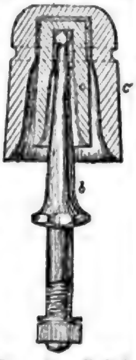

Fig. 1.—Varley's double cup insulator, one-fourth full size.

Underground lines.

In the underground system the main line generally consists of a copper wire, or a thin strand of copper wires, covered with a continuous coating of gutta percha, india-rubber, or some equivalent insulating substance, served with tarred tape and enclosed in earthenware, iron, or lead pipes laid below the surface of the ground. This system is largely used for street and tunnel work, and to a considerable extent, especially in Germany, for ordinary lines. Each tube generally contains a number of wires, which are either laid up into a cable and covered with a serving of tarred tape or hemp before being drawn into the tube, or—as is more commonly the case in the United Kingdom—simply laid together in a parallel group and tied at intervals with binders, which are removed as the wires are drawn into the tube. On some long underground lines in Germany the insulated wires are laid up into a cable, served with jute or hemp, and sheathed with a continuous covering of iron wires, precisely similar to the submarine cables described below. The cable is laid in a deep trench and coated with bitumen. This form of cable is easily laid, and if properly manufactured is likely to be very durable.

Submarine cables.

Submarine Cables.—A submarine cable (figs. 2-4), as usually manufactured at present, consists of a core *a* in the centre of which is a strand of copper wires varying in weight for different cables between 70 and 400 ℔ to the mile. The stranded form was suggested by Prof. W. Thomson at a meeting of the Philosophical Society of Glasgow in 1854, because its greater flexibility renders it less likely to damage the insulating envelope during the manipulation of the cable. The central conductor is covered with several continuous coatings of gutta percha, the total weight of which also varies between 70 and 400 ℔ to the mile. With a light core the weight of the gutta percha generally exceeds that of the copper, while in some heavy cores the copper is heavier. The different coatings of gutta percha and of the conductor are usually separated by a thin coating of Chatterton's compound (a mixture of gutta percha, resin, and Stockholm tar), in order to make them adhere firmly together. This practice has recently been departed from by Messrs Siemens Brothers, who have succeeded by an improved process of manufacture in getting perfect adhesion without the use of the compound. The core is served with a thick coating of wet jute, yarn, or hemp (*h*), forming a soft bed for the sheath, which consists of soft iron, or of homogeneous iron, wires of the best quality. The sheathing wires are usually covered with one or two servings of tarred canvas tape (*t*), or of tarred hemp, laid on alternately with coatings of a mixture of asphaltum and tar. The weight of the iron sheath varies greatly according to the depth of the water, the nature of the sea bottom, the prevalence of currents, and so on. Fig. 2 shows the intermediate type again sheathed with a heavy armour to resist wear in the shallow water near shore. In many cases a still heavier type is used for the first mile or two from shore, and several intermediate types are often introduced, tapering gradually to the thin deep-water type. Captain S. Trot and Mr F. A. Hamilton have proposed[1] to abandon the iron sheath and substitute a strong double serving of hemp, laid on in such a way as to prevent twisting when the cable is under tension. This suggestion, which is a revival with some modifications of an old idea, is, however, still in the experimental stage.

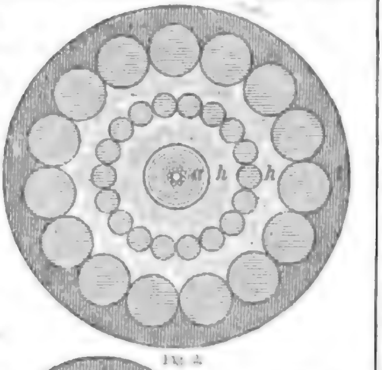

Fig. 2.

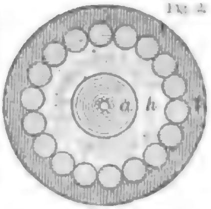

Fig. 3.

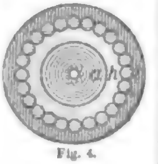

Fig. 4.

Figs. 2-4.—Sections of three types of submarine cables, full size. Fig. 2.—Type of shore end. Fig. 3.—Intermediate type. Fig. 4.—Deep sea type.

We will now describe very briefly a few of the most important processes in the manufacture and submergence of submarine cables.

In manufacturing a cable (fig. 5) the copper strand is passed through a vessel A containing melted Chatterton's compound, then through the cylinder C, in which a quantity of gutta percha, purified by repeated washing in hot water, by mastication, and by filtering through wire-gauze filters, is kept warm by a steam-jacket. As the wire is pulled through, a coating of gutta percha, the thickness of which is regulated by the die D, is pressed out of the cylinder by applying the requisite pressure to the piston P. The newly coated wire is passed through a long trough T, containing cold water, until it is sufficiently cold to allow it to be safely wound on a bobbin B′. This operation completed, the wire is wound from the bobbin B′ on to another, and at the same time carefully examined for air-holes or other flaws, all of which are eliminated. The coated wire is treated in the same way as the copper strand,—the die D, or another of the same size, being placed at the back of the cylinder and a larger one substituted at the front. A second coating is then laid on, and after it passes through a similar process of examination a third coating is applied, and so on until the requisite number is completed. The finished core changes rapidly in its electric qualities at first, and is generally kept for a stated interval of time before being subjected to the specified tests. It is then placed in a tank of water and kept at a certain fixed temperature, usually 75° Fahr., until it assumes approximately a constant electrical state. Its conductor and dielectric resistance and its electrostatic capacity are then measured. These tests are generally repeated at another temperature, say 50° Fahr., for the purpose of obtaining at the same time greater certainty of the soundness of the core and the rate of variation of the conductor and dielectric resistances with temperature. Should these tests prove satisfactory the core is served with jute yarn, coiled in water-tight tanks, and surrounded with salt water. The insulation is again tested, and if no fault is discovered the served core is passed through the sheathing machine, and the iron sheath and the outer covering are laid on. As the cable is sheathed it is stored in large water-tight tanks and kept at a nearly uniform temperature by means of water.

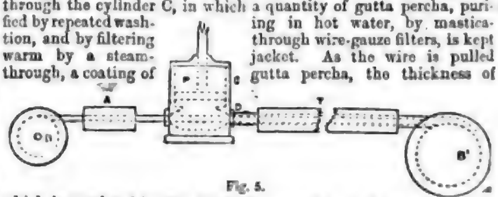

Fig. 5.

The cable is now transferred to a cable ship, provided with water-tight tanks similar to those used in the factory for storing it. The tanks are nearly cylindrical in form and have a truncated cone

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[1] *Journn. Soc. Telegr. Eng.*, vol. xii. p. 495.

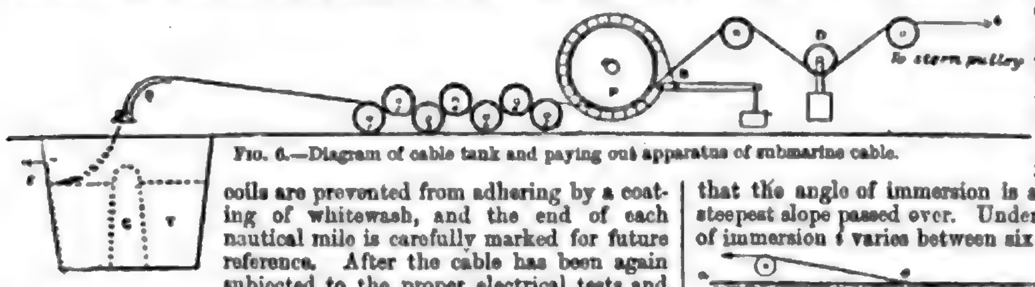

FIG. 6.—Diagram of cable tank and paying out apparatus of submarine cable.

fixed in the centre, as shown at C, fig. 6. The cable is carefully coiled into the tanks in horizontal flakes, each of which is begun at the outside of the tank and coiled towards the centre. The different coils are prevented from adhering by a coating of whitewash, and the end of each nautical mile is carefully marked for future reference. After the cable has been again subjected to the proper electrical tests and found to be in perfect condition, the ship is taken to the place where the shore end is to be landed. A sufficient length of cable to reach the shore or the cable-house is paid overboard and coiled on a raft or rafts, or on the deck of a steam-launch, in order to be connected with the shore. The end is taken into the testing room in the cable-house and the conductor connected with the testing instruments, and, should the electrical tests continue satisfactory, the ship is put on the proper course and steams slowly ahead, paying out the cable over her stern. The cable must not be overstrained in the process of submersion, and must be paid out at the proper rate to give the requisite slack. This involves the introduction of machinery for measuring and controlling the speed at which it leaves the ship and for measuring the pull on the cable. The essential parts of this apparatus are shown in fig. 6. The lower end *s* of the cable in the tank T is taken to the testing room, so that continuous tests for electrical condition can be made. The upper end is passed over a guiding quadrant Q to a set of wheels or fixed quadrants 1, 2, 3, ... then to the paying-out drum P, from it to the dynamometer D, and finally to the stern pulley, over which it passes into the sea. The wheels 1, 2, 3, ... are so arranged that 2, 4, 6, ... can be raised or lowered so as to give the cable less or more bend as it passes between them, while 1, 3, 5, ... are furnished with brakes. The whole system provides the means of giving sufficient back-pull to the cable to make it grip the drum P, round which it passes several times to prevent slipping. On the same shaft with P is fixed a brake-wheel furnished with a powerful brake B, by the proper manipulation of which the speed of paying out is regulated, the pull on the cable being at the same time observed by means of D. The shaft of P can be readily put in gear with a powerful engine for the purpose of hauling back the cable should it be found necessary to do so. The length paid out and the rate of paying out are obtained approximately from the number of turns made by the drum P and its rate of turning. This is checked by the mile marks, the known position of the joints, &c., as they pass. The speed of the ship can be roughly estimated from the speed of the engines; it is more accurately obtained by one or other of the various forms of log, or it may be measured by paying out continuously a steel wire over a measuring wheel. The average speed is obtained very accurately from solar and stellar observations for the position of the ship. The difference between the speed of the ship and the rate of paying out gives the amount of slack. The amount of slack varies in different cases between three and ten per cent., but some is always allowed, so that the cable may easily adapt itself to inequalities of the bottom and may be more readily lifted for repairs. But the mere paying out of sufficient slack is not a guarantee that the cable will always lie closely along the bottom or be free from spans. Whilst it is being paid out the portion between the surface of the water and the bottom of the sea lies along a straight line, the component of the weight at right angles to its length being supported by the frictional resistance to sinking in the water. If, then, the speed of the ship be v, the rate of paying out u, the angle of immersion i, the depth of the water h, the weight per unit length of the cable w, the pull on the cable at the surface P, and A, B constants, we have—

$$P = h\left\{ w - \frac{A}{\sin i} f(u - v\cos i) \right\} \quad \ldots\ldots\ldots\ldots\ldots(\alpha)$$

and

$$w\cos i = Bf(v\sin i) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(\beta),$$

where f stands for "function." The factors $Af(u - v\cos i)$ and $Bf(v\sin i)$ give the frictional resistance to sinking, per unit length of the cable, in the direction of the length and transverse to the length respectively.[1] It is evident from equation (β) that the angle of immersion depends solely on the speed of the ship; hence in laying a cable on an irregular bottom it is of great importance that the speed should be sufficiently low. This may be illustrated very simply as follows:—suppose *a a* (fig. 7) to be the surface of the sea, *b c* the bottom, and *e e* the straight line made by the cable; then, if a hill H, which is at any part steeper than the inclination of the cable, is passed over, the cable touches it at some point *t* before it touches the part immediately below *t*, and if the friction between the cable and the ground is sufficient the cable will either break or be left in a long span ready to break at some future time. It is important to observe that the risk is in no way obviated by the increasing slack paid out, except in so far as the amount of sliding which the strength of the cable is able to produce at the points of contact with the ground may be thereby increased. The speed of the ship must therefore be so regulated that the angle of immersion is as great as the inclination of the steepest slope passed over. Under ordinary circumstances the angle of immersion i varies between six and nine degrees.[2]

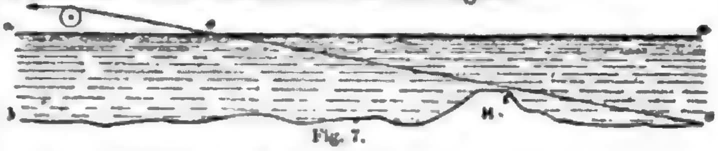

Fig. 7.

Qualities of a Telegraph Line.—The efficiency of the telegraph depends on three qualities of the main line—(1) its conducting quality, (2) its insulation, and (3) its electrostatic capacity.

Conducting quality. 1. The conducting quality of a wire or other elongated portion of matter is measured by the quantity of electricity which it allows to flow through it when a stated "electromotive force," or "difference of electric potentials," is maintained between its two ends. It may be most naturally, and is in point of fact generally, expressed in terms of resistance to transmission, regarded as a quality inverse to that of conducting power, and expressed numerically by the reciprocal of the measure of the conducting power. An independent explanation and definition of the electrical resistance of a conductor may be given as follows:—the electrical resistance of a conductor is measured by the amount of electromotive force, or difference of potentials, which must be maintained between its ends to produce a stated strength of electric current through it.

Insulation. 2. The true measure of the insulation of a body is the resistance to conduction offered by its supports. The reciprocal of this, or the conducting power of the supports, measures the defectiveness of the insulation. Since no substance yet known is absolutely a non-conductor of electricity, perfect insulation is impossible. If, however, the supports on which a telegraph wire rests present, on each part and on the whole, so great a resistance to electric conduction as to allow only a small portion of the electricity sent in, in the actual working, at one end to escape by lateral conduction, instead of passing through the line and producing effect at the other end, the insulation is as good as need be for the mode of working adopted. With the good insulation attained in a submarine line, round every part of which the gutta percha is free from flaws, no telegraphic operation completed within a second of time can be sensibly influenced by lateral conduction. A charge communicated to a wire thus insulated under water, at the temperature of the sea-bottom, is so well held that, after thirty minutes, not so much as half of it is found to have escaped. From this, according to the familiar "compound interest" problem, it appears that the loss must be at the rate of less than five per cent. per two minutes.

Electrostatic capacity. 3. In 1849 Werner Siemens proved that "when a current is sent through a submerged cable a quantity of electricity is retained in charge along the whole surface, being distributed in proportion to the tension of each point,"—that is to say, to the difference of potentials between the conductor at any point and the earth beside it. In 1854 Faraday showed the effect of this "electrostatic charge" on signals sent through great lengths of submerged wire, bringing to light many remarkable phenomena and pointing out the "inductive" embarrassment to be expected in working long submarine telegraphs. In letters[3] to Professor Stokes in November and December of the same year, Prof. W. Thomson gave the mathematical theory of these phenomena, with formulæ and diagrams of curves, containing the elements of synthetical investigation for every possible case of practical operations. Some of the results of this theory are given at the end of the present article. The conductor of a submarine cable has a very large electrostatic capacity in comparison with that of a land telegraph wire in consequence of the induction, as of a Leyden phial, which takes place across its gutta percha coat, between it and its moist outer surface, which may be regarded as perfectly connected with the earth,—that is to say, at the same potential as the earth. The mathematical expressions for the absolute electrostatic capacity C, per unit of length, in the two cases are as follows.

Submarine line. Let D = diameter of the inner conductor, supposed to be that of a circular cross section, or of a circle inappreciably less than one circumscribed about the strand which constitutes a modern submarine conductor; D′ = outer diameter of the insulating coat; I = specific inductive capacity of the gutta percha or other substance constituting the insulating coat. Then

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[1] See Sir W. Thomson, *Mathematical and Physical Papers*, vol. ii. p. 165.

[2] For details of cable manufacture and laying consult Douglas's *Telegraph Construction*, London, 1877, and Captain V. Hoskiær's *Laying and Repairing of Electric Telegraph Cables*, London, 1878.

[3] Published in *Proc. Roy. Soc.* for 1855.

$$C = \frac{I}{2\log_e D'/D}.$$

AL-line. In the case of a single wire of circular section, diameter D, undisturbed by the presence of others, and supported at a constant height h above the earth by poles so far apart as not to influence its capacity sensibly—

$$C = \frac{1}{2\log_e 4h/D}.$$

Example 1. In a submarine cable in which D′ = 1 centimètre; D = 0·4 centimètre; and I = 3·2—

$$C = \frac{I}{2\log_e D'/D} = \frac{3{\cdot}2 \times {\cdot}4343}{2 \times {\cdot}3979} = 1{\cdot}75.$$

Example 2. In a land line in which D = 0·6 centimètre and h = 600 centimètres—

$$C = \frac{1}{2\log_e 4h/D} = \frac{{\cdot}4343}{7{\cdot}204} = \frac{1}{16{\cdot}6}.$$

The capacity, therefore, is in this case less than one-twenty-ninth of that of the submarine cable of example 1 for the same length.

Telegraph Testing.

Standards of measurement. *Standards of Measurement.*—A brief consideration of the standards according to which the electrical qualities referred to in the last section are measured, and the measurements to be described in this section are made, will render the statements of those qualities and quantities more definite. A complete and universally comparable system of standards for physical measurements can be obtained by adopting arbitrarily as fundamental units those of length, mass, and time, and expressing in terms of these in a properly defined manner the units of all the other quantities. The units now adopted all over the world for electrical measurements take the centimètre as the unit of length, the gramme as the unit of mass, and the mean solar second as the unit of time. There are two systems in use, the electrostatic and the electromagnetic. In the former the mutual forces exerted by two bodies, each charged with static electricity, are taken as the starting-point, and in the latter the mutual forces exerted between a current of electricity and a magnet. The units according to these two systems are definitely related; but as we deal in the present article with the electromagnetic system we give the following brief account of it only.

Units. The *dyne* or *unit force* is that force which, acting on a gramme of matter, free to move, imparts to it a velocity of 1 centimètre per second. *Unit quantity of magnetism* or *unit magnetic pole* is that quantity of magnetism which, when placed at a distance of 1 centimètre from an equal and similar quantity of magnetism or a magnetic pole, repels it with unit force. *Unit magnetic field* is a field which, when a unit quantity of magnetism or a unit magnetic pole is placed in it, is acted on by unit force. *Unit current* is a current which, when made to flow round a circle of unit radius, produces a magnetic field of 2π units' intensity at the centre of the circle, or acts on a unit quantity of magnetism placed at the centre of the circle with 2π units of force. *Unit quantity of electricity* is the quantity conveyed by the unit current in one second. *Unit difference of potential* is the difference of potential between the ends of a conductor of unit length when it is placed with its length at right angles to the direction of force in a unit magnetic field and kept moving with a velocity of 1 centimètre per second in the direction at right angles to its own length and to the direction of the magnetic force. *Unit electromotive force* is produced in a closed circuit if any unit of its length is held in the manner, and moved in the direction and with the velocity, described in the last section. *Unit resistance* is the resistance which, when acted on by unit electromotive force, transmits unit current. *Unit capacity* is the capacity of a body which requires unit quantity of electricity to raise its potential by unity. The units above specified are generally referred to as the absolute C.G.S. electromagnetic units of the different quantities. In practice their magnitudes were found inconvenient, and certain multiples and submultiples of them have been adopted as the practical units of measurement: thus the *ohm* is equal to 10^9 C.G.S. units of resistance; the *volt* is equal to 10^8 C.G.S. units of electromotive force; the *ampere* is equal to 10^{-1} C.G.S. units of current; the *coulomb* is equal to 10^{-1} C.G.S. units of quantity; the *farad* is the capacity which is charged to a volt by a coulomb, and is equal to 10^{-9} C.G.S. units of capacity; the *microfarad* is the millionth part of the farad, and is equal to 10^{-15} C.G.S. units of capacity.

We are here chiefly concerned with the units of electromotive force, resistance, and capacity. No universally recognized standard of electromotive force has yet been established, but the want has been to a great extent supplied by the potential galvanometers, electrostatic voltmeters, standard cells, and other instruments devised by Sir W. Thomson and others. The work of Lord Rayleigh, Dr. Fleming, and other experimenters on the Clark and Daniell standard cells has shown conclusively that an electromotive force can be reproduced with certainty within one-tenth per cent. of accuracy by means of either of these cells. Specimens of the standard unit of resistance, or ohm, made of an alloy of platinum and silver, or of platinum and iridium, have been constructed, and can be relied on, if properly taken care of, to remain very nearly accurate from year to year. Similar specimens of the standard unit of capacity or microfarad which remain very nearly constant have been successfully produced. For a fuller treatment of this subject and of the methods of determining the different units, see ELECTRICITY, vol. viii. p. 40 *sq.*[1]

Telegraph line testing consists mostly of comparisons of the resistance of the conductor and the insulator with sets of standard resistances, and of comparisons of the inductive capacity of the line or cable with standard condensers of known capacity. When, as is sometimes the case, the strength of the current flowing through the line or through a particular instrument is to be determined, it is measured by an electrodynamometer, or by a current galvanometer, properly constructed for indicating currents in absolute measure. In the absence of such an instrument it may be obtained accurately by the use of a standard galvanometer in a known or determined magnetic field, or, taking advantage of Faraday's discovery of the electro-chemical equivalents, by measuring the amount of silver or of copper deposited by the current when it is made to pass through an electrolytic cell; or the electromotive force per unit resistance of the circuit may be determined by the use of standard resistances and a standard cell. Space does not allow us to do more than simply refer to these methods, the first two at least of which involve accurate and somewhat difficult experimental work.[2]

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Measurement of Wire Resistance.—(1) By *Wheatstone's bridge.*[3] Let l (fig. 8) be the line with its distant end connected with the earth, a and b known resistances, x a resistance which can be varied, G a galvanometer, K a single lever key, K_1 a reversing key, and B a battery. Put the zinc pole of the battery to the line and adjust the resistance x until the galvanometer G shows no deflexion when K_1 is depressed. We then have, assuming no electromotive force in the line, $l = ax_1/b$. Next put the copper pole to the line and repeat the test, and suppose in this case $l = ax_2/b$; if these two values of l nearly agree the true value may be taken as $2ax_1x_2/b(x_1+x_2)$. The effect of an electromotive force in the line itself is nearly eliminated by reversing the battery.

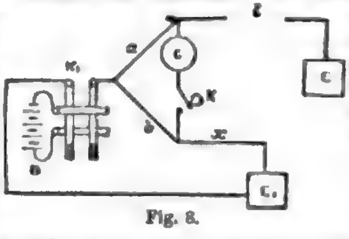

Fig. 8.

By d defle (2) Let the battery B (fig. 9) be connected through the keys K_1 and K and the galvanometer G with the line l, which has its distant end to the earth as before; shunt the galvanometer by a shunt s until a convenient deflexion is obtained, and then take as quickly as possible a series of readings with zinc and copper alternately to the line. Next substitute for l a set of resistance coils and vary the resistance until the same series of readings is obtained. The resistance introduced for the reproduction of each reading indicates the apparent resistance of the line when that reading was taken. The readings will generally differ because of the existence of a variable electromotive force in the line. If, however, the difference is not very great, the harmonic mean of the arithmetic mean of the resistances, when zinc and copper were respectively to the line, will give nearly the true resistance. Since the deflexions are reproduced by substituting resistances for the line, the galvanometer zero may be off the scale to one side, and hence the total deflexion, and therefore the sensibility, may be made very considerable. In this case the reversing key K is required for keeping the deflexion in the same direction. With a perfectly insulated battery this can be accomplished by putting the galvanometer between the battery and the key K; but the arrangement shown is safer. The most suitable galvanometer for these tests is a dead-beat mirror galvanometer with a long enough suspension to prevent error from the viscosity of the fibre. Such an instrument is much to be preferred to the astatic form, especially when variable earth-currents are present.

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[1] For the development of this important part of electrical science, see Weber, "Messungen galvanischer Leitungswiderstände nach einem absoluten Maasse," in *Poggendorff's Annalen*, March 1851; Thomson, "Mechanical Theory of Electrolysis," "Application of the Principle of Mechanical Effect to the Measurement of Electromotive Force, and of Galvanic Resistances in Absolute Units," and "Transient Electric Currents," in *Phil. Mag.*, 1851 and 1852; Weber, *Electrodynamische Maassbestimmungen, insbesondere Zurückführung der Stromintensitätsmessungen auf mechanischen Maass*, Leipsic, 1856; Thomson, "On the Electric Conductivity of Commercial Copper," "Synthetical and Analytical Attempts" on the same subject, and "Measurement of the Electrostatic Force between the Poles of a Daniell's Battery, and Measurement of the Electrostatic Force required to produce a Spark in Air," *Proc. Roy. Soc.*, 1857 and 1860; reprint of *Reports* of Brit. Assoc. Committee on Electr. Stand., &c., edited by Prof. F. Jenkin; Thomson, *Electrical Units of Measurement*, a lecture delivered at Institution of Civil Engineers, 1883; *Reports* of the International Conference for the Determination of the Electrical Units, held at Paris in 1882 and 1884; A. Gray, *Absolute Measurements in Electricity and Magnetism*, London, 1884.

[2] See A. Gray, *Absolute Measurements in Electricity and Magnetism*, pp. 27, 74; also T. Gray, *Phil. Mag.*, November 1886. The following quotation from the art. TELEGRAPH in the 8th ed. of the *Ency. Brit.* shows how comparatively recent is the introduction of anything like absolute measurement in telegraph testing:—"The ordinary test for insulation consists in applying a galvanic battery, with one pole to earth and the other through a galvanometer coil, to the line of telegraph of which the remote end is kept insulated. If the insulation of the whole line were perfect, the galvanometer needle would stand at zero; but, when looked for with a battery of suitable power and a galvanometer of suitable sensibility, indications of a current are always found, unless it is a very short length of very perfectly insulated line that is tested. The absolute measure of the strength of this current divided by the absolute measure of the electromotive force of the battery gives an absolute measure for the insulation of the cable. No telegraphic testing ought in future to be accepted in any department of telegraphic business which has not this definite character, although it is only within the last year that convenient instruments for working in absolute measure have been introduced at all, and the whole system of absolute measurement is still almost unknown to practical electricians." It was put in practice systematically for the first time in 1859, in experiments by Prof. F. Jenkin.

[3] For this theory, see ELECTRICITY, vol. viii. p. 44.

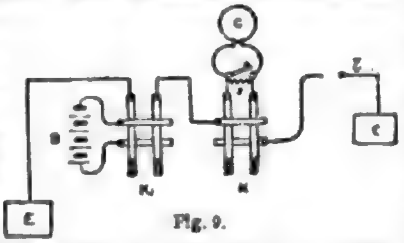

Fig. 9.

By differential galvanometer.

(3) A highly sensitive modification of method (2) is obtained by the use of a differential galvanometer, one coil of which is joined in circuit with the standard resistances and the other coil with the line. The resistances are then adjusted to balance, or to give no permanent deflexion when the battery circuit is closed. Several balances with positive and negative currents must be taken and the results combined as indicated above.

By electrometer.

(4) When an electrometer is employed for testing insulation, as described below, it may be used for the wire resistance also either by substituting it for the galvanometer in Wheatstone's bridge method (fig. 8, G) or by that shown in fig. 10. One pole of the battery B is joined to the line through the reversing key K and the resistance R, the other pole being to the earth. The electrometer *El* is then applied to the two ends of R and to the end of *l* and the earth alternately and the relative deflexion noted. The deflexions should be as nearly as possible equal; that is, R should be as nearly as possible equal to *l*. The form of reversing key shown at K_1 is convenient for this test, as it allows the comparisons to be made quickly; and, as the readings can be always taken to the same side of zero, the whole length of the scale is available for each deflexion. The key consists of two ordinary front and back stop single lever keys fixed together by an insulating piece *i* at such a distance apart that the contact stops *a*, *b* and *c*, *d* are at the corners of a square. Suppose one pole of the battery put to the line and the resistance R adjusted until no change of deflexion is obtained by depressing K_1; then R is equal to *l* if there is no earth disturbance. Then put the other pole of the battery to the line; turn the levers of K through 90° round the pivot *p*; and repeat the adjustment of R for a second determination of *l*. Repeat these measurements several times and combine the results in the manner described in method (2). If R is not made equal to *l*, the resistances are in the ratio of the corresponding deflexions.

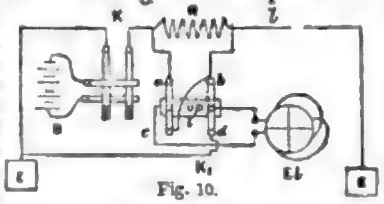

Fig. 10.

Measurement of insulator resistance; direct deflexion method.

Measurement of Insulator Resistance.—(1) In the direct deflexion method the connexions are the same as those shown in fig. 9, except that the distant end of the line is insulated. Very great care must be taken that the galvanometer and all the connexions between it and the end of the line are so well insulated that no sensible part of the observed deflexion is due to leakage through them. In making the test, first earth the line for five minutes; then, with the galvanometer short-circuited, apply the zinc pole of the battery to the line; at the end of from thirty seconds to a minute, depending on the length and capacity of the line, remove the short-circuit plug; and record the deflexion at the end of every ten or fifteen seconds during the whole time (usually from ten to twenty minutes) the test is continued. Again earth the line for an interval equal to that during which the battery was applied; then apply the copper pole of the battery and repeat the readings as before. Using the deflexions as ordinates and the corresponding times as abscissæ, construct a smooth curve for both the zinc and the copper test. The galvanometer constant divided by the mean ordinate of these curves at any time gives the insulation at that time. To determine the galvanometer constant, substitute a high resistance R, say one megohm, for the line, and shunt the galvanometer with a shunt *s*. If the deflexion under these circumstances is *d* and G is the galvanometer resistance, the constant is

$$C = Rd\frac{G+s}{s}.$$

Electrometer method.

(2) The electrometer method is only applicable to lines of considerable inductive capacity, but is particularly well suited for cable testing. The battery B (fig. 11) is connected through a reversing key K, to the ends of the resistance slide *ab*, one end of which is put to earth. The slide generally consists either of 10 or 100 equal resistances, amounting in the aggregate to from 10,000 to 100,000 ohms. The cable can be connected by means of the reversing key K to either pair of quadrants of the electrometer *El*, the slider *s* being at the same time put to the other pair. To determine the constant of the electrometer, connect the earth wire *w* with the cable terminal and the slider with contact 1, and observe the deflexion; this should be the same for both directions of the current through the slide; its value multiplied by 10, when the slide is made up of ten coils, gives the value in scale divisions of the full difference of potential between the ends of the lide. This number added to the zero reading of the electrometer is called the *inferred zero*. To find the insulation of the cable, remove the wire *w*, put in the short circuit plug *y*, move the slider to contact 10, and, the distant end of the cable being insulated, apply by means of K_1 the zinc pole of the battery to the cable and the copper pole to the earth. Allow sufficient time for the cable to charge—say one minute for a cable of 2000 knots—then remove the short-circuit plug and take readings every fifteen or thirty seconds. The difference of these readings from zero gives the fall of potential of the cable due to discharge through the insulating coat. Next earth the cable at both ends for a time equal to the duration of the last test, and after reversing K put the copper pole of the battery to the cable and the zinc pole to the earth and take another series of readings. Subtract these readings from the inferred zero, and, using the differences as ordinates and the corresponding times as abscissæ, draw two curves. To find the insulation of the cable at any interval *t* after the battery was applied, draw a tangent to the curve at the point corresponding to that time and produce it to cut the axis of the ordinates. Let D_1 be the ordinate to the point of intersection, and D the ordinate at the time *t*; then, if C be the capacity of the cable in microfarads and I its insulation in megohms,

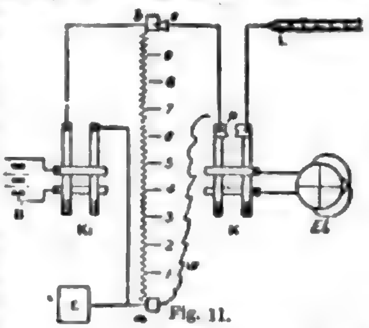

Fig. 11.

$$I = \frac{tD}{C(D_1 - D)}$$

If the difference between the reading and the inferred zero at the times *t* and t_1 be D and D_1, the insulation is given by the equation

$$I = \frac{\cdot 4343(t_1 - t)}{C \log D/D_1},$$

when $t_1 - t$ is reckoned in seconds. This latter is the formula commonly used; it gives the insulation at some time in the interval between the two observations; the exact time depends on the rate of "absorption" of the cable.

The advantages of the electrometer method of testing cables are the comparative steadiness of the needle during earth-current disturbances, its high sensibility for the detection of small intermittent faults, and the fact that simultaneous tests can be taken from both ends of the cable. In order to test from both ends simultaneously one or other of the following methods may be adopted. Call the ends of the cable A and B, and suppose the operator at A is to begin the test. The operator at B joins the copper pole to the earth and the zinc pole to the line, and leaves the slider of his slide resistance at the earth end of the slide. Then, at a time previously arranged, he watches until he sees the electrometer begin to indicate a charge in the cable, and moves the slider along the slide so as to keep the electrometer near zero. As soon as the electrometer ceases to indicate increase of charge he ceases to move the slider and begins to record the deflexions at regular intervals, the first reading being taken as zero. The other method is to leave the slider permanently to earth and keep the electrometer so insensitive that the deflexion is always within the limits of the scale. Observe the time at which the electrometer begins to be deflected, and from that time onward take readings every thirty seconds during the time of the test. The mean of the readings taken at both ends, reduced to the same sensibility, should be used for calculating the insulation. This method not only eliminates the effects of earth-current disturbance but also throws light on the nature and distribution of such disturbances.

Fall of potential method by galvanometer.

When an electrometer is not available and the line is too much disturbed for good tests to be obtained by the galvanometer method, the following procedure may be adopted. Join the battery and the galvanometer in series with the cable as for the direct deflexion test. Short-circuit the galvanometer and charge the cable for one minute. Insulate the cable for fifteen seconds; then break the short circuit of the galvanometer; again apply the battery, and take the deflexion produced by the charge. Keep the battery on the cable for fifteen seconds, and during that time take if possible the direct deflexion reading two or three times. Again insulate for fifteen seconds and repeat the above readings; and continue the same cycle of operations for the whole time of the test. After earthing the cable for the proper interval repeat the above test with the other pole of the battery to the cable. To reduce the charge readings to absolute measure, find the deflexion of the galvanometer needle due to the charge of a condenser of *n* microfarads capacity by the testing battery; let *d* be this deflexion. Then the deflexion that would be obtained by charging the whole cable would be C*d*/*n*, and, if D be any one of the deflexions during the test, D*n*/C*d* is the fraction of the whole charge which has been lost in the fifteen seconds immediately preceding this charge; thus

$$I=\frac{\cdot 4343\times 15}{C\log\frac{C^2d^2}{C^2d^2-n^2D}}$$

The method just described takes advantage in a somewhat imperfect manner of both the direct deflexion and the electrometer test; but the galvanometer should have such a long period that the whole of the charge can take place before the needle is sensibly moved from its zero position, and that the vibration of the needle must not be damped to any great extent,—a condition which renders the instrument unsuitable for direct deflexion testing.

The points with regard to the cable which should be particularly attended to when testing for insulation are—the continuity of the insulation all through the test, that is, there should be no sign of a breakdown for ever so short a time; the rate of polarization with positive and negative current is always the same in a perfect cable, but is seldom so when a fault exists; the absolute insulation with both currents should also be the same if the cable is perfect, but is never so for any length of time when a fault exists. If the insulations show any sign of being defective great care must be taken not to apply a powerful battery to the cable, unless the object is to increase or "break down" the fault. The resistance of a fault is generally diminished by applying the zinc pole of the battery to the cable and increased by applying the copper pole; but if the fault is small it sometimes happens that both currents increase the resistance. Even a very powerful battery may in such a case fail to increase the fault.

Thomson's capacity test

Capacity Tests.—The arrangement of the connexions for Thomson's capacity test are shown in fig. 12. A well-insulated battery B is connected through a reversing key K_1 to the slide resistance *ab*, and by means of a key K *a* can be put to a standard condenser C and *b* to the cable, or the condenser and the cable can be connected together and then both put to earth through the galvanometer G by closing the key K_2. Any point in the resistance *ab* can be put to earth by means of the slider *s*. Suppose the middle point put to the earth, then C and L will be charged to equal potentials but of opposite sign. If the connexions to the slide are broken and C is joined to L, the resulting charge will be zero when the capacity C is equal to the capacity L, and when K_2 is closed no current will flow through G. Similarly, if *as* is to *sb* as L is to C the resulting charge is zero. Hence when, after joining C to L, no deflexion is shown on G when K_2 is closed—

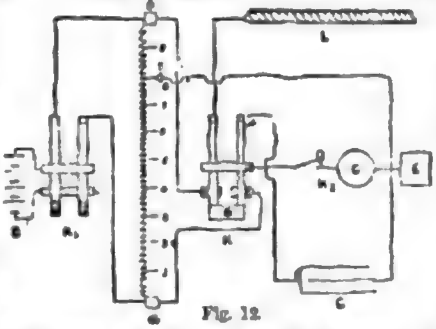

Fig. 12.

$$L=C\frac{as}{sb}.$$

Gott's test.

A modification of this test has been suggested by Mr John Gott. The condenser C is joined in series with the cable and one end of the slide is put to earth. The galvanometer G is joined from the end of the cable to the slider *s* and the position of the latter, which gives no deflexion, is found by successive trials, the cable being discharged and recharged between the trials. A small condenser in the galvanometer circuit is an advantage, as it allows several adjustments to be made without discharging the cable. The most suitable instrument, however, is an electrometer, as it allows the adjustment to be made at once.

De Sauty's test.

The capacities of condensers may be compared by charging or discharging them through a galvanometer and comparing the deflexions, or, as in De Sauty's method, by substituting them for two sides of a Wheatstone's bridge and finding the ratio of the resistances in the other two sides; then, with the galvanometer circuit closed, the battery circuit can be closed without producing any deflexion. The galvanometer circuit must join the condensers at the same points as the bridge resistances. These methods are quite unsuited for telegraph-line testing because of the resistance and the inductive retardation of the line.

Tests of submerged cable.

Tests of a Submerged Cable.—During the submergence of a cable is necessary to provide the means of knowing at every instant whether it continues in perfect electrical condition, so that should any fault develop it can be at once detected and further paying out stopped until it is removed. It is also of great importance that the ship and shore should be in telegraphic communication with each other. The arrangements made for these purposes by different electricians vary considerably; but the general principle will be gathered from fig. 13, which includes all that is absolutely necessary for the purpose. The principal testing station is always on board the ship, and from it all the testing operations both on board and on shore are regulated. Referring first to the arrangements on board, B is the testing battery, K the testing key, and G the testing galvanometer; B_1 is the signalling or "speaking" battery, K_1 the key, and G_1 the galvanometer; R is a resistance box and E the earth-plate—the ship's side in this case. The battery B is connected through the key K, the resistance R, and the galvanometer G to the cable, as for direct deflexion testing. The shore end of the cable is at the same time connected to one set of plates of a highly insulated condenser C_1 and (although this may be omitted) to one pair of quadrants of an electrometer *El*. The other pair of plates of the condenser are put to earth through the signalling key K_1. It is convenient also to have a second condenser C, on shore, the capacity of which can be readily varied, so arranged that its capacity can be added to that of C_1 by depressing the key K, and again discharged through a galvanometer G by releasing the key. The operations are then conducted as follows. The insulation is measured on board ship, alternately with positive and negative currents of from ten to fifteen minutes' duration, by observing the deflexion on the galvanometer G; and the reading at the end of each minute, or oftener, is recorded in a diary. The continuity of the conductor is tested at short intervals—say every five minutes—by the observer on shore depressing the key K and thus adding the capacity of C to the cable. This gives a sudden deflexion on the galvanometer G on board, and at the same time shows that the conductor is continuous and that the observer on shore is attending to his duties. When the shore key K is released, the discharge through G is indicated by a throw deflexion, the amount of which is recorded in the diary and shows the potential to which the shore end of the cable is kept charged. When the electrometer *El* is used, a continuous test of the potential at the shore end is obtained, and the development of a fault in the cable is at once indicated. It is convenient for this purpose to dispense with the charge in the electrometer jar and needle and connect the needle to the pair of quadrants which are joined to the cable. The deflexion is then proportional to the square of the potential and is always to one side of zero, so that the whole range of the scale is available for the deflexion. The tests for wire-resistance and capacity are practically the same as those already described. They are in ordinary circumstances of much less importance than the insulation tests. The wire resistance test is of great value, however, for giving a close estimate of the temperature of the submerged cable, and hence for giving the means of comparing the tests of the submerged cable with those of the cable previous to submersion. In laying short lengths of cable the shore station may be dispensed with and capacity tests relied on for continuity. Communication between ship and shore is carried on by means of the keys K_1, K_1, the galvanometer G_1, and the batteries B_1, B_1. The signalling key on board the ship adds or subtracts the electromotive force of the battery B_1 from the testing battery, and hence varies the potential of the cable. This is shown on shore by the partial charge or discharge of C_1 passing through the galvanometer G_1 and is interpreted in accordance with the single needle alphabet in the ordinary way. In a similar manner the signalling key on shore varies the charge of C_1, and so causes slight variations of the testing-current on board the ship, which are read on the galvanometer G_1 and interpreted in the same way. The testing is usually suspended during the signalling; but if the message is long an insulation reading is taken every few minutes according to pre-arrangement.

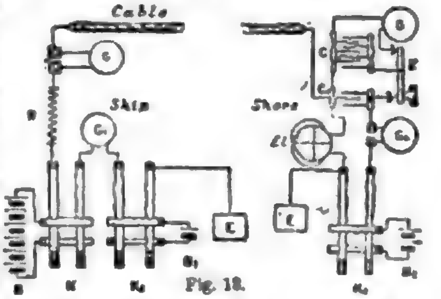

Fig. 13.

Marine galvanometer.

The galvanometers used at sea require to be constructed so that the rolling of the ship does not deflect the needle, either on account of its inertia and the action of gravity, or of the relative changes in the position of the ship's magnetism. The best form of marine galvanometer consists of two short bobbins of fine silk-covered wire placed end to end, about an eighth of an inch apart, and having their axes in the same line, with a very light mirror, carrying cemented to its back one or more small magnets suspended between the two bobbins in such a way that the centre of the mirror is in their common axis. The mirror and magnet system weighs from one-half to one grain. It is suspended as shown in fig. 14 by a single silk fibre *f*, which passes through the centre of inertia of the mirror and needle system *m* and is fixed at one end directly to the frame F and at the other end to a light spring *s*. The frame F is made thin enough to slide into the opening between the two bobbins, so that the mirror can be easily taken out for adjustment when necessary. So long as the suspending fibre passes through the centre of inertia of *m* it is clear that no motion of translation of F can produce rotation of the mirror. When the instrument requires to be highly sensitive, as for testing purposes, it is shielded from the action of the ship's and the earth's magnetism by enclosing it in a massive iron case. For signalling purposes the controlling magnet is arranged to produce at the needle a field so strong that the effect of variations of external magnetism is inappreciable.

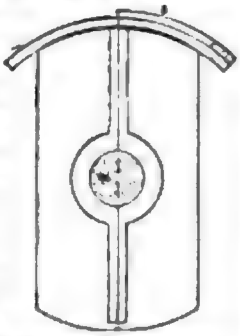
FIG. 14.—Marine galvanometer.

Testing for Faults.—Numerous methods have been proposed for the localization of faults in telegraph lines, some of a complex character and adapted to the cases of faults of a kind which fortunately seldom, if ever, occur. We give here a brief outline of the tests for the cases of most common occurrence.

For the determination of the position of a complete rupture with the conductor insulated both the insulation and the capacity tests are theoretically applicable. The insulation of a line of uniform type and material is inversely as its length; hence if a piece is broken off the insulation is increased. If I be the total insulation before rupture, I_1 the insulation of one section after rupture, and l the total length of the line, the length of the section is Il/I_1. Unfortunately it is difficult to obtain the necessary accuracy in insulation testing on account of the great influence of earth-currents on the result; but apart from this there is always some uncertainty, especially in cables, as to the insulation at the break. For cables a fairly reliable test can be obtained from the capacity even when the insulation at the fault is somewhat imperfect, if it be sufficient to hold the greater part of the charge for a few seconds, since the amount of loss in any short interval can be estimated by a separate test. The capacity of a uniform cable is inversely as its length; hence, if C be the total capacity of the perfect cable and C_1 the capacity of one section, the length of that section is lC_1/C. When—as is almost always the case—the cable is not quite uniform in electrical quality and in temperature, a table or a curve showing the wire resistance, the insulation, and the capacity up to any point from either end should be kept for reference.

It is not at all uncommon in cables for one side of a fracture to be partially insulated through the conductor not breaking exactly at the same point as the insulator. In this case, however, the other end will be in most cases almost perfectly earthed and the position of the fault can be very nearly determined by the wire-resistance test. When both ends are partially insulated it is very difficult to obtain a near approach to the position of the fault because of the uncertainty as to which side of the break offers the greatest resistance. A first approximation is obtained by finding the wire resistance from both ends and subtracting the total wire resistance of the cable from the sum of these. This gives the sum of the resistances at the fracture, and half of this, if it is not too great, subtracted from the resistance of either section gives an approximation to the resistance of that section up to the break. If, however, the resistance at the fracture is comparable to the total wire resistance of the cable, this method is useless. An approach to the solution of the difficulty can be obtained from capacity tests, the cable being discharged through different resistances at the testing end. But the procedure is very uncertain and difficult, and a full discussion of it would take more space than can be afforded here. The resistance at a fault can sometimes be greatly diminished by repeated application alternately of the positive and negative poles of a powerful battery to the cable, but this should never be resorted to if it can possibly be avoided. The direct deflexion method of taking wire resistance is most suitable for these tests. The resistance seems to diminish gradually after the battery is applied until it reaches a minimum value, after which it again increases. This maximum deflexion should be taken as indicating most nearly the true wire resistance up to the fracture.

When the fault is a partial earth without fracture, and both ends of the cable are available—as in factory testing, or when a second well-insulated cable can be used—the most satisfactory method is the loop test. In this the two sections of the cable form two sides of the Wheatstone's bridge; one pole of the battery is put to the junction of the other two sides and the other pole to earth,—that is, practically to the fault. The ratio of the resistances in the bridge when balance is obtained gives the ratio of the resistances of the two sections of the cable, or the ratio of the resistance of one section to the resistance of the other section plus the resistance of the second cable. The total resistance of the cable being known, it is easy to determine the position of the fault. When the fault has a high resistance it is necessary to make a correction for the want of perfect insulation in the sound part of the cable. When both ends of the cable are not available, measure the potential at the testing end and the resistance between that end and the earth, and simultaneously measure, by means of a slide resistance and zero galvanometer or by means of a quadrant electrometer, the potential at the distant end. Then, if V be the potential at the testing end, v the potential at the distant end, and R the resistance measured, the true resistance of the fault is $R(1-v/V)$. Another simple, although less perfect method, may be mentioned. Measure the resistance between both ends and the earth and subtract from the sum the true wire resistance of the cable; the difference is twice the resistance of the fault. The imperfection of this method, and indeed of any which involves two observations not made simultaneously, lies in the variable character of the resistance of a fault.

III. MODERN TELEGRAPHS.

Morse system.

The code of signals introduced by Morse is still employed in the United States and Canada, and the international code in vogue in Europe differs only slightly from it. Currents in one direction only are used, and different combinations of from one to four long and short contacts form the letters, while the numerals are represented by groups of five signals, and punctuation and other special signs by groups of six and sometimes more. The instruments used for land telegraphs on this system are of two types,—"sounders," which indicate by sound, and "recorders," which record the signals.

Morse recorders.

(1) Recorders vary in details of construction, but all have the same object, namely, to record the intervals during which the current is applied to the line. In the earlier forms of instrument the record was made by embossing lines on a ribbon of paper by means of a sharp stile fixed to one end of a lever, which carried at the other end the armature of an electromagnet. This method of recording is still largely employed in America, and certainly has the advantage of simplicity. The form of instrument almost universally used in Europe makes the record in ink, and hence is sometimes called the "ink-writer." This method has the advantage of distinctness, and so is less trying to the eyes of the operators. The action of the instrument will be understood from the annexed sketch (fig. 15). Suppose *s* to be a strip of paper which is being pulled towards the left by means of two rollers r_1 and r_2 moved by a train of mechanism. Underneath the roller r_1 a small wheel *i* is kept turning by the same mechanism, and has its lower edge in contact with the surface of ink in the ink-well *w*. When a current is sent through the magnet *m*, the armature *a* is attracted and the lever *l* lifts the ink-wheel *i* into contact with the paper, against the surface of which it rolls until the current is broken, thus making a mark the length of which depends on the speed of the mechanism and the time the current flows. As the speed of the mechanism is nearly constant, the relative lengths of the marks depend only on the duration of the current. In this way the letters of the alphabet, or any other understood signs, are indicated by groups of long and short marks, commonly called "dashes" and "dots."

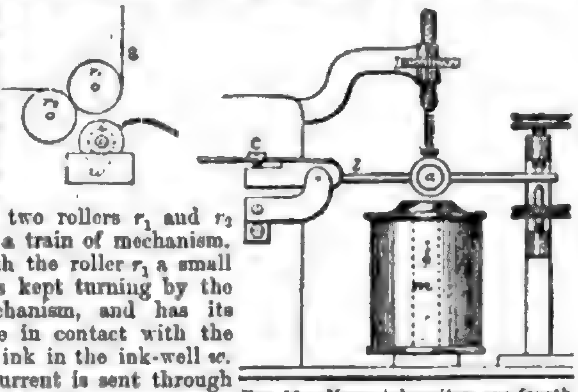

FIG. 15.—Morse ink-writer, one-fourth full size.

Morse sounders.

(2) Operators who use the recording instrument soon learn to read the message by the click of the armature against its stop, and as this is a less fatiguing method of reading, and leaves the hands and eyes free to write, the sound is usually preferred. Thus, when it is not necessary to keep a copy, a much simpler instrument may be employed and the message read by sound. The earliest successful form was Bright's bell sounder, which consisted of two bells of distinct tone or pitch, one of which was sounded when the current was sent in one direction and the other when it was reversed. This instrument was capable of giving very considerable speed, but it was more complicated than that now in use, which consists only of an electromagnet, with its armature lever arranged to stop

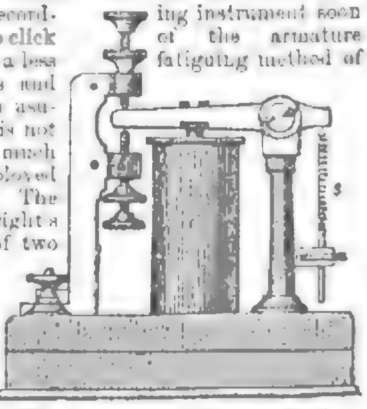

FIG. 16.—Morse sounder, one-fourth full size.

against an anvil or screw *b* (fig. 16) in such a way as to give a distinct and somewhat loud sound. Dots and dashes are distinguished by the interval between the sounds of the instrument in precisely the same way as they are distinguished when reading from the recorder by sound. The form of sounder commonly used in England is shown in fig. 16; it is one of the simplest possible instruments, is easily adjusted to the current by tightening or slackening the spring *s*, and is very little liable to get out of order.

Chemical telegraphs.

Another and in some respects a simpler method of recording is to use a chemically prepared ribbon of paper. Suppose, for instance, the paper ribbon to be soaked in a solution of iodide of potassium and a light contact spring made to press continuously on its surface as it is pulled forward by the mechanism. Then, if a current is sent from the spring to the roller through the paper, a brown mark will be made by the spring due to the liberation of iodine. This was the principle of the chemical telegraph proposed by Edward Davy in 1838 and of that proposed by Bain in 1846. It gives a ready means of recording on the Morse plan at a high rate of speed, and Bain's telegraph was successfully worked for some years in America. Several ingenious applications of his method have been proposed, as, for example, the copying telegraph of Bakewell and of Cros, by means of which a telegram may be transmitted in the sender's own handwriting; the pantelegraph of Caselli; the autographic telegraphs of Meyer, Lenoir, Sawyer, and others; and the autographic typo-telegraph of Bonelli. The principle of action of these instruments is this. Suppose two metallic cylinders, one at the sending and the other at the receiving station, to be kept revolving synchronously, and suppose the axis of each to be threaded with a fine screw so that as it revolves rapidly it has a slow side motion. Wrap round the cylinder at the sending station a ribbon of tinfoil, or paper covered with a conducting coating, on which the message is written in varnish or some other insulating substance. Suppose also a ribbon of paper which has been soaked in iodide of potassium to be wrapped round the cylinder at the receiving station. Cause a stile, as in the Bain telegraph, to press on each cylinder and set it in motion. It is evident that so long as the stile at the sending end presses on the clean foil the stile at the receiving end will continue to make a brown mark, but that when it passes over the varnish the mark will be interrupted. In this way, as the two cylinders revolve and move sideways, the series of interruptions made at the receiving end form an exact copy of the varnish marks at the sending end. These instruments are at present but little used.

Automatic telegraphs.

It has been found possible to make the Morse ink-writer so sensitive that it can record signals sent over land lines of several hundred miles in length very much faster than they can be transmitted by hand, and this has led to the adoption of automatic methods of transmission. One was proposed by Bain as early as 1846, but it did not come into use. That now employed is, however, practically a development of his idea. It consists in punching, by means of "a puncher," a series of holes in a strip of paper in such a way that, when the strip is sent through another instrument, called the "transmitter," the holes cause the circuit to be closed at the proper times and for the proper proportionate intervals for the message to be correctly printed by the receiving instrument or recorder. The most successful apparatus of this kind is that devised by Wheatstone; others have been introduced by Siemens and Halske, Garnier, Humaston, Siemens, and Little.

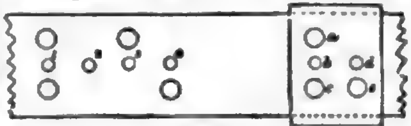

Fig. 17.

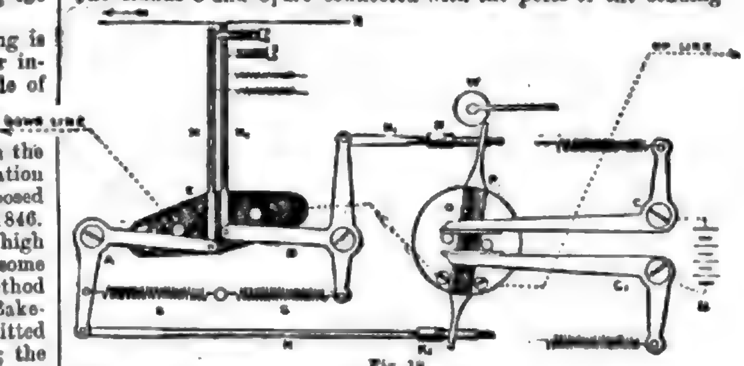

Fig. 18.

Wheatstone's automatic system.

In Wheatstone's automatic apparatus three levers are placed side by side, each acting on a set of small punches and on mechanism for feeding the paper forward a step after each operation of the levers. The punches are arranged as shown in fig. 17, and the levers are adjusted so that the left-hand one moves *a*, *b*, *c* and punches a row of holes across the paper (group 1 in the figure), the middle one moves *b* only and punches a centre hole (2 in the figure), while the right-hand one moves *a*, *b*, *d*, *e* and punches four holes (3 and 4 in the figure). The whole of this operation represents a dot and a dash or the letter "a." The side rows of holes only are used for transmitting the message, the centre row being required for feeding forward the paper in the transmitter. The perforation of the paper when done by hand is usually performed by means of small mallets, but at the central telegraph office in London the keys are only used for opening air-valves, the actual punching being done by pneumatic pressure. In this way several thicknesses of paper can be perforated at the same time, which is a great convenience for press work, since copies of the same message have often to be transmitted to several newspapers at the same time. The mode of using the paper ribbon for the transmission of the message is illustrated in fig. 18. An ebonite beam E is rocked up and down rapidly by a train of mechanism and moves the cranks A and B by means of two metal pins *p*, *p*. A and B are in metallic contact with each other through the springs *s*, *s*, and they carry two light vertical rods M, M_1, the one as much in front of the other as there is space between two successive holes in the perforated ribbon. To the other ends of A, B rods H, H_1 are loosely hinged, their ends passing loosely through holes in the ends of the bar P, which is fixed to the divided disk D. By means of two collars K, K_1 and the wheel W, the disk D is made to oscillate in unison with the beam E. The cranks C and C_1 are connected with the poles of the sending battery B. The operation is as follows. The paper ribbon R is moved forward by its centre row of holes at the proper speed above the upper ends of the rods M, M_1; should there be no hole in the ribbon it pushes the crank A or B out of contact with the pins *p*, *p* and prevents a current passing to the line. Should, however, a row of holes, like group 1 above, be perforated, the rod M_1 will first be allowed to pass through the paper and copper will be put to the line; at the next half stroke of the beam, M will pass through, and as the disk D reverses the battery zinc will be put to the line. Thus for a dot first a positive and then a negative current are sent to the line, the effect of the positive current continuing during the time required for the paper to travel the space between two holes. Again, suppose groups 3 and 4 to be punched. The first part will be, as before, copper to the line; at the next half stroke of the beam M will not pass through, as there is no hole in the paper; but at the third half stroke it passes through and zinc is put to the line. Thus for a dash the interval between the positive and the negative current is equal to the time the paper takes to travel over twice the space between two successive holes. Hence for sending both a dot and a dash reverse currents of short duration are sent through the line, but the interval between the reversal is three times as great for the dash as for the dot. In the receiving instrument the electromagnet is so constructed that the armature, if pulled into any position by either current, remains in that position, whether the current continues to flow or not, until a reverse current is made to act on the magnet. For the dot the armature is deflected by the first current, the ink-wheel being brought into contact with the paper and after a short interval pulled back by the reverse current. In the case of the dash the ink-wheel is brought into contact with the paper by the first current as before and is pulled back by the reverse current after three times the interval. The armature acts on an inking disk on the principle described above, save only that the disk is supplied with ink from a groove in a second wheel, on which it rolls: the grooved wheel is kept turning with one edge in contact with ink in an ink-well. By this method of transmission the battery is always to the line for the same interval of time, and alternately with opposite poles, so that the effect of electrostatic induction is reduced to a minimum. Through the instrumentality of this method as many as 400 words per minute have lately been transmitted by Mr Preece between London and Newcastle, a distance of 278 miles.

Hughes's type-printing telegraph.

The first considerable improvement on the House type-printer, referred to above, was made by D. E. Hughes of Kentucky in 1855. In the Hughes instrument (see fig. 19) two trains of clockwork mechanism, one at each end of the line, are kept moving synchronously by powerful spring governors. Each instrument is provided with a key-board, resembling that of a small piano, the key levers of which communicate with a circular row, R, of vertical pins. A horizontal arm A fixed to a vertical shaft in gear with the mechanism sweeps over these pins at the rate of from one to two turns per second. When a key is depressed, slightly raising one of the pins, the battery is put to the line for a short time at that part of the revolution by means of a sledge S carried by the horizontal arm. The current thus sent to the line may be made either to act directly on the printing instrument or to close a local circuit by means of a relay. For simplicity we will suppose direct action. The current then passes through the coils of a powerful electromagnet M, which relieves the printing mechanism. The electromagnet consists of two coils each containing a soft iron core of the same length as the coil. These cores rest on the ends of the two arms of a powerful horse-shoe permanent magnet, and thus become strongly polarized by induction. A soft iron armature is placed across the free ends of the soft iron cores and is pulled by a strong spring, the tension of which is adjusted so as to be nearly equal to the magnetic attraction. The current is sent in the proper direction to diminish the power of the magnet and allow the spring to preponderate. A very powerful action is thus obtained by means of a very small current, the actual work being done by motive-power in the instrument itself. After the letter is printed the mechanism short-circuits the magnet and replaces the armature automatically. The printing action is as follows. The type-wheel W is carried round continuously by the clockwork, to which it is attached through a friction sleeve which allows it to be stopped, and pushed backward or forward without stopping the mechanism. Another shaft carrying three cams is arranged so as to be locked into gear with the wheelwork when the armature leaves the poles of the magnet. The cams then come into action in rotation; the first moves the adjustment lever, shown to the left of W in the figure, which pushes a wedge-shaped piece into the teeth of the type-wheel and adjusts it exactly to the proper position for printing; the second cam presses the paper against the type; the third moves forward the paper; a fourth cam replaces the armature of the magnet and relieves the cam shaft, leaving the instrument ready to receive another letter. The whole of this operation occupies only a small fraction of a second. By means of the adjustment lever or "corrector" *l* every error in synchronism decidedly less than half the space from letter to letter is perfectly corrected each time an impression is made. Thus, during the time the receiving instrument at one station is in use, its type-wheel is kept in perfect agreement with the sending wheel at the other station; and, if the electric action keeps time, a wrong letter cannot be printed unless the rate of the clockwork is at fault by some such amount as one or two per cent. If the two wheels are allowed to run a long time without the electric maintenance of agreement, they will be found more or less at variance, as the pieces of clockwork, however good, cannot be perfect. All that is necessary to bring them into agreement again is to strike several times the key corresponding to a prearranged adjustment signal—that corresponding to the dot type, for instance. The receiver knows (according to the regulated system of working) that it is adjustment, not message, that is being sent; and he turns his type-wheel by hand till it prints dots. He then signals back "O.K." ("All correct!") and is ready to receive the message. If by any accident his type-wheel gets on a wrong letter in the course of a message, he disturbs the sender (who all the time sees the effect of his sending printed before his own eyes) by sending back a few currents on him; he receives dots by way of acknowledgment, and resets his type-wheel to print correctly. This system of telegraphic printing has a great advantage over the step-by-step system in using continuous instead of intermittent currents, and so avoiding the necessity for the rapidly acting electric escapement, which, however skilfully planned and executed, is always liable to failure when worked too rapidly. In Hughes's instrument almost perfect accuracy and certainty have been attained; and in actual practice it has proved to be decidedly superior to all previous type-printing telegraphs, not only in speed and accuracy, but in less liability to mechanical derangement from wear and tear and from accident. It involves many novel features: the receiving electromagnet is of peculiar construction and remarkable efficiency; the transmitting apparatus has a contrivance to prevent unintentional repetitions of a letter through the operator holding his finger too long on a key; the type-wheel has a lock for each station, to be opened by its own key, one of the letter keys of any of the instruments in the circuit. This instrument was for some years extensively used in the United States, until superseded by G. M. Phelps's modification of it, known as the "American combination printing telegraph," because it embodied part of Hughes's and part of House's instruments. With this modified form somewhat greater speed was obtained, but it was found difficult to drive, requiring the use of steam or some such motive-power. In a subsequent modification introduced in 1875 an electromotor is applied to drive the printing mechanism. This allows a shorter train and stronger wheelwork to be used, secures more certain action, and involves less risk of derangement. Hughes's form was taken up by the French Government in 1860, and is still very largely in use in France.

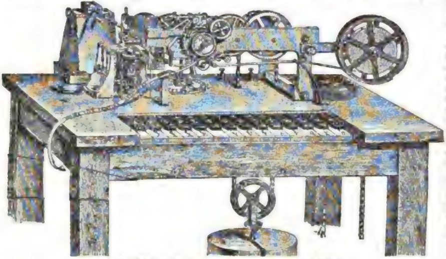

Fig. 19.—Hughes's type-printing instrument, one tenth full size.

Stock telegraphs.

Stock and private line telegraphs constitute an important class of instruments, of which Laws's "gold indicator," introduced in 1866, may be taken as the forerunner. A brief description of Calahan's stock telegraph, introduced in 1867, will give a general idea of the action of this class of instruments. The printing mechanism consists of two type-wheels, on the edge of one of which are the letters of the alphabet and on the edge of the other the numerals from 1 to 9 and fractions by eighths up to unity. The type-wheels are placed side by side, but can be turned independently of each other. Beneath them a platen is carried on one end of a lever, whose other end is attached to the armature of an electromagnet. Between the platen and the wheels a ribbon of paper broad enough to cover the edges of both wheels is passed. The instrument is worked by three lines of wire, one for driving each type-wheel and one for printing and feeding the paper forward. The movement of the type-wheel is accomplished by an escapement acted on by closing and opening the circuit of an electromagnet. For the convenience of the sender the transmitting instrument is made in the form of two dials, each resembling the dial of an A B C instrument, round the edge of one of which letters are printed, and round the other the numerals and fractions. Mechanism is provided for opening and closing the circuit, so that by turning a handle (fixed to an axis passing through the centre of the dial) until an index attached to it points to the letter which is to be printed, the type-wheel of the receiving instrument is in the proper position to print that letter, and this is accomplished by depressing a key and closing the third circuit. The printing magnet then raises the platen and presses the paper against the type. Suppose direct United States telegraph stock is to be reported and the price is 9[illegible]. The operator turns the index on the letter dial to D and presses the printing key; he next turns the index to period and again presses the printing key; he then turns in succession to U, to period, to S, to period, and prints these; then he turns the index on the figure dial to 9 and prints it, lastly to [illegible] and to period, and prints them. The quotation then reads on the paper ribbon D. U. S. 9[illegible].

Various modifications of this instrument have since been introduced. In one form, the "universal stock printer," two lines of wire are required, and both type-wheels are driven by one wire, the printing magnet being made to change the action from one wheel to the other when the wheels are brought into a particular position. In another, "Phelps's stock printer," only one line of wire is required, a polarized armature being used for moving the type-wheels and an ordinary neutral armature for the printing. The rapid reversals which work the polarized armature do not last long enough to move the printing lever, but when a pause is made the printing mechanism is relieved and a letter printed. This instrument is similar in principle to the House apparatus and is capable of working at a considerable speed.[1]

Cowper's writing telegraph.

Cowper's writing telegraph is designed to record the message in written characters; its arrangement is as follows:—Two lines of wire are connected, one with each of two small resistance slides, which are placed in such a way that the sliders move in the same plane but in directions at right angles to each other. A pen placed at the point of intersection of the lines of motion of the two sliders is connected with them in such a way that, when it is moved, as in the act of writing, each slider takes up that component of the motion which is in the direction in which it is free to move. The sliders thus vary the resistance in the line circuits by an amount proportional to the motion of the pen, and when a battery is kept joined in the circuit the current varies in the same way. The current is passed through the coils of two electromagnets at the receiving end, each capable of giving motion to a pencil in one line, at right angles to the direction of motion of the other. When the pen at the sending end is moved as in the act of writing a message the pencil at the receiving end moves in a corresponding manner on account of the variations of the current, and in this way it writes the message on a slip of paper moving beneath its point.

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[1] For these and other type-printing instruments, see Prescott's *Electricity and the Electric Telegraph*.

Open circuit, single-current system.

Methods of Working Telegraph Circuits.—(1) The arrangement on the open circuit system for single-current working is shown in fig. 20, in which L_1 represents the line, G a simple form of galvanoscope, used simply to show that the currents are going to line when the message is being transmitted, K the transmitting key, B the battery, I the receiving instrument, and E the earth-plate. The complete circuit is from the plate E through the instrument I, the key K, and the galvanoscope G to the line L_1, then through the corresponding instruments to the earth-plate E at the other end, and back through the earth to the plate E. The earth is always, except for some special reason, used as a return, because it offers little resistance and saves the expense and the risk of failure of the return wire. The earth-plate E ought to be buried in moist earth or in water. In towns the water and gas pipe systems form excellent earth-plates. It will be observed that the circuit is not in this case actually *open*; the meaning of the expression "open circuit" is "no battery to line." Under normal circumstances the instruments at both ends are ready to receive, both ends of the line being to earth through the receiving instruments. A signal is sent by depressing the key K, and so changing the contact from *a* to *b*, and thus putting the battery to line. On circuits where the traffic is small it is usual to make one wire serve several stations. The connexions at an intermediate or wayside station are shown at W. S is a switch, consisting of three blocks of brass fixed to an insulating base. W may be made the terminal station of L_1 by inserting plug 3, and of L_2 by inserting plug 2, or the instruments may be cut out of circuit by inserting plug 1. In ordinary circumstances the messages from all stations are sent through the whole line, and thus the operator at any station may transmit, if the line is free, by manipulating his key. The greatest inconvenience of this system arises from the varying strength and resistance of the batteries used at the different stations. As, however, delicate recording instruments are seldom required on such circuits little difficulty is experienced.

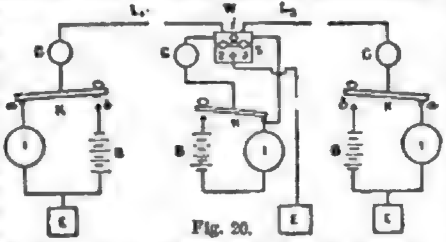

Fig. 20.

Positive and negative current.

(2) The connexions for positive and negative current or single-needle working on open circuit are shown in fig. 21, in which all the letters have the same meanings as before. But N is a single needle instrument, and K is a reversing key. The levers 1 and 2 press against the stops *a* when the line is free; hence the line is to earth at both ends. But, if lever 1 is depressed, one pole of the battery is put to line; if 2 is depressed, the other pole is put to the line. In this way the needles of the receiving instrument may be made to turn to either left or right; and, if we call a motion to the left a dot and a motion to the right a dash, the Morse alphabet may be read from these motions. The connexions for wayside stations are illustrated at W, and will be readily understood from the description given under single-current working above.

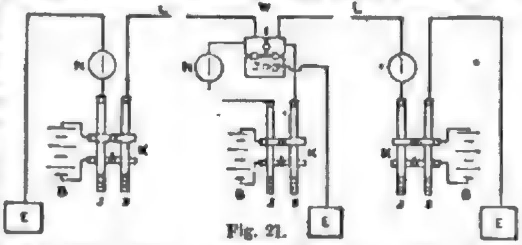

Fig. 21.

Double current.

(3) When the line consists in whole or in part of underground or submarine cable the capacity causes a very considerable diminution in the speed of working. This is to some extent got over by putting the earth connexion in the middle of the battery and using double the number of cells, as shown in fig. 22. The stop *a* of the key K is connected through a switch S with one pole of the battery B, and the stop *b* in the usual way with the other pole. Suppose the arm *c* of the switch S to be in contact with 2; then when the key is manipulated it sends alternately positive and negative currents into the line. If the positive is called the signalling current, the line will be charged positively each time a signal is sent; but as soon as the signal is completed a negative charge is communicated to the line, thus hastening the discharge and the return of the relay lever to its insulated stop. This method of working has been already referred to in connexion with Wheatstone's automatic system.

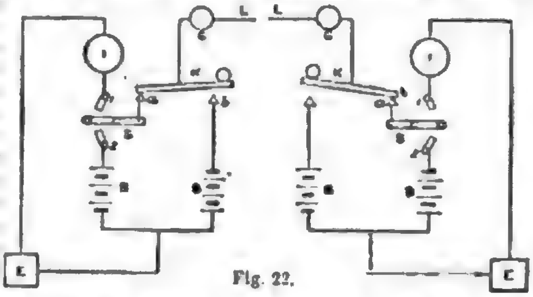

Fig. 22.

Closed circuit system.

The connexions for single-current working on this system are illustrated in fig. 23. It differs from the open circuit in only requiring one battery (although, as in the figure, half of it is often placed at each end), in having the receiving instrument between the line and the key, and in having the battery continuously to the line. The battery is kept to the line by the bar *c*, which short-circuits the keys. When signals are to be sent from either station the operator turns the bar *c* out of contact with the stop *b*, and then operates precisely as in open circuit sending. This system is more expensive than the open circuit system, as the battery is always at work; but it offers some advantages on circuits where there are a number of intermediate stations, as the circuit is under a constant electromotive force and has the same resistance no matter which station is sending or receiving. The arrangement at a wayside station is shown at W. When the circuit is long and contains a large number of stations, the sending battery is sometimes divided among them in order to give greater uniformity of current along the line. When only one battery is used the current at the distant end may be considerably affected by the leakage to earth along the line.

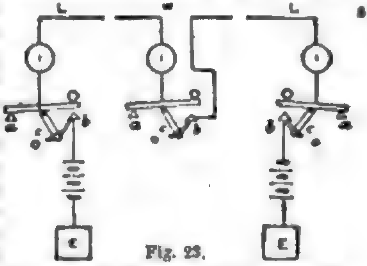

Fig. 23.

Relay working.

In working long circuits with ordinary instruments inconveniently high battery power is required in order to send sufficient current to produce the signals. In such cases it is usual to employ a local battery to produce the signals and to close the local battery circuit by means of a delicate circuit-closing apparatus called a *relay*, which is a very delicate electromagnetic key having its lever attached to the armature of the magnet. The arrangement at a station worked by relay is shown in fig. 24, where L is the line of wire, joined through the key K to one end of the coil of the relay magnet R, the other end of which is put to earth. When a current passes through R the armature A is attracted and the local circuit is closed through the armature at *b*. The local battery B_1 then sends a current through the instrument I and records the signal.

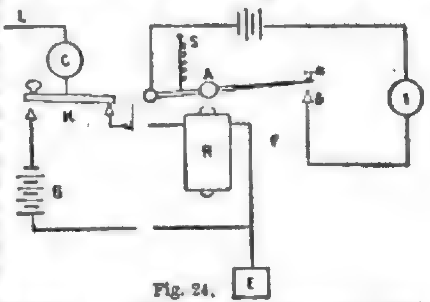

Fig. 24.

In the form of relay indicated in the figure the armature is held against the stop *a* by a spring S. In some cases—as, for example, in Siemens's polarized relay, shown in fig. 25—the armature *a* is put in contact through the pivot *h* with one pole N of a permanent magnet *m*, the other pole *s* of which is fixed to the yolk *y* of a horse-shoe electromagnet M. The armature is placed between the poles of the electromagnet, a little nearer one pole than the other, so that the magnetic attraction holds the contact lever against the insulated stop without the aid of a spring. This form of relay only answers to currents in one direction, but it is capable of giving great sensibility, and for some purposes—for instance, in some methods of quadruplex working—its directional character is an advantage.

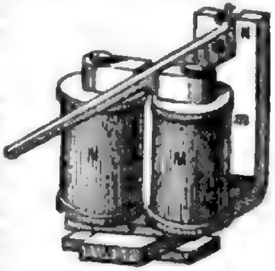

Fig. 25.—Siemens's polarized relay.

Translation.

Translation.—In a precisely similar manner a relay may be made to re-transmit automatically the message over another line, or, what is the same thing, over a continuation of the same line when the whole length is too great for direct working. It is not usual in practice to employ the delicate receiving relay for re-transmitting the message, but it is made to work a coarser instrument, which takes the place of the sounder, or, it may be, the sounder itself, in the local circuit. It is clear that one receiving relay may be used to work a number of re-transmitting keys in the same local circuit, and hence to distribute a message simultaneously over a number of branch lines from a central station.

Duplex.

Duplex, Quadruplex, and Multiple Telegraphy.—Duplex telegraphy consists in the simultaneous transmission of two messages, one in each direction, over the same wire. The solution of this problem was attempted by Gintl of Vienna in 1853 and in the following year by Frischen and by Siemens and Halske. Within a few years several methods had been proposed by different inventors, but none were at first very successful, not from any fault in the principle, but because the effect of electrostatic capacity of the line was left out of account in the early arrangements. The first to introduce a really good practical system of duplex telegraphy, in which this difficulty was sufficiently overcome for land line purposes, was J. B. Stearns of Boston (Mass.) In order that the line between two stations S_1 and S_2 may be worked on the duplex system it is essential that the receiving instrument at S_1 shall not be acted on by the currents sent into the line at S_1, and similarly that the currents sent into the line at S_2 shall not act on the receiving instrument at S_2, while at the same time these currents must act on the instrument at S_2 and S_1 respectively. The two methods most commonly employed are the following.

Differential method.

(1) In fig. 26 B is the sending battery, B_1 a resistance equal to that of the battery, R a set of resistance coils, and C a condenser. Suppose the key at station S_1 to be depressed; then a current flows into the line through circuit 1, and to earth through circuit 2. Now, if both these currents pass, as indicated in the figure, round the electromagnet of the receiving instrument, but in opposite directions, and if their strengths are properly adjusted, no effect will be produced on that instrument. At station S_2, however, the current flows to earth, partly through circuit 1 and partly through circuit 2, but in the same direction round the coils of the receiving instrument. Hence, if the current is strong enough, the receiving instrument at S_2 will be set in action. Similarly the depression of the key at S_2 can be made to produce a signal at S_1 and yet have no effect on the instrument at S_2. The necessary and sufficient condition is that the currents in circuits 1 and 2 at the sending station shall at all times bear a certain fixed ratio to each other, depending on the coils of the receiving instrument at that station. If for simplicity we suppose the resistance of the line to be constant and not to be affected by the transmitting apparatus, and to be of zero electrostatic capacity, the fixed ratio may be obtained by adjusting R in the auxiliary circuit 2. In actual practice the line has capacity, and this is compensated for by supplying to R from the condenser C capacity equivalent to that of the line. C should be of such a form that the capacity in the circuit can be varied, and it must have the same inductive retardation as the line; that is to say, the capacity must be distributed along the resistance R in a manner equivalent to that in which the capacity of the line is distributed along its resistance. A rough approximation to this adjustment will answer the purpose for ordinary land line working, but for submarine cable work a very accurate adjustment is necessary. In order that the manipulation of the key may not affect the resistance of the line, the resistance between the point D and E should be as nearly as possible the same for all positions of the key. This implies that the keys shall not at any time break circuit, nor make contact on both the front and the back stops for more than an instant, for an instantaneous break of the circuit would affect the signals being received from the other station. The principle of the "continuity preserving key," used for duplex working, will be understood from the figure. So long as the key is not depressed the line is kept to earth through the resistance B_1; when the key is pushed down it suddenly changes to the battery B, being at the transition in contact with both B and B_1. This produces very little disturbance, because the key is moving quickly at that part of its stroke, and the resistance of the line and receiving instrument is generally much higher than that of B_1. This is called the "differential method." The principle was first enunciated by Frischen; but its present condition is the result of the labours of a large number of experimenters, among whom may be mentioned Siemens and Halske, Stark, Edlund, Gintl, Nyström, Preece, Nodden, Farmer, Maron, Winter, Stearns, and Muirhead.

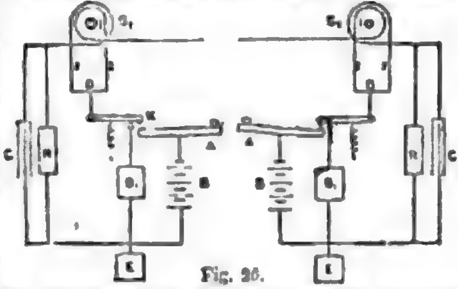

Fig. 26.

Bridge method.

(2) The second method to which we may here refer is known as the "bridge method" from the similarity of the arrangement (see fig. 27) to that of the Wheatstone bridge. Instead of sending the currents in the two branches of the divided circuit DP and DQ through the two coils of a differentially wound relay or receiving instrument, as in Frischen's method, two resistances *a* and *b* are inserted and the instruments are joined between P and Q. It is clear that if the difference of potential between P and Q is unaffected by closing the sending key K no change of current will take place in the instrument circuit. The relative potential of P and Q is not affected by the manipulation of K if the resistance *a* is to that of *b* as the resistance of L is to that of R; hence that is the arrangement used. The same remarks with regard to retardation and capacity that were made when describing the differential method apply here also. One very great advantage in this method is that the instrument used between P and Q may be of any ordinary form.

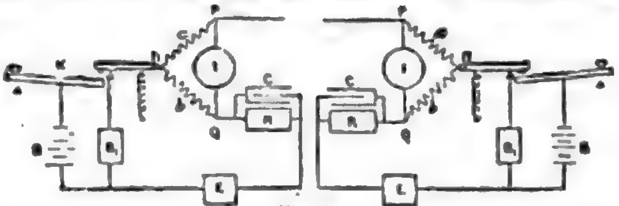

Fig. 27.

Most important cables, such as those of the Eastern Telegraph Company and the various Atlantic cables, are worked duplex on Muirhead's plan. What may be called a mechanical method of duplexing a cable was described by Sir W. Thomson in a patent taken out by him in 1858. In this, as in the ordinary methods, a differentially wound receiving instrument was used, one coil being connected with the cable and the other with the earth; but it differed from other methods in requiring no "artificial" or model cable. The compensation was to be obtained by working the slides of a resistance slide included in the circuit of the compensating coil, either by the sending key or by clockwork relieved by the key, so as to vary the resistance in that circuit according to any law which might be required to prevent the receiving instrument being affected by the outgoing current. Four years later Varley patented his model cable, which was the first near approach to a successful solution of the duplex problem on the principle now adopted. It was not, however, a sufficiently perfect representation of a laid cable to serve for duplexing cables of more than a few hundred miles in length.[1]

By an interesting modification of the bridge method, which has been applied with excellent results by Dr Muirhead to submarine work, condensers are substituted for *a* and *b*, one being also placed in the circuit between P and Q. In this case no current flows from the battery through the line or instruments, the whole action being inductive. As we have already stated, the distribution of the capacity along the resistance R must in submarine cable work be made to correspond very accurately with the distribution of the capacity along the resistance of the cable. This is accomplished by Dr Muirhead in the following manner. One side of a sheet of paraffined paper is covered with a sheet of conducting substance, say tinfoil, and over the other side narrow strips of the same substance are arranged gridironwise to form a continuous circuit along the strip. The breadth and thickness of the strip and the thickness of the paraffined paper are adjusted so that the relative resistance and capacity of this arrangement are the same as those of the cable with which it is intended to be used. A large number of such sheets are prepared and placed together, one over the other, the end of the strip of the first sheet being connected with the beginning of the strip of the second, and so on to the last sheet, the whole representing the conductor of the cable. In the same way all the conducting sheets on the other side of the paper are connected together and form the earth-plate of this artificial cable, thus representing the sea. The leakage through the insulator of the cable is compensated for by connecting high resistances between different points of the strip conductor and the earth coating. Faults or any other irregularity in the cable may be represented by putting resistances of the proper kind into the artificial line. This system of duplexing cables has proved remarkably successful.

Quadruplex.

Quadruplex telegraphy consists in the simultaneous transmission of two messages from each end of the line. The only new problem introduced is the simultaneous transmission of two messages in the same direction; this is sometimes called "diplex transmission." The solution of this problem was attempted by Dr J. B. Stark of Vienna in 1855, and during the next ten years it was worked at by Bosscha, Kramer, Maron, Schaak, Schreder, Wartmann, and others. The first to attain success was Edison, and his method with some modifications is still used. One of the latest arrangements is shown in fig. 28, a brief description of which will indicate the general principle involved. K_1 and K_2 are two transmitting keys the nature of which will be understood from the illustration; R_1 and R_2 are two differentially wound polarized relays, both of which are supposed to respond to positive currents and to be held against their back-stops by negative currents. When neither key is depressed a current, which for convenience we call −4, flows to the line; this is sufficient to overcome the pull of the spring T in the relay R_1 (the receiving instruments are supposed to be at the other end of the line), and hence the levers of both relays are held against their back-stops. When K_1 is depressed a current −1 is sent to the line, and, this being too weak to overcome the spring T, the lever

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[1] See De Sauty, Journ. Soc. Tel. Eng., vol. ii. 1873.

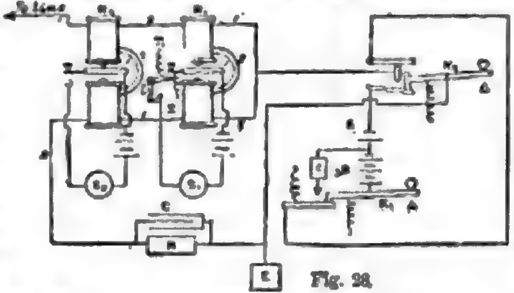

Fig. 28.

of R_1 moves into contact with the auxiliary lever *l* and closes the circuit of the sounder S_1. When K_2 only is depressed a current +4 is sent to the line. This acts on both relays, but is powerful enough to overcome the pull of the spring T_1, and so to move the lever *l* and break the circuit of the sounder S_1 before it has time to act. Thus K_2 acts on the sounder S_2 but not on the sounder S_1. When both keys are depressed a current +1 is sent into the line. This is sufficient to move the lever of R_1 into contact with *l* but not to overcome the pull of T_1, and hence the circuit of sounder S_1 is closed; it is also sufficient to move the lever of R_2 and close the circuit of S_2. When therefore both keys are down the sounders S_1 and S_2 at the other end of the line are both set in action; the first responds to K_1 and the second to K_2. Thus all the conditions for the simultaneous transmission of two messages are provided for. It is not necessary to enter again into the question of continuity at the different positions of the keys. The figure illustrates how this diplex system may be duplexed, and hence how quadruplex working can be obtained. It is only necessary to wind the coils of the relay magnets differentially, when, by means of a precisely similar arrangement to that used for simple duplex, the instruments at the sending station are left unaffected by the outgoing currents, but are affected by the incoming currents. The method here indicated is on the differential principle; but it is scarcely necessary to say that the bridge method is equally applicable. A combination of the bridge and the differential methods has been used by Prescott and Smith, and possesses some advantages in certain cases. It is impossible in this article to go into the great variety of detail in arrangement and method with which it is possible to obtain good results.

Multiple.

The several methods that have been proposed for the transmission of a number of messages in one direction on the same wire are reducible to two classes. In one the time which a revolving contact slider takes to make one revolution is divided into as many intervals as there are sets of sending and receiving instruments on the line, and by means of it the current is closed through the different sets of apparatus in succession. This implies the synchronous movement of the revolving sliders at the two ends of the line. In a sense this may be said to be simultaneous transmission: all the messages are being sent at the same time, but the progress of any one message is slower than it would be if it alone was occupying the whole line in the ordinary way. The method possesses some advantages when the line is capable of being worked at a higher speed than a single operator can attain, or when one of the stations can advantageously be used as a distributing station, for in that case one set of apparatus may be used as an automatic distributor. Multiple telegraphy on this plan was proposed by Thomson in 1858.[1] A very complete set of apparatus for the purpose was shown by Meyer at the Vienna exhibition of 1873.[2] Delaunay's multiple telegraph is the most recent development of the system, and has been lately adopted on some circuits in Great Britain.[3]

In the other class there are joined to the two ends of the line of wire a number of branch circuits, in each of which a set of transmitting and receiving apparatus is included. In the circuit, between the line and each of the sending keys, an electromagnetic vibrator is placed so as to open and close the circuit a great number of times during each signal. The vibrators in the key circuits at one end of the line have all different and, if possible, relatively incommensurable periods. The receivers at the other end of the line consist of a corresponding set of electromagnetic vibrators, mounted on resonators and having exactly the same vibrational periods as those in the key circuits at the sending end. When any one of the keys is manipulated the currents sent into the line have such a pulsatory character that they only affect the receiver, which is capable of vibrating freely in unison with these pulsations. When a number of keys are manipulated at the same time the receivers analyse the resultant wave, each picking out its own component, thus separating the different messages. The "harmonic telegraph" of Mr Elisha Gray of America is a good example of this class.

Connexions.

Working of Submarine Cables.—The arrangement of the apparatus for working some of the most recent cables is shown in fig. 29. The cable is supposed to be worked duplex; but, if S, C_1, C_2, and AC are removed and the key connected directly with C_1, the arrangement for simplex working is obtained. The apparatus consists of a sending battery B, a reversing transmitting key K, a slide of small resistance S, three condensers C_1, C_2, C_3, an artificial cable AC, the receiving instruments I and G, and one or more resistances R for adjusting the leakage current. The peculiar construction of AC has been already referred to. The conductor of the cable is practically insulated, as the condensers in the bridge have a very high resistance; hence no appreciable current ever flows into or out of the line. Two receiving instruments, a siphon recorder and a mirror galvanometer, are shown; one only is absolutely necessary, but it is convenient to have the galvanometer ready, so that in case of accident to the recorder it may be at once switched into circuit by the switch *s*. When one of the levers of K is depressed, the condensor C_1 and the cable, and the condenser C_2 and the artificial cable, are simultaneously charged in series; but, if the capacity of C_1 bears the same proportion to the capacity of the cable as the capacity of C_2 bears to the capacity of the artificial cable, and if the other adjustments are properly made, no charge will be communicated to C_3. After a very short interval of time, the length of which depends on the inductive retardation of the cable, the condensers corresponding to C_1 and C_3 at the other end begin to be charged from the cable, and since the charge of C_3 passes through the receiving instrument I or G the signal is recorded. The charging of C_3 at the receiving end will take place, no matter what is the absolute potential of the condensers, consequently the incoming signals are not affected by those which are being transmitted from that end. In actual practice the receiving instrument is so sensitive that the difference of potential between the two coatings of the condenser C_3 produced by the incoming signal is only a very small fraction of the potential of the battery B. When the key is relieved the condensers and cables at once begin to return to zero potential, and if the key is depressed and relieved several times in rapid succession the cable is divided into sections of varying potential, which travel rapidly towards the receiving end, and indicate their arrival there by producing corresponding fluctuations in the charge of the condenser C_3. All cables of any great length are worked by reverse currents, the single needle alphabet being used: that is to say, currents in one direction indicate dots and in the other direction dashes.

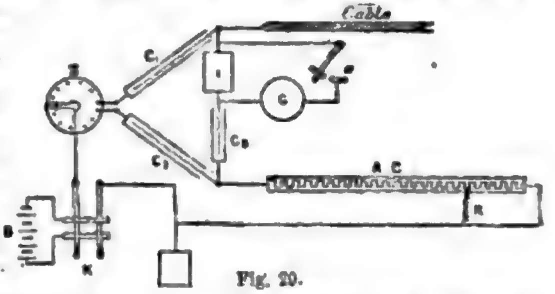

Fig. 29.

The following descriptions of the mirror galvanometer and the siphon recorder are, with some slight alteration, taken from a lecture delivered by Sir W. Thomson before the Institution of Engineers and Shipbuilders in Scotland.[4]

(1) The instrument first used for receiving signals through a long submarine cable (the short-lived 1858 Atlantic cable) was the mirror galvanometer,[5] which consisted of a small mirror with four light magnets attached to its back (weighing in all less than half a grain), suspended by means of a single silk fibre within the hollow of a bobbin of fine wire,—a suitable controlling magnet being placed adjacent to the apparatus. The action of the instrument is as follows. On the passage of a current of electricity through the fine wire coil the suspended magnets with the mirror attached tend to take up a position at right angles to the plane of the coil, and are deflected to one side or the other according as the current is in one direction or the other. Deflexions to one side are interpreted as dots and to the other side as dashes, and the messages are transmitted in accordance with the international Morse code of signals.

(2) The spark recorder in some respects foreshadowed the more perfect instrument—the siphon recorder—which was introduced some years later. Its action was as follows. To an indicator, suitably supported, a to-and-fro motion was given by the electromagnetic actions due to the electric currents constituting the signals. The indicator was connected with a Ruhmkorff coil or other equivalent apparatus, designed to cause a continual succession of sparks to pass between the indicator and a metal plate situated beneath it and having a plane surface parallel to its line of motion. Over the surface of the plate and between it and the indicator there was passed, at a regularly uniform speed, in a direction perpendicular to the line of motion of the indicator, a material capable of being acted on physically by the sparks, either through their chemical action, their heat, or their perforating force. The record of the signals given by this instrument was an undulating line of fine perforations or spots, and the character and succession of the undulations were used to interpret the signals desired to be sent.

(3) The latest form of receiving instrument for long submarine cables is the siphon recorder, for which Sir W. Thomson obtained

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[1] *Tel. Journ.*, September 1886.

[2] For a description, see Prescott's *Electric Telegraph*, p. 862.

[3] Preece, *Journ. Soc. Tel. Eng.*, vol. xv. p. 231

[4] See his *Mathematical and Physical Papers*, vol. ii. p. 168.

[5] For a description of the mirror galvanometer, see art. GALVANOMETER, vol. x. p. 50 sq.

his first patent in 1867. Within the three succeeding years great improvements were effected on it, and the instrument has since that date been exclusively employed in working most of the more important submarine cables of the world,—indeed all except those on which the mirror galvanometer method is in use. In the siphon recorder (see fig. 30) the indicator consists of a light rectangular signal coil of fine wire, suspended between the poles of two powerful electromagnets M, M so as to be free to move about its longer axis, which is vertical, and so joined that the electric signal currents through the cable pass through it. A fine glass siphon tube is suspended with freedom to move in only one degree, and is connected with the signal-coil and moves with it. The short leg of the siphon tube dips into an insulated ink-bottle, so that the ink it contains becomes electrified, while the long leg has its open end at a very small distance from a brass table, placed with its surface parallel to the plane in which the mouth of the leg moves, and over which a slip of paper may be passed at a uniform rate, as in the spark recorder. The ink is electrified by a small induction electrical machine E placed on the top of the instrument; this causes it to fall in very minute drops from the open end of the siphon tube upon the brass table or the paper slip passing over it. When therefore the signal-coil moves in obedience to the electric signal currents passed through it, the motion communicated to the siphon is recorded on the moving slip of paper by a wavy line of ink-marks very close together. The interpretation of the signals is according to the Morse code,—the dot and dash being represented by deflexions of the line of dots to one side or other of the centre line of the paper. A very much simpler form of siphon recorder has been devised and brought into use within the last few years. Instead of the electromagnets, two bundles of long bar-magnets of square section and made up of square bars of glass-hard steel are used. They are supported vertically on a cast-iron socket, and on the upper end of each is fitted a soft iron shoe, shaped to concentrate the lines of force and thus produce a strong magnetic field in the space within which the signal-coil is suspended. Instruments of this kind have been made to work both with and without electrification of the ink. Without electrification the instrument (see fig. 31) is very simple and compact, and capable of doing good work on cables 500 or 600 miles long. When constructed for electrification of the ink they are available for much greater lengths, but for cables such as the Atlantic the original form is still used. The strongest magnetic field hitherto obtained by permanent magnets (of glass-hard steel) is about 3000 C.G.S. With the electromagnets used in the original form of siphon recorder a magnetic field of about or over 5000 C.G.S. is easily obtained. Fig. 32 shows a facsimile of part of a message received and recorded by a siphon recorder, such as that of fig. 30, from one of the Eastern Telegraph Company's cables about 330 miles long.

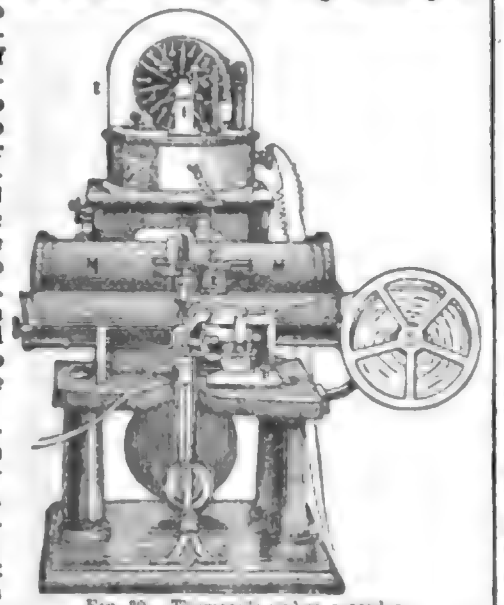

Fig. 30.—Thomson's siphon recorder.

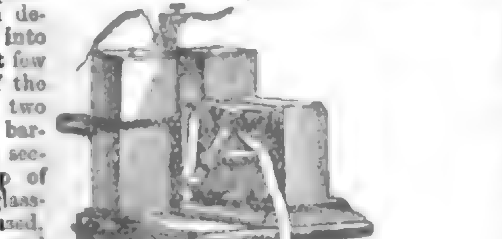

Fig. 31.—Siphon recorder.

Automatic curb sender.

(4) The automatic curb sender was designed by Sir W. Thomson for the purpose of diminishing the effect of inductive embarrassment in long cables. In ordinary hand-sending the end of the cable is put to one or the other pole of the battery and to earth alternately, the relative time during which it is to battery and to earth depending to a great extent on the operator. By the automatic curb sender the cable is put to one or the other pole of the battery and then to the reverse pole for definite proportionate times during each signal. The cable is thus charged first positively and then negatively, or *vice versa*, for each signal. This method not only facilitates the discharge of the cable, and so accelerates the return of the index of the receiving instrument to zero, but provides the means of sending positive and negative currents into the cable at the proper times and for the proper intervals. The action of the instrument is regulated, like that of Wheatstone's automatic transmitter, by a perforated slip of paper. The arrangement of the perforations and the method of using the paper slip are, however, quite different. The paper is fed forward by a central row of holes, which are therefore continuous. The dots and dashes of the message are represented by the side rows of holes; but the two currents required for a dot are produced wholly by one hole on one side and those for a dash by one hole on the other side. The perforated slip is exactly similar to the message written by the siphon recorder, the side holes occupying the same relative positions as the loops to one side or other of the central line in the record. As the side holes reach a certain point in their passage through the instrument they allow the end of one or the other of two levers to fall; the other end of the lever lifts a light contact spring, forming one lever of a reversing key, and makes electrical connexion between the battery and another set of springs, which also form the levers of a reversing key. The spring is held up, by a flange on the edge of a revolving wheel passing under it, during the time required by the paper to advance through the distance between two central holes. During this interval the current is reversed at the proper time by a pair of adjustable cams fixed to the same spindle as the flanged wheel. This method of transmission has been found quite successful, though it has not been brought into use, as hand-sending has hitherto proved sufficient for the work required.

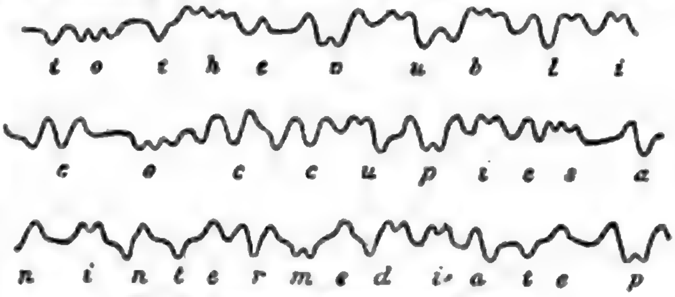

Fig. 32.—Facsimile of siphon recorder message.

Speed of signalling.

Speed of Signalling.—The mathematical theory of the speed of telegraphic signalling was given in a paper on "The Theory of the Electric Telegraph" communicated by Sir W. Thomson[1] to the Royal Society in 1855. He shows that, if k be the wire resistance, c the capacity per unit length, and l the total length of the line, the current at the receiving end at any time t after the application of the battery at the sending end is given by the equation

$$C_t = C\{1 - 2(\epsilon - \epsilon^4 + \epsilon^9 - \epsilon^{16} + \&c.)\},$$

where C is the maximum current which the battery is capable of maintaining through the line, and ϵ is equal to $(\frac{4}{5})^{\frac{t}{a}}$ when a is equal to $kcl^2 \log_e(\frac{5}{4})/\pi^2$. The number $\frac{4}{5}$ is quite arbitrary; it is chosen because it makes a nearly equal to the time required for the current to become sensible at one end of the line after the battery has been applied to the other end. The number $10^{\frac{1}{10}}$, which is more convenient for calculation and which does not differ greatly from $\frac{4}{5}$, was subsequently adopted by Sir W. Thomson, and also by Professor Jenkin.[2] The equation may be written

$$C_t = C\left\{1 - 2\left(e^{-\pi^2 t/kcl^2} - e^{-4\pi^2 t/kcl^2} + e^{-9\pi^2 t/kcl^2} - \&c.\right)\right\},$$

which shows plainly how the current is affected by the length, the resistance, and the capacity of the line.

It is evident from this equation that a finite time is required after the battery has been applied at the sending end for the current to become sensible at the receiving end, the interval being practically equal to a, and also that for similar actions the intervals between operations for one line must be to the corresponding intervals for another line directly as the values of a or of kcl^2 for the two lines. We see, therefore, that for lines of the same type, worked in the same manner, the speed of working will be inversely as the square of the length of the line, or, if the type varies, inversely as the product KQ, where K is the total resistance and Q the total capacity of the line. The interval *a* must not be confounded with the time required for each signal: it is a measure of the slowness of transmission; but the number of signals which can be received in a given time, on any one line, depends on the method of working and on the sensibility of the instruments employed. The ratios of the number of signals which can be sent over different lines in a stated time are the same as the ratios of the values of *a* for these lines. The value of *a* for the different Atlantic cables varies between a fifth and a quarter of a second, and, as the time required for the current to reach 90 per cent. of its maximum value is ten times *a*, an instrument which requires as much as 90 per cent. of the full current to produce a signal and a fall to 50 per cent. between the signals could only receive about one signal every two seconds or between one and two words per minute. The instruments actually used attain to a speed of about twenty times this; but they are capable of showing distinctly a current of a ten-thousandth, or even less, of the maximum current. The value of *a* for ordinary land lines is very small, probably not exceeding the five-thousandth part of a second for a circuit 500 miles in length. The current, therefore, rises almost to its full value for each signal when the time of contact is as small as the five-hundredth part of a second, or, on the Wheatstone instrument, when the speed is about 500 words per minute. There is, however, a very sensible increase in the effective resistance of the circuit, especially when iron wire is used, when signals are sent as rapidly as 100 per second, so that higher battery power is required for fast than for slow rates of speed. The difficulty in working land lines at rates up to 300, or even more, words per minute is not to any serious extent electrical, but is in great measure due to material and magnetic inertia in the receiving instruments. Although land lines can be worked at a very high speed when the whole of the wire is insulated on poles, the rate is greatly diminished if a length of underground or of submarine cable is included in the circuit. In practice also the speed depends greatly on the position of the cable in the circuit; for example, the actual speed from Dublin to London, according to Mr Preece, is about twice as great as that from London to Dublin. Mr Culley states that the greatest effect is produced when the cable is in the middle of the circuit. (T. GR.)

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[1] See his *Mathematical and Physical Papers*, vol. ii. p. 61.

[2] See Jenkin, *Electricity and Magnetism*, p. 331.

TELEMETER, or RANGEFINDER. This is an instrument used in modern warfare to determine the distance or range to an enemy's position, in order that correct elevations may be given to guns or rifles directed against it. Telemeters have been made on three distinct principles, and classified as acoustic, optical, and trigonometrical respectively.

Acoustic telemeters record the time which elapses between seeing the flash or smoke and hearing the report of a gun, rifle, or shell, the range being given in yards as "the time in seconds × 364·6." The Boulengé telemeter is the best known of this class. It consists of a graduated glass tube filled with liquid and containing a small metal traveller. At the flash the instrument is brought to a vertical position, and the traveller starts from zero; at the detonation it is turned to a horizontal position and the traveller stops. The objections to the acoustic telemeter are that the rate of transmission of sound in air is affected by wind and other local conditions and that the instrument cannot be used until firing has commenced.

Optical or *perspective telemeters* determine the distance to any point by observing the size of some object of known dimensions, as seen in a graduated telescope. Porro's telemeter, Elliott's telescope, and Nordenfelt's macrometer illustrate the principle. The chief defect of the system is that the objects most conveniently observed—men and horses—vary considerably in size, so that the assumption of a constant dimension may be productive of error.

Trigonometrical telemeters shorten the ordinary methods of surveying by adapting them to military purposes. They are of two kinds,—field rangefinders and rangefinders for coast batteries.

(1) *Field rangefinders* exist in great variety, and differ from one another both in the trigonometrical methods pursued and in the mechanical peculiarities exhibited. The following are the common solutions of what is technically called "the range-finding triangle,"—*i.e.*, a triangle in which O (fig. 1) is the object the distance to which is required, AOB an acute angle, and AB the base,—O being visible both from A and B. (i.) Where the base is a fixed length and the angles are variable.—A fixed base is rarely adopted except when the base forms part of the instrument, the angles being observed by powerful telescopes. The range is usually read in yards by the assistance of verniers, extreme perfection of mechanism being necessary. Many ingenious instruments of the kind have been devised, but none have as yet proved satisfactory. With a fixed base the accuracy diminishes as the range increases. (ii.) Where the base and the angles are variable.—The base angles are generally observed by instruments of the theodolite type, and the base is actually measured or found by means of a sub-base. The range is obtained by table or calculating scale. The Nolan rangefinder, which was the first telemeter used by the British artillery, was of this kind. (iii.) Where one base angle is a right angle, the other angles and base being variable.—The instrument used is generally double-reflecting of the sextant type,—the base being found as in (ii.). The most perfect example is the Watkin rangefinder, used by the British horse and field artillery. It (fig. 2) consists of an horizon glass capable of assuming two positions, and an index glass set in a steel arm, which is worked by a movable collar on a graduated bar, and this again is moved by the turning of a graduated cylinder. O (fig. 3) being the object, the observer sets up a picket at A, and with the instrument at zero (the horizon glass being inclined 45° to the index glass) finds the right angle at the point C. A sub-base AB of 6 yards is then set off, and (with glasses set parallel and the sliding collar at 6) the observer reflects B upon A by turning the cylinder, which is thus made to record the base AC in yards. This reading being set on the graduated bar by moving the sliding collar, the observer proceeds to A, and from there reflects C upon O, which causes the range to be given in yards on the cylinder. In this operation the position of the sliding collar regulates the movement of the steel bar so that the number of turns of the cylinder is always a true measure of the range OC, whatever the length of the base AC. (iv.) Where the angles are fixed and the base is a measure of the range.—The base points are determined by the use of prisms or of mirrors reflecting the particular angles adopted. The base is measured or found by a subsidiary triangle, and multiplied by a constant to give the range. The Weldon rangefinder, recently issued to the British infantry, is on this principle. It consists of three prisms, and is generally used as follows. O (fig. 4) being the object and D a convenient distant point, the observer makes with the first prism the right angle OAD. He then retires in the direction DA till the second prism records the angle OBD=

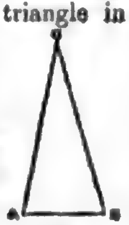

Fig. 1.

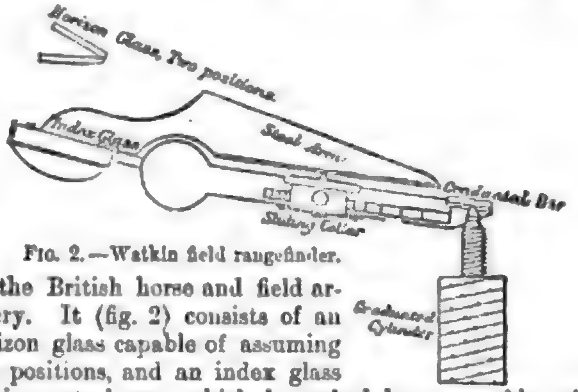

FIG. 2.—Watkin field rangefinder.

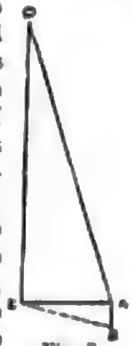

Fig. 3.

88° 51′ 15″, when the range = 50 × AB. If it is inconvenient to measure AB, the observer can retire from B in the line OB until the third prism records the angle OCA = 74° 53′ 15″, when the range = 200 × BC. The prisms must be held in the plane of the objects and looked into at the same point. This rangefinder is very simple and portable, but is frequently inapplicable on hilly or broken ground, and does not possess great accuracy.

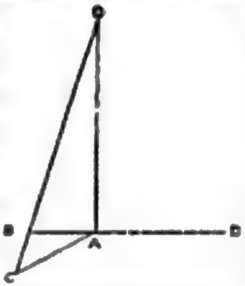

Fig. 4.—Weldon rangefinder.

The merits of different field rangefinders depend mainly upon the balance of advantages they offer with respect to accuracy, suitability to variety of ground, simplicity, portability, and durability, these conditions being of a more or less conflicting character. The following are recognized principles:—(1) the naked eye cannot with certainty appreciate less than one minute difference of angle, therefore telescopic power is necessary in proportion as the base is short compared with the range; (2) telescopes of high power cannot be steadied by hand alone; (3) the longer the base the more inconvenient are any restrictions as to its length or direction; (4) it is a disadvantage to be compelled to traverse the line joining base points; (5) the longest base which it is convenient to measure by hand is that length of measuring line which can be stretched tight in a high wind.

(2) *Rangefinders for Coast Batteries.*—Rangefinding is less adapted to the requirements of coast defence than "position finding,"—a method which furnishes every gun with its proper training and elevation so that it can be fired without sighting the target. Rangefinders are, however, sometimes employed. The most worthy of notice is the Watkin depression rangefinder used by the British artillery in coast batteries. The instrument resembles in principle the Watkin field rangefinder, the height above the sea-level being a vertical base. The range is found by observing the angle of depression to the object. This is done by a powerful cross-wire telescope, which forms part of the instrument. The fastest steamer can be continuously followed, and even the successive grazes of shot and shell can be observed. The instrument is levelled upon a tripod stand. When necessary, it finds its exact height in feet above the water-level in any state of tide by reference to a datum distance, and it records the range in yards automatically on a graduated cylinder. An interesting contrivance combining telemeter and gun-sight, applicable to guns in permanent emplacements over non-tidal waters, has been tried in Italy. By means of a cam the hind-sight of the gun is always maintained in the position necessary to give the proper elevation in firing, so that it only remains to make the sights cover the target. (A. W. W.*)

TELEPHONE

TELEPHONY is the art of reproducing sounds at a distance from their source. The term was first used by Philip Reis of Friedrichsdorf, in a lecture delivered before the Physical Society of Frankfort in 1861.[1] But, although this lecture and Reis's subsequent work received considerable notice, little progress was made until the subject was taken up between 1874 and 1876 by Alexander Graham Bell, a native of Edinburgh, then resident in Boston, Mass. Bell, like Reis, employed electricity for the reproduction of sounds; but he attacked the problem in a totally different manner. This will be better understood if we consider shortly on what the chief characteristics of sound depend (compare ACOUSTICS).

Characteristics of sound.

The sensation of sound is produced by rapid fluctuations in the pressure of the atmosphere on the tympanum of the ear. If the fluctuations are irregular and non-periodic, the sound is called a noise; if they are cyclic and follow a regular and sufficiently rapid periodic law, the sound is musical. In connexion with the present subject it is important to notice the three characteristics of a musical sound, namely, *pitch*, *loudness*, and *quality*. The pitch of a musical sound depends on the number of cycles passed through by the fluctuations of the pressure per unit of time; the loudness depends on the amount or the amplitude of the fluctuation in each cycle; the quality depends on the form or the nature of the fluctuation in each cycle. The necessary condition for a successful system of telephony is the ability to reproduce these characteristics.

I. HISTORY.

In 1831 Wheatstone by his "magic lyre" experiment showed[2] that, when the sounding-boards of two musical instruments are connected together by a rod of pine wood, a tune played on one will be faithfully reproduced by the other. This only answers, however, for telephoning musical sounds to short distances. Another and somewhat similar example is furnished by what has been variously designated as the "string," "toy," "lovers," and "mechanical" telephone. Two disks of thin metal, or two stretched membranes, each furnished with a mouthpiece, are connected together by a thin string or wire attached at each end to the centres of the membranes. A good example may be made with two cylindrical tin cups; the bottoms form the membranes and the cups the mouthpieces. When the connecting string is held taut and sounds, such as those of ordinary speech, are produced in front of one of the membranes, pulses corresponding to the fluctuations of the atmospheric pressure are transmitted along the string and communicated to the other membrane, which in its turn communicates them to the air, thus reproducing the sound. In both these examples all the three characteristics—pitch, relative intensity, and quality—of sound are reproduced.

Mechanical telephone.

Page's discovery.

Let us now return to the development of the application of electricity to telephony. In July 1837 Dr C. G. Page of Salem, Mass., drew attention to the sound given out by an electromagnet at the instant when the electric circuit is closed or broken, and in October of the same year he discussed, in a short article[3] entitled "Galvanic Music," the musical note produced by rapidly revolving the armature of an electromagnet in front of the poles. Experiments bearing on this subject were subsequently made by a great number of investigators.[4] Page's discovery is of considerable importance in connexion with the theory of action of various forms of telephone, and was a very important feature in the early attempts by Reis to transmit music and speech. On

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[1] "Ueber Telephonie durch den galvanischen Strom," in *Jahresber. d. physikalischen Vereins zu Frankfurt am Main* 1860-61, p. 57.

[2] See his *Scientific Papers*, p. 47

[3] See *Silliman's Journ.*, xxxii. p. 396 and xxxiii. p. 118.

[4] Marrian, *Phil. Mag.*, 3d ser., xxv. p. 382; Beatson, *Arch. de l'Élect.*, v. p. 197; De la Rive, *Treatise on Electricity*, vol. i. p. 306, also *Phil. Mag.*, 3d ser., vol. xxxv. p. 422, and *Comp. Rend.*, xx. p. 1287, xxii. p. 432; Matteucci, *Arch. de l'Élect.*, v. 389; Guillemin, *Comp. Rend.*, xxii. p. 264; Wertheim, *Comp. Rend.*, xxii. pp. 336, 544, xxvi. p. 505, also *Ann. de Chim. et de Phys.*, xxiii. p. 302, and *Phil. Mag.*, 3d ser., xxviii. p. 544; Jannair, *Comp. Rend.*, xxiii. p. 319; Joule, *Phil. Mag.*, 3d ser., xxv. pp. 76, 225; Laborde, *Comp. Rend.*, l. p. 692; Poggendorff, *Pogg. Ann.*, lxxxvii. p. 139, xcviii. p. 198; Du Moncel, *Exp. de l'Élect.*, vol. ii. p. 125, iii. p. 83: and Delezenne, *Bibl. Univ.*, 1841, xvi. p. 406.

Bourseul's suggestions.

26th August 1854 there appeared in *L'Illustration* (Paris) an interesting article by Charles Bourseul on the electric transmission of speech.[1] The writer recommended the use of a flexible plate at the source of sound, which would vibrate in response to the varying pressure of the air, and thus open and close an electric circuit, and of a similar plate at the receiving station, which would be acted on electromagnetically and thus give out as many pulsations as there are breaks in the current. These suggestions were to some extent an anticipation of the work of Reis; but the conditions to be fulfilled before the sounds given out at the receiving station can be similar in pitch, quality, and relative intensity to those produced at the transmitting station are not stated, and do not seem to have been appreciated.

Reis's telephone.

In Reis's lecture an apparatus was described which has given rise to much discussion as to priority in the invention of the telephone. The instrument was described in over fifty publications[2] in various countries, and was well known to physicists previous to Bell's introduction of the electric telephone as a competitor with the electric telegraph. Reis caused a membrane to open and close an electric circuit at each vibration, thus transmitting as many electric pulses through the circuit as there were vibrations in the sound. These electric pulses were made to act on an electromagnet at the receiving station, which, in accordance with Page's discovery, gave out a sound of a pitch corresponding to the number of times it was magnetized or demagnetized per second. Reis's object was to reproduce at a distance not only music but also human speech; but that he did not wholly succeed is clear from the following extract from his lecture: "Hitherto it has not been possible to reproduce human speech with sufficient distinctness. The consonants are for the most part reproduced pretty distinctly, but not the vowels as yet in an equal degree." Considering the time at which he wrote, Reis seems to have understood very well the nature of the vibrations he had to reproduce, but he failed to comprehend how they could be reproduced by electricity. His fundamental idea—the interruption of the current—was a fatal mistake, which was not at the time properly understood. The suggestion of Bourseul and the experiments of Reis are founded on the idea that a succession of currents, corresponding in number to the successive undulations of the pressure on the membrane of the transmitting instrument, could reproduce at the receiving station sounds of the same character as those produced at the sending station. Neither of them seemed to recognize anything as important except pitch and amplitude, and Reis thought the amplitude was to some extent obtained by the varying length of contact in the transmitting instrument. This might possibly be to a small extent true; but, considering the small capacity of the circuits he used and the nature of his receiving instrument, it is hardly probable that duration of contact sensibly influenced the result. The quality of the sounds was to some extent also reproduced; but, judging from the results of recent telephone investigation, it is highly probable that this was due, not to the varying duration, but to the varying firmness of the contact. Since the effect of the degree of contact has, through the researches of Bell, Berliner, Edison, Hughes, Elisha Gray, and others, become generally understood, it has become easy to make instruments very similar to those of Reis; and even his instruments, with slight modification, can be made to speak fairly well. The accidental transmission of words by Reis, the occasional recognition of the voice of a singer, and other instances of the transmission of quality were no doubt due to this element, the existence of or the necessity for which was never, so far as the present writer knows, hinted at by Reis.

Bell's researches.

The next worker at the telephone, and the one to whom the present great commercial importance of the instrument is due, was Bell. His aim was the production, by means of the undulations of pressure on a membrane caused by sound, of an electric current the strength of which should at every instant vary directly as the pressure varied.[3] His first idea seems to have been to employ the vibrations of the current in an electric circuit, produced by moving the armature of an electromagnet included in the circuit nearer to or farther from the poles of the magnet. He proposed to make the armature partake of the vibrations of the atmosphere either by converting it into a suitable vibrator or by controlling its vibrations by a stretched membrane of parchment. In the early trials the armature had the form of a hinged lever of iron carrying a stud at one end, which pressed against the centre of a stretched membrane. The experiments with this form were not successful, and, with the view of making the moving parts as light as possible, he substituted for the comparatively heavy lever armature a small piece of clock spring, about the size of a sixpence, glued to the centre of the diaphragm. The magnet was mounted with its end carrying the coil opposite, and very close to, the centre of the piece of clock spring. This answered sufficiently well to prove the feasibility of the plan, and subsequent experiments were directed to the discovery of the best form and arrangement of the parts. An increase in the size of the iron disk attached to the membrane augmented both the loudness and the distinctness of the sounds, and this finally led to the adoption of the thin iron disk now in use, which is supported round its edge, and acts as both membrane and armature. Again, the form of the opening or mouthpiece in front of the membrane exercised considerable influence on the efficiency of the instrument, and it was ultimately ascertained that a small central opening, with a thin air space extending across the face of the membrane was best. It was also found that comparatively small magnets were sufficient, and that there was no particular virtue in the closed circuit and electromagnet, but that a small permanent magnet having one pole in contact with the end of the core of a short electromagnet, the coil of which was in circuit with the line, but which had no permanent current flowing through it, answered the purpose quite as well.[4] In fact the effect of keeping a permanent current flowing through the line and the coils of the electromagnet was to keep the core of the electro-magnet magnetized. This seems to have been almost simultaneously pointed out by Bell and others who were working in conjunction with him and by Professor Dolbear. Many experiments were made for ascertaining the best length of wire to use in the coil of the transmitting and the receiving instrument; but this is clearly a question dependent to a large extent on the nature of the line and the system of working adopted.

After Bell's success a large number of experimenters entered the field, and an almost endless variety of modifications have been described. But few possess any real merit, and almost none have any essentially new principle.[5]

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[1] See also *Didaskalia: Blätter für Geist, Gemüth, u. Publicität*, Frankfort, No. 232, 28th September 1854; Du Moncel, *Exposé des Applications de l'Électricité*, Paris, vol. ii. p. 25, ed. 1854, vol. iii. p. 110, ed. 1856, and *Comp. Rend.*, 26th November 1877.

[2] The English reader may consult—*Journ. Soc. Tel. Eng.*, March 1883; *British Assoc. Rep.*, 1863; *Civ. Eng. and Arch. Journ.*, vol. xxvi. p. 307; R. M. Ferguson, *Electricity*, London, 1866, p. 257; S. P. Thompson, *Philip Reis, the Inventor of the Telephone*, London, 1883.

[3] See A. G. Bell, "Telephone Researches," in *Journ. Soc. Tel. Eng.*, 31st October 1877.

[4] The extreme smallness of the magnets which might be successfully employed was first demonstrated by Professor Peirce of Brown University, Providence, R.I.

[5] For a detailed description, in a collected form, of a large number

Edison's transmitter and friction receiver.

A telephone transmitter and a receiver on a novel plan were patented in July 1877 by Edison, shortly after the introduction of Bell's instruments. The receiver was based on the change of friction produced by the passage of an electric current through the point of contact of certain substances in relative motion. In one form a drum, mounted on an axis and covered by a band of paper soaked in a solution of caustic potash, is turned under a spring the end of which is in contact through a platinum point with the paper. The spring is attached to the centre of a diaphragm in such a way that, when the drum is turned, the friction between the point of the spring and the paper deflects the diaphragm. The current from the line is made to pass through the spring and paper to the cylinder. Now it had been previously shown by Edison that, when a current is made to pass through an arrangement like that just described, the friction between the paper and the spring is greatly diminished. Hence, when the undulating telephonic currents are made to pass through the apparatus, the constant variation of the friction of the spring causes the deflexions of the diaphragm to vary in unison with the variation of the electric currents, and sounds are given out corresponding in pitch, and also to some extent in quality, with the sounds produced at the transmitting station. A cylinder of chalk was used in some of Edison's later experiments with this receiver. The transmitter is illustrated (see fig. 10) and described (p. 132) below.

Elisha Gray's experiments.

Experiments very similar to these of Edison were made by Elisha Gray of Boston, Mass., and described by him in papers communicated to the American Electrical Society in 1875 and 1878. In these experiments the electric current passed through the fingers of the operator's hand, which thus took the place of the spring in Edison's apparatus. The diaphragm was itself used as the rubbing surface, and it was either mounted and rotated or the fingers were moved over it. When the current passed, the friction was felt to increase, and the effect of sending a rapidly undulating current through the arrangement was to produce a sound. The application of this apparatus to the transmission of music is described by Gray.[1]

Dolbear's condenser telephone.

In another form of telephone, brought prominently forward by Professor Dolbear,[2] the effects are produced by electrostatic instead of electromagnetic forces, as in the Bell telephone. Sir W. Thomson observed in 1863[3] that when a condenser is charged or discharged a sharp click is heard, and a similar observation was made by Cromwell F. Varley, who proposed to make use of it in a telegraphic receiving instrument.[4] In Dolbear's instrument one plate of a condenser is a flexible diaphragm, connected with the telephone line in such a way that the varying electric potential produced by the action of the transmitting telephone causes an increased or diminished charge in the condenser. This alteration of charge causes a corresponding change in the mutual attraction of the plates of the condenser; hence the flexible plate is made to copy the vibrations of the diaphragm of the transmitter. It is obvious that this apparatus may be used either as a transmitter or as a receiver, but that the effects must under ordinary circumstances be in either case extremely feeble.

In the Reis instruments the transmitter and receiver are separate parts, which are not interchangeable. The Bell telephone can be used either as a transmitter or as a receiver. The Edison receiver and the Dolbear condenser were only intended to be used as receiving instruments.

Liquid transmitters of Bell and E. Gray

It was very early recognized—and, indeed, is mentioned in the first patents of Bell, and in a caveat filed by Elisha Gray in the United States patent office only some two hours after Bell's application for a patent—that sounds and spoken words might be transmitted to a distance by causing the vibrations of a diaphragm to vary the resistance in the circuit. Both Bell and Gray proposed to do this by introducing a column of liquid into the circuit, the length or the resistance of which could be varied by causing the vibrations of the diaphragm to vary the depth of immersion of a light rod fixed to it and dipping into the liquid (see figs. 8, 9 below). This idea has been perhaps the most fruitful of any modification of telephonic apparatus introduced.

Berliner's microphone transmitter

On 4th April 1877 Mr Emile Berliner filed a caveat in the United States patent office, in which he stated that, on the principle of the variation with pressure of the resistance at the contact of two conductors, he had made an instrument which could be used as a telephone transmitter, and that, in consequence of the mutual forces between the two parts of the current on the two sides of the point of contact, the instrument was capable of acting as a receiver. The caveat was illustrated by a sketch showing a diaphragm with a metal patch in the centre, against which a metal knob was lightly pressed by an adjusting screw. This seems to have been the first transmitter in which it was proposed to use the resistance at the contact of two conductors.

Edison's microphone transmitter

Almost simultaneously with Berliner, Edison conceived the idea of using a variable resistance transmitter.[5] He proposed to introduce into the circuit a cell containing carbon powder, the pressure on which could be varied by the vibrations of a diaphragm. He sometimes held the carbon powder against the diaphragm in a small shallow cell (from a quarter to half an inch in diameter and about an eighth of an inch deep), and sometimes he used what he describes as a *fluff*, that is, a little brush of silk fibre with plumbago rubbed into it. In another form the plumbago powder was worked into a button cemented together with syrup and other substances. In the specification of the patent applied for on 21st July 1877 he showed a sketch of an instrument which consisted of a diaphragm, with a small platinum patch in the centre for an electrode, against which a hard point, made of plumbago powder cemented together with india-rubber and vulcanized, was pressed by a long spring, the pressure of the carbon against the platinum disk being adjusted by a straining screw near the base of the spring. Subsequently he filed an application for a patent in which various forms of springs and weights assisted in maintaining the contacts and otherwise improved the instrument.

Hughes's microphone

In the early part of 1878 Professor Hughes, while engaged in experiments upon a Bell telephone in an electric circuit, discovered that a peculiar noise was produced whenever two hard electrodes, such as two wires, were drawn across each other, or were made to touch each other with a variable degree of firmness. Acting upon this discovery, he constructed an instrument which he called a microphone,[6] and which consisted essentially (see fig. 11) of two hard carbon electrodes placed in contact, with a current passing through the point of contact and a telephone included in the same circuit. One of the electrodes was attached to a sounding board capable of being vibrated by sound-waves, and the other was held either by springs or weights

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of these modifications, see Du Moncel, "Le Téléphone," in *Bibliothèque des Merveilles*, Paris, 1882.

[1] See George B. Prescott, *The Speaking Telephone*, London, 1879, pp. 151-205.

[2] *Scientific American*, 18th June 1881.

[3] *Electrostatics and Magnetism*, p. 236.

[4] See *Tel. Journ.*, 1st August 1877, p. 178; also Adams, *Journ. Soc. Tel. Eng.*, 1877, p. 476.

[5] See *Journal of the Telegraph*, New York, April 1877; *Philadelphia Times*, 9th July 1877; and *Scientific American*, August 1877.

[6] This term was used by Wheatstone in 1827 for an acoustic apparatus intended to convert very feeble into audible sounds; see his *Scientific Papers*, p. 32

in delicate contact with it. When the sounding board was spoken to or subjected to sound-waves, the mechanical resistance of the loose electrode, due to its weight, or the spring, or both, served to vary the pressure at the contact, and this gave to the current a *form* corresponding to the sound-waves, and it was therefore capable of being used as a speaking-telephone transmitter.[1] The best transmitters now in use are modifications of Hughes's apparatus. A microphonic apparatus very similar to it is described in the specification of a German patent taken out by Robert Lutdge on 12th January 1878. In this patent the action of the microphone is also described.[2]

Blake transmitter.

The next transmitter of note, introduced by Mr Francis Blake, U.S. (see fig. 13 below), although it does not, like the first microphones, embody anything intrinsically new, is one of the most perfect and convenient forms of microphone. It is at present almost universally used in the United States.

Modifications of Edison's transmitter.

It appears to be pretty well established that carbon in one form or another is the best material for one or both of the contacts of a microphone transmitter. When both the contacts are of carbon and the surfaces have considerable area, say from a quarter to half an inch in diameter, the sounds are loud, but have a tendency to harshness. When, as in the Blake transmitter, one of the contacts is a piece of polished gas carbon and the other a small sphere of platinum about the twentieth of an inch in diameter, the articulation is clear, but less loud. For most purposes, however, the increased clearness more than compensates for the diminished loudness. Many transmitters in actual use—as, for instance, the "Gower," largely employed in the United Kingdom—have a number of contacts. Some of these when properly adjusted are both loud and clear in their action. Although the Blake instrument is most in vogue in America, in the United Kingdom and on the Continent multiple contact microphones have found more favour. Carbon powder instruments have been to some extent used, and in one or two cases—as, for example, the Hunnings transmitter—with considerable success. The fault in most of them is the tendency of the powder to "pack," which causes the instrument to rapidly lose sensibility. In the Hunnings transmitter this difficulty is to a large extent overcome by the use of a coarse granular powder in a somewhat large cell (about an inch in diameter and from one-eighth to one-fourth of an inch deep). The front face of the cell is a piece of platinum foil, which serves both as an electrode and as a diaphragm. The cell is placed either on edge or in an inclined position when in use, the action being precisely similar to that in other transmitters. In addition to its freedom from packing, the carbon, in consequence of the inclined position of the cell, is also less liable to fall away from the electrode and break the circuit. Some packing of the powder, however, does occur, and several modifications have been proposed by Blake and others for making the sound vibrations stir the powder and keep it loose. Good results appear to have been got by placing the cell mouth downwards, the carbon powder lying on the platinum foil, and by forming the upper electrode either of wire gauze or of a perforated plate completely immersed in the powder. The sound vibrations are conveyed to the bottom of the cell by a bent tube communicating with a mouthpiece. Instruments of this class are very loud-speaking, and therefore very serviceable for long or disturbed circuits.

Radiophone.

The radiophone is an instrument proposed by A. G. Bell and Sumner Tainter in 1880 for utilizing radiant energy, such as light or radiant heat, for the transmission of sound. The apparatus forms a telephone transmitter of a particularly interesting kind. In the earlier papers describing it and the experiments which led to its invention it is called *photophone*, because at that time the effects were supposed to be wholly due to light. Afterwards, in order to avoid ambiguity, Bell changed the name to *radiophone* and suggested that, to distinguish between instruments depending on the different kinds of radiation, the names *photophone*, *thermophone*, &c., should be employed. He also proposed the name *spectrophone* for an application of this instrument to spectrum investigation.[3] The apparatus is founded on the discovery, made by Mr May while carrying out experiments on selenium for Mr Willoughby Smith, that when selenium is exposed to light its electrical resistance is very different from what it is in the dark. This discovery led to a great many interesting experiments by other investigators.[4] In thinking over this discovery in 1878 Bell conceived the idea that, if a beam of light proceeding from one station could be made to fall on a selenium plate at another station, and if its intensity could be varied by the voice of a speaker, then by connecting a telephone and a battery in circuit with the selenium plate the words spoken at the distant station would be heard in the telephone. This was found to be the case. At first, to vary the intensity of the beam, it was passed through a small opening, the width of which could be varied by the vibrations of a diaphragm against which the speech was directed. But better results were afterwards obtained when the diaphragm formed a mirror from which the beam of light was reflected. The spreading of the beam, due to the vibrations of the mirror diaphragm, served to vary its intensity (see fig. 18 below).

Edison's phonograph.

Edison's phonograph (see fig. 19 below) is an instrument whose action somewhat resembles that of a telephone transmitter and which has been much talked of in regard to its possible applications in telephony. It was invented shortly after the introduction of the telephone for the purpose of recording sounds, and was included in some of Edison's telephone patents as a means of working a telephone transmitter, and thus telephoning sounds which had been previously recorded on the phonograph sheets.

II. Telephonic Instruments.

One of the best-known forms of the Reis telephone is shown in fig. 1. The transmitter consists of a box A, provided with a mouthpiece M. In the top of the box a round hole is cut and across it a membrane S of hog's bladder is stretched. A thin strip of platinum *p* fixed to the box at one side of the hole and extending to the centre of the membrane, supports at that point one foot of a light metal tripod *egf*. One of the feet, *e* or *f*, rests in a cup containing mercury, which is in metallic connexion with the terminal *b*, while

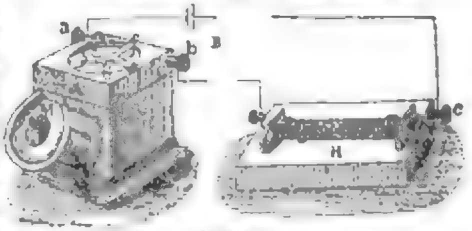

Fig. 1.—Reis's telephone.

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[1] See *Proc. Roy. Soc.*, vol. xxvii. p. 362; *Proc. Phys. Soc.*, vol. ii. p. 255; *Phil. Mag.*, 5th ser., vol. vi. p. 44; Preece, *Journ. Soc. Tel. Eng.*, vol. vii. p. 270.

[2] Although this patent is dated prior to Hughes's publications, it does not follow that the descriptions were filed before these.

[3] On this subject see A. G. Bell, *Phil. Mag.*, 5th ser., vol. xi. p. 510, and *Journ. Soc. Tel. Eng.*, vol. ix. p. 404; Mercadier, *Phil. Mag.*, 5th ser., vol. xi. p. 78; Tyndall, *Proc. Roy. Soc.*, vol. xxxi. p. 307; Routgen, *Phil. Mag.*, 5th ser., vol. xi. p. 308; Preece, *Proc. Roy. Soc.*, vol. xxxi. p. 506; Rayleigh, *Nature*, vol. xxiii. p. 274, and *Proc. Roy. Soc.*, 1877; Bidwell, *Phil. Mag.*, 5th ser., vol. xi. p. 302; S. P. Thompson, *Phil. Mag.*, 5th ser., vol. vi. p. 276.

[4] See W. Smith, *Journ. Soc. Tel. Eng.*, vol. v. p. 183, and vol. vi. p. 423; M. L. Sale, *Proc. Roy. Soc.*, vol. xxi. p. 283, and *Phil. Mag.*, 4th ser., vol. xlvii. p. 216; Draper and Moss, *Proc. Roy. Irish Acad.*, vol. i. p. 529; Rosse, *Phil. Mag.*, 4th ser., vol. xlvii. p. 161; W. G. Adams, *Proc. Roy. Soc.*, vol. xxiii. p. 535 and vol. xxiv. p. 163; W. G. Adams and R. E. Day, *ibid.*, vol. xxv. p. 113; Werner Siemens, *Monatsber. kön. Preuss. Akad. der Wissensch. zu Berlin*, 1875, p. 280, and *Phil. Mag.*, 4th ser., vol. i. p. 416; Sabine, *Phil. Mag.*, 5th ser., vol. v. p. 401.

the end of the strip *p* is similarly in connexion with the terminal *c*. The receiver consists of an electromagnet made up of a magnetizing coil H, with a stout knitting needle for a core. When in use these two instruments are joined in circuit with a battery B, so that under ordinary circumstances a continuous current is flowing through the line. Suppose a sound is then produced in front of the mouthpiece M, the successive variations in the pressure of the air are communicated to the inside of the box, and cause the membrane to vibrate in unison with the sound Reis's theory of the action of the instrument was that at each outward impulse of the membrane the point *g* would be thrown out of contact with the plate underneath it and would thus break the circuit. There would consequently result as many breaks in the circuit as there were vibrations in the sound, and, in conformity with Page's discovery, the electromagnetic receiver would give out a rapid succession of beats, which would together form a continuous sound of the same pitch as that to which the transmitter was subjected.

Bell's first telephone.

Fig. 2 shows the first telephone made by Bell for transmitting speech. It consisted of a wooden frame F, to one side of which a tube T was fixed; over the end of the tube a membrane M was stretched taut by a stretching ring R. To the opposite side of the frame and with its axis in line with that of the tube T was fixed an electromagnet H, and between the membrane M and the end of the electromagnet a hinged armature A was arranged in such a way that its motions would be controlled by the membrane. The instrument was joined in circuit with a battery and another similar instrument placed at a distance. A continuous current was made to flow through the circuit, which kept the electromagnet magnetized. Bell reasoned thus: when words are spoken in front of the tube T the membrane will be set in vibration and with it the armature A, and the vibration of the armature in front of the electromagnet will induce variations in the line current; their magnitude will be proportional to the amplitude, and their frequency to the frequency, of the vibrations of the armature; in fact, the difference between the actual and the average current in the circuit will be at each instant proportional to the rate of motion of the armature. It follows from this that the armature and membrane of the distant instrument should have induced in them a motion precisely similar to that of the membrane of the transmitter. This telephone was made in June 1875, but was put aside after trial as unsatisfactory on account of the feebleness of the sounds it produced; since then, however, a successful telephone has been made on precisely the same plan as that here indicated.

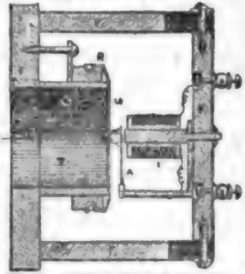

FIG. 2.—Bell's first telephone; one-fifth full size.

ll's ond telephone.

The next form tried is shown in fig. 3. It is very similar except in constructive details to the first; the hinged armature, however, is omitted, its place being taken by a small iron disk A fixed to the centre of the diaphragm D. The electromagnet H is, as before, placed so as to have the centre of the soft iron core C opposite to the centre of the disk, and the theory according to which it was expected to act is the same. The results obtained with this instrument were much more satisfactory; indeed it was with one precisely like that shown in the figure that the remarkable results of the Philadelphia exhibition in 1876 were obtained. A perspective and a sectional view of the receiving instrument used along with that shown in fig. 3 are illustrated in figs. 4 and 5. It consisted of an iron cylindrical box B, through the axis of which a rod of soft iron C was passed to form the core of an electromagnet, having the magnetizing helix H wound on the upper half of its length. Across the top of the box a thin disk D of soft iron was fixed, the core C being just clear of the disk when the strongest current is flowing through the helix. In the perspective view the disk is removed, showing the end of the core.

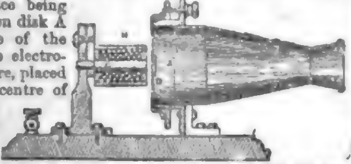

FIG. 3.—Bell's second telephone; one-fifth full size.

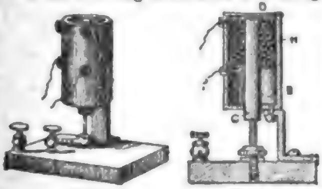

Fig. 4. Fig. 5.

FIGS. 4, 5.—Bell's iron box receiver (1876). Fig. 4, perspective view; fig. 5, sectional view.

These instruments are interesting, not only because they may be considered the first really successful speaking telephones, but because they are of the same form as those brought to Great Britain in 1876 by Sir W. Thomson, and exhibited before the British Association at Glasgow in that year.

Fig. 6 shows one of the earliest forms brought into commercial use. On each pole of a somewhat large horse-shoe permanent magnet M a short coil E with a soft iron core was fixed This is one of the early forms of permanent magnet telephones, of which there were at that time several, including a hand telephone very similar to that shown in fig. 7. In another form, introduced about the end of 1877, the small magnetizing coils and soft iron cores were fixed on the side and opposite the poles of the horse-shoe magnet, and the diaphragm was placed with its plane parallel to that of the magnet. The diaphragm in these telephones was of thin sheet iron and a little over 4 inches in diameter.

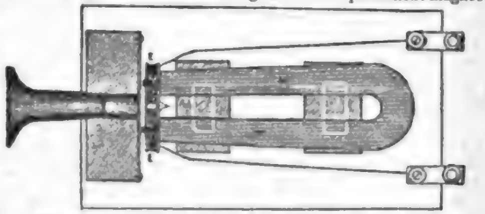

FIG. 6.—Bell's multiple pole telephone (1877); one-fifth full size.

Bell's hand telephone

The form of telephone now almost universally in use is shown in fig. 7. It was introduced in December 1877 and consists of a compound permanent magnet M, fitted into the centre of a tube of vulcanite or "hard rubber" and carrying at one end a short electromagnet, the coil of which through its terminals *t*, *t* is included in the circuit when the instrument is in use. In front of the electromagnet, with its plane normal to the axis of the magnet, is fixed a thin soft iron disk about 1⅞ inches in diameter, which has its cover cut to a convenient shape to form a mouthpiece. This telephone acts well either as a transmitter or as a receiver; but for the former purpose it is now seldom used on account of the great advances which have been made in "microphone" transmitters.

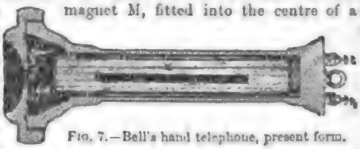

FIG. 7.—Bell's hand telephone, present form.

Bell's liquid transmitter.

It has been stated that Bell and Elisha Gray almost simultaneously suggested the use of a column of liquid to vary the resistance in the circuit. The form of instrument proposed by the former and said to have been exhibited at the Philadelphia exhibition is shown in fig. 8. It consists of a speaking tube or mouthpiece M, across the lower end of which a membrane D is stretched. To the centre of the membrane a light rod R, made of metal or of carbon, is fixed with its length at right angles to the plane of the membrane. Under the lower end of R a small metallic vessel C is supported on a threaded rod, working in a nut fixed to the sole F, so that its height may be readily adjusted. Suppose C to be filled with water or any other conducting liquid, and the rod R to be of metal. C is raised until the liquid just touches the point of the rod, when advantage is taken of the change of contact resistance with the greater or less immersion of R during the vibration of D Good results were obtained with mercury as the liquid and with a rod of carbon.

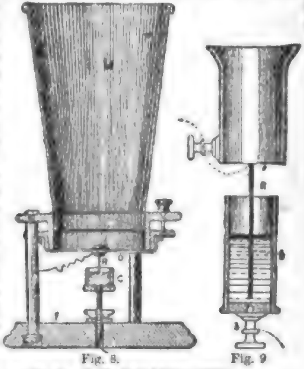

Fig. 8. Fig. 9

FIG. 8.—Bell's liquid transmitter.
FIG. 9.—Elisha Gray's liquid transmitter.

E. Gray's liquid transmitter.

The arrangement proposed by Elisha Gray is almost identical in form with Bell's. The only difference seems to be that Gray intended the rod R (fig. 9) to reach near to the bottom of the vessel B or to the end of another rod, a prolongation of *b*, projecting up from the bottom. The variation of the current was produced by the variation of the distance between the ends of the rod caused by the vibrations of the diaphragm. This plan was not tried until after the success of Bell's experiments was known, and when it was tried the results did not prove encouraging. Indeed the variations of the resistance which can be produced in this way must be excessively small, unless the liquid has a very high specific resistance, the distance between the ends is very small, and the sides of the rods are prevented by an insulating covering from interfering with the results. Neither of these transmitters has any great merit as such, but they show that both Bell and Gray clearly recognized the principle on which successful transmission of the different forms of sound, including speech, could be accomplished.

Edison's micro-phone trans-mitter.

The first successful microphone transmitter was Edison's. An early form of it (fig. 10) somewhat resembles Bell's hand telephone in external form. A cell of insulating material has at its bottom a flat-headed platinum screw G; on the top of G is a layer of carbon powder C, on the top of that a thin platinum disk D, and above that, forming the cover of the cell, a disk of ivory B, held in position by a ring E. Resting on the centre of this disk is a small piece of rubber tubing, which is lightly pressed by the diaphragm A, and this, as in the hand telephone, is held in position by the mouthpiece M. The varying pressure on A, when a sound is produced near it, causes corresponding variations in the pressure on the carbon powder, and this produces similar variations in its electrical resistance. Thus, when the instrument is included in an electric circuit through which a current is flowing, undulations in the pressure on the diaphragm produce corresponding undulations in the current.

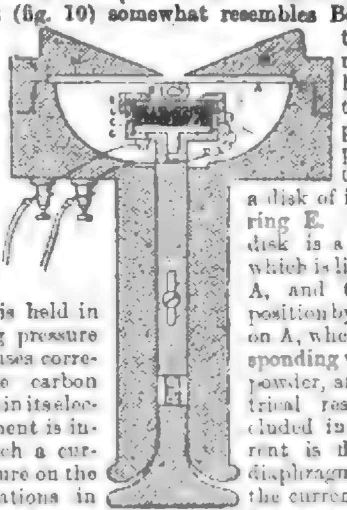

Fig. 10.—Edison's microphone transmitter.

Hughes's micro-phones.

Perhaps the best known forms of the microphone are those introduced by Prof. Hughes. One of the commonest is shown in fig. 11. It consists of two rectangular pieces of wood, B and D, fixed together with their planes at right angles to each other. D forms the base, and to B two small blocks of carbon C, C are attached. Between these a light rod A of the same material is supported on small cups formed in C, C. To the blocks two electrodes e, e are connected for the purpose of inserting the instrument in an electric circuit. The material which Hughes found most suitable for the carbon blocks and rod was wood charcoal metallized by heating it to redness and plunging it while hot into mercury. If this microphone is joined in circuit with a telephone and a small battery, say one or two small Daniell cells, the vibration produced by a fly walking on the base D can be distinctly heard in the telephone. The same apparatus will also act as a microphone transmitter, but the sounds are apt to be harsh. A better form for this purpose is shown in fig. 12. In this a light pencil of carbon M is pivoted at b and has one end resting on two blocks of carbon c, c, the lower one being fixed to the base. The pressure of M on the carbon block is regulated by a spring s. This arrangement is enclosed in a box of thin wood, against which the sound is directed. It is capable of acting well as a transmitter, and especially in a modified form used by Hughes as a microphone receiver. The lower block c is then attached to the centre of a vertical diaphragm and against it the sounds are directed.

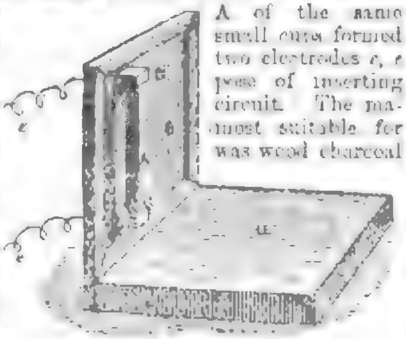

Fig. 11.—Hughes's microphone.

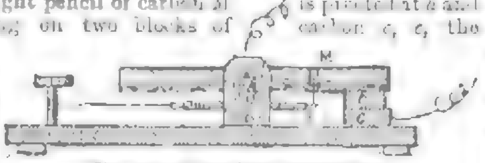

Fig. 12.—Microphone transmitter.

Blake trans-mitter.

The Blake transmitter, which is perhaps most widely used of all, is a simple modification of the Hughes instrument last described. It consists (fig. 13) of a frame F, to which is attached a diaphragm D of thin sheet iron; in front of this is a cover M, M provided with a suitable cavity for directing the sound-waves against the diaphragm. The microphonic arrangement consists of a spring S, about the hundredth of an inch thick and the eighth of an inch broad, fixed at one end to a lever L, and carrying at its free extremity a brass block W. In one side of W a small disk C of gas carbon is inserted, resting on the hemispherical end of a small platinum pin K, about the twentieth of an inch in diameter, held in position by a thin spring A. The pressure of the carbon on the platinum point can be adjusted by the screw N, which turns the lever about the flexible joint G. The electrical connexions of the instrument as arranged for actual use are also illustrated in the figure. The current circuit goes through S, W, C, K, A, and the primary circuit of the induction coil I to the battery B, and thence to S again. This forms a local circuit at the transmitting station. The line of circuit passes through the secondary of the induction coil I to the line, from that to the telephone T at the receiving station, and then either to earth or back to the induction coil by a return line of wire.

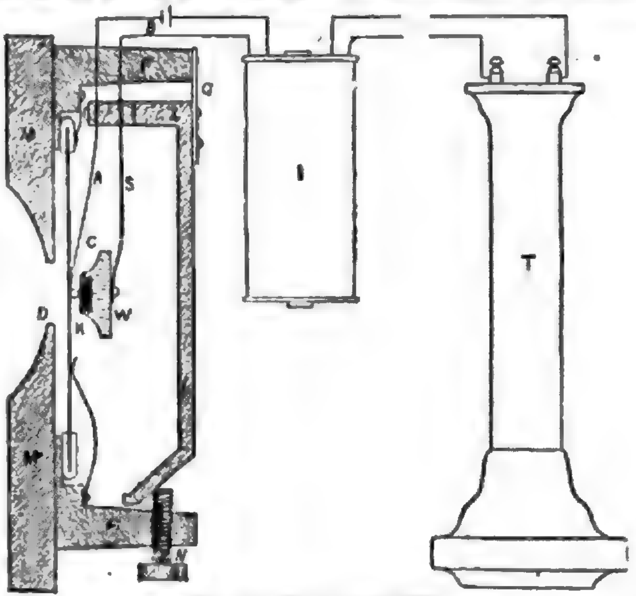

Fig. 13.—Blake's transmitter.

Telephonic Circuits.

Tele-phone wires.

The lines used for telephone purposes are, generally speaking, so far as erection, mode of insulation, and so on are concerned, much the same as those used for ordinary telegraphs. In towns where a very large number of wires radiate from one centre or exchange, as it is called, where thick wires are unsightly, and where it is often necessary to provide for long spans, a comparatively thin wire of strong material is employed. For this reason various bronzes, such as silicon, aluminium, &c., have come to be extensively used for making wires for telephone lines. They are made from about the twentieth to the thirtieth of an inch in diameter, and are found to wear well in the somewhat mixed atmosphere of a town; and owing to their lightness and considerable tensile strength it is comparatively easy to erect them and keep them in order. The main objection to them is the high electrical resistance they oppose to the current. The lines on a town exchange system are not, however, as a rule, so long as to make this objection of great importance. But long lines, such as those extending between towns some miles apart, should be made of pure copper wire hard drawn. It has lately been found possible to draw copper so hard as to be almost equal to bronze in strength, and yet to retain about three times the electric conductivity of that substance. Copper and bronze wires possess great advantages for telephonic purposes over the iron wires employed in telegraph lines, in that they offer a much lower effective resistance to the rapidly undulating and intermittent currents produced by telephonic transmitters. The electric resistance opposed by a wire to the passage of such a current is always greater than that opposed to a steady current, and this difference is much more marked when the wire is of magnetic material like iron. This increased resistance rises in proportion to the rapidity of the undulations of the current; consequently high notes are more resisted than low notes. Besides this variable resistance, telephony has to contend with "self-induction" (see ELECTRICITY, vol. viii. p. 76 *sq.*) of the current on itself, and this is by no means unimportant, especially on long circuits.[1] The marked difference between iron and copper for long circuits is plainly shown by the fact that Rysselberg and others have spoken clearly to a distance of over 1000 miles through a copper wire insulated on poles, whereas Preece could not work a similar line of iron wire between London and Manchester.

Capac

The electrostatic capacity of the line (see TELEGRAPH, p. 115 above) is also diminished by the use of thin wires of highly conducting material. They should all if possible be erected on poles at a considerable height above the earth. It is not practicable to work an ordinary underground line through more than 20 miles, and cable telephony through distances of over 100 miles may in the present state of science be put down as an impossibility.

Another element of great importance in connexion with telephone

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[1] See papers by Prof. Hughes, *Proc. Soc. Tel. Eng.*, vol. xv. p. 6, and *Proc. Roy. Soc.*, vol. xl. p. 468, with remarks on them by Prof. H. F. Weber, *Tel. Journ.*, vol. xviii. p. 321 and vol. xix. p. 30; by Oliver Heaviside, *Phil. Mag.*, vol. xxii. p. 118; by Rayleigh, *Phil. Mag.*, vol. xxi. p. 381 and vol. xxii. p. 469. See also Prof. Chrystal on the "Differential Telephone," in *Trans. Roy. Soc. Edinb.*, vol xxxi. pp. 609-636.

Methods for overcoming induction.

lines, which in most cases does not require to be attended to in ordinary telegraph circuits, is the induction from one line to another (see ELECTRICITY, vol. viii. p. 76 *sq.*). When two lines having, as in ordinary telegraphy, an earth connexion at each end run for any great distance, say a mile or more, parallel to each other on the same supports, a conversation which is being carried on through one of them can be overheard by means of the telephones on the other. This is due to the fact that, when a current is suddenly set up in one closed circuit, it induces an instantaneous current in any other closed circuit which is near to it. This induced current not only destroys the privacy of the circuit in question but also lowers its efficiency. The mischief is even greater when telegraph and telephone lines run along the same route supported on the same poles, because the strong intermittent currents sent through telegraph wires, and the irregular manner in which the intermittences follow each other, induce a series of such powerful secondary currents in the telephone lines that the noise heard in the telephone is often sufficient, when the line is a mile or two long, to drown all speech. In the case of parallel telephone lines the best, if not the only, cure is to use return wires, and arrange them so that the currents induced in the outgoing wire shall be neutralized by the corresponding current induced in the incoming wire. For mixed telegraph and telephone circuits various methods have been proposed; but the most generally approved plan is to have return wires. For circuits worked wholly on the return principle the main thing to be attended to is the symmetrical arrangement of the wires, so that the outgoing and incoming wires may be subjected to the same influence. This is nearly provided for by running them in such a way that they may be all supposed to lie on the surface of a cylinder in lines parallel to its axis, the two wires at the opposite ends of a diameter being always used for the same circuit. When more than four wires form the group complete compensation is not obtained in this way, because the current is always stronger near the transmitting end of the line than near the receiving end, on account of the very sensible effect of the capacity and the leakage of the line. It is therefore best to arrange the wires in groups of four—that is, in pairs of circuits—and run them so as to form spiral lines round an axial line equidistant from each of the four wires. Any pair of wires forming a circuit which runs parallel to other wires can be arranged so as to be very nearly free from induction by interchanging their position relatively to the other wires at short distances along the line. Care must, however, be taken, when more than one group of four or when more than one pair are run, that the compensation produced by the twisted arrangement of one set, or of the interchanges of the wires in the different pairs, is not spoiled by the twisting or interchanging of another set or pair. Telephone lines running parallel to telegraph lines should be formed into one or more groups, each being run on the twist plan so as to eliminate as completely as possible the effect of the telegraph signals; the small residual effect of the telephone signals is of comparatively little importance in such a case. A twisted cable of telephone wire may, when each circuit is formed by diametrically opposite wires, be placed in the same tube with similar cables employed for telegraph purposes. The central wire of the cable may be used either as a telegraph line or as a telephone line having an earth return. Another method is to use powerful telephone transmitters and insensitive receivers; that is to say, make the telephone currents so powerful that the telegraphic induced currents will be small in comparison, and use receivers so insensitive as to suit such currents. One of the main obstacles in the way of this method at present is the difficulty of getting strong telephonic currents, for even the best transmitters are not yet sufficiently powerful, and there is, besides, a decided tendency towards a loss of quality in the sound when the transmitter is made powerful. A third method is to render the telegraphic current comparatively harmless by taking away the suddenness of the intermittences. This is quite possible because the number of currents sent per second, even on fast working circuits, is not such as to produce a high musical note. If, then, the currents be made in some way to rise slowly to their full strength and fall again slowly to zero the diaphragm of the receiving instrument, instead of showing the sudden rise and sudden fall as at present, would move so slowly backwards and forwards that the ear would not be disturbed by the sound. Perhaps the simplest way to accomplish this is to place an electromagnet in the circuit of the telegraph line at the sending station, for the self-induction of the magnet coil prevents the current assuming its strength suddenly. But on telegraph circuits where speed is of great importance this method cannot be followed owing to the retardation of the telegraph signals and the consequent loss of speed thereby occasioned.

Rysselberg's system.

An ingenious application of the method of compensation just indicated has been made by Rysselberg, who has used not only wires carried on the same poles as the telegraph but even the telegraph lines themselves for telephone purposes. The arrangement of his system is shown in fig. 14, where L and L_1 represent two telegraph lines. Between these, at each end, are inserted two condensers C_1, C_2 and a telephone T, together with transmitters, &c., so that, supposing the telegraph instruments removed, the two wires would be an ordinary telephone circuit worked through condensers. The telegraph apparatus consists of an ordinary receiver R, sending battery B, and key K, together with a condenser C, inserted between the earth and the line terminal of the key, and two electromagnetic inductors E, E'. When the key is depressed the current is retarded by the electromagnet E and the condenser C, which has to be charged, giving in fact additional electrostatic capacity at the sending end of the line. The current is still further retarded by the electromagnet E'; hence the condenser C_1 becomes charged so gradually that very little disturbance is noticeable in the telephone T. The condensers C_1, C_2 prevent leakage from one line to the other, but have sufficient capacity to allow the telephone to act as if it were in a metallic circuit.

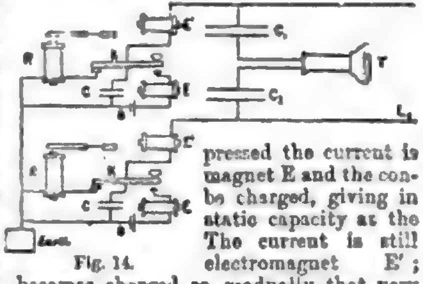

Fig. 14.

The Working of Telephone Circuits.

Early methods.

The method first employed for working a telephone line was extremely simple. A single line of wire, like an ordinary telegraph line, had a Bell telephone included in it at each end and the ends were put to earth. Words spoken to the telephone at one end could be heard by holding the telephone to the ear at the other. To obviate the inconvenience of placing the telephone to the mouth and the ear alternately, two telephones were commonly used at each end, joined either parallel to each other or in series. The contrivance most generally adopted for calling attention is the call bell, rung either by a small magneto-electric machine or by a battery. The telephone was switched out of circuit when not in use and the bell put in its place, an ordinary key being used for putting the battery in circuit to make the signal. This arrangement is still employed, a hook being attached to the switch lever so that the mere hanging up of the telephone puts the bell in circuit. In some cases, when the bell is rung by a magneto machine, the coil of the machine is automatically cut out of circuit when it is not in action, but the turning of the handle moves a centrifugal arrangement by which it is thrown in.

Working with microphone.

At first it was usual to employ the same instrument both as transmitter and as receiver, and to join it in the direct circuit. But it was soon found that the microphone transmitter could only be used to advantage in this way when the total resistance of the circuit, exclusive of the microphone, was small compared with the resistance of the microphone,—that is, on very short lines worked with low resistance telephones. The transmitter on long and high resistance lines worked better by joining indirectly in a local circuit, in the manner shown in fig. 13, the microphone, a battery, and the primary of an induction coil, and putting the line in circuit with the secondary of the induction coil, which acted as the transmitter. The resistance of the microphone can thus be made a large fraction of the total resistance of the circuit in which it is placed; hence, by using considerable currents, small variations in its resistance can be made to induce somewhat powerful currents in the line wire. The requisite energy is derived from the battery. If there are other resistances in the circuit it is, in some cases, better to join it as a shunt to the primary circuit of the induction coil. It may even prove advantageous to insert resistances in the circuit, increase the battery power, and join the microphone as here indicated, because in this way powerful currents can be obtained in the line without the harshness which is apt to be produced by the variations of a strong current passing through the microphone.

Translation.

Translation from one line to another, or from one section to another of the same line, is effected by putting the primary of an induction coil in the place of the receiving telephone, the secondary being in circuit with the second line or section. This plan is useful where the same message is to be sent to different places at once (distributed), and is sometimes used for translating from a double wire to a single wire system. Probably a better plan is to work a microphone by the membrane of the receiving telephone, and retransmit the message, taking new energy from a second battery.[3] When the induction coil arrangement is used for translating from a double to a single wire circuit, or *vice versa*, it is necessary to make the induction coil suit the circuits, so that either coil may be used as primary, according to the end from which the message is sent. Everything else being similar, the resistances of the coils should be in nearly the same ratio as the resistances of the lines in which they are placed.

Exchanges.

In a large town it is neither practicable nor desirable to connect each subscriber directly with all the other subscribers, hence a system of "exchanges" has been adopted. An exchange is a central station to which wires are brought from the different subscribers, any two of whom can be put in telephonic communication with each other when the proper pairs of wires are joined together in the exchange. The arrangement is illustrated in fig. 15, where C represents an exchange from which wires radiate to the points *a*, *b*, *c*, *d*, . . . Suppose *a* wishes to speak to *d*; he communicates his wish to an attendant at C, who first calls *d*, and then connects 6 to 1, making the circuit continuous from *a* to *d*. The arrangements at the exchange for facilitating connexions vary considerably, but are similar in principle to the switch boards used in telegraphy. Each of the wires is first brought to an indicator and then to a set of terminals arranged in an orderly manner on a board, the number of the terminal for any one wire being the same as the number under the shutter of the indicator in that wire circuit. In many cases the terminals take the form of spring clips, which connect the line to earth, and under which a thin piece of metal, covered with insulating material on one side and called a "jack," can be readily inserted for connecting that circuit with any other. A piece of flexible wire cord, carrying a jack at each end, forms a ready and common medium of connexion; but in many cases the switch board is arranged with cross strips of metal so that by inserting a jack into the terminals of the two wires they can be both connected to the same strip of metal and therefore together. In large exchanges one switch board of moderate size is not sufficient, and so a number are fitted, being connected together by several conductors, in order that no interruption may ensue in consequence of these being all occupied. A line on one board is connected with one on another board by joining the terminal of the first to one of the conductors connecting the two boards by a jack-cord, and then by another jack-cord connecting that conductor to the terminal of the other line. Thus different switch boards may be looked upon as separate exchanges, connected together by a number of trunk wires after the manner described below.

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[3] See Thomson and Houston, *Tel. Journ.*, 15th August [illegible].

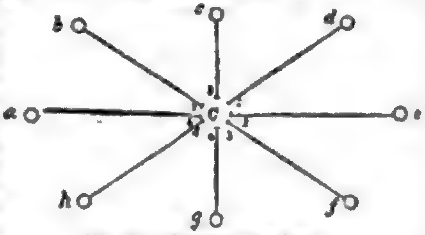

FIG. 15.—Telephone exchange.

In a large system it is much more convenient and economical to have exchanges in the various districts, and connect these with a central exchange by a sufficient number of trunk lines. A subscriber in one district wishing to speak to a subscriber in another calls the exchange in his own district and is put in communication by the attendant stationed there with the central exchange. The attendant at the central exchange puts the subscriber in communication with the district he requires, and the attendant there calls the other subscriber and joins the two subscribers' lines together. In some cases neighbouring district exchanges have, besides a common means of communication through the central exchange, an independent connexion. These arrangements are diagrammatically illustrated in fig. 16, where 1, 2, 3, 4, 5, 6 represent district exchanges and C the central exchange; districts 3 and 4 and 4 and 5 are supposed to have independent connexions.

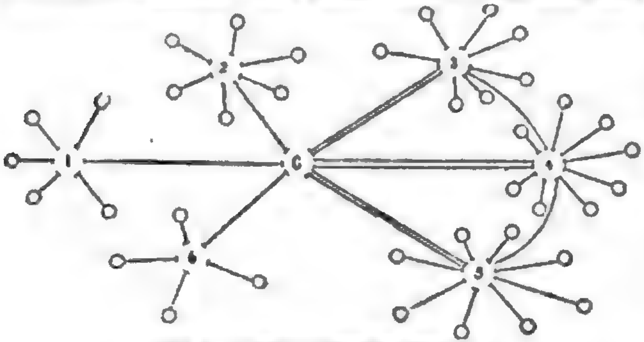

FIG. 16.—Telephone district exchanges.

Sinclair's automatic exchange.

An arrangement was proposed about two years ago by Mr D. Sinclair of the Glasgow telephone exchange for allowing small district exchanges to be worked by the attendants at the central exchange.[1] The two exchanges are connected by a trunk line and from the district exchange wires are led to the different subscribers. These wires are in the normal state of matters connected with contact plates, over which an arm joined to the trunk wire can be made to travel. Suppose the central exchange wishes to speak to any one of the subscribers, the arm is made to travel round, by currents sent from the exchange through an electromagnetic step by step arrangement, until it comes in contact with the proper plate, after which the subscriber is called in the ordinary way. When one subscriber belonging to the district exchange wishes to speak to another in the same district, he rings the bell in the ordinary way, and this operation disconnects all other subscribers and puts him in connexion through the trunk line with the central exchange. The attendant there ascertains to whom it is that he wishes to speak, and by moving round the contact arm puts the two subscribers' lines in contact.

Indicator or annunciator.

The indicator, or annunciator as it is sometimes called, is shown in fig. 17. It consists of an electromagnet M, which on a current being sent through it pulls down the armature *a*, relieves the catch *c*, and allows the shutter *d* to fall down, exposing a plate *p*, on the front of which the number of the subscriber is printed. When the exchange is called, the shutter *d* is dropped, the attendant connects the line leading to the exchange table with the terminal corresponding to the indicator, and finds who is wanted; then he calls that subscriber, makes the through connexion, and puts up the shutter. When the subscribers have finished, both call the exchange or, as it is commonly put, "ring off"; this drops both shutters and serves as the signal that they have finished speaking.

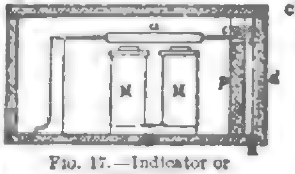

FIG. 17.—Indicator or annunciator.

Radiophone.

The principle of transmitting sound by the radiophone will be understood from fig. 18. M represents a mirror, from which a beam of light is reflected through the lens *l* to a second mirror *m*, and *m* forms a diaphragm against the back of which the sound vibrations sent through the tube *t* are made to impinge. The beam of light, after being reflected from *m*, passes through the lower lens *l*, and thence as a nearly parallel beam to the parabolic reflector R. A photophonic receiver P, supposed in this case to be a spiral of selenium wire wound on the surface of a cylinder, is placed at the focus of the reflector so that the beam of light from *m* is concentrated on it. In circuit with the receiver P a battery B and a telephone T are included and through the circuit a feeble electric current flows continuously. The photophonic receiver should be placed so as to receive as little light as possible from any other source than the mirror *m*. Words spoken through the tube *t* make the mirror *m* vibrate, so that the beam of light reflected from it becomes more or less spread. The lens *l* is then unable to bring the beam into parallelism, and the intensity of the reflexions from R to P is varied, therefore also the current through the coil of the telephone, which in consequence gives out a sound. The amount of spreading of the beam being proportional to the intensity of the vibrations of *m*, and this again proportional to the intensity of the sounds, the sounds heard in the telephone are similar to those produced at the end of *t*. Theoretically the receiver may be at any distance from the transmitter, but considerable difficulty arises if the distance is great.

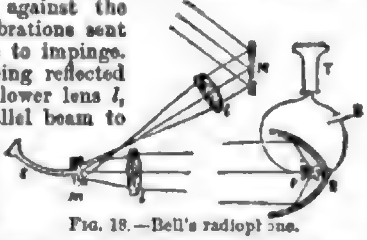

FIG. 18.—Bell's radiophone.

Phonograph.

One of the simplest forms of the phonograph is shown in fig. 19. It consists of a rigid spindle S screwed for about one-third of its length, and fitted to work smoothly but tightly in the frame *f*, *f*, which is securely attached to a sole plate P. On the spindle a drum D is fixed, the axis of which coincides accurately with that of the spindle. On the surface of the drum a screw is cut of precisely the same pitch as that on the spindle. A fly-wheel W is fixed to one end of the spindle, and is provided with a handle H, by which the spindle and drum can be conveniently turned. One of the bearings has either a screw thread cut along it, or is fitted with one or more studs which work easily, but without shake, in the screw thread. When the spindle is turned, it receives a transverse motion, and a point fixed relatively to the sole plate P and touching the drum traces out a spiral on its surface, exactly coinciding with the screw thread cut on it. A mouthpiece M, like that of a telephone transmitter, provided with a diaphragm of parchment or similar substance, is mounted on a lever, which is pivoted at A and provided with a set screw *b*. A blunt needle point is either fixed to the centre of the diaphragm or carried by a light spring in such a way as to press on the centre of the diaphragm with the needle point projecting outwards. To use the instrument, the drum D is covered with a sheet of somewhat stiff tinfoil, and the mouthpiece is adjusted as shown in the figure, with the needle point over the hollow part of the tinfoil, and fixed by the set screw to make a slight indentation in it. The drum is then turned and words spoken in a somewhat loud and clear tone in front of the

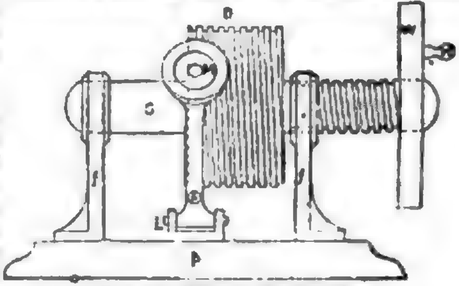

FIG. 19.—Edison's phonograph.

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[1] See *Proc. Phil. Soc. of Glasgow*, vol. xvii. p. 39.

mouthpiece. The vibrations of the diaphragm cause the needle point to make indentations more or less deep, according to the intensity of the sound, in the surface of the tinfoil. If the mouthpiece is then raised, the drum turned back to its original position, the mouthpiece lowered so that the point rests on the groove which it previously made, and the drum again turned, the diaphragm, acted on by the needle point passing over the indentation, will give out the same words which were spoken to it. (T. GR.)

TELESCOPE

THE telescope is an optical instrument employed to view or discover distant objects.[1] The fundamental optical principles involved in its construction have already been dealt with in the articles LIGHT and OPTICS, and these should be first perused by the reader.

HISTORY.

The credit of the discovery of the telescope has been a fruitful subject of discussion. Thus, because Democritus announced that the milky way is composed of vast multitudes of stars, it has been maintained that he could only have been led to form such an opinion from actual examination of the heavens with a telescope. Other passages from the Greek and Latin authors have similarly been cited to prove that the telescope was known to the ancients. But, as has been remarked by Dr Robert Grant (*History of Physical Astronomy*, p. 515), we are no more warranted in drawing so important a conclusion from casual remarks, however sagacious, than we should be justified in stating that Seneca was in possession of the discoveries of Newton because he predicted that comets would one day be found to revolve in periodic orbits. Molyneux, in his *Dioptrica Nova*, p. 256, declares his opinion that Roger Bacon (who died *c.* 1294) "did perfectly well understand all kinds of optic glasses, and knew likewise the method of combining them so as to compose some such instrument as our telescope." He cites a passage from Bacon's *Opus Majus*, p. 377 of Jebb's edition, 1733, translated as follows:—

> "Greater things than these may be performed by refracted vision. For it is easy to understand by the canons above mentioned that the greatest objects may appear exceedingly small, and the contrary, also that the most remote objects may appear just at hand, and the converse; for we can give such figures to transparent bodies, and dispose them in such order with respect to the eye and the objects, that the rays shall be refracted and bent towards any place we please, so that we shall see the object near at hand or at any distance under any angle we please. And thus from an incredible distance we may read the smallest letters, and may number the smallest particles of dust and sand, by reason of the greatness of the angle under which we see them. . . . Thus also the sun, moon, and stars may be made to descend hither in appearance, and to be visible over the heads of our enemies, and many things of the like sort, which persons unacquainted with such things would refuse to believe."

Molyneux also cites from Bacon's *Epistola ad Parisiensem*, "Of the Secrets of Art and Nature," chap. 5:—

> "Glasses or diaphanous bodies may be so formed that the most remote objects may appear just at hand, and the contrary, so that we may read the smallest letters at an incredible distance, and may number things, though never so small, and may make the stars also appear as near as we please."

These passages certainly prove that Bacon had very nearly, if not perfectly, arrived at theoretical proof of the possibility of constructing a telescope and a microscope; but his writings give no account of the trial of an actual telescope, nor any detailed results of the application of a telescope to an examination of the heavens. It has been pointed out by Dr Smith, in his *Complete System of Optics*, that Bacon imagines some effects of telescopes which cannot be performed by them, and his conclusion is that Bacon never actually looked through a telescope.

Giambattista della Porta, in his *Magia Naturalis*, printed in 1558, makes the following remarkable statement:—

> "If you do but know how to join the two (viz., the concave and the convex glasses) rightly together, you will see both remote and near objects larger than they otherwise appear, and withal very distinct."

Wolfius infers from this passage that its author was the first actual constructor of a telescope, and it appears not improbable that by happy accident Porta really did make some primitive form of telescope which excited the wonder of his friends. Here, however, his interest in the matter appears to have ceased, and he was unable either to appreciate the importance of his discovery or to describe the means by which the object was attained. Kepler, who examined Porta's account of his concave and convex lenses by desire of his patron the emperor Rudolph, declared that it was perfectly unintelligible. Poggendorff (*Gesch. der Physik*, p. 134) throws considerable doubt on the originality of Porta's statement.

Leonard Digges.

Thomas Digges, in his *Stratioticus*, p. 359, published in 1579, states that his father, Leonard Digges,

> "among other curious practices had a method of discovering by perspective glasses set at due angles all objects pretty far distant that the sun shone upon, which lay in the country round about,"

and that this was by the help of a manuscript book of Roger Bacon of Oxford, who he conceived was the only man besides his father who knew it. There is also the following passage in the *Pantometria* (bk. i. chap. 21) of Leonard Digges[2] (originally published by his son Thomas in 1571, and again in 1591):—

> "Marvellous are the conclusions that may be performed by glasses concave and convex, of circular and parabolic forms, using for multiplication of beams sometime the aid of glasses transparent, which, by fraction, should unite or dissipate the images or figures presented by the reflection of other."

He then describes the effects of magnification from a combination of lenses or mirrors, adding:—

> "But of these conclusions I minde not here to intreate, having at large in a volume[3] by itselfe opened the miraculous effects of perspective glasses."

It is impossible to discredit the significance of these quotations, for the works in which they occur were published more than twenty years before the original date claimed for the discovery of the telescope in Holland.

The Dutch telescope of 1608.

That Roger Bacon had tolerably clear ideas as to the practical possibility of constructing telescopes, and that Leonard Digges had access to some unpublished MSS. of Bacon, and by their aid constructed some form of telescope, seem to be obvious inferences from the preceding evidence. But it is quite certain that previous to 1600 the telescope was unknown, except possibly to individuals who failed to see its practical importance, and who confined its use to "curious practices" or to demonstrations of "natural magic." The practical discovery of the instrument was certainly made in Holland about 1608, but the credit of the original invention has been claimed on behalf of three individuals, Hans Lippershey and Zacharias Jansen, spectacle-makers in Middelburg, and James Metius of Alkmaar (brother of Adrian Metius the mathematician).

Descartes, in his treatise on *Dioptrics* (1637), attributes the discovery to Metius "about thirty years ago," whilst Schyrælus de Rheita, a Capuchin friar, in his *Oculus Enoch et Eliæ* (Antwerp, 1645), gives the credit to Lippershey about 1609. Peter Borel, physician to the king of France, published at The Hague, in 1655, a work *De Vero Telescopii Inventore*. He was assisted in its preparation by William Borel, Dutch envoy at the court of France, and the latter declares, as the result of patient investigation, that

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[1] In recent years the term "photographic telescope" has been applied to instruments employed to record the appearance of celestial objects by photography.

[2] He died about 1570. His son alludes to his untimely death in the preface to the *Pantometria*.

[3] There is no further trace of this volume.

Jansen. Jansen and his father were the real inventors of the telescope in 1610, and that Lippershey only made a telescope after hints accidentally communicated to him of the details of Jansen's invention. But the most trustworthy information on the subject is to be got from the researches of Van Swinden.[1] Briefly summarized, this evidence is as follows. In the library of the university of Leyden, amongst the MSS. of Huygens there is an original copy of a document (dated 17th October 1608) addressed to the states-general by Jacob Andrianzoon (the same individual who is called James **Metius.** Metius by Descartes), petitioning for the exclusive right of selling an instrument of his invention by which distant objects appear larger and more distinct. He states that he had discovered the instrument by accident when engaged in making experiments, and had so far perfected it that distant objects were made as visible and distinct by his instrument as could be done with the one which had been lately offered to the states by a citizen and spectacle-maker of Middelburg. Among the Acts of the states-general preserved in the Government archives at The Hague, Van Swinden found that on 2d October 1608 the assembly of the states took into **Lippershey.** consideration the petition of Hans Lippershey, spectacle-maker, a native of Wesel and an inhabitant of Middelburg, inventor of an instrument for seeing at a distance. On 4th October a committee was appointed to test the instrument, and on the 6th of the same month the assembly agreed to give Lippershey 900 florins for his instrument. Further, on the 15th December of the same year they examined an instrument invented by Lippershey at their request to see with both eyes, and gave him orders to execute two similar instruments at 900 florins each; but, as many other persons had knowledge of this new invention to see at a distance, they did not deem it expedient to grant him an exclusive privilege to sell such instruments. The dates of these documents dispose effectually of Borel's statement that Lippershey borrowed the ideas of Jansen in 1610. They also prove that, whilst Metius was in possession of a telescope, with which he may have experimented, about the time when Lippershey presented his application for patent rights, yet he makes no pretension that Lippershey borrowed the invention from him. The conclusion is that Lippershey was the first person who independently invented the telescope, and at the same time made the instrument known to the world. The common story is that Lippershey, happening one day, whilst holding a spectacle-lens in either hand, to direct them towards the steeple of a neighbouring church, was astonished, on looking through the nearer lens, to find that the weathercock appeared nearer and more distinct. He fitted the lenses in a tube, in order to adjust and preserve their relative distances, and thus constructed his first telescope. But doubt may be thrown on this traditional account owing to the further statement that the image of the weathercock so viewed was seen turned upside down. All the original Dutch telescopes were composed of a convex and a concave lens, and telescopes so constructed do not invert. The inverting telescope, composed of two convex lenses, was a later invention; still it is not impossible that the original experiment was made with two convex lenses.

Telescopes seem to have been made in Holland in considerable numbers soon after the date of their invention, and rapidly found their way over Europe. Sirturus, in his *De Telescopio* (1618), states that "a Frenchman proceeded to Milan in the month of May 1609 and offered a telescope for sale to Count di Fuentes"; and Lorenzi Pigorna writes,[2] under date 31st August 1609, that "Galileo had been appointed lecturer at Padua for life on account of a perspective like the one which was sent from Flanders to Cardinal Borghese." Simon Marius, the German astronomer, appears to have made astronomical observations in 1609 with a telescope which he procured from Holland, and Professor Rigaud of Oxford found from the MSS. of Harriot, the mathematician, that he had been making astronomical observations with a Dutch telescope **Galileo.** as early as July 1609. Galileo, in his *Nuncius Sidereus*, states that, happening to be in Venice about the month of May 1609, he heard that a Belgian had invented a perspective instrument by means of which distant objects appeared nearer and larger, and that he discovered its construction by considering the effects of refraction. In his *Saggiatore* Galileo states that he solved the problem of the construction of a telescope the first night after his return to Padua from Venice, and made his first telescope next day by fitting a convex lens in one extremity of a leaden tube and a concave lens in the other one. A few days afterwards, having succeeded in making a better telescope than the first, he took it to Venice, where he communicated the details of his invention to the public, and presented the instrument itself to the doge Leonardo Donato, sitting in full council. The senate, in return, settled him for life in his lectureship at Padua and doubled his salary, which was previously 500 florins, and which then became treble that which any of his predecessors had enjoyed. Galileo may thus claim to have invented the telescope independently, but not till he had heard that others had done so. In fact the time was ripe; and, as often happens in similar circumstances, only a hint was necessary to complete the latent chain of thought. Galileo devoted all his time to improving and perfecting the telescope. Knowing the theory of his instrument, and possessed of much practical skill, coupled with unwearied patience, he conquered the difficulties of grinding and polishing the lenses, and soon succeeded in producing telescopes of greatly increased power. His first telescope magnified three diameters; but he soon made instruments which magnified eight diameters, and finally one that magnified thirty-three diameters.[3] With this last instrument he discovered in 1610 the satellites of Jupiter, and soon afterwards the spots on the sun, the phases of Venus, and the hills and valleys on the moon. He demonstrated the rotation of the satellites of Jupiter round the planet, and gave rough predictions of their configurations, proved the rotation of the sun on its axis, established the general truth of the Copernican system as compared with that of Ptolemy, and fairly routed the fanciful dogmas of the philosophers. These brilliant achievements, together with the immense improvement of the instrument under the hands of Galileo, overshadowed in a great degree the credit due to the original discoverer, and led to the universal adoption of the name of the Galilean telescope for the form of the instrument invented by Lippershey.

Kepler first explained the theory and some of the practical **Kepler.** advantages of a telescope constructed of two convex lenses in his *Catoptrics* (1611). The first person who actually constructed a telescope of this form was Father Scheiner, who gives a description of it in his *Rosa Ursina* (1630). William Gascoigne was the first who practically **Gascoigne.** appreciated the chief advantages of the form of telescope suggested by Kepler, viz., the visibility of the image of a distant object simultaneously with that of a small material object placed in the common focus of the two lenses. This led to his invention of the micrometer and his application of telescopic sights to astronomical instruments of precision (see MICROMETER, vol. xvi. p. 242). But it was not till about the middle of the 17th century that Kepler's telescope came into general use, and then, not so much because of the advantages pointed out by Gascoigne, but because its field of view was much larger than in the Galilean telescope. The first powerful telescopes of this construction were made by Huygens, after much labour, **Huygens.** in which he was assisted by his brother. With one of these, of 12-feet focal length, he discovered the brightest of Saturn's satellites (Titan) in 1655, and in 1659 he published his *Systema Saturnium*, in which was given for the first time a true explanation of Saturn's ring, founded on observations made with the same instrument. The sharpness of image in Kepler's telescope is very inferior to that of the Galilean instrument, so that when a high magnifying power is required it becomes essential to increase the focal length. Cassini **Cass** discovered Saturn's fifth satellite (Rhea) in 1672 with a telescope of 35 feet, and the third and fourth satellites in 1684 with telescopes made by Campani of 100 and 136 feet focal length. Huygens states that he and his brother made object-glasses of 170 and 210 feet focal length, and he presented one of 123 feet to the Royal Society of London. Auzout and others are said to have made telescopes of from 300 to 600 feet focus, but it does not appear that they were ever able to use them in practical observations. Bradley, on 27th December 1722, actually measured the diameter of Venus with a telescope whose object-glass had a focal length of $212\frac{1}{4}$ feet. In these very long telescopes no tube was employed, and they were consequently termed *aerial telescopes.*

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[1] See Dr Moll of Utrecht, in *Journ. Roy. Inst.*, vol. i., 1831.

[2] *Lettre d'Uomini Illustri*, p. 112, Venice, 1744.

[3] This last power could not be exceeded with advantage in this form of telescope till after the invention of the achromatic object-glass.

Aerial telescopes.

Huygens contrived some ingenious arrangements for directing such telescopes towards any object visible in the heavens,—the focal adjustment and centring of the eye-piece being preserved by a braced rod connecting the object-glass and eye-piece. Other contrivances for the same purpose are described by La Hire (*Mém. de l'Acad.*, 1715) and by Hartsoeker (*Miscel. Berol.*, vol. i. p. 261). Telescopes of such great length were naturally difficult to use, and must have taxed to the utmost the skill and patience of the observers. One cannot but pay a passing tribute of admiration to the men who, with such troublesome tools, achieved such results.

Reflecting telescopes.

Until Newton's discovery of the different refrangibility of light of different colours, it was generally supposed that object-glasses of telescopes were subject to no other errors than those which arose from the spherical figure of their surfaces, and the efforts of opticians were chiefly directed to the construction of lenses of other forms of curvature.

Gregory.

James Gregory, in his *Optica Promota* (1663), discusses the forms of images of objects produced by lenses and mirrors, and shows that when the surfaces of the lenses or mirrors are portions of spheres the images are curves concave towards the objective, but if the curves of the surfaces are conic sections the spherical aberration is corrected. He was well aware of the failures of all attempts to perfect telescopes by employing lenses of various forms of curvature, and accordingly proposed the form of reflecting telescope which bears his name. But Gregory, according to his own confession, had no practical skill; he could find no optician capable of realizing his ideas, and after some fruitless attempts was obliged to abandon all hope of bringing his telescope into practical use.

Newton.

Newton was the first to construct a reflecting telescope. When in 1666 he made his discovery of the different refrangibility of light of different colours, he soon perceived that the faults of the refracting telescope were due much more to this cause than to the spherical figure of the lenses. He over-hastily concluded from some rough experiments (*Optics*, bk. i. pt. ii. prop. 3) "that all refracting substances diverged the prismatic colours in a constant proportion to their mean refraction"; and he drew the natural conclusion "that refraction could not be produced without colour," and therefore "that no improvement could be expected from the refracting telescope" (*Treatise on Optics*, p. 112). But, having ascertained by experiment that for all colours of light the angle of incidence is equal to the angle of reflexion, he turned his attention to the construction of reflecting telescopes. After much experiment he selected an alloy of tin and copper as the most suitable material for his specula, and he devised means for grinding and polishing them. He did not attempt the formation of a parabolic figure on account of the probable mechanical difficulties, and he had besides satisfied himself that the chromatic and not the spherical aberration formed the chief faults of previous telescopes. Newton's first telescope so far realized his expectations that he could see with its aid the satellites of Jupiter and the horns of Venus. Encouraged by this success, he made a second telescope of $6\frac{1}{2}$-inches focal length, with a magnifying power of 38 diameters, which he presented to the Royal Society of London in December 1671.

Cassegrain.

A third form of reflecting telescope was devised in 1672 by Cassegrain (*Journal des Sçavans*, 1672).

Hadley.

No further practical advance appears to have been made in the design or construction of the instrument till the year 1723, when John Hadley (best known as the inventor of the sextant) presented to the Royal Society a reflecting telescope of the Newtonian construction, with a metallic speculum of 6-inches aperture and $62\frac{5}{8}$-inches focal length, having eye-pieces magnifying up to 230 diameters. The instrument was examined by Pound and Bradley, the former of whom reported upon it in *Phil. Trans.*, 1723, No. 378, p. 382. After remarking that Newton's telescope "had lain neglected these fifty years," they stated that Hadley had sufficiently shown "that this noble invention does not consist in bare theory." They compared its performance with that of the object-glass of 123-feet focal length presented to the Royal Society by Huygens, and found that Hadley's reflector

> "will bear such a charge as to make it magnify the object as many times as the latter with its due charge, and that it represents objects as distinct, though not altogether so clear and bright. . . . Notwithstanding this difference in the brightness of the objects, we were able with this reflecting telescope to see whatever we have hitherto discovered with the Hugenian, particularly the transits of Jupiter's satellites and their shadows over his disk, the black list in Saturn's ring, and the edge of his shadow cast on his ring. We have also seen with it several times the five satellites of Saturn, in viewing of which this telescope had the advantage of the Hugenian at the time when we compared them; for, being in summer, and the Hugenian telescope being managed without a tube, the twilight prevented us from seeing in this some of these small objects which at the same time we could discern with the reflecting telescope."

Bradley and Molyneux, having been instructed by Hadley in his methods of polishing specula, succeeded in producing some telescopes of considerable power, one of which had a focal length of 8 feet; and, Molyneux having communicated these methods to Scarlet and Hearn, two London opticians, the manufacture of telescopes as a matter of business was commenced by them (Smith's *Optics*, bk. iii. ch. 1).

James Short.

But it was reserved for James Short of Edinburgh to give practical effect to Gregory's original idea. Born at Edinburgh in 1710 and originally educated for the church, Short attracted the attention of Maclaurin, professor of mathematics at the university, who permitted him about 1732 to make use of his rooms in the college buildings for experiments in the construction of telescopes. In Short's first telescopes the specula were of glass, as suggested by Gregory, but he afterwards used metallic specula only, and succeeded in giving to them true parabolic and elliptic figures. Short then adopted telescope-making as his profession, which he practised first in Edinburgh and afterwards in London. All Short's telescopes were of the Gregorian form, and some of them retain even to the present day their original high polish and sharp definition. Short died in London in 1768, having realized a considerable fortune by the exercise of his profession.

Achromatic telescope

The historical sequence of events now brings us to the discovery of the achromatic telescope.

Chester M. Hall.

The first person who succeeded in making achromatic refracting telescopes seems to have been Chester Moor Hall, a gentleman of Essex. He argued that the different humours of the human eye so refract rays of light as to produce an image on the retina which is free from colour, and he reasonably argued that it might be possible to produce a like result by combining lenses composed of different refracting media[1] After devoting some time to the inquiry he found that by combining lenses formed of different kinds of glass the effect of the unequal refrangibility of light was corrected, and in 1733 he succeeded in constructing telescopes which exhibited objects free from colour. One of these instruments of only 20-inches focal length had an aperture of $2\frac{1}{2}$ inches. Hall was a man of independent means, and seems to have been careless of fame: at least he took no trouble to communicate his invention to the world. At a trial in Westminster Hall about the patent rights granted to Dollond (Watkin *v.* Dollond),[1] Hall was admitted to be the first inventor of the achromatic telescope; but it was ruled by Lord Mansfield that "it was not the person who locked his invention in his scrutoire that ought to profit for such invention, but he who brought it forth for the benefit of mankind."[2] In 1747 Euler communicated to the Berlin Academy of Sciences a memoir in which he endeavoured to prove the possibility of correcting both the chromatic and the spherical aberration of an object-glass. Like Gregory and Hall, he argued that, since the various humours of the human eye were so combined as to produce a perfect image, it should be possible by suitable combinations of lenses of different refracting media to construct a perfect object-glass. Adopting a hypothetical law of the dispersion of differently coloured rays of light, he proved analytically the possibility of constructing an achromatic object-glass composed of lenses of glass and water. But all his efforts to produce an actual object-glass of this construction were fruitless,—a failure which he attributed solely to the difficulty of procuring lenses worked precisely to the requisite curves (*Mem. Acad. Berlin*, 1753). Dollond admitted the accuracy of Euler's analysis, but disputed his hypothesis on the grounds that it was purely a theoretical assumption, that the theory was opposed to the results of Newton's experiments on the refrangibility of light, and that it was impossible to determine a physical law from analytical reasoning alone (*Phil. Trans.*, 1753, p. 289). In 1754 Euler communicated to the Berlin Academy a further memoir, in which, starting from the hypothesis that light consists of vibrations excited in an elastic fluid by luminous bodies, and that the difference of colour of light is due to the greater or less frequency of these vibrations in a given time, he deduced his previous results. He did not doubt the accuracy of Newton's experiments quoted by Dollond, because he asserted that the difference between the law deduced by Newton and that which he assumed would not be rendered sensible by such an experiment.[3] Dollond did not reply to this memoir, but soon afterwards he received an abstract of a memoir by Klingenstierna, the Swedish mathematician and astronomer, which led him to doubt the accuracy of the results deduced by Newton on the dispersion of refracted light. Klingenstierna showed from purely geometrical considerations, fully appreciated by Dollond, that the results of Newton's experiments could not be brought into harmony with other universally accepted facts of refraction. Like a practical man, Dollond at once put his doubts to the test of experiment, confirmed the conclusions of Klingenstierna, discovered "a difference far beyond his hopes in the refractive qualities of different kinds of glass with respect to their divergency of colours," and was thus rapidly led to the construction of object-glasses in which first the chromatic and afterwards the spherical aberration were corrected (*Phil. Trans.*, 1758, p. 733).

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[1] The same argument was employed by Gregory more than fifty years previously, but had been followed by no practical result. The lens of the human eye is not achromatic (see LIGHT, vol. xiv. p. 601).

Euler.

Klingenstierna.

We have thus followed somewhat minutely the history of the gradual process by which Dollond arrived independently at his invention of the refracting telescope, because it has been asserted that he borrowed the idea from others. Montucla, in his *Histoire des Mathématiques* (pp. 448-449), gives the following footnote, communicated to him by Lalande:—

> "Ce fut Chestermonhall" (an obvious misprint for Chester Moor Hall) "qui, vers 1750, eut l'idée des lunettes achromatiques. Il s'adressoit à Ayscough,[4] qui faisoit travaillir Bass. Dollond ayant eu besoin de Bass pour un verre que demandoit le duc d'York, Bass lui fit voir du crown-glass et du flint-glass. Hall donna une lunette à Ayscough, qui la montra à plusieurs personnes; il en donna la construction à Bird, qui n'en tint pas compte. Dollond en profita. Dans le procès qu'il y eut entre Dollond et Watkin, au banc du roi, cela fut prouvé; mais Dollond gagna, parce qu'il étoit le premier qui eût fait connoître les lunettes achromatiques."

It is clearly established that Hall was the first inventor of the achromatic telescope; but Dollond did not borrow the invention from Hall without acknowledgment in the manner suggested by Lalande. His discovery was beyond question an independent one. The whole history of his researches proves how fully he was aware of the conditions necessary for the attainment of achromatism in refracting telescopes, and he may be well excused if he so long placed implicit reliance on the accuracy of experiments made by so illustrious a philosopher as Newton. His writings sufficiently show that but for this confidence he would have arrived sooner at a discovery for which his mind was fully prepared. It is, besides, impossible to read Dollond's memoir (*Phil. Trans.*, 1758, p. 733) without being impressed with the fact that it is a truthful account, not only of the successive steps by which he independently arrived at his discovery, but also of the logical processes by which these steps were successively suggested to his mind.

The triple object-glass, consisting of a combination of two convex lenses of crown glass with a concave flint lens between them, was introduced in 1765 by Peter, son of John Dollond, and many excellent telescopes of this kind were made by him.

The limits of this article do not permit a further detailed historical statement of the various steps by which the powers of the telescope were developed. Indeed, in its practical form the principle of the instrument has remained unchanged from the time of the Dollonds to the present day; and the history of its development may be summed up as consisting not in new optical discoveries but in utilizing new appliances for figuring and polishing, improved material for specula and lenses, more refined means of testing, and more perfect and convenient methods of mounting. About the year 1774 William Herschel, then a teacher of music in Bath, began to occupy his leisure hours with the construction of specula, and finally devoted himself entirely to their construction and use. In 1778 he had selected the *chef d'œuvre* of some 400 specula which he made for the celebrated instrument of 7-feet focal length with which his early brilliant astronomical discoveries were made. In 1783 he completed his reflector of $18\frac{7}{10}$-inches aperture and 20-feet focus, and in 1789 his great reflector of 4-feet aperture and 40-feet focal length. The fame of these instruments was rapidly spread by the brilliant discoveries which their maker's genius and perseverance accomplished by their aid. The reflecting telescope became the only available tool of the astronomer when great light grasp was requisite, as the difficulty of procuring disks of glass (especially of flint glass) of suitable purity and homogeneity limited the dimensions of the achromatic telescope. It was in vain that the French Academy of Sciences offered prizes for perfect disks of optical flint glass. Some of the best chemists and most enterprising glass-manufacturers exerted their utmost efforts without succeeding in producing perfect disks of more than 3½ inches in diameter. All the larger disks were crossed by striæ, or were otherwise deficient in the necessary homogeneity and purity.

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[1] At a meeting of the Royal Astronomical Society held on 9th May 1886 a legal document, signed by Chester Moor Hall, was presented by Mr R. B. Prosser of the Patent Office to the society. On the same occasion Mr Ranyard made the following interesting statement respecting Hall:—

"Some years ago very little was known about Moor Hall. It was known that, about seven years after the patent for making achromatic object glasses was granted to Dollond, his claim to the invention was disputed by other instrument-makers, amongst them by a Mr Champness, an instrument maker of Cornhill, who began to infringe the patent, alleging that John Dollond was not the real inventor, and that such telescopes had been made twenty five years before the granting of his patent by Mr Moor Hall. John Dollond, to whom the Copley medal of the Royal Society had been given for his invention, was then dead, and his son brought an action for infringing the patent against Champness. There is no report of the case, but the facts are referred to in the reports of subsequent cases. It appears that workmen who had been employed by Mr Moor Hall were examined, and proved that they had made achromatic object-glasses as early as 1733. Dollond's patent was not set aside, though the evidence with regard to the prior manufacture was accepted by Lord Mansfield, who tried the case, as having been satisfactorily proved. . . . Mr Hall was a bencher of the Inner Temple, and was alive at the time of the action. He was a man of some property, and is spoken of on his tombstone as an excellent lawyer and mathematician. He was not a fellow of the Royal Society, but must certainly have known of the gift of the Copley medal to Dollond. It is very curious the conflicting evidence we have to reconcile, but I think the balance of evidence is in favour of there having been a prior invention of achromatic object-glasses before the date of Dollond's patent" (*Astron. Register*, May 1886; see also the *Observatory* for same date).

[2] *Gentleman's Magazine*, 1790, part ii. p. 890.

[3] For a good account of this controversy, see Dr. H. Servus, *Geschichte des Fernrohrs*, p. 77 sq., Berlin, 1886.

[4] Ayscough was an optician in Ludgate Hill, London.

uinand Pierre Louis Guinand, a humble watchmaker living near Chaux de Fond in Neuchâtel, Switzerland, was the first who succeeded in making marked progress in the manufacture of optical flint glass. After making preliminary experiments extending over seven years (1784-90), and nothing daunted by their comparative want of success, he erected a furnace near Les Brenets, and devoted most of his slender earnings (then derived from making the bells, or rather gongs, of repeating watches) to the fulfilment of his ambition. His persistency, courage, and self-denial recall forcibly the story of Palissy. In 1805 he joined the optical establishment of Fraunhofer and Utzschneider and remained with them about nine years. During this period extensive experiments were instituted with remarkable success. It is said that the disks for the Dorpat refractor (9·6 inches aperture, with which the observations of Wilhelm Struve were made) were manufactured during this period, though the complete instrument was not delivered till 1823. un- fer. Fraunhofer had, however, profited so fully by the suggestions of Guinand, and had probably also so far improved on the original methods, that he afterwards succeeded in producing still larger object-glasses. After Fraunhofer's death in 1826 his successors Merz and Mahler carried out successfully the methods handed down to them by Guinand and Fraunhofer, and produced some large and excellent telescopes, which are hereafter mentioned. Meanwhile Guinand, having returned to his native country in 1814, resumed there the manufacture of disks of optical glass, discovered a method of removing striæ by breaking and reuniting the portions by heat, when the glass was in a plastic state, and eventually produced perfect disks up to 18 inches in diameter. Most of these he disposed of to Lerebours and Secretan, opticians in Paris, by both of whom some fine object-glasses were made.[1] Guinand communicated his secrets to his sons before his death in 1823. About 1829 Bontemps entered into partnership with one of the sons, and another son carried on his father's manufacture in partnership with his mother. The latter firm was succeeded by Dauget of Soleure, whose exhibits of optical glass excited so much attention at the London exhibition of 1851. About 1848 Bontemps joined the firm of Chance Brothers of Birmingham, and thus carried the secret of Guinand's methods to England. It is not a little remarkable that the only firms in the world by whom large disks of optical glass have been produced trace their success to information derived more or less directly from Guinand. MM. Feil of Paris, who are direct descendants of Guinand, and Messrs Chance Brothers of Birmingham are at the present time the only makers of optical glass in disks of larger diameter than 20 inches.

INSTRUMENTS, &c.

We now proceed to give an account of the methods and principles of construction of the various kinds of telescopes, and to describe in detail special typical instruments, which, owing to the work accomplished by their aid or the practical advances exemplified in their construction, appear most worthy of record or study.

Refracting Telescope.

Early forms. In its simplest form the telescope consists of a convex object-lens capable of forming an image of a distant object and of an eye-lens, concave or convex, by which the image so formed is magnified. When the axis of the eye-lens coincides with that of the object-glass, and the focal point of the eye-lens is coincident with the principal focus of the object-lens, parallel rays incident upon the object-glass will emerge from the eye-piece as parallel rays. These, falling in turn on the lens of the human eye, are converged by it and form an image on the retina.[2] Fig. 1 shows the course of the rays when the eye-lens is convex (or positive), fig. 2 when the eye-lens is concave (or negative) The former represents Kepler's, the latter Lipperhey's or the Galilean telescope. The magnifying power obviously depends on the proportion of the focal length of the object-lens to that of the eye-lens, that is,

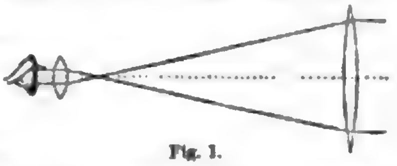

Fig. 1.

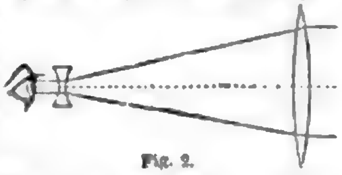

Fig. 2.

$$\text{magnifying power} = F/e,$$

where F is the focal length of the object-lens and e that of the eye-lens. Magnifying power. Also the diameter of the pencil of parallel rays emerging from the eye-lens is to the diameter of the object-lens inversely as the magnifying power of the telescope. Hence one of the best methods of determining the magnifying power of a telescope is to measure the diameter of the emergent pencil of rays, after the telescope has been adjusted to focus upon a star, and to divide the diameter of the object-glass by the diameter of the emergent pencil. If we desire to utilize all the parallel rays which fall upon an object-glass it is necessary that the full pencil of emerging rays should enter the observer's eye. Assuming with Sir William Herschel that the normal pupil of the eye distends to one-fifth of an inch in diameter when viewing faint objects, we obtain the rule that the minimum magnifying power which can be efficiently employed is five times the diameter of the object-glass expressed in inches. The defects of the Galilean and Kepler telescopes are due to the chromatic and spherical aberration of the simple lenses of which they are composed (see OPTICS, vol. xvii. p. 802 *sq.*). The substitution of a positive or negative eye-piece for the simple convex or concave eye-lens, and of an achromatic object-glass for the simple object-lens, transforms these early forms into the modern achromatic telescope. The Galilean telescope with a concave eye-lens instead of an eye-piece still survives as the modern opera-glass, on account of its shorter length, but the object-glass and eye-lens are achromatic combinations.

Achromatic object-glass. The principles of an achromatic combination of prisms or lenses have been explained in LIGHT (vol. xiv. pp. 592, 595) and further developed in OPTICS (vol. xvii. p. 804 *sq.*). As a lens may be regarded as built up of a series of thin slices of prisms, divided from each other by planes parallel to the axis of the lens, it will be seen that, if a prism perfectly achromatic for rays of two definite wave-lengths, and approximately achromatic for all rays, can be constructed by combining two prisms of different kinds of glass, all that is required to produce an object-glass with similar small chromatic errors is to combine a convex lens of crown glass and a concave one of flint glass as in fig. 3, their surfaces being of such curvatures as to form a series of imaginary prisms (such as we have supposed an object-glass to consist of) through any one of which all kinds of light falling on the object-glass parallel to its axis will be refracted very nearly to a common focus F. Accordingly any pro-

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[1] See Wolf, *Biographien*, vol. ii. p. 301, and Clerke, *History of Astronomy*, pp. 146-147.

[2] In the case of short-sighted persons the image for very distant objects (that is, for parallel rays) is formed in front of the retina; therefore, to enable such persons to see distinctly, the rays emerging from the eye piece must be slightly divergent; that is, they must enter the eye as if they proceeded from a comparatively near object. For normal eyes the natural adaptation is not to focus for quite parallel rays, but on objects at a moderate distance, and practically, therefore, most persons do adjust the focus of a telescope, for most distinct and easy vision, so that the rays emerge from the eye-piece very slightly divergent. Abnormally short-sighted persons require to push in the eye-lens nearer to the object-glass, and long-sighted persons to withdraw it from the adjustment employed by those of normal sight. It is usual, however, in computations of the magnifying power of telescopes, for the rays emerging from the eye-piece when adjusted for distinct vision to be parallel.

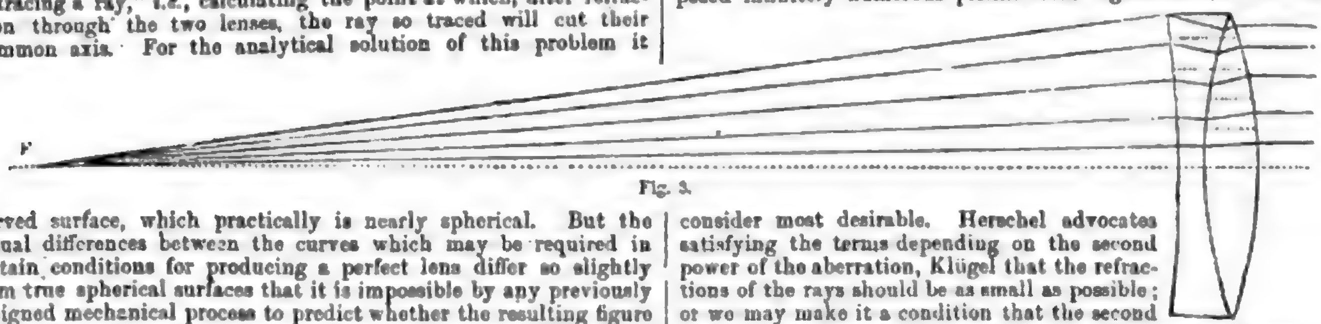

Fig. 3.

posed object-glass can be tested as regards its optical conditions by "tracing a ray," *i.e.*, calculating the point at which, after refraction through the two lenses, the ray so traced will cut their common axis. For the analytical solution of this problem it is necessary to assume that the adjacent surfaces of the supposed infinitely numerous prisms form together some continuous curved surface, which practically is nearly spherical. But the actual differences between the curves which may be required in certain conditions for producing a perfect lens differ so slightly from true spherical surfaces that it is impossible by any previously designed mechanical process to predict whether the resulting figure will be that of a sphere or some other curve very nearly that of a sphere. The mathematician, therefore, who discusses the subject is compelled to adopt spherical curves as the basis of his calculation. On this assumption we may then trace a ray rigidly through any supposed object-glass as follows. Let A, B, A', B' be respectively the points where the refracted ray produced would intersect the optical axis after refraction at the first, second, third, and fourth refracting surfaces respectively; also let a be the first angle of incidence, μ and μ' the refractive indexes for the crown and flint lens respectively for a ray of the wave-length whose course is to be traced, r and s the first and second radii for the crown lens, r' and s' the first and second radii for the flint lens, a, β, a', β', a', and b' auxiliary angles, d the thickness of the crown lens, d' the thickness of the flint lens, Δ the distance between the second and third surfaces. Then for the intersect after refraction at the first surface

$$\sin a = \frac{1}{\mu}\sin a\,;$$

$$(A) = a - a\,;\ A = \frac{r\,.\,\sin a}{\sin(A)} + r\,;$$

for the intersect after refraction at the second surface

$$\sin b = \frac{A + s - d}{s}\sin(A)\,;$$

$$\sin\beta = \mu\,.\,\sin b\,;$$

$$(B) = (A) + \beta - b\,;\ B = \frac{s\sin\beta}{\sin(B)} - s\,;$$

for the intersect after refraction at the third surface

$$\sin a' = -(B - r' - \Delta)\frac{\sin(B)}{r'}\,;$$

$$\sin a' = \frac{1}{\mu'}\sin a'\,;$$

$$(A') = (B) + a' - a'\,;\ A' = r - r'\,.\,\frac{\sin a}{\sin(A')}\,;$$

for the intersect after refraction at the fourth surface

$$\sin b' = -(A' + s' - d')\sin\frac{(A')}{s'}\,;$$

$$\sin\beta' = \mu'\sin b'\,;$$

$$(B') = (A') + b' - \beta'\,;\ B' = -s - s'\,.\,\frac{\sin\beta'}{\sin(B')}.$$

The computation is very much simplified when we consider the angle of incidence to be very small—*i.e.*, the point of incidence very near the optical axis, viz.,

$$\frac{r}{A} = \frac{\mu - 1}{\mu}\,;\ \frac{s}{B} = \frac{\mu s}{A - d} + \mu - 1\,;$$

$$\frac{r'}{A'} = \frac{r'}{\mu'(B - \Delta)} + \frac{\mu' - 1}{\mu'}\,;\ \frac{s'}{B'} = \frac{\mu' s'}{A' - d'} + \mu' - 1.$$

By means of these formulæ we can compute B' (the point where a ray, entering the first surface of the object-glass, will intersect the optical axis) for any angle of incidence $= a$, when for a ray of that wave-length the indexes of refraction are known for the glass of which the lenses are composed, if the radii of curvature of the lenses are also known. The most perfect object-glass would be one in which the value of B' is the same for two rays of the two selected wave-lengths, through whatever portion of the object-glass they may pass. This, however, is a condition which cannot be mathematically satisfied with spherical surfaces. It is of course possible to find values of the four unknown quantities r, s, r', and s' such that four conditions shall be satisfied. The ordinary approximate method is to find such values of the radii that B' is the same for rays of two different wave-lengths when the incident rays are near the axis, and for mean rays which enter near the margin of the lens; but of course this solution is indeterminate, and only becomes rigid when two radii are assumed. Thus, for any crown lens of any radii of curvature it is possible to find a flint lens to satisfy these conditions. The rigid solution becomes one of successive approximation to such four conditions as the computer may consider most desirable. Herschel advocates satisfying the terms depending on the second power of the aberration, Klügel that the refractions of the rays should be as small as possible; or we may make it a condition that the second and third surfaces shall have the same radius, so that the surfaces may be cemented together. The fourth condition is of course the desired focal length. But for all practical purposes it is sufficient to have placed the reader in a position to test the optical conditions of any combinations that may be proposed, and to refer him to the works mentioned in the subjoined note[1]; for, in fact the construction of object-glasses on paper is of far higher interest as a mathematical exercise than as a practical matter. By a slight departure from the spherical figure—a departure so minute that there are no mechanical means sufficiently delicate to measure it with certainty—the optician may fail to realize true spherical surfaces, and thus on the one hand miss the fine definition which his calculation led him to expect, or on the other hand convert an object-glass which with spherical curves would have large spherical aberration into one perfectly corrected in this respect. Having, therefore, for particular kinds of glass ascertained a good general form of object-glass, it becomes only necessary for the optician to perform an approximate calculation of the curvatures requisite to produce correction of the chromatic aberration, and to trust to the process of final figuring for correction of the final spherical and chromatic aberration. It fortunately happens that in the rigid equations the terms which express the thickness and distance apart of the lenses involve only the focal distances of central rays, and have but a small influence on the ratios of the aberrations of the lenses; and, further, they affect chiefly the focal length of the lens, and have a very small influence on the chromatic aberration. Thus in the preliminary computation the optician may neglect the thickness of the lenses and employ the simple approximate formulæ given under OPTICS, vol. xvii. p. 804—

$$\frac{\delta\mu}{\mu - 1}\cdot\frac{1}{f} + \frac{\delta\mu'}{\mu' - 1}\cdot\frac{1}{f'} = 0,$$

$$\frac{1}{F} = \frac{1}{f} + \frac{1}{f'},$$

where $\frac{\delta\mu}{\mu - 1}$ and $\frac{\delta\mu'}{\mu' - 1}$ are the dispersive powers of the two kinds of glass for the two rays which he desires to unite, f and f' the corresponding focal lengths of the two lenses, and F the focal length of the combination. The focal lengths of the two lenses which secure the conditions of achromatism having been thus computed, the radii of curvature may be computed for either lens by the usual formula (see LIGHT, vol. xiv. p. 593)—

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{r} - \frac{1}{s}\right).$$

In the last expression, where r and s correspond to the radii of curvature, the optician has an infinite range of choice. He will of course select such a proportion of r to s as experience or more elaborate calculation has shown to be favourable. In the form of object-glass recommended by Sir John Herschel, as fulfilling the most favourable conditions for correction of a spherical aberration for parallel as well as nearly parallel rays, the required curvatures for the exterior surfaces of the crown and the flint lens were found to vary very slightly for a considerable range of the ratio of the dispersive powers of the crown and the flint glass. Assuming μ (the mean index of refraction) to be 1·542 for crown glass and 1·585 for flint glass, Herschel proved that, if the radii in question are taken to be 6·72 for the crown lens and 14·20 for the flint lens (supposing the focal length of the desired combination to be 10), we have only to compute the radii of the second and third surfaces by means of the above simple formulæ and the measured dispersive and refractive power of the glass of the lenses. (The method of determining μ, &c., is given under OPTICS, vol. xvii. p. 800.) The form generally adopted (see fig. 4) in the best modern object-glasses is extremely simple, viz., an equi-convex crown lens and a flint lens whose first surface has the same radius of curvature as the surfaces of the crown lens—this radius depending on the focal length which it is desired to give to the object-glass. Since in order to fulfil the conditions of achromatism the focal lengths of the two lenses have to be proportional to their dispersive powers (for the rays which it is desired to unite), and as in the two descriptions of glass in question the dispersion of flint glass for C to rays between F and G is very nearly twice that of crown glass, the posterior surface of the flint lens becomes nearly a plane. The final correction for achromatism is made, if necessary, by departing slightly from a plane in the curvature of the last surface of the flint lens, and the final correction for spherical aberration in the figuring of the surfaces. In a lecture delivered at the Royal Institution on 2d April 1886 Sir Howard Grubb, optician, of Dublin, said:

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[1] Euler, *Dioptrica*, St Petersburg, 1767-71; Clairaut, *Mém. de l'Acad. Scien.*, 1757; D'Alembert, *Opusc.*, vol. iii.; Lagrange, *Miscl. Taurin.*, iii. 2, p. 152 and *Mem. Acad. Berl.*, 1778; Schmidt, *Lehrbuch der analytischen Optik*; Santini, *Teorica degli Strumenti Ottici*; Klügel, in Gilbert's *Ann. d. Physik*, xxxiv., 1810, pp. 265-275 and 276-291; Herschel, *Phil. Trans. Roy. Soc.*, 1821, pp. 222-267; Littrow, *Mem. R.A.S.* (London), vol. iii. pp. 235-255; Robinson, *Mechanical Philosophy*, art. "Telescope," vol. iii. pp. 403-514; Gauss, "Ueber die achromatischen Doppel-Objective," in Lindenau's *Zeitschr.*, iv., 1817, pp. 345-351, and Gilbert's *Ann. d. Physik*, lix. pp. 188-195; Gauss, in Louville's *Journal*, 1856, i. pp. 9-43; Steinheil *Astron. Nach.*, xlviii., 1851, col. 225-228, liii., 1860, col. 305-306, and 1861, col. 269-270; A. Steinheil, *Ueber Berechnung optischer Constructionen*; Carl Steinheil, *Repertorium*, iii., 1867, pp. 430-440, and *München Akad. Sitz.*, 1867, ii. pp. 284-297; Steinheil (Carl A. and H. A.), *Göttingsche Nachrichten*, 1865, pp. 131-143, 211-214.

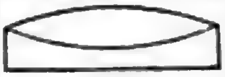

Fig. 4.

> "A truly spherical curve is the exception, not the rule. When I tell you that a sensible difference in correction for spherical aberration can be made by half an hour's polishing, corresponding probably to a difference in the first place of decimals in radii of the curves, you will see that it is practically not necessary to enter upon any calculation for spherical aberration. We know about what form gives an approximate correction; we adhere nearly to that, and the rest is done by figuring of the surface. To illustrate what I mean, I would be quite willing to undertake to alter the curves of the crown or flint lens of any of my objectives by a very large quantity, increasing one and decreasing the other so as to still satisfy the conditions of achromatism, but introducing theoretically a large amount of positive or negative spherical aberration, and yet to make out of the altered lens an object-glass perfectly corrected for spherical aberration. . . . I may remark that it is sometimes possible to make a better objective by deviating from the curves which give a true correction for spherical aberration, and correcting that aberration by figuring, rather than by strictly adhering to the theoretical curves."

Colour correction.

When an object-glass is designed for use as an ordinary telescope it is usual to select for the rays of different colour to be united those near C and those between F and G, since rays of lower and higher refrangibility produce a comparatively faint impression on the sense of sight. In such a telescope of any considerable aperture the image of a bright star at focus is surrounded by a halo of bluish or violet-coloured light,—a defect which is unavoidable in an object-glass composed of a crown and flint lens on account of the irrationality of their spectra (LIGHT, vol. xiv. p. 592). There seems to be no doubt that different eyes are differently impressed by rays of different wave-length.[1] Thus two observers will often have different opinions as to the chromatic corrections of the same object-glass: the observer whose eye is abnormally sensitive to violet light will pronounce the chromatic aberration over-corrected in an object-glass which another will consider perfect in this respect, and *vice versa*. Probably it is partly owing to this cause that the object-glasses of different makers show systematic differences in their colour correction.

Correction for chromatic aberration.

An exceedingly sensitive method of testing this correction devised by Professor Stokes is given under OPTICS, vol. xvii. p. 804. Another method, due to Professor Harkness and first carried out by Dr Vogel, is the following. Place behind the eye-piece a direct vision prism (*cf.* OPTICS, p. 801). The image of a star in the field will then be converted into a narrow spectrum, which, if there were no chromatic aberration, would when focused be represented by a faint coloured straight line, uniformly sharp and narrow. But in an ordinary object-glass only two points in the spectrum can be perfectly focused simultaneously; therefore all its other parts are spread out, forming a coloured band of variable breadth. If we focus on the brightest part of the spectrum, both its extreme ends become spread out into a more or less trumpet-shaped form, enabling the observer to note the range of the spectrum over which precise definition can be expected. The amount of this extension will depend in some degree on the form of the object-glass, but much more (if the achromatism is fairly well corrected) on the irrationality of the spectra of the glass of which the lenses are composed. If we then focus, for example, on the C line, we shall have the band of light contracted at C and at another point (probably between F and G), widening to a slightly trumpet-shaped form below C, and markedly so above G. This second point of greatest contraction gives the wave-length of the ray which has the same focus as C. If the telescope has a focusing scale, we can also measure directly in this way the change of focus for rays of different colours. The chromatic aberration will be best corrected for the rays of minimum focus, and this minimum focus should for an ordinary telescope correspond with the brightest part of the spectrum, viz., with rays between D and E. A comparison of the chromatic correction of object-glasses by different makers is given by Dr Vogel (*Monatsber. der Berliner Akad.*, April 1880), obtained in the manner just described. The telescopes compared are—

Maker.	Observatory to which Instrument belongs.	Aperture of Object-Glass.	Focal Length.	No. of Apertures in Focal Length.
		m.	m.	
Schröder	Potsdam	0·298	5·4	18·1
Grubb..........	"	0·207	3·16	15·3
Fraunhofer	Berlin	0·243	4·331	17·8

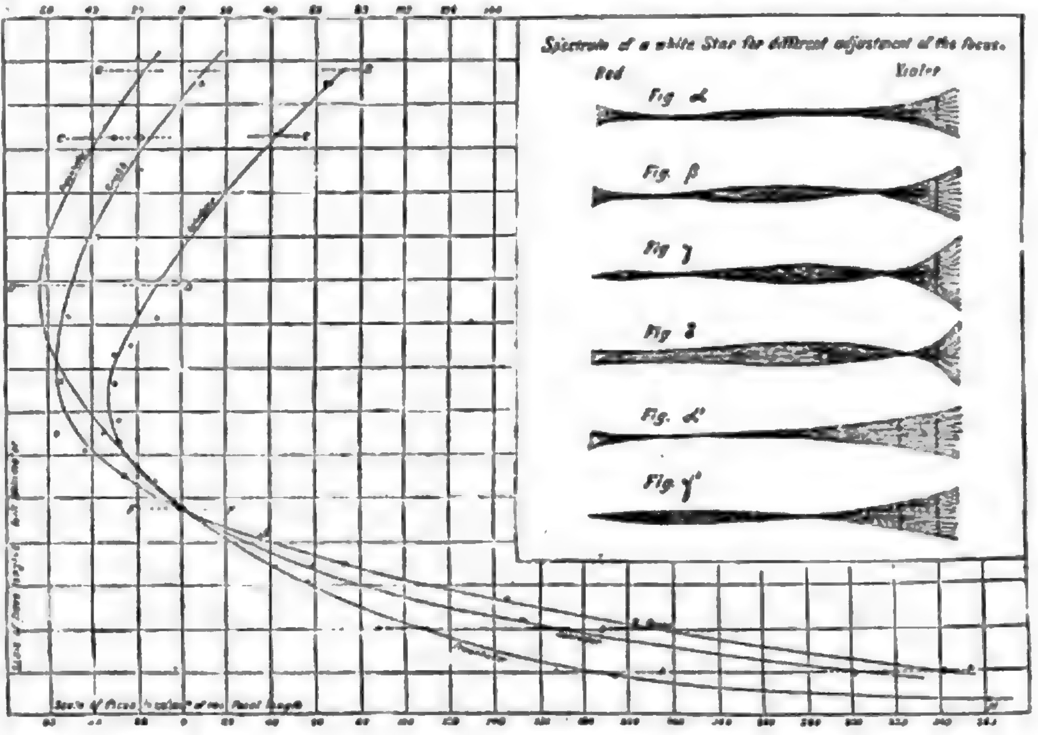

Fig. 5.

Fig. 5, taken from the above-quoted paper, affords most interesting information as to the colour-correction of these three typical object-glasses. The curves of the diagram show the variation of the focal point for rays of different wave-lengths in the case of each object-glass. It will be seen that Fraunhofer has united the rays about C with those of wave-length 525 millionths millimètres, Grubb with those about wave-length 494, and Schröder about wave-length 463. The object-glasses of Grubb and Schröder are composed of modern glass, which is comparatively colourless, whilst Fraunhofer's glass is decidedly green in colour. The minimum focus in Fraunhofer's telescope is placed near D (rather at wave-length 585), because the absorption of the blue and violet rays of the spectrum by the flint lens renders the brightest part of the spectrum less blue than in an objective composed of modern glass by Chance or Feil, which is nearly colourless. This circumstance enabled Fraunhofer to apply a very large over-correction for colour,—that is, to unite as perfectly as possible the red and central part of the spectrum, and to leave the outstanding violet rays to be in great part absorbed by the colour of the glass. The colour-corrections in the object-glasses of Grubb and Schröder are very different in character. In Grubb's object-glass the minimum focus is for rays of wave-length about 545, that of Schröder's is about wave-length 533, which appears to prove that Grubb's eye is more sensitive to red and Schröder's to blue light. Also Grubb's object-glass unites the red rays very closely with the brightest part of the spectrum, and leaves the blue and violet rays outstanding. Schroder, on the other hand, leaves the red rays outstanding in order to unite the rays between D and F more closely. The conclusion is that to Grubb's eye the red rays would be obtrusively prominent in Schröder's telescope, and that he would pronounce the object-glass under-corrected; whilst Schröder's eye would find the outstanding violet rays too prominent in Grubb's telescope, and pronounce it over-corrected. The absolute amount of light in the secondary spectrum in viewing the same object depends, *cæteris paribus*, upon the square of the aperture; therefore telescopes of large aperture have to be made of greater proportional focal length than those of small aperture, in order to diminish the secondary spectrum. Figs. α, β, γ, δ in the diagram give the form of the spectrum of a star in Schröder's telescope for various adjustments of the focus; figs. α' and γ' give the corresponding forms for Fraunhofer's telescope. Fig. α represents the eye-piece focused for the brightest part of the spectrum; fig. β when the red rays and those near Hα are simultaneously focused; fig. γ when the extreme red rays are in focus, the corresponding focus being a little below Hγ; fig. δ when focused on Hγ.

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[1] See Abney and Festing, Bakerian Lecture, *Phil. Trans.*, 1886; also *Photographic News*, May 1886, p. 322.

Photographic object-glasses.

When a telescope is to be constructed for photographic purposes the aim should be to unite, as perfectly as possible, the rays near that portion of the spectrum which act most powerfully on the photographic plate to be employed. This latter point has been determined for the various photographic processes by Captain Abney.[1] The results are shown graphically in fig. 6 for the processes practically employed at present in astronomical photography.

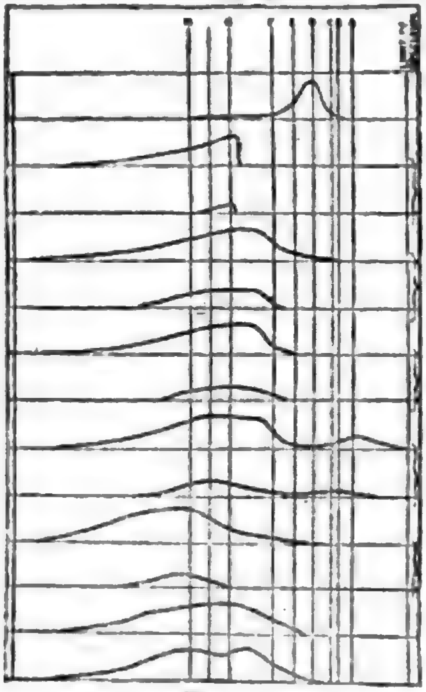

Fig. 6.

To unite the rays near G or H the angle of the flint prism must be diminished; that is, the focal length of the flint lens must be lengthened as compared with that of an object-glass of similar construction suited for eye observations; and the rays of greatest photographic action can be united more perfectly than the visible rays.

Triple object-glasses.

If an object-glass is composed of three lenses of different kinds of glass it is theoretically possible to unite three instead of two points of the spectrum, besides improving the correction for spherical aberration. The most important practical applications of such a system have been—(1) the triple object-glass of John Dollond; (2) the application of a convex crown glass in front of an ordinary object-glass in order to alter its chromatic correction from that best suited for eye observations to that best suited for photographic observation. John Dollond's object-glass is generally described as a concave flint lens between two crown lenses. If the crown lenses are of similar glass, there is no gain as to the correction of the secondary spectrum; it becomes only possible to correct the spherical aberration more perfectly. Very few telescopes with triple object-glasses have been made since the days of John Dollond. But the great and detrimental obtrusiveness of the secondary spectrum in the large object-glasses of the present day can be diminished in no other way, unless very extreme focal lengths are adopted, or some new kinds of glass that can be produced in large disks are discovered, in which the irrationality of their spectra is less, and in which also there is the necessary difference in the relation between refractive index and dispersive power. The cost of a triple object-glass would of course be at least 50 per cent. greater than that of a double object-glass; but, on the other hand, the extreme focal length necessary for large object-glasses might be considerably reduced. Thus the cost saved by a less heavy mounting and a smaller observatory and dome might counterbalance to some extent, if not entirely, the additional cost of the triple object-glass. Dr Schröder has constructed for the present writer an exquisite triple object-glass (three different kinds of glass) of 3½-inches aperture and only 18-inches focal length. Its performance with its highest eye-piece of ½-inch focus (power 72) is most admirable. It would probably be impossible to construct large telescopes approaching such short focal length, but there is no doubt that a large triple object-glass of 10 or 12 apertures focus would have an enormous advantage in colour correction, and probably in spherical aberration, over a double object-glass of the same aperture and much greater focal length. One peculiarity of such a triple object-glass is that three points in the spectrum can have the same focus, and therefore the point of minimum focus may for the best chromatic adjustment not quite correspond with the focal point for the brightest part of the spectrum; but, obviously, the rays of the whole visible spectrum may thus be brought to intersect the axis much more nearly at the same point. There will probably be a far wider adoption of the triple object-glass in the future, especially as the greater intrinsic brilliancy of the image in short-focus telescopes is a matter of high importance in the spectroscopic and photographic processes of modern astronomy. On the subject of triple object-glasses the reader is referred to an admirable paper by Professor C. S. Hastings (*Amer. Journal of Science and Arts* for December 1879, p. 429), which exhibits the results to be got from combinations of different existing kinds of glass.

The following table exhibits the excess of the focus for any ray over the true focus, the unit being [illegible] of the focal length, in—I. the actual results of Dr Vogel's observations on three existing object-glasses already quoted, but each reduced to comparison with its true or minimum focus; II. the theoretically best possible results from a double object-glass consisting of Feil's crown 1219 and Feil's flint 1237, as computed by Hastings; III. the theoretical results of four different triple object-glasses, capable of practical construction, of which details are given by Hastings

	Double Object-Glasses.				Triple Object-Glasses.			
	I.			II.	III.			
	Fraunhofer.	Grubb.	Schröder.	Hastings.	Hastings 1	Hastings 2	Hastings 3	Hastings 4
A	..	..	..	+ 136	..	+ 2	..	− 3
B	+ 47	+ 64	+ 106	+ 66	+ 1	− 63	− 22	− 35
C	+ 36	+ 41	+ 78	+ 41	0	+ 41	+ 91	+ 50
D	0	+ 6	+ 23	0	0	+ 28	+ 41	+ 2
E	+ 27	+ 39	0	+ 18	+ 25	− 10	− 67	− 10
F	+ 64	+ 56	+ 83	+ 73	0	− 14	− 60	− 4
G	+ 171	+ 226	+ 243	+ 287	0	+ 2	+ 21	− 3

Prof. Hastings's first condition in these computations is that the radius of curvature of none of the surfaces shall exceed one-fifteenth of the focal length. He also neglects the thickness and distance apart of the lenses, since these affect chiefly the focal length, but do not very materially affect the difference of the foci for different rays. The expression for the focal length F is then

$$\phi=(\mu'-1)\left(\frac{1}{r_1}+\frac{1}{r_2}\right)+(\mu''-1)\left(\frac{1}{r_3}+\frac{1}{r_4}\right)+(\mu'''-1)\left(\frac{1}{r_5}+\frac{1}{r_6}\right),$$

where $\phi=\frac{1}{F}$, μ', μ'', μ''' are the indexes of refraction for the three kinds of glass, and $r_1, r_2, \ldots r_6$ the radii of curvature for the six successive surfaces. Writing this in the form

$$\phi=(\mu'-1)A+(\mu''-1)B+(\mu'''-1)C,$$

we may call A, B, and C the *curvature sums* of the first, second, and third lenses respectively. The problem then is to find, for existing specimens of glass, values of A, B, and C no one of which shall exceed 30 when $\phi=1$, and which shall make ϕ independent of the wave-length of the light transmitted. The resulting values of A, B, and C for the first combination (marked "Hastings 1") are

A	B	C
2·47026	7·20827	− 8·35472;

the curvatures are therefore very moderate and perfectly practicable. The constants for the glass of the first and second lenses have been determined by the author with great accuracy (see *Amer. Jour.*, vol. xv. p. 273). The third glass is Fraunhofer's flint 13 (Hastings ι, misprinted ν in his table, in *Amer. Jour.*, vol. xviii. p. 131), for which the constants are given in Schumacher's *Astron. Abhandlung für 1823*. If this glass can be reproduced in large disks, as no doubt it could be, we have the means of making an object-glass very superior to any in existence and equally available for eye and photographic observation. Such an object-glass could be made of much shorter proportional focus than is usual or possible in double object-glasses, not only because of the absence of secondary spectrum but also from the command afforded over the spherical aberration by six surfaces. After satisfying the conditions of focal length, the first power of the spherical aberration, and two conditions of achromatism, we have still two available arbitrary conditions, which may be that $r_2 = r_3$ and $r_4 = r_5$. If these lead to convenient forms, as seems likely in the case in point, the whole may constitute a cemented lens; thus the loss of light at the interior surfaces may be eliminated, and the final perfecting of the spherical aberration be left to the figuring of the surfaces.

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[1] *Proc. Roy. Soc.*, vol. xxxiii. pp. 164-186.

Change of chromatic correction by separating lenses.

In some recent large double object-glasses, especially those of Alvan Clark, it has been usual to leave a space between the crown and the flint lens sufficient to afford access, through apertures in the cell, for cleaning the inner crown and flint surfaces, without risk of disturbing the lenses and their centring.[1] If in fig. 3 we imagine the lenses to be considerably separated and through both lenses trace a ray entering the crown lens parallel to and at some distance from the axis, we shall find that the effect of the separation is to diminish the power of the flint lens, and therefore to change the character of the chromatic aberration. Thus an object-glass over-corrected for colour can be improved in this respect by increasing the distance between the lenses. It has been suggested that a telescope can be made suitable for both eye observation and photographic purposes if means are provided for increasing the distance between the lenses without risk of deranging the centring when the telescope is to be employed for photography. But the great change that would be necessary in such a case cannot be brought about consistently with preservation of the perfection of the corrections for spherical aberration.[2]

Vernon Harcourt's phosphatic glass.

Any account of the achromatic object-glass would be incomplete without reference to the labours of the Rev. W. Vernon Harcourt and Prof. Stokes. Experiments in the production of optical glass were instituted by the former in 1834; and specimens, exhibited at the meeting of the British Association at Cambridge in 1862, were placed in the hands of Prof. Stokes, who determined the optical constants of the numerous specimens of glass which Harcourt produced, and indicated from these results the direction in which fresh experiments should be undertaken. It was discovered that titanic acid extends the blue end of the spectrum more than corresponds to the dispersive power of the glass, whilst boracic acid has the opposite effect (*Report Brit. Assoc.*, 1871, p. 38). At a meeting of the British Association at Belfast in 1874 a telescope was exhibited whose object-glass was constructed from Harcourt's glass by Sir Howard Grubb of Dublin. The following is Prof. Stokes's complete and concise account of it.

> "The original intention was to construct the objective of a phosphatic glass containing a suitable percentage of titanic acid, achromatized by a glass of terborate of lead. (The percentage of titanic acid was so chosen that there should be no irrationality of dispersion between the titanic glass and the terborate.) As the curvature of the convex lens would be rather severe if the whole convex power were thrown into a single lens, it was intended to use two lenses of this glass, one in front and one behind, with the concave terborate of lead placed between them. It was found that, provided not more than about one-third of the convex power were thrown behind, the adjacent surfaces might be made to fit, consistently with the condition of destroying the spherical as well as the chromatic aberration. This would render it possible to cement the glasses, and thereby protect the terborate, which was rather liable to tarnish. At the time of Mr Harcourt's death two disks of the titanic glass had been prepared which it was hoped would be good enough for employment, as also two disks of terborate. These were placed in Mr Grubb's hands. On polishing, one of the titanic disks was found to be too badly striated to be employed; the other was pretty fair. As it would have required a rather severe curvature of the first surface and an unusual convexity of the last to throw the whole convex power into the first lens, using a mere shell of glass to protect the terborate, Professor Stokes thought it more prudent to throw about one-sixth of the whole convex power into the third or crown glass lens, though at the sacrifice of an *absolute* destruction of secondary dispersion, which by this change from the original design might be expected to be just barely perceptible. Of the terborate disks, the less striated happened to be slightly muddy, from some accident in the preparation; but, as this signified less than the striæ, Mr Grubb deemed it better to employ this disk. The telescope exhibited to the meeting was of about 2½-inches aperture and 28-inches focal length, and was provided with an object-glass of the ordinary kind, by which the other could be replaced, for contrasting the performance. When the telescope was turned on to a chimney seen against the sky or other suitable object, and half the object-glass covered by a screen with its edge parallel to the edges of the object, in the case of the ordinary objective vivid green and purple were seen about the two edges, whereas with the Harcourt objective there was barely any perceptible colour. It was not of course to be expected that the performance of the telescope should be good, on account of the difficulty of preparing glass free from striæ, but it was quite sufficient to show the possibility of destroying the secondary colour."

An experiment to determine whether the substitution of titanic acid for a portion of the silica in ordinary crown glass would have an effect similar to that which had been observed in the phosphatic series of glasses (viz., whilst somewhat raising the dispersive power, to produce a separation of the colours at the blue as compared with the red end of the spectrum, to an extent ordinarily belonging only to glass of much higher dispersive power) was carried out by Mr Hopkinson at the glass works of Messrs Chance of Birmingham; but it proved unfortunately in this combination that, whilst the dispersive power was increased, as in the phosphatic glasses, the blue end of the spectrum, as compared with the red end, was not spread out more than in ordinary glass of like dispersive power (*Report Brit. Assoc.*, 1875, p. 26). It is to be hoped, however, that makers of optical glass will not relax their efforts till astronomers shall be able to obtain refracting telescopes in which the secondary spectrum is nearly if not quite eliminated. Abbe's new optical glass[3] leads one to believe that this hope will soon be realized.

The addition of a convex crown lens in front of the ordinary object-glass, to diminish the colour-correction and change the minimum focus from that for rays between D and E to that for rays near G, was first made by Rutherford of New York. In this way he altered his telescope from one suited for eye observations to one in the best chromatic adjustment for photographic work. The chromatic effect is the same as increasing the convexity of the crown lens, and by proper proportioning of the two radii of curvature it becomes possible also to conserve, and even to further perfect, the destruction of spherical aberration. The great object-glass of 36-inches aperture, now (1887) under construction for the Lick observatory by Messrs Clarke of Boston (Mass.), is to be provided with an additional crown lens for this purpose.[4]

Blair's achromatic fluid object-glasses.

The problem of making a perfectly achromatic object-glass has been solved by Dr Blair (*Edin. Trans.*, vol. iii. p. 53) by employing fluid media, and he actually constructed an object-glass consisting of a plano-convex lens and a meniscus lens, both of crown glass with their convexities turned towards each other, the space between the lenses being filled with hydrochloric acid. Unfortunately such combinations are practically useless, not only on account of unavoidable leakage, but also because currents are set up in fluid lenses by changes of temperature, which correspond in effect with want of homogeneity in the flint lens in an ordinary object-glass.

Eye-Pieces.

Eye-pieces.

The first substitute for the single lens of the Galilean and Kepler telescopes was the compound eye-piece invented by Rheita. Behind the convex eye-lens of the Kepler telescope he applied a second short telescope, consisting of two convex lenses, their distance being the sum of their focal lengths. The principal effect was to erect the inverted image, and thus to constitute the simplest form of the day eye-piece, or common terrestrial telescope. The next improvement was the Huygenian eye-piece, which consists of two convex lenses (see fig. 7),—the "field-lens," that next the object-glass, having its focal length to that of the "eye-lens" as 3 to 1; the distance between them is twice the focal length of the latter, the combination being so placed as to form the visible image half-way between the two. This eye-piece is achromatic in the sense in which an eye-piece is said to be so: a colourless image seen through it does not appear bordered with coloured fringes, as is the case with a single lens or Rheita's eye-piece. This is not because, as in the achromatic object-glass, all the central coloured rays are collected in one focus, which in the case of an eye-piece is a matter of comparatively small consequence, but because it possesses the same magnifying power for rays of all colours on an object of sensible angular diameter, so as not to form overlapping coloured pictures of it on the retina. This condition it is which furnishes the "equation of achromaticity" of an eye-piece. An expression for the magnifying power of a telescope provided with a certain eye-piece is formed in general terms which involve the focal length of its lenses, their distances from each other, and their refractive indexes; and, this being made to vary by the variation of the last-mentioned elements only, the variation is equated to zero. The algebraic working, which even for a two-glass eye-piece is a little complex, is given in H. Lloyd's *Treatise on Light and Vision* (London, 1831), and in an elaborate paper by Littrow in the fourth volume of the *Trans. Roy. Astron. Soc.* (p. 599). From the former we extract the following proposition: An eye-glass of two lenses of the same medium is achromatic when the interval between the lenses is an arithmetical mean between their focal length,—a condition which the Huygenian construction evidently satisfies. The rationale of this is obvious, independently of algebraic analysis, by inspection of the course of the rays in fig. 7, where AC, BD are the lenses, PQ the image which would be formed by the object-glass alone, *pq* that really formed by the action of the field-glass. The object-glass being supposed achromatic, a ray of white light, as OC, going to form the image of a point Q, will be refracted by the field-glass at O towards the corresponding point *q* of the new image, but not as a

Huygenian eye-piece.

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[1] This arrangement also helps to equalize the temperatures of the lenses with each other and with the outer air.

[2] Quite recently Prof. Stokes has suggested that to adapt a telescope to either photographic or telescopic purposes at pleasure the crown lens should be reversible as well as changeable as to distance with respect to the flint. In this way doubtless the chromatic and spherical aberration could be preserved for the two kinds of work.

[3] See *Nature*, vol. xxxiv. p. 622, 28th October 1886.

[4] For recent literature on the secondary spectrum in double and triple object-glasses, &c., see W. Schmidt, *Die Brechung des Lichtes in Gläsern, insbesondere d. achromat. und aplanat. Objectivlinse*, Leipzic, 1874; W. Harkness, "On the Colour Correction of Achromatic Telescopes," in *Amer. Jour. of Science and Arts*, September 1879, pp. 189-196; C. S. Hastings, "Triple Objectives with Complete Colour Correction," *ib.*, December 1879, pp. 429-435; Perty, *Ueber die Grenzen der sichtbaren Schöpfung nach den jetzigen Leistungen der Mikroskope und Fernröhre*, Berlin, 1874; H. C. Vogel, *Ueber eine einfache Methode zur Bestimmung der Brennpunkte und der Abweichungskreise eines Fernrohr-Objectivs für Strahlen von verschiedener Brechbarkeit*; C. A. Young, "The Colour-Correction of Certain Achromatic Object-Glasses," in *Amer. Jour. Sci.*, June 1880, pp. 454-456; also a review of these papers by A. Safarik, *Vierteljahrschrift der astronomischen Gesellschaft*, 1882, pp. 13-30.

single white ray; it will be separated into coloured rays, following different courses. The red ray C*r* being less refracted will fall on a point *r* of the eye-glass more remote from its centre B than

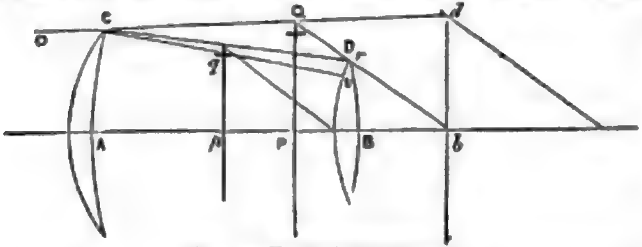

FIG. 7.—Huygenian eye-piece.

the violet ray C*v*, and (the prismaticity of the lens increasing from the centre outwards) will in proportion by the second transmission be more bent aside than the violet, and thus a compensation is effected, and the two rays finally emerge parallel, their exact parallelism being secured by the proportion of their focal lengths. The Huygenian eye-piece possesses also other important advantages. The total deflexion of the light, to produce the magnifying power, is equally divided between the two glasses,—the most favourable condition for diminishing that distortion which is always perceived in looking obliquely through a lens; and the field of view is greatly enlarged in proportion to the size of the eye-lens, being such as would require, to produce the same magnifying power, a single lens of the much greater semi-diameter *bd*, found by drawing Q*b* parallel to *q*B and erecting *bd*. The inconvenience of this eye-piece (whence it is improperly termed a negative eye-piece) is that the image, being formed between its lenses, undergoes a certain amount of distortion by the field-glass, owing to which equal linear portions of it do not correspond precisely to equal angular measures of the distant object. Equal parts of a micrometer applied at the place of the image, so as to be seen at the same time through the eye-lens, will not correspond to precisely equal angular intervals.

Common or positive eye-piece.

The common astronomical or positive eye-piece, described by Ramsden (*Phil. Trans.*, 1783), consists of two plano-convex lenses of equal lengths, having their convexities turned towards each other and separated by two-thirds of the focal length of either, as in fig. 8. This combination is placed behind the image PQ formed by the object-glass, at a distance AP equal to one-fourth of the focal length of A. The first or field-glass, therefore, forms an enlarged image *pq*, at a distance one-third of that focal length which places it in the focus of the eye-glass. This eye-piece is not properly achromatic, but its spherical aberration is much less than in any of the other constructions, and it has the advantage of giving a flat field of view, requiring no change of focus to see the centre and borders of the field with equal distinctness.

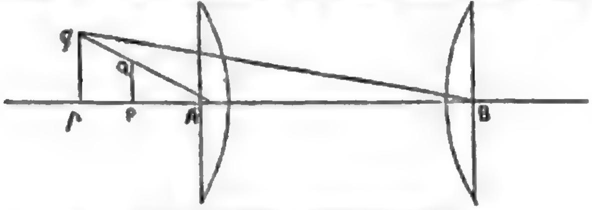

FIG. 8.—Common or positive eye-piece.

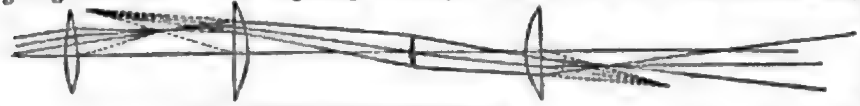

FIG. 9.—Erecting or terrestrial eye-piece.

Erecting or terrestrial eye-piece.

The erecting or terrestrial eye-piece was invented by Dollond. The principle of its construction will be understood from fig. 9. It is convenient for telescopes of ordinary use, because it presents a non-inverted image to the eye, although at some sacrifice of light and definition.

Airy on eye-pieces.

For an account of the theory of the chromatic and spherical aberration of eye-pieces by Sir George B. Airy, see *Trans. Phil. Soc. Camb.*, vol. ii. p. 243 and vol. iii. p. 61. The author's conclusions are the following. (1) To secure the greatest distinctness with an eye-piece of the Huygenian type, the field-lens should be a meniscus of focal length 3, the radii of its surfaces 11:4, and its convexity towards the object-glass; the eye-lens should be a double convex of focal length 1, the radii of its surfaces 1:6, and its more convex side towards the field-lens. The distance of the lenses should be 2. There should be a perforated diaphragm at distance 1 from the eye-lens. If a bright object appears yellow or a dark one blue at the edge farthest from the centre of the field, the lenses must be brought a little nearer together. (2) For an eye-piece of Ramsden's type the two lenses should be plano-convex, of focal length 3, placed at distance 2, their convex surfaces being turned towards each other. (3) For an erecting eye-piece of four lenses the first and fourth (reckoned from the object-glass towards the eye) should be crossed lenses of focal length 3, the radii of their surfaces 1:6, with their convex surfaces towards each other. The second lens should be a meniscus of focal length 4, the radii of its surfaces 25:11, and its convexity towards the eye. The third lens should be plano-convex, of focal length 4, its plane side towards the eye. The distance of the centre of the second lens from that of the first = 4; that of the third from the second = 6; and that of the fourth from the third = 5·13. If a bright object appears yellow or a dark one blue at the edge farthest from the centre of the field, the third and fourth lenses must be together pushed inwards towards the second lens.

In many telescopes constructed specially for star observation only the object-glass is over-corrected for colour and under-corrected for spherical aberration; both these errors may sometimes be nearly eliminated by a properly constructed Huygenian eye-piece (see MICROSCOPE, vol. xvi. pp. 266-267). But, when a telescope is to be used over a considerable range of field for micrometric measurements, it is obvious that the spherical aberration should be corrected by the object-glass alone. It is possible, however, to improve the appearance of objects somewhat in a telescope in which the chromatic aberration is over-corrected by employing an eye-piece somewhat under-corrected for colour, and *vice versa*; but the only satisfactory plan is to have both object-glass and eye-piece as free as possible from both chromatic and spherical aberration. In order to secure this, or a very large field of view, many forms of eye-piece have been devised. Achromatic combinations have been substituted in some cases for the field-lens, in others for the eye-lens, in others for both simple lenses of the Ramsden eye-piece. The best of these combinations which the present writer has tested and which practically fulfil all requirements of the astronomer are due to Dr Hugo Schröder, to whom he is indebted for information as to their construction.

H. Schröder's high power eye-piece.

Fig. 10 represents Schröder's high power eye-piece, which is admirably suited for micrometer work, not only because there are only two reflecting surfaces in the triple lens of which it is composed, but also because there is a comparatively large distance between the lens and the micrometer web when the latter is in focus. This condition is essential when it is desired to get the best bright illumination of the wires in a dark field (see MICROMETER, vol. xvi. p. 218). The triple lens is composed of a dense fluid plano-convex lens between two lenses of soft crown glass. The radii of curvature are—

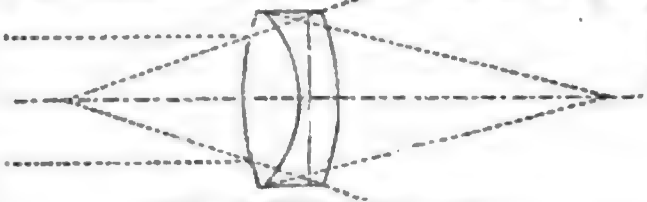

FIG. 10.—Schröder's high power eye-piece.

	r_1 = 80·026	convex	soft crown glass,
surfaces cemented	r_2 = 36·536	convex	
	r_3 = 36·536	concave	dense flint glass,
surfaces cemented	r_4 = ∞	plano	
	r_5 = ∞	plane	soft crown glass.
	r_6 = 80·026	convex	

The corresponding foci for zones of different distance from the axis are—axis = 100·00; zones 12·5 from axis, 99·81; 25 from axis, 99·32; 40 from axis, 98·36; 45 from axis, 100·15; 50 from axis, 101·85. Thus the aperture of the lens may be half its focal length without any sensible defect.

O. Schröder's aplanatic eye-piece.

Fig. 11 represents Dr O. Schröder's aplanatic eye-piece. The glass employed is Dauget's crown (Cb_1) and flint (Fb_1). The refractive power of crown is 1·5126 for D, that of flint 1·6405; the dispersive power of both kinds of glass is 9·588.

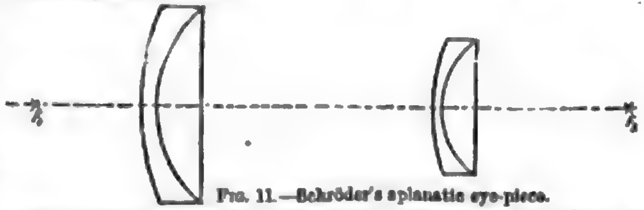

FIG. 11.—Schröder's aplanatic eye-piece.

The radii of curvature for a lens of 1 inch (27·07 mm.) focal length are—

mm.	mm.
r_1 = 20·12	r_5 = 13·20
r_2 = r_3 = 10·94 cemented	r_6 = r_7 = 7·00 cemented
r_4 = ∞	r_8 = ∞

F_1 = focal point of combination = − 9·05 mm. from vertex of r_1;
F_2 = position of observer's eye = − 14·49 mm. from vertex of r_8.

The thicknesses and distances apart of the surfaces are—

1st vertex	to 3d	= 0·70	mm.	flint glass,
3d	,, ,, 4th	= 3·50	,,	crown glass,
4th	,, ,, 5th	= 19·51	,,	air,
5th	,, ,, 6th	= 0·61	,,	flint glass,
7th	,, ,, 8th	= 2·45	,,	crown glass.

The distance between the plane surfaces is 22·57 mm. This form of eye-piece has been employed by Schönfeld in his southern "Durchmusterung," and Dr Schröder has made one for the present writer which gives a perfect field 4½° in diameter on the telescope of 18 inches focal length and 3¼ inches aperture already referred to.

Reflecting Telescope.

The following are the various forms of reflecting telescopes. The Gregorian telescope is represented in fig. 12. AA and BB are concave mirrors having a common axis and their concavities facing each other. The focus of A for parallel rays is at F, that of B for parallel rays at *f*—between B and F. Parallel rays falling on AA converge at F, where an image is formed; the rays are then reflected from B and converge at P, where a second and more enlarged image is formed. Gregory himself showed that, if the large mirror were a segment of a paraboloid of revolution whose focus is F, and the small mirror an ellipsoid of revolution whose foci are F and P respectively, the resulting image will be plane and undistorted. The image formed at P is viewed through the eye-piece at E, which may be of the Huygenian or Ramsden type. The focal adjustment is accomplished by the screw S, which acts on a slide carrying an arm to which the mirror B is attached. The practical difficulty of constructing Gregorian telescopes of good defining quality is very considerable, because if spherical mirrors are employed their aberrations tend to increase each other, and it is extremely difficult to give a true elliptic figure to the necessarily deep concavity of the small speculum. Short appears to have systematically conquered this difficulty, and his Gregorian telescopes attained great celebrity. The use of the Gregorian form is, however, practically abandoned in the present day. The magnifying power of the telescope is $=\frac{F+f}{e+x}$, where F and *f* are respectively the focal lengths of the large and the small mirror, *e* the focal length of the eye-piece, and *x* the distance between the principal foci of the two mirrors (=F*f* in the diagram) when the instrument is in adjustment for viewing distant objects. The images are erect.

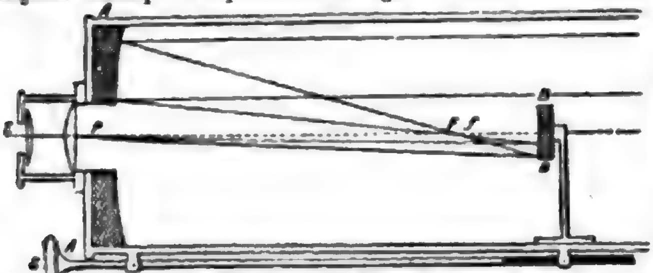

Fig. 12.—Gregorian telescope.

The Cassegrain telescope differs from the Gregorian only in the substitution of a convex hyperbolic mirror for a concave elliptical mirror as the small speculum. This form has two distinct advantages: (1) if spherical mirrors are employed their aberrations have a tendency to correct each other; (2) the instrument is shorter than the Gregorian, *cæteris paribus*, by twice the focal length of the small mirror. Fewer telescopes have been made of this than perhaps of any other form of reflector; but in comparatively recent years the Cassegrain has acquired importance from the fact of its adoption for the great Melbourne telescope. The magnifying power is computed by the same formula as in the case of the Gregorian telescope.

The Newtonian telescope is represented in fig. 13. AA is a concave mirror whose axis is *aa*. Parallel rays falling on AA converge on the plane mirror BB, and are thence reflected at right angles to the axis, forming an image in the focus of the eye-piece E. The surface of the large mirror should be a paraboloid of revolution, that of the small mirror a true optical plane. The magnifying power is $=F/e$. This form is employed in the construction of most modern reflecting telescopes. A glass prism of total reflexion is sometimes substituted for the plane mirror.

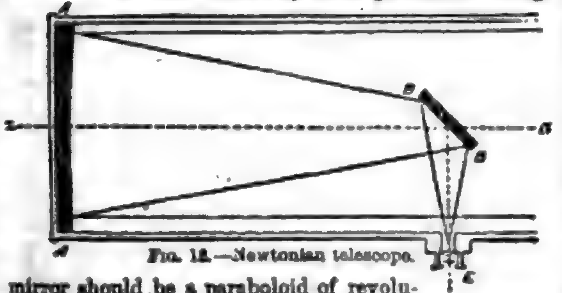

Fig. 13.—Newtonian telescope.

The Herschelian or front view reflector is represented in fig. 14. AA is a concave parabolic mirror, whose axis *ac* is inclined to the axis of the tube *ab* so that the image of an object in the focus of the mirror may be viewed by an eye-piece at E, the angle *bae* being equal to the angle *eaE*. This form was adopted by the elder Herschel to avoid the loss of light from reflexion in the small mirror of the Newtonian telescope. It has several disadvantages. (1) The upper part of the observer's head must necessarily obstruct some of the rays which would otherwise fall on the large mirror; but when a telescope of very large aperture is employed the loss of light thus occasioned is comparatively insignificant. Moreover, disturbance of the air in front of the telescope is created by heat from the observer's head and body, and this is fatal to the best definition. To avoid the latter drawback Sir John Herschel (*Ency. Brit.*, 8th ed., art. "Telescope," vol. xxi. p. 128) suggested the employment of a small right-angled prism of total reflexion placed close to the eye-lens of the eye-piece, to permit the observer to view the image by looking in a direction at right angles to the eye-piece, and therefore at right angles to the tube. (2) In consequence of the tilting of the mirror aberration is created, and this increases rapidly with increased tilting. The construction is thus limited to telescopes in which the proportion of aperture to focal length is not too great. In Herschel's 40-feet telescope the proportion was 1 to 10, and the construction would hardly be applicable to modern telescopes, in which the proportion often rises to 1 to 5 or 6. Yet, when exceedingly faint objects have to be observed, this form of telescope has great advantages. Herschel found that some objects which he discovered with such an instrument could not even be seen when the same telescope was used in the Newtonian form. The front view telescope, however, has hardly been at all employed except by the Herschels. But at the same time none but the Herschels have swept the whole sky for the discovery of faint nebulæ; and probably no other astronomers have worked for so many hours on end for so many nights as they did, and they emphasize the easy position of the observer in using this form of instrument.

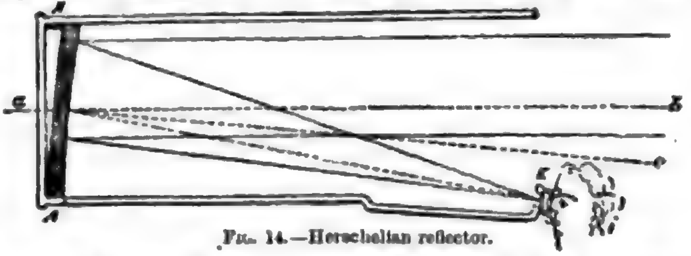

Fig. 14.—Herschelian reflector.

Construction of Object-Glasses.

Testing glasses.

The first point is the selection of glass disks of suitable quality. The requisites are (1) general transparency and freedom from mechanical defects, such as specks, air-bubbles, &c.; (2) homogeneity; (3) freedom from internal strain. The disk being roughly polished on the sides, faults of the first class are easily detected by inspection. In order to secure the maximum of light grasp for aperture it is desirable that the glass should be as colourless as possible; if the roughly polished disk is laid upon white paper the amount of discoloration can be readily estimated by comparing the colour of the sheet as seen directly with that seen through the glass. Fraunhofer's glass was far from colourless, Dollond's more coloured still; and we have shown that, for purposes when extreme light grasp is not an object, the less transparency of such glass to the blue rays of the spectrum affords advantages for a better correction of the chromatic aberration of rays in the brighter part of the spectrum. The amount of light excluded by specks, air-bubbles, or even scratches is quite insignificant; but these blemishes create diffraction phenomena and scattered light in the field, which are very injurious to the performance of the instrument, especially when faint objects are searched for in the neighbourhood of brighter ones. It is essential for a telescope lens that the glass should be perfectly homogeneous; that is, the refractive index must be identical for every part of the disk. This can be tested with extreme delicacy by grinding the disk into the form of a lens and testing it by Töppler's method,[1] described under OPTICS (vol. xvii. p. 805). If the disk is intended for a concave lens and is already so thin that it becomes undesirable to make it thinner at the edges by converting it, in the first place, into a convex lens, it may be tested by placing one of its surfaces in contact with and at right angles to the axis of a crown lens of known perfection, and testing the combination by Töppler's method.

Annealing.

If a glass disk is not properly annealed—that is, if it has been too quickly cooled, so that the outer shell has hardened before the inner portion—the finally solidified mass must be in a state of tension, like that of "Rupert's drops." Unless cooled very gradually an optical disk would fly to pieces, but a very much smaller defect in the annealing process would be fatal for refined optical purposes. Changes of temperature would produce changes of curvature, and the lens would also change its form when successive portions of the strained outer shell were removed in the process of grinding and polishing. Fortunately, defects in annealing are very easily detected by means of the polariscope. The polished disk is placed in light reflected from a polarizing surface, such as a sheet of glass blackened at the back, and examined with a Nicol's prism as an analyser. If the bright rings and black cross (see LIGHT, vol. xiv. p. 613) are visible the disk is unfit for use; but, since few disks are so perfectly annealed as not to show a trace of the black cross, such as show it in no marked degree may be safely employed. Perfect annealing has now become the most difficult portion of the art of making optical glass, and large disks (more particularly of crown glass) are rejected by the optician more frequently for defects in annealing than for any other cause.

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[1] *Pogg. Annal.*, cxxxi., 1867.

The disks having been selected, their refractive and dispersive powers determined, and the radii of curvature computed, it remains to convert the disks into lenses with surfaces of the required curvature, and to complete the object-glass. The work consists of five distinct operations—(1) rough grinding by a revolving tool supplied with sand and water; (2) fine grinding with emery; (3) polishing with oxide of iron, rouge, or putty powder, the grinder being faced with fine cloth, satin, paper, or—best of all—pitch; (4) centring; (5) figuring and testing. These processes are essentially of a technical character, and can only be familiar to those who practise the art. The details would be out of place here, but are well described in a lecture delivered by Sir Howard Grubb at the Royal Institution, 6th April 1886, and printed in *Nature*, 27th May 1886.

Construction of Specula.

Construction of specula. The composition of metallic specula in the present day differs very little from that used by Sir Isaac Newton. Many different alloys have been suggested, some including silver, nickel, zinc, or arsenic; but that which has practically been found best is an alloy of four equivalents of copper to one of tin, or the following proportions by weight:—copper 252, tin 117·8. Such speculum metal is exceedingly hard and brittle, takes a fine white polish, and when protected from damp has little liability to tarnish. The process of casting and annealing, in the case of the specula of the great Melbourne telescope, was admirably described by Dr Robinson in *Phil. Trans.*, 1869, vol. clix. p. 135. Shaping, polishing, and figuring of specula are accomplished by methods and tools precisely similar to those employed in the construction of lenses. The reflecting surface is first ground to a spherical form, the parabolic figure being given in the final process by regulating the size of the pitch squares and the stroke of the polishing machine. The process of testing is identical with that of an object-glass.

Soon after Liebig's discovery of a process for depositing a film of pure metallic silver upon glass from a salt of silver in solution, Steinheil (*Gaz. Univ. d'Augsburg*, 24th March 1856), and later, independently, Foucault (*Comptes Rendus*, vol. xliv., February 1857), proposed to employ glass for the specula of telescopes, the reflecting surface of the glass speculum to be covered with silver by Liebig's process. These silver-on-glass specula are now the rivals of the achromatic telescope, and it is not probable that many telescopes with metal specula will be made in the future. The best speculum metal and the greatest care are no guarantee of freedom from tarnish, and, if such a mirror is much exposed, as it must be in the hands of an active observer, frequent repolishing will be necessary. This involves refiguring, which is the most delicate and costly process of all. Every time, therefore, that a speculum is repolished, the future quality of the instrument is at stake; its focal length will probably be altered, and thus the value of the constants of the micrometer also have to be redetermined. Partly for these reasons the reflecting telescope with metallic mirror has never been a favourite with the professional astronomer, and has found little employment out of England. In England, in the hands of the Herschels, Rosse, Lassell, and De la Rue it has done splendid service, but in all these cases the astronomer and the instrument-maker were one. The silver-on-glass mirror has the enormous advantage that it can be resilvered with little trouble, at small expense, and without danger of changing the figure. Its chief work has been done in the hands of Draper and Common, who were the engineers, if not the actual constructors, of their own instruments. Glass is lighter, stiffer, less costly, and easier to work than speculum metal. The silvered mirrors have also some advantage in light grasp over those of speculum metal, though, aperture for aperture, the former are inferior to the modern object-glass. Comparisons of light grasp derived from small, fresh, carefully silvered surfaces are sometimes given which lead to illusory results, and from such experiments Foucault claimed superiority for the silvered speculum over the object-glass. But the present writer has found from experience and careful comparison that a silvered mirror of 12-inches aperture mounted as a Newtonian telescope (with a silvered plane for the small mirror), when the surfaces are in fair average condition, is equal in light grasp to a first-rate refractor of 10-inches aperture, or area for area as 2 : 3. This ratio will become more equal for larger sizes on account of the additional thickness of larger object-glasses and the consequent additional absorption of light in transmission.

Mounting of Telescopes.

Mounting of telescopes. The proper mounting of a telescope is hardly of less importance than its optical perfection. Freedom from tremor, ease and delicacy of movement, facility of directing the instrument to any desired point in the heavens, are the primary qualifications. Our limits forbid an historical account of the earlier endeavours to fulfil these ends by means of motions in altitude and azimuth, nor can we do more than refer to mountings such as those employed by the Herschels, or those designed by Lord Rosse to overcome the engineering difficulties of mounting his huge telescope of 6 feet aperture. Both are abundantly illustrated in most popular works on astronomy, and it seems sufficient to refer the reader to the original descriptions.[1]

Equatorial. We pass, therefore, directly to the equatorial telescope, the instrument *par excellence* of the modern extra-meridian astronomer, and relegate to the article TRANSIT CIRCLE (*q.v.*) a description of those mountings in which the telescope is simply a refined substitute for the sights or pinules of the old astronomers. The equatorial in its simplest form consists of an axis parallel to the earth's axis, called the "polar axis"; a second axis, at right angles to this, called the "declination axis"; and a telescope fixed at right angles to the latter. In fig. 15 AA is the polar axis; the telescope is attached to the end of the declination axis; the latter rotates in bearings attached to the polar axis, and concealed by the telescope itself. The telescope is counterpoised by a weight attached to the opposite end of the declination axis. The lower pivot of the polar axis rests on a cup bearing at C, the upper pivot upon a strong metal casting MM, attached to a stone pier S. A vertical plane passing through AA is therefore in the meridian, and, when the declination axis is horizontal, the telescope moves in the plane of the meridian by rotation on the declination axis only. Thus, if a graduated circle BB is attached to the declination axis, together with the necessary microscopes or verniers V, V for reading it (see TRANSIT CIRCLE), so arranged that when the telescope is turned on the declination axis till it is parallel to AA the vernier reads 0° or 90°, and when at right angles to AA 90° or 0°, then we can employ the readings of this circle to measure the polar distance or declination of any star seen in the telescope, and these readings will also be true (apart from the effects of atmospheric refraction) if we rotate the instrument through any angle on the axis AA. Thus one important attribute of an equatorially mounted telescope is that, if it is directed to any fixed star, it will follow the diurnal motion of that star from rising to setting by rotation of the polar axis only. If we further attach to the polar axis a graduated circle DD, called the "hour circle," of which the microscope or vernier R reads 0^h when the declination axis is horizontal, we can obviously read off the hour angle from the meridian of any star to which the telescope may be directed at the instant of observation. If the local sidereal time of the observation is known, the right ascension of the star becomes known by adding the observed hour angle to the sidereal time if the star is west of the meridian, or subtracting it if east of the meridian. Since the equatorial is unsuitable for such observations when great accuracy is required (see TRANSIT CIRCLE), the declination and hour circles of an equatorial are employed not for determination of the right ascensions and declinations of celestial objects, but for directing the telescope with ease and certainty to any object situated in a known position, and which may or may not be visible to the unaided eye, or to define approximately the position of an unknown object. Further, by causing the hour circle, and with it the polar axis, to rotate by clockwork or some other mechanical contrivance at the same angular velocity as the earth on its axis, but in the opposite direction, the telescope will automatically follow a star from rising to setting.

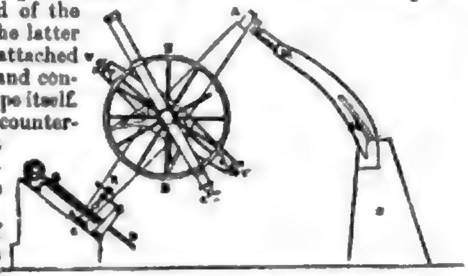

FIG. 15.—Equatorial telescope.

Types of equatorials. Equatorial mountings may be divided into five types. (A) The pivots or bearings of the polar axis are placed at its extremities. The declination axis rests on bearings attached to opposite sides of the polar axis. The telescope is attached to one end of the declination axis, and counterpoised by a weight at the other end, as in fig. 15. (B) The polar axis is supported as in type A; the telescope is placed between the bearings of the declination axis and is mounted symmetrically with respect to the polar axis; no counterpoise is therefore requisite. (C) The declination axis is mounted on the prolongation of the upper pivot of the polar axis; the telescope is placed at one end of the declination axis and counterpoised by a weight at the other end. (D) The declination axis is mounted on a forked piece or other similar contrivance attached to a prolongation of the upper pivot of the polar axis; the telescope is mounted between the pivots of the declination axis. (E) The eye-piece of the telescope is placed in the upper pivot of the polar axis; a portion or the whole of the axis of the telescope tube coincides with the polar axis. Mountings of types A and B—that is, with a long polar axis supported at both ends—are often called the "English mounting," and types C and D, in which the declination axis is placed on the extension of the upper pivot of the polar axis, are called the "German mounting," from the first employment of type C by Fraunhofer. A description of some of the best examples of each type will illustrate their relative advantages or peculiarities.

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[1] Herschel, *Phil. Trans.*, 1795, vol. lxxxv. p. 347; Rosse, *Phil. Trans.*, 1840, p. 503, and 1861, p. 681.

Type A.

Fig. 15 may be taken as a practical example of the earlier equatorials as made by Troughton in England and afterwards by Gambey for various Continental observatories. In the *Phil. Trans.* for 1824 (part 3, pp. 1-412) will be found a description by Sir John Herschel and Sir James South of the equatorial telescope which they employed in their measurements of double stars. The polar axis was similar in shape to that of fig. 15 and was composed of sheets of tinned iron. In Smyth's celebrated Bedford telescope the polar axis was of mahogany. Probably the best example of this type of mounting applied to a refractor is that made by the elder Cooke of York for Mr Fletcher of Tarnbank; the polar axis is of cast iron and the mounting very satisfactory and convenient, but unfortunately no detailed description has been published. In recent years no noteworthy refractors have been mounted on this plan; but type A has been chosen by Grubb for the great Melbourne reflector, with marked ingenuity of adaptation to the peculiar requirements of the case. Fig. 16 shows the whole instrument on a small scale, and fig. 17 represents part of it on a larger scale, the upper part of the tube and polar axis being omitted. The figures show the telescope directed to the pole, the hour circle being set 6^h from the meridian. The polar axis consists of a hollow cone C (fig. 17) of cast iron bolted to a hollow cast-iron cube H, to the lower side of which is attached a short steel axis carrying the driving sector EF and the hour circle R, and terminating in the lower pivot of the polar axis. This pivot *a* is terminated by a piece of chilled cast iron polished flat on its lower face, which face revolves in contact with a piece of bell metal, flat on its upper and partly spherical on its lower side, bearing in a correspondingly shaped annulus, formed to receive it in the cast-iron block which is attached to the pier. This arrangement enables the bell-metal cushion to take its own position when the direction of the polar axis is slightly changed in process of adjustment. The pressure of the pivot on its bearings, in the direction at right angles to the polar axis, is relieved by the sector A, which is forced up by the screw *d* acting through laminæ of steel springs. The end pressure of *a* upon its bearings is relieved by a weight. The friction of the upper pivot is relieved by a sector pressed up against it by the action of two weights. In this way, although the moving part of the telescope weighs 18,170 lb, it can be turned with a pressure of 12½ lb, acting at a radius of 20 feet. The driving sector EF is 5 feet in radius; its circular rim is accurately toothed to fit a square threaded endless screw E, which is turned by the driving clock. A toothed wheel attached to H and acted on by a pinion connected with a hand-wheel affords an easy means of setting the instrument in hour angle, or moving the telescope quickly in right ascension. The telescope is clamped by iron bands to the strong cast-iron cradle, which is cast with and forms one extremity of the declination axis. The counterpoise U is attached to the other extremity. There is an elegant arrangement for diminishing the friction of the declination axis, which our limits do not permit us to describe, and the means for clamping and giving slow motion in declination do not require special notice. The reader is referred for a fuller description to *Phil. Trans.*, 1869, pp. 127-161. The telescope is of the Cassegrain form, the mirror having a 4-feet aperture and 30½-feet focal length.

Great Melbourne telescope.

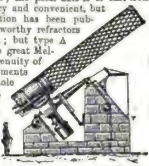

FIG. 16.—Melbourne reflector.

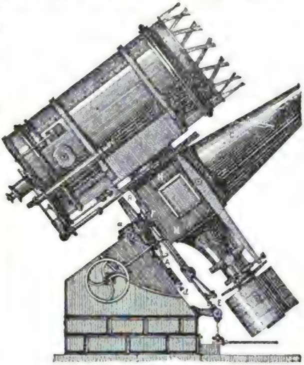

FIG. 17.—Section of Melbourne reflector.

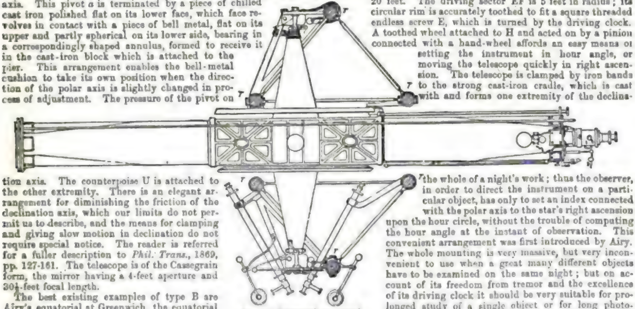

FIG. 18.—Greenwich equatorial.

ype B.

The best existing examples of type B are Airy's equatorial at Greenwich, the equatorial at Liverpool (also designed by Airy), and the photographic equatorial recently erected at the Paris observatory. The polar axis of the Greenwich equatorial consists of six iron tubes arranged so as to form two triangular braced beams connected by very strong elliptical wheels of cast iron, which carry the upper and lower pivots of the polar axis. These tubes are shown in section at the points T, fig. 18, which represents a section through the declination axis in the plane of the equator when the telescope is directed to a star at the equator (for the general arrangement of the mounting, see fig. 19). The driving circle is 6 feet in diameter, and turns freely on the lower pivot of the polar axis, under the action of the driving clock. The hour circle is graduated on the driving circle, and may be set to show sidereal time during the whole of a night's work; thus the observer, in order to direct the instrument on a particular object, has only to set an index connected with the polar axis to the star's right ascension upon the hour circle, without the trouble of computing the hour angle at the instant of observation. This convenient arrangement was first introduced by Airy. The whole mounting is very massive, but very inconvenient to use when a great many different objects have to be examined on the same night; but on account of its freedom from tremor and the excellence of its driving clock it should be very suitable for prolonged study of a single object or for long photographic exposures.[1] Quite recently Sir Howard Grubb has signed a contract to make a telescope of 28-inches aperture and 28-feet focal length,[2] which is to be substituted for the present telescope by Merz & Son of 12¾-inches aperture and 18-feet focus. Fig 19 is engraved from a photograph of the model of the original polar axis. The model was prepared to illustrate the manner in which the new telescope is to be mounted, and we are indebted for the picture

reen-ich ua-rial.

New Green-wich telescope

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[1] See the detailed account in *Greenwich Observations*, 1868.

[2] This object-glass will have the shortest proportional focal length of any yet constructed of aperture exceeding 16 inches. The following table gives the focal length in apertures of the largest existing refractors:—

Vienna	telescope	(Grubb)	27-inches aperture,	focal length	[illegible] apertures
Washington	,,	(Clark)	26 ,,	,,	15·0 ,,
Pulkowa	,,	(Clark)	30 ,,	,,	18·0 ,,

to the kindness of Mr Christie, astronomer royal. The object-glass will be actually outside the dome when the telescope is pointed near the zenith or near the horizon. The dew-cap, not shown in the model, will be always outside the dome. and it is not impossible that this arrangement may be favourable to good definition, except in case of high wind. When the telescope is not in use the dew-cap slides backwards on four rails parallel to the axis of the telescope, and the whole is housed in the position shown in fig. 19. The spectroscope is used at right angles to the telescope tube, a right-angled prism of total reflexion being interposed in the converging cone of rays near the focus. This prism can be turned 180° and an eye-piece inserted on the opposite side from the spectroscope for observations near the zenith or horizon, otherwise the eye end would be too near the floor or northern pier.[1]

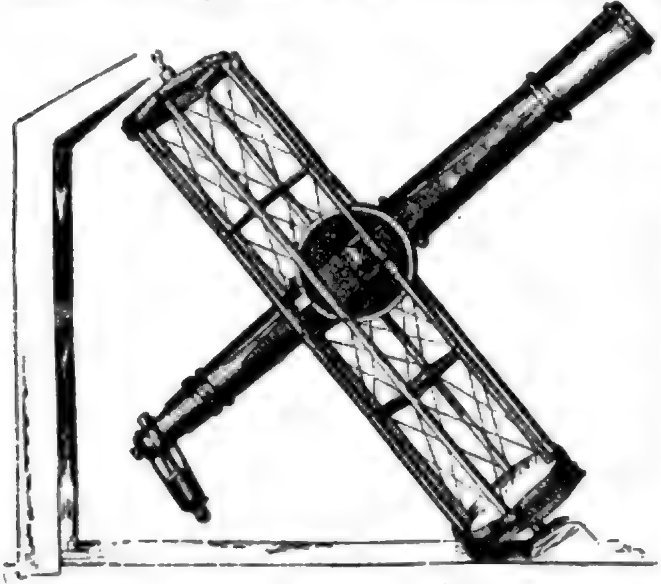

FIG. 19.—Grubb's telescope for Greenwich.

Paris photographic telescope.

A figure of the new photographic telescope erected at the Paris observatory may be seen in *Nature*, 13th May 1886. The object-glass is by MM. Paul and Prosper Henry, the mounting by M. Gautier. Here Airy's braced tubes are replaced by hollow metal beams of triangular shape (as for the Liverpool equatorial). The hour circle has two toothed circles cut upon it, one acted upon by a screw attached to the pier and driven by the clock, the other by a second screw attached to the polar axis, which can be turned very slowly by a handle in the observer's hand. Thus a very slow movement can be given to the telescope in right ascension, independently of the clock. Slow motion in declination can be communicated by a screw acting on a long arm, which can be clamped at pleasure to the polar axis by a convenient handle. An oblong metallic box, fitted with pivots, whose bearings are attached to the triangular beams, forms the tube for two parallel telescopes; these are separated throughout their length by a metallic diaphragm. The chromatic aberration of the object-glass of one of these telescopes is corrected for photographic rays, and the image formed by it is received on a highly sensitive photographic plate. The other telescope is corrected for visual rays and its image is formed on the plane of the spider lines of a filar micrometer. The peculiar form of the tube is eminently suited for rigid preservation of the relative parallelism of the axes of the two telescopes, so that, if a certain selected star is retained in bisection by two intersecting wires in the micrometer, by means of the driving clock, aided by small corrections given by the observer in right ascension and declination (required on account of irregularity in the clock movement, error in astronomical adjustment of the polar axis, or changes in the star's apparent place produced by refraction), the image of a star will continue on the same spot of the photographic plate during the whole time of exposure. Exquisite photographs of star clusters, double stars, the moon, and planets have been obtained by MM. Henry, and they are the most eloquent testimony to the optical perfection of the object-glass and the efficiency of the mounting. They show also that we are entering upon a new era in practical astronomy, in which photography is destined to play a leading part. The Henry photographic object-glass is of 13·4-inches aperture and only 10 apertures in focal length. The "guiding telescope" is of 9½-inches aperture and nearly 12-feet focus. The photographic object-glass, notwithstanding its small proportional focal length, covers a field of 2¼° in diameter with perfect precision.

Type C.

Many more telescopes have been made of type C than of any other, and it is now almost exclusively employed for the mounting of modern refractors. Its essential features are (1) a comparatively short polar axis and (2) a cross-head attached to the extension of the upper pivot of the polar axis, to carry the bearings of the declination axis. Fig. 20 shows the Dorpat refractor, the *chef d'œuvre* of Fraunhofer, and the first equatorial of any importance that was provided with clockwork. AA is the polar axis, B the hour circle graduated on the face and read by the vernier V. C' is the driving clock, which turns an endless screw S, that gears in the toothed edge of the circle B. D is the cross head supporting at its extremities the bearings of the declination axis. The wooden telescope tube rests in a strong cradle FF of cast brass, which is screwed to a flange on one end of the declination axis; the declination circle EE, which is attached to its opposite end, serves to clamp the instrument in declination to the arm G. H is a weight acting on a lever which presses the wheels *k* (one only seen in the figure) against the upper pivot of the polar axis in order to relieve the friction of that pivot on its bearing. The counterpoise W balances the tube about the polar axis. M, M are counterpoise weights which act on levers *m*, *m*, whose fulcra are universal joints at *n* attached to the cradle. These weights serve to counterpoise the longer end of the tube and to check its flexure. QQ is the finder, a small telescope whose axis is parallel to the great telescope; having a low magnifying power and a large field of view, it serves to direct the large telescope to any object seen in the sky, which otherwise would be difficult to find in the comparatively limited field of the large telescope. The stand TTT is of oak. The instrument is described in detail by Struve (*Beschreibung des auf der Sternwarte zu Dorpat befindlichen grossen Refractors von Fraunhofer*, Dorpat, 1825, fol.). The instrument was an enormous advance upon all previous telescopes for micrometric research. In the hands of Struve results were obtained by it which in combined quality and quantity had never before been reached in micrometric research. Its success was such that the type of Fraunhofer's telescope became stereotyped for many years not only by his successors but throughout Germany. When twelve years afterwards Struve ordered the 15-inch refractor for the new observatory at Pulkowa, the only important change made by Fraunhofer's successors was, at Struve's suggestion, the substitution of a stone pier for the wooden stand in the original instrument.

Dorpat refractor.

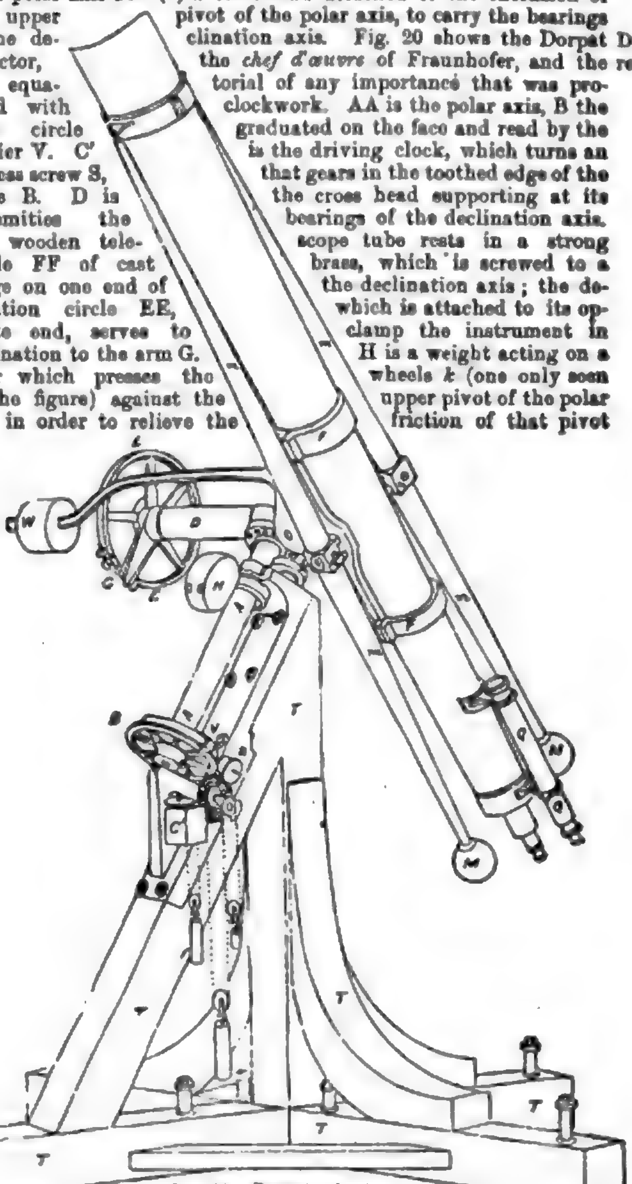

FIG. 20.—Dorpat refractor.

Both the Dorpat and the Pulkowa refractor are defective in rigidity, especially in right ascension. The declination circle is most inconvenient of access, and slow motion in declination can only be effected when the instrument is clamped by a long and inconvenient handle, so that practically clamping in declination was not employed. The slow motion in right ascension is defective, being accomplished in the Dorpat refractor by changing the rate of the clock, and in the Pulkowa refractor by a handle which when used affects very injuriously the rate of the clock for the time being. Struve's skill as an observer was such that he used to complete the bisection on the fixed wire of the micrometer by a pressure of the finger on the side of the tube,—a method of proved efficiency in such hands, but plainly indicative of the want of rigidity in the instrument and of the deficiency of the slow motions (see MICROMETER, vol. xvi. p. 245). The driving circle is also much too small, so that a very slight mechanical freedom of the screw in the teeth involves a large angular freedom of the telescope in right ascension, whilst its position at the lower end of a too weak polar axis tends to create instability in right ascension from torsion of that axis. Strange to say, the wooden tube has till very recently retained its place in German mountings.

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[1] These inconvenient conditions are imposed by the dimensions of the existing dome and may lead to accidents in practice.

Oxford heliometer.

About 1840 a great advance was made in the right direction by the Repsolds of Hamburg in the equatorial mounting of the Oxford heliometer. The driving circle was greatly increased in diameter, and placed at the upper end of the polar axis, and both the polar axis and the declination axis were made much stronger in proportion to the mass of the instrument they were destined to carry. (A figure of this instrument is given in the Oxford *Observations* for 1850.)

Cooke's equatorial.

About 1850 Thomas Cooke of York began his career as a maker of equatorial telescopes, and gave a new character to the German mounting. Fig. 21 represents a typical equatorial of his design. A strong cast-iron pillar is substituted for Fraunhofer's stand. On the semi-cylindrical top of the pillar rests the cast-iron box AA, which contains at its upper and lower extremities the bearings of the polar axis. Its mode of connexion with the pillar permits the inclination of the box to be changed for adjustment of the inclination of the polar axis. The strong cross-head C, supporting the bearings of the declination axis, is of cast iron, bolted to a flange on the upper pivot of the polar axis. Fraunhofer's cradle and wooden tube are abolished, and in their place is a cast-iron cylindrical tube D, flanged at both ends and also at the point where it is bolted to a corresponding flange on the end of the declination axis, all three flanges being cast in one piece with the central tube; the rest of the tube consists of two slightly tapered brass cylinders bolted by strong flanges to the central tube D. The handle F clamps the arm H to the cross-head C at pleasure, and slow motion in declination is communicated by the handles at E and G. Two circles at K and M are attached to the upper part of the polar axis. To one of these motion is communicated by the tangent screw at M (turned by the clock N) acting on teeth cut at the edge of the circle. The other is a graduated hour circle read by two opposite microscopes, one of which is seen at P. The endless cord hanging down and holding a sliding ring at Q is employed to give slow motion in right ascension, in some instruments by moving the frame of the driving screw in the direction of the axis of the screw, in others by moving differential wheels which accelerate or retard the velocity of rotation of the driving screw without affecting the rate of the clock. The declination circle RR is attached to the farther end of the declination axis and is inconvenient of access. Cooke's stand is admirable for its symmetry and simplicity of design, its just apportioning of strength, and a general rigidity with suitability of means to ends.

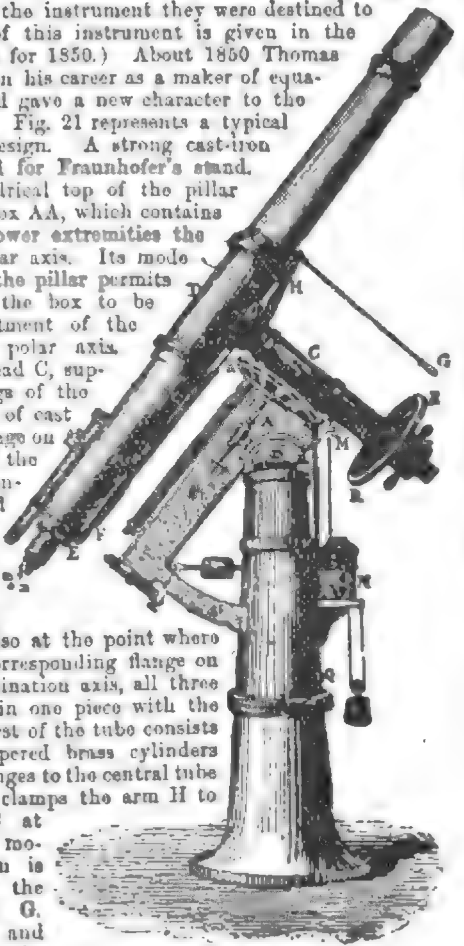

FIG. 21.—Cooke's equatorial.

It is not a little curious that the obvious improvement of transferring the declination circle as well as the declination clamp to the telescope end of the declination axis was so long delayed; we can ascribe the delay only to a desire to retain the declination circle as part of the counterpoise. We believe that the first important equatorials in which the declination axis was read from the eye end were the 15-inch by Grubb and the 6-inch by Cooke, made for the observatory of Lord Crawford (then Lord Lindsay) at Dun Echt (Aberdeenshire) about 1873. The plan is now almost universally adopted. Telescopes of such dimensions can be conveniently directed to any object by the circles without the observer being under the necessity to climb a special ladder. But when much larger instruments are required the hour circle becomes inaccessible from the floor, and means have to be devised for reading both circles from the eye end.

Great Vienna telescope.

This was first accomplished by Grubb in the great refractor of 27-inches aperture which he constructed for the Vienna observatory, represented in section in fig. 22. The observer's eye is applied to the small telescope E, which (by means of prisms numbered 1, 2, 3, 4) views the vernier attached to the cross-head simultaneously with the hour circle attached to the upper end of the polar axis. Light to illuminate the vernier and circle is thrown from the lamp L upon prism 4 by the prisms 6 and 5. Prism 1 is in the axis of the declination circle and always reflects rays along that axis, whatever the position of the telescope may be, whilst the prisms 2, 3, 4, 5, and 6 are attached to the cross-head and therefore preserve their relative positions to each other. Through the eye-piece of the bent[1] telescope E′ another hour circle attached to the lower end of the polar axis can be seen; thus an assistant is able to direct the telescope by a handle at H to any desired hour angle. A slight rotatory motion of the telescope E on its axis enables the vernier of the declination circle to be read through prism 1. The leading features of this fine instrument represent those of all Grubb's large telescopes. The mode of relieving the friction of the declination axis is similar to that employed in the Melbourne telescope and in the account of the Vienna telescope published by Grubb. The end friction of the polar axis is relieved by a ring of conical rollers shown in section beside the principal figure.

From this point we must condense further description into critical remarks on a few typical modern instruments.

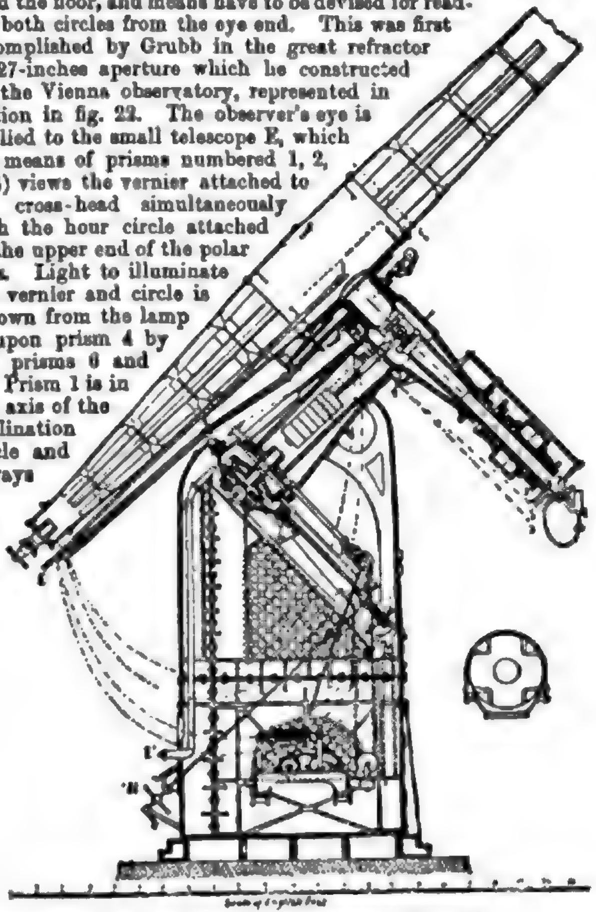

FIG. 22.—Grubb's 27-inch refractor (Vienna).

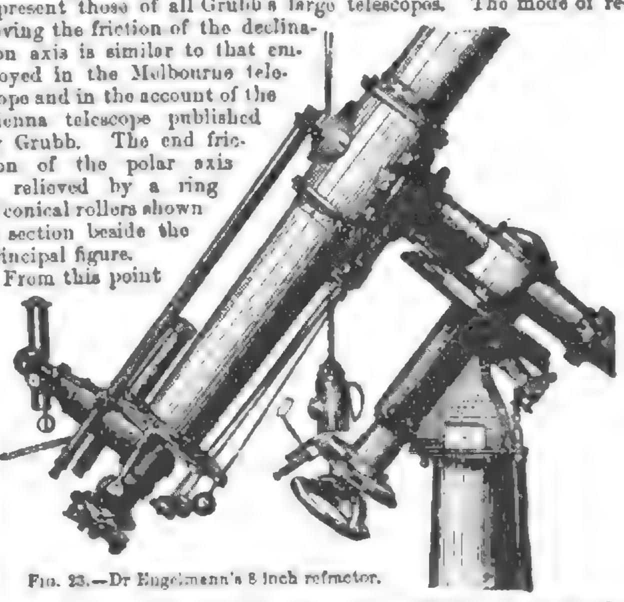

FIG. 23.—Dr Engelmann's 8 inch refractor.

(1) *Telescopes of Moderate Size for Micrometric Research only.*—

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[1] In the bent telescope refracting prisms are employed at the corners to change the direction of the rays.

Repsolds' small equatorial.

Fig. 23 shows the mounting of the 8-inch refractor, of 9-feet focal length, at the private observatory of Dr Engelmann, Leipsic. The object-glass is by Messrs Clark of Cambridge, Mass., the mounting by the Repsolds of Hamburg. The declination circle reads from the eye end, and four handles for clamping and slow motion in right ascension and declination are situated near the observer's hands. The tube is of sheet steel, light, stiff, and free from tremor. The eye end carries the micrometer with an illuminating apparatus similar to that previously described under MICROMETER, vol. xvi. p. 246 *sq.*, figs. 16, 17, 20, and 21. The lamp near the eye end illuminates the field or the wires at pleasure, as well as the position circle of the micrometer and the declination circle; a separate lamp illuminates the hour circle. An excellent feature (see fig. 24) is the short distance between the eye-piece and the declination axis, so that the observer has to follow the eye end in a comparatively small circle; another good point is the flattening of the cast-iron centre-piece of the tube so that the flange of the declination axis is attached as near to the axis of the telescope tube as is consistent with free passage of the cone of rays from the object-glass. For purposes of micrometric research with the ordinary micrometer this instrument is the most elegant, satisfactory, and useful that we know, as was shown by the exceedingly accurate observations of the minor planets Victoria and Sappho for solar parallax, by Galle's method (see PARALLAX, vol. xviii. p. 249), made by Dr Engelmann in 1882. The substitution of small incandescent electric lamps for the oil lamps would be an improvement.

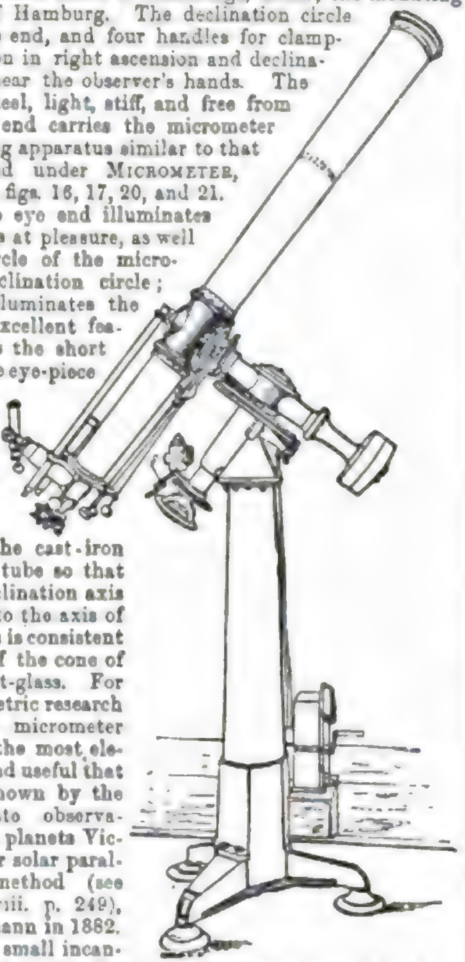
FIG. 24.—Dr Engelmann's 8-inch refractor.

Grubb's small equatorial.

(2) *Telescopes of Moderate Size for General Purposes.*—The modern equatorial should for general purposes be capable of carrying spectroscopes of considerable weight, so that the strength of the axis and the rigidity of the instrument generally have to be considerably increased. Grubb has realized our ideas of what such an instrument should be in an equatorial of 6-inches aperture which he has recently made for the royal observatory at the Cape of Good Hope. The principal features are its great strength and rigidity, with special precautions to ensure preservation of the instrumental declination. The observations of Victoria and Sappho in 1882 revealed the great deficiency of most modern equatorials in this respect. That is to say, if a star near the meridian is first made to run along the measuring web of the micrometer, the clockwork then set in action, and the star brought back to the centre of the field by the slow-motion handle in right ascension, it will be found that the perfection of the bisection is no longer preserved. Thus at most observatories the measures of difference of declination when the clockwork was employed were far inferior to those made with the telescope at rest. The reason seems to be that in most equatorials the lower pivot is cylindrical, and enters an ordinary cylindrical bearing which cannot be a perfect fit. Also the cross-head, telescope, counterpoise, &c., generally together overbalance the polar axis about the upper bearing, so that the lower pivot presses upwards in its bearing, and its rotation, under the action of the clock or slow motion coupled with the friction of the surfaces, gives rise to a small rolling freedom which creates the errors in question. In this telescope the lower pivot is of steel, made slightly conical, and carefully ground to fit a long conical bearing, in which it would work very tightly, or even jam, but for spring pressure brought to bear on its lower hardened flat end, which relieves the greater part of the thrust; and the polar axis is accurately balanced about its upper bearing by a weight at the lower end of the polar axis, so that the thrust is exactly in the axis of the cone. The upper pivot (4 inches in diameter) is also of steel, finished with the same care as that of a transit circle, so that the telescope rotates with the precision of a meridian instrument. Unusual rigidity has also been given to the declination clamping arms, and the new slow motion in declination is by far the best yet contrived; it is a recent invention of Grubb's, and is described below in his own words. The eye end, suitable for heavy spectroscopes, &c., is fitted to the butt end of the telescope by bayonet joints and tightening screws, so that it can be exchanged for a micrometric eye end with almost as little trouble as the exchanging of an eye-piece. The illumination of the circles and the micrometer is by electric incandescent lamps. The instrument may be adjusted to any latitude and is probably the most practical and serviceable equatorial made. The subjoined description of the new slow motion in declination is taken from *Proc. R. Dubl. Soc.*, 1886, p. 107.

> "The slow motion arrangements usually used in equatorials are of either of two forms, viz., (c) an endless screw working into a sector or portion of a toothed circle of long radius, or (b) a screw applying or pushing directly against an arm, that arm being kept in contact with the screw by a spiral or some other form of spring having a considerable range of motion. The first (a) possesses the disadvantage that, however carefully made, it is impossible it is quite free from 'loss' or 'back lash'; and consequently the position of the telescope is not perfectly determinate in declination, which fault is inconvenient when delicate measures are required. The second (b) has practically no 'back lash,' as spring keeps the arm in perfect contact with screw, but it has the disadvantage that, whatever range of motion is required, the spring must be capable of working through the same range; consequently the spring will be much stronger in action at one end of the range than the other, unless it be made very long indeed, in which case its action is uncertain and unpleasant. To remedy these defects the author [Grubb] has devised the following, which possesses the advantages of both:—ABCD (fig. 25) is a portion of the arms attached to telescope, or cradle, on which is planted the block (*b*), forming the bearing of the screw. The nut (*n*) is in the form of a ball working in a socket on the extremity of the clamp-arm EFG. A short stiff spring (*s*) is attached to this clamp-arm, bearing, not directly against any part of other arm, but against end of a second screw of same pitch as the main screw, the nut of which (*oo*) is toothed on edge, and works into a wheel of equal size (*pp*) on main screw. The point of this second screw, therefore, advances as much in one direction as the frame ABCD is carried in other, according as the milled head is turned; and consequently the point of the screw does not sensibly vary in its position with respect to the clamp-arm EFG. A short stiff spring can therefore be used, and the disadvantage above mentioned disappears."

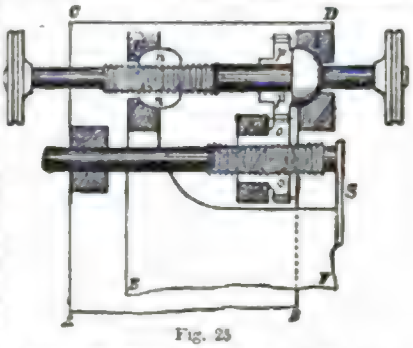

Fig. 25

This form of slow motion could be applied with advantage to the right ascension also, and probably to the separation of the segments of heliometers.

Large equatorials. Washington telescope.

(3) Of large equatorials we name first the great refractor at Washington of 26-inches aperture and 32½-feet focal length.[1] The mounting appears to be unworthy of the well-known excellence of the object-glass. To illuminate the micrometer an assistant is required to hold a lamp in his hand. No convenient means are provided for illuminating the declination axis; and in order to point the telescope in declination the following elaborate process has to be performed:—

> "The instrument is brought into the meridian and set by the observer within a degree by means of coarse divisions painted on the edge of the declination circle. These divisions are rendered visible by lighting one or two of the gas burners of the dome, and viewed by the astronomer with an opera-glass. Then an assistant mounts by a ladder to a high platform and holds a gas lamp near the vernier, and the fine setting is accomplished by the observer seated in the observing chair, the declination clamp and slow motion screw being convenient to his hand" (*Washington Observations*, 1874, Appendix I., p. 33).

The polar and declination axes are of steel, only 7 inches in diameter at the thickest point, and the driving arc, which is far too small, is placed at the lower end of this slender axis. There must thus be considerable liability to tremor in right ascension. However well the instrument may act in specially practised hands with an excellent Clark's micrometer (art. MICROMETER, vol. xvi. p. 245), the instrument must be considered wanting in the rigidity and convenience which a modern equatorial should possess. In his official report on the instruments of European observatories Newcomb defends the want of solidity and convenience of this instrument as compared with the Vienna telescope, because its smaller axes (notwithstanding Grubb's anti-friction arrangements) permit it to turn more easily and the mounting to be of far simpler design. But at the time of Newcomb's visit the Vienna telescope had not been brought into work, and cannot have been in proper working order if the motion in declination was so stiff as he describes it, at least when the present writer tested the instrument in Dublin that motion was surprisingly easy.

Pulkowa refractor.

The great Pulkowa refractor (fig. 26) erected in 1885 is of 30-inches aperture and 45-feet focal length. The object-glass is by Clark, the mounting by the Repsolds. The tube is cylindrical, of riveted steel plate, graduated in thickness from the centre to its extremities, and bolted by very powerful flanges to a strong short cast-iron central tube, in which, as in Dr Engelmann's telescope (fig. 23), the attachment to the flange of the declination axis is placed as close as it can be to the axis of the tube without interfering with rays converging from the object-glass to any point in the field of view. A new feature in this instrument is the platform at the lower end of the polar axis, where an assistant can view the hour circle by one eye-piece and the declination circle by another (looking up the perforated polar axis), and where he can also set the telescope to any hour angle by one wheel, or to any declination by a second, with the greatest ease. The observer at the eye end can also read off the hour and declination circles and communicate quick or slow motions to the telescope both in right ascension and declination by conveniently placed handles. The eye end presents an appearance too complicated to be figured here; it has a micrometer and its illumination for the position circle, a micrometer head, and a bright or dark field,[1] clamps in right ascension and declination and quick and slow motion in the same, a finder, microscopes for reading the hour and declination circles, an illuminated dial showing sidereal time and driven by a galvanic current from the sidereal clock, and counter weights which can be removed when a spectroscope or other heavy appliance is added. All these, although making up an apparently complicated apparatus, are conveniently arranged, and are all necessary for the quick and easy working of so large an instrument. We have the authority of Otto Struve for stating that in practice they are all that can be desired. There is in this instrument a remarkably elegant method of relieving the friction of the polar axis. Let AA (fig. 27) be a section of the polar axis; it is then easy to adjust the weight P of the circles, &c., attached to its lower end so that the centre of gravity X of the whole moving parts of the instrument shall be in the vertical (VV) of a line passing through the apex of the hollowed flange *pq* at *q*, which flange forms part of the polar axis. If now a wheel W is forced up against *q* with a pressure equal to the weight of the moving part of the instrument, the whole weight of the moving part would rest upon W in unstable equilibrium; or if a pressure R, less than W, is employed, we have the end friction on the lower bearing removed to an extent $= R \sin \phi$, and the friction on the bearings of the upper pivot removed to the extent of $F \cos \phi$,—where ϕ is the latitude of the place. The wheel W is therefore mounted on a guided rod, which is forced upwards by suitable levers and weights, and this relief of pressure is precisely proportional to the pressure on the respective bearings. The Repsolds find it unnecessary to relieve the friction of the declination axis.

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[1] Described and figured in the *Washington Observations*, 1874. App. I.

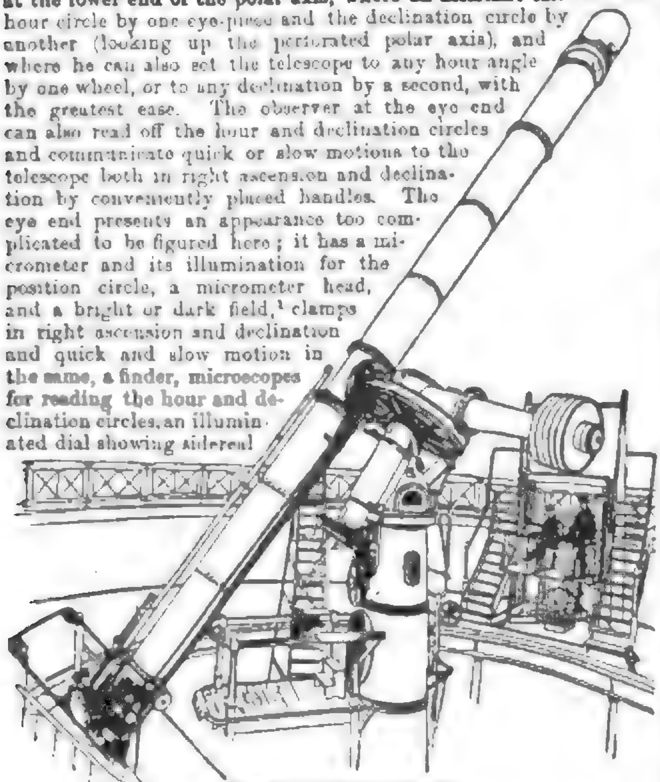

FIG. 26.—Pulkowa refractor.

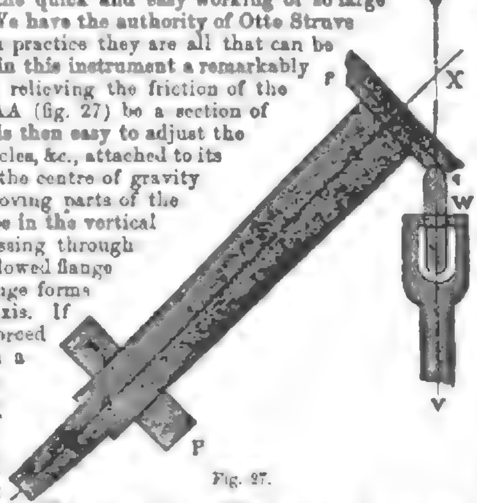

Fig. 27.

Grubb's design for 36-inch refractor.

Fig. 28 shows the equatorial mounting which Grubb designed for the great object-glass of 36-inches aperture that Messrs Clark have completed for the Lick trustees, and which may be supposed to express Grubb's latest ideas as to the mounting for a very large telescope. The Repsolds have a large driving circle at the upper end of the polar axis, thus avoiding torsion of the polar axis at the expense of greatly increased length of the cross-head. Grubb by employing a driving arc gets the telescope much closer to the polar axis with an increased radius for driving, and he makes the polar axis a very large hollow steel or cast-iron cylinder in which torsion is insensible. Both Grubb and the Repsolds seem to think that for the tube of the telescope all necessary rigidity can be attained with cylindrical tubes of riveted steel, the thickness of the successive sheets of which diminish from the centre-piece outwards without making the extremities cone-shaped.

In these very large telescopes the arrangements for giving access to the eye end and for following its diurnal motion have hitherto proved a source of difficulty. The travelling stages of the new Pulkowa telescope are the most manageable and practical that have yet been contrived, but even they leave much to be desired. For energetic work the standing position is best, provided that the eye-piece is situated at the precise height above the stage which is most convenient for the observer, and that the altitude of the observed object is not greater than 60°. For altitudes above 60° a small chair with a back, the top of which is stuffed for the head to rest upon, is the best seat, provided that the observer's eye can be kept at the height of the eye-piece. Accordingly Grubb has suggested the following plan for the observatory at Mount Hamilton, California, which is to cover the Lick telescope. The whole floor, 70 feet in diameter, is to be raised or lowered by water-power under control of the observer by means of electric keys, which act on a secondary piece of mechanism, that in turn works the valves and reversing gear of the water-engines. Other water-engines, similarly connected with keys at the observer's hands, rotate the dome and perform the quick motions in right ascension and declination.[2] By this arrangement a large instrument can be worked with perfect facility and comfort. There is only one other plan, that of suspending the observer's chair to the eye end, so that his eye is near the centre of motion of the chair. This is quite practicable for a 36-inch telescope, and one observer, with the necessary guiding keys at hand, could easily work a telescope and dome of the largest dimensions as quickly and with more ease than he could one of 10 or 12 inches aperture. Probably a nervous astronomer would prefer a solid floor to work upon, as in Grubb's proposal; in the latter case the quickest working can only be accomplished by two persons, one seated on the platform at the foot of the polar axis and doing the rough setting in right ascension and declination, the other meanwhile adjusting the height of the floor and the azimuth of the dome opening.

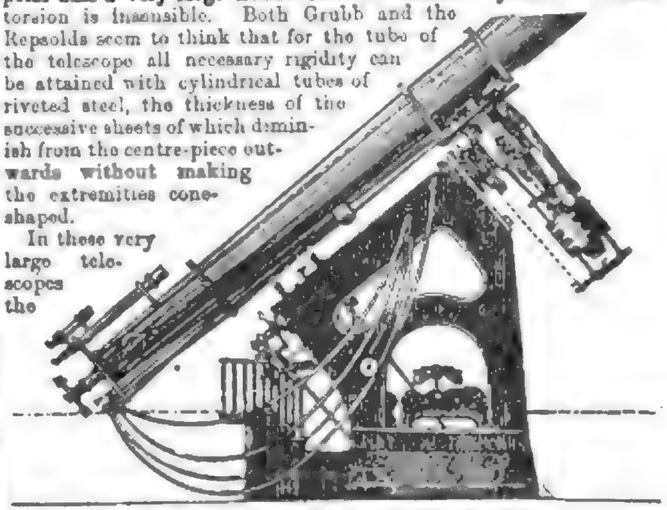

FIG. 28.—Grubb's mounting for the Lick object-glass.

Proposed facilities for using large telescopes.

In very large equatorials there must be in existing methods considerable inconvenience from the extended width of the apparatus at the eye end. Were we called upon to design a great refractor we should abolish all such apparatus and provide the observer with a few conveniently placed small handles or keys for electrical connexions, and we should perform all motions of the telescope whatsoever by electromotors. There is no form of energy so convenient for the astronomer. It provides by incandescent lamps the most suitable light for his purpose, perfectly constant, giving off little heat, and unaffected by wind; and such a light can be placed where required without the aid of reflectors or any complicated apparatus, and its intensity can be regulated with ease and precision by changing the resistance of the conductors. Moreover the electromotors can be as powerful or as delicate as we please, and can be placed in the most convenient or suitable positions. The energy of a 5-horse-power steam-engine working for ten hours can be stored in accumulators of no inconvenient dimensions ready for use as required during a whole week or even a month, and can be brought into action in force equivalent to several horse-power to raise or lower the floor or turn the dome, or to perform slow motions requiring no greater energy than that exercised by the finger and thumb, or to illuminate a lamp of ½ or ¼ candle-power. There would be no limit to the rigidity which could be given to such a telescope, as great ease of motion would not have to be considered, and we should abolish all complicated anti-friction apparatus for the declination axis, retaining it only for the polar axis to save wear in the teeth of the driving arc. Finally, instead of making the finder a short telescope attached to the eye end of the instrument, we should give it a focal length equal to that of the great object-glass, attaching the cell of its object-glass rigidly to the cell of the large object-glass and its eye end to the butt end of the main telescope, in order to secure the utmost rigidity in the relations of the axes of the two telescopes. Such a finder would correspond in efficiency to that of the Henry photographic telescope, and would be available as a guiding telescope in photographic work, or for keeping a star exactly on the slit of a spectroscope.

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[1] There is also an elegant arrangement for printing on a ribbon of paper, by pressure of the finger, the readings of the number of revolutions and fractions of a revolution of the head at each observation, the ribbon being automatically moved forward for another record after each observation.

[2] A woodcut showing these arrangements appeared in the *Engineer*, 9th July 1886.

Type D.

Lassell's mounting.

The first important instruments of type D were Mr Lassell's reflectors, the largest of which, and the last, is represented in fig. 29. The polar axis is sufficiently rigid, but the long and comparatively slender forks which carry the pivots of the central cradle are elements of instability, especially when the instrument is directed to an object of considerable hour angle. There is practical confession of this instability in the cross-bracing which connects the two forks, and which must be removed if the telescope is pointed to an object between the zenith and the elevated pole.

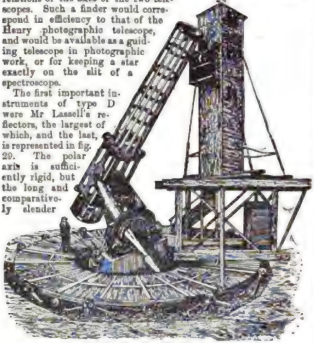
FIG. 29.—Lassell's reflector.

Common's mounting.

The best example of type D is the reflecting telescope of 36-inches aperture designed by Mr. A. A. Common, with which his exquisite photographs of nebulæ, &c., were made. The principal preliminary conditions which he laid down as necessary were the following[1]:—(1) no tube properly so called, to avoid air-currents in the tube; (2) no mass of metal either below or at the side of the line joining the large and small mirrors, to avoid currents from possible difference of temperature between the mass of metal and the surrounding air; (3) an equatorial mounting capable of direction to any part of the visible heavens and of continued observation past the meridian without reversal; (4) an efficient means of supporting the mirror without flexure; (5) driving clock; circles to find or identify an object, and motions taken to eye end, (6) a mounting which will give the greatest amount of steadiness with the least amount of friction. Fig. 30 is a section of the instrument in the plane of the meridian. DD_1 is a cast-iron hollow cylinder, accurately bored out, attached to a strong base block. D_2 is a cover bolted on the bottom of this cylinder, in the centre of which is a tapering steel pin D_3, which enters a corresponding hole in the bottom of the polar axis E, and serves as the lower pivot of the polar axis. The cylindrical part of the polar axis is accurately turned to a diameter one-eighth of an inch less than the outer cylinder, and the otherwise severe friction on the pin D_3 is relieved by filling in the space between D and E with mercury, so far as sufficient nearly to float the whole moving part of the telescope. The upper elbow-shaped part of the polar axis E_2 is flanged and bolted to the lower part. In the section at right angles to that exhibited in fig. 30 this elbow-shaped part is T-shaped, and the cross of the T is bored to receive the declination axis; and, as the elbow puts the polar axis considerably out of balance, the T-shaped head is carried forward of the axial line about 1¼ inches, so that the whole weight of the telescope above just restores the balance. Two heavy weights X, X counterpoise the eye end F with the four braced tubes T, T which support it. B is the declination circle. It is impossible to describe this fine instrument adequately within our limits; we mention as specially worthy of study the method of supporting the mirror and the eminently ingenious and practical form of the observatory, and refer the reader to Common's illustrated account of the instrument in *Mem. R. A. S.*, vol. xlvi. pp. 173-182.

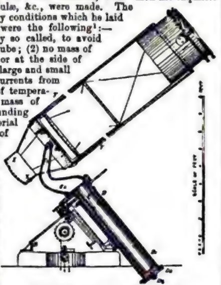
FIG. 30.—Common's reflecting telescope.

Rosse's 3-foot mounting.

There is also an admirable mounting of type D designed by Lord Rosse for his 3-foot reflector at Birr Castle, described by him in *Phil. Trans.*, vol. clxxi. p. 153. The instrument is planned on the broad lines of Lassell's telescope (fig. 29), but the badly planned and weak fork of the latter is replaced by a thoroughly rigid bent fork made of boiler plate a quarter of an inch thick, firmly riveted to angle iron of $2\frac{1}{4} \times 2\frac{1}{4} \times \frac{5}{16}$ inch scantling along each angle, the whole, as we have proved by trial, being exceedingly rigid. It would be an improvement to adopt Mr Common's plan of putting the declination axis a little out of the line of prolongation of the polar axis, and thus dispense with the counter-weight; and we should prefer hollow steel tubes with push and pull bracing rather than the angle iron rods and bracing which form the tube.

Type E.

Grubb's siderostatic telescope.

In the *Proceedings* of the Royal Dublin Society (vol. ii. p. 362) Grubb describes a "siderostatic telescope," which forms a good elementary example of type E. In fig. 31 TT is the tube of a telescope of 4-inches aperture, which is mounted to rotate about its axis, the latter forming the polar axis. MM is a plane mirror reflecting rays from a star S to the object-glass, so that its image can be viewed from the eye-piece at E. The star is retained in the field by the clock C. Stars of different declination can be viewed by rotating the mirror on its axis G, and in different hour angles by rotating the tube upon its axis. The instrument in European latitudes cannot command a view of the heavens between the elevated pole and the zenith unless the distance OG is made exceedingly great; even then only a limited range beyond the zenith is possible. The instrument is primarily intended for solar spectroscopy, and thus these drawbacks do not apply. The resulting advantage is that the observer may be in complete darkness and his observations are not interrupted by change of position.

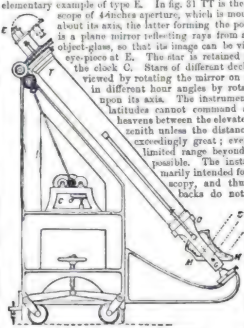

FIG. 31.—Grubb's siderostatic telescope.

Loewy's equatorial coudé.

In *Comptes Rendus* for the year 1883, vol. xcvi. pp. 735-741, M. Loewy gives an account of an instrument which he calls an "equatorial coude," designed (1) to attain greater stability and so to measure larger angles than is generally possible with the ordinary equatorial; (2) to enable a single astronomer to point the telescope and make observations in any part of the sky without changing his position; (3) to abolish the usual expensive dome, and to substitute a covered shed on wheels (which can be run back at pleasure), leaving the telescope in the open air, the observer alone being sheltered. These conditions are fulfilled in the manner shown in fig. 32. EP is the polar axis, rotating on bearings at E and P. The object-glass is at O, the eye-piece at E. There is a plane mirror at M, which reflects rays converging from the object-glass to the eye-piece at E. A second mirror N, placed at 45° to the optical axis of the object-glass, reflects rays from a star at the pole; but by rotating the box which contains this mirror on the axis of its supporting tube T a star of any declination can be observed, and by combining this motion with rotation of the polar axis the astronomer seated at E is able to view any object whatever in the visible heavens, except those situated between 10^h and 12^h hour angle. An hour circle attached to EP and a declination circle attached to the box containing the mirror N, both of which can be read or set from E, complete the essentials of the instrument. Its mechanical details present no great difficulty, and are most conveniently arranged. But we entertain grave doubts as to the practical value of the instrument, not on mechanical, but on optical grounds. There must be a certain loss of light from two additional reflexions; but that could be tolerated for the sake of other advantages, provided that the mirrors could be made sufficiently perfect optical planes. A few years ago it was very difficult to obtain an optically perfect plane 6 inches in diameter, and having obtained it there remained the further difficulty of mounting it so that in all positions it should be free from flexure. By making the mirrors of silvered glass, one-fourth of their diameter in thickness, MM. Henry have not only succeeded in mounting them with all necessary rigidity free from flexure but have given them optically true plane surfaces, notwithstanding their large diameters, viz., 11 and 15·7 inches. The present-writer tested the equatorial coudé on double stars at the Paris observatory in 1884, and his last doubts as to the practical value of the instrument were dispelled. He has never seen more perfect optical definition in any of the many telescopes he has employed, and certainly never measured a celestial object in such favourable conditions of physical comfort. The easy position of the observer, the convenient position of the handles for quick and slow motion, and the absolute rigidity of the mounting leave little to be desired. In future instruments the object-glass will be placed outside the mirror N, so that both the silvered mirrors will be protected from exposure to the outer air, and probably will retain the brilliancy of their surfaces for a long period.

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[1] *Monthly Notices R. A. S.*, vol. xxxix. p. 384.

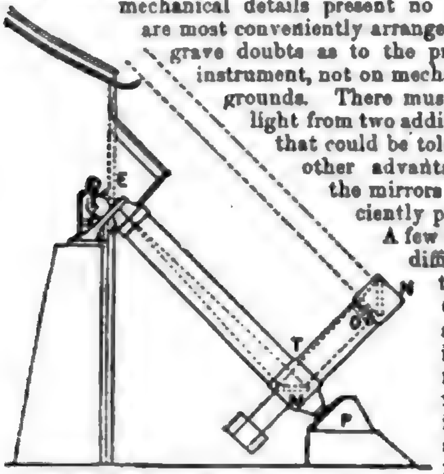

Fig. 32.—Loewy's coudé equatorial.

Adjustment of the Equatorial.

Let us take the usual case, that of an equatorial of type C. (1) By means of an azimuth compass, or, better, by the shadow of a plumb line at apparent noon, lay down a meridian line on the upper surface of the stone pier, or other foundation, previously built for the instrument. (2) Employ this meridian line to set up the instrument and with it the polar axis approximately in the azimuth of the meridian, which can be tested by stretching a wire through the centres of the bearings of the polar axis, and dropping a plumb line from the extremities of the wire upon the meridian line. If this is carefully done when the azimuth adjustment is near the middle of its range all desirable accuracy in this preliminary desideratum will be secured. (3) Place the polar axis approximately at the altitude of the pole. This is very easily done for an instrument in which the polar axis is cylindrical or is encased in a box with an upper side parallel to that axis (as in Grubb's or Cooke's equatorials). Prepare a right-angled triangle of wood of which the acute angles represent the latitude and co-latitude of the place. Lay the hypothenuse of this triangle upon the line of the instrument parallel to the polar axis (or the wire of operation 2) with the angle equal to the co-latitude next to the elevated pole, and change the inclination of the polar axis till a mason's level placed on the side of the triangle opposite to the angle of the latitude shows the side in question to be horizontal. (4) Adjust the movable micrometer web to coincidence with the axis of the position circle by bisecting the image of a distant object and reading the number of revolutions or fractions of a revolution at two different readings of the position circle 180° apart. The mean of these two readings is the reading for coincidence with the axis of the position circle. Set the micrometer to this mean. (5) Adjust the polar axis more exactly to the required altitude as follows. Point the telescope to a well-known star not far from the equator and near the meridian, and turn the position circle so that the image of the star by the diurnal motion runs along the web. Read the declination circle. Now reverse the telescope to the other side of the polar axis and bisect the same star again, and again read the declination circle. The mean of the two readings is the star's instrumental apparent declination; the difference of the two readings is twice the index error. To eliminate this latter it is only necessary to shift the vernier of the declination circle by the screws provided for the purpose, without unclamping in declination, till the circle reads the star's instrumental apparent declination. This being done, select another star near the meridian and compute its apparent declination (allowing for refraction). Set the telescope to this computed reading and clamp in declination; then cause an assistant to change the altitude of the polar axis (by the screw for the purpose) till the star is bisected by the micrometer wire. (6) Select any convenient known star about six hours from the meridian; compute its apparent declination (allowing for refraction); and set the telescope to this reading in declination. Cause the assistant to turn the slow motion in azimuth till the image of the star is bisected by the micrometer web. (7) Repeat operation 5 and make final corrections if necessary. (8) Repeat operation 6 with stars both east and west of the meridian, and readjust azimuth if necessary. (9) Turn the position circle of the micrometer 90°; place the declination axis nearly horizontal; clamp the telescope in right ascension; and observe the time of transit of a known star across the web of the micrometer. Compute the true hour angle of the star from the known error of the micrometer and the star's right ascension, and set the vernier so that the hour circle shall read the computed hour angle. By these means, with a previously prepared programme, the writer has frequently completely adjusted an equatorial in less than an hour, so far as operations 4 to 9 were concerned.

There still remain two instrumental errors of the stand. (1) The line joining the optical centre of the lens with the axis of rotation of the position circle may not be at right angles to the declination axis. (2) The declination axis may not be at right angles to the polar axis. In modern equatorials it is usual to leave these adjustments to the maker, as to leave them to the astronomer would be incompatible with the greatest stability of the instrument. In a good instrument these errors will certainly be extremely small and have no influence on its efficiency for practical purposes. The methods for determining their amount are given in most works on practical astronomy.[1]

There remain two important optical adjustments which must be very carefully attended to, viz., the centring of the lenses of the object-glass relative to each other and the centring of the axis of the object-glass relative to that of the eye-piece. The former consists in placing the lenses of the object-glass so that the centres of curvature of their surfaces shall lie in one straight line, which line is the axis of the object-glass. This operation is so delicate and requires such special experience and skill that it should be left to the maker of the object-glass. An elegant method of testing this adjustment was given by Wollaston in *Phil. Trans.*, 1822, p. 32. If the object-glass itself is perfectly centred, the test of the centring of its axis with that of the eye-piece is very easy: are the diffraction rings which surround the image of a bright star shown as in fig. 33, or is there flare, that is, are the rings extended on one side as in fig. 34? If the latter is the case, that side of the object-glass towards which the flare is directed is too far from the eye-piece, and should be brought towards it by the appropriate screws or other means provided by the maker. In a good object-glass perfectly centred, on a night of steady definition, a bright star in focus should appear as in fig. 33.

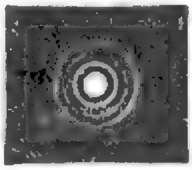
Fig. 33.

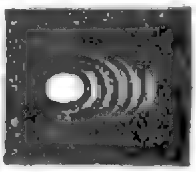
Fig. 34.

A useful apparatus for the adjustment of centring is a small telescope (fig. 35) whose axis is in the centre of and at right angles to a flat piece of brass in the shape of an equilateral triangle fitted with screws at the three angles. To use this instrument, place the points of the screws on the object-glass as in fig. 36, so that two angles of the triangle are in contact with the inner edge of the cell of the object-glass, and adjust the screw *a* so that the cross-wires in the common focus of the object-glass and eye-piece of the small telescope coincide with the image of the cross-wires of the micrometer of the telescope which mark the axis of rotation of the position circle. Now, keeping the same angles of the brass triangle in contact with the cell, move the small centring telescope round the circumference of the object-glass and note where there is the greatest departure from coincidence. Correct this departure half by the screw *a* of the small centring telescope and half by the centring screws of the object-glass. The adjustment is perfect when the centring telescope can be moved round the whole periphery of the object-glass in the above manner whilst its cross-wires continue to bisect the cross-wires of the micrometer of

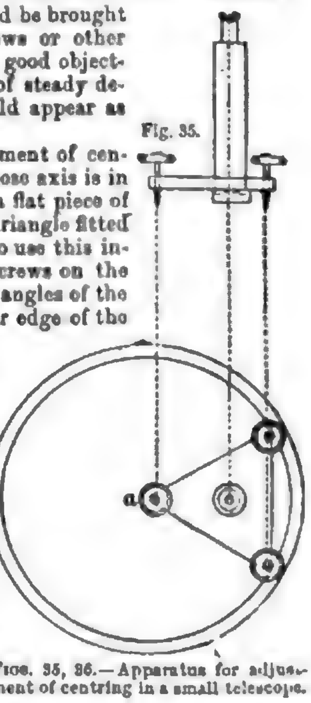
Fig. 35.

Figs. 35, 36.—Apparatus for adjustment of centring in a small telescope.

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[1] Chauvenet, *Practical and Spherical Astronomy*, vol. ii. pp. 379-390; Brunnow, *Spherical Astronomy*, p. 445; and Loomis, *Practical Astronomy*, pp. 28-32.

the telescope. If after this adjustment has been perfected the diffraction rings are still not circular round the images of stars, the fault is in the centring of the lenses of the object-glass with respect to each other, and the object-glass should be sent to the maker for rectification.

Driving Clock.

Driving clock.

The means employed to cause an equatorial telescope to follow the diurnal motion of a star obviously must not resemble the intermittent motion of an ordinary clock. Numerous devices have been contrived for producing uniform motion. But the limits of this article will only allow us to refer briefly to a few of those most commonly in use. Fig. 37 represents Fraunhofer's governor. On its axis C is a pinion driven by a train of wheels. The axis carries an arm BB, at the extremities of which, attached by springs *f*, *f′*, are the weights D, D′. When these weights acquire a certain velocity of rotation the centrifugal force is sufficient to cause the weights to fly out and rub against the inside of the cylinder AA, and their velocity is checked. Instead of a cylinder, the balls may rub against the inside of a hollow cone, and by raising or lowering the axis C the contact of the weights with the cone may be made to take place when the balls have slightly greater or less velocity, and thus the rate of the clock is regulated. A much better arrangement is a modification of Watt's governor, employed by Grubb and Cooke. The governor balls *g*, *g* (fig. 38) repose on the points *h*, *h* of the arm KK till they reach their normal velocity, when they fly outwards and bring the point S (tipped with leather) into contact with the friction plate *p*. These clocks are simple in construction and act very well. Newcomb in the Washington equatorial has employed a long suspended conical pendulum; when this pendulum in the least exceeds its normal velocity (that is, its normal departure from the vertical) it establishes an electrical contact which brings friction to bear, and thus reduces the power applied to the pendulum. There is occasional tendency to elliptical motion, and the clock is otherwise troublesome. In the Repsolds' driving clock of the 30-inch Pulkowa refractor the conical pendulum is reversed, being a heavy weight at the top of a vertical steel rod, kept in conical rotation by a pin at its upper end, which enters a slot in a revolving arm. The rod is in fact a spring of such a form as to cause the revolutions to be nearly or perfectly isochronous whatever the angle of the cone of motion; the clock is therefore, within limits, independent of the power applied to it or the force to be overcome.

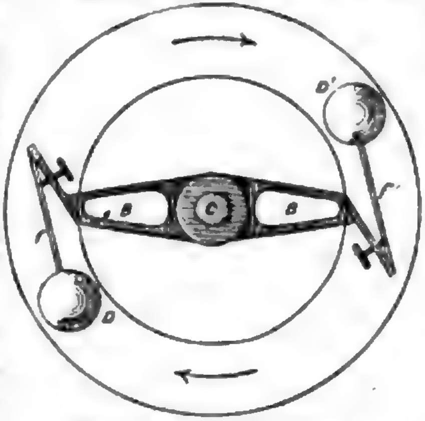

FIG. 37.—Fraunhofer's governor.

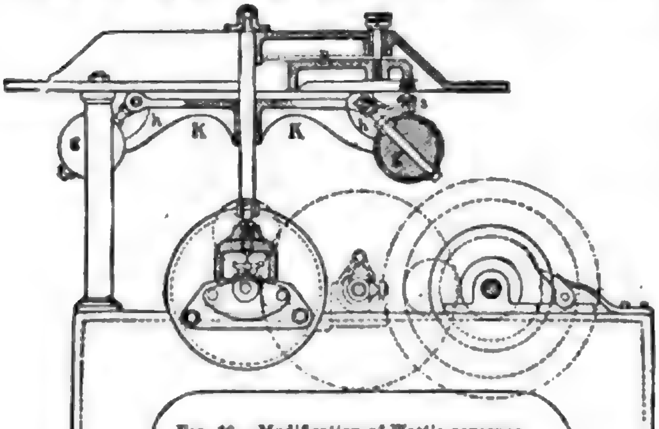

FIG. 38.—Modification of Watt's governor.

Many forms of air-fans have been suggested; probably the best is the modification of Foucault's proposed by Hilger (see *Monthly Notices R.A.S.*, vol. xlvi. p. 155), which is shown in fig. 39. E is the axis of rotation; C and D are fans that are pulled towards the spindle E by chronometer springs in the boxes A and B. The fans fly out symmetrically when the velocity exceeds 25 or 30 revolutions per second; the increased resistance of the air thus produced checks the velocity of rotation. By means of the small weights W, W attached to arms on the fans Hilger states that it is possible to adjust this governor so that it shall even lose by an increase of the driving weight.

For the most refined work none of these governors can be said to be perfect; none would be even tolerable as a clock for astronomical time-keeping purposes. It is possible that the elaborate Greenwich driving clock may give better results, but its construction is too complicated to be frequently repeated (see, for a description of it, the Greenwich *Observations* for 1868). The only way in which nearly perfect uniform motion can be realized is to control it in some way from a swinging pendulum. This is done in Bond's spring governor[1] and by Grubb, the latter employing the arm of a remontoir train connected with a dead-beat escapement to bring friction to bear on a revolving plate connected with the axis of his governor (see fig. 38). The best existing driving clock is probably that at Lord Crawford's observatory at Dun Echt.[2] An account of its performance is given by Dr Copeland in *Vierteljahrsschr. astron. Gesellsch.*, 16 Jahrg., p. 305. In this clock gain of a hundredth of a second, or even less, introduces increased friction on the revolving disk during the next second, or until the gain has been corrected. A still more perfect clock could probably be made on a similar plan by abolishing the clock weight and making the origin of power an electromotor, the current being cut off in a way similar to that in the Dun Echt clock if the clock of continuous motion gets in advance of the ordinary clock.

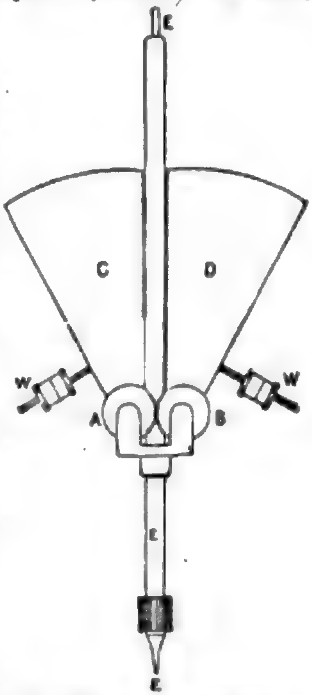

FIG. 39.—Hilger's modification of Foucault's air-fan.

For information on clockwork of equatorials and telescope mountings generally, see Konkoly's *Practische Anleitung zur Anstellung astron. Beobachtungen.* (D. GI.)

TELESPHORUS, bishop of Rome from about 128 till about 137, succeeded Sixtus I. and was followed by Hyginus. Eusebius in his *History* gives the date of the martyrdom of Telesphorus as the first year of Antoninus Pius (138) and in his *Chronicle* as the eighteenth year of Hadrian (135).

TELFORD, THOMAS (1757-1834), civil engineer, was the son of a shepherd in Eskdale, Dumfriesshire, and was born in the valley of the Megget, 9th August 1757. From early childhood he was employed as a herd, occasionally attending the parish school of Westerkirk, where his quickness and diligence helped to make up for his lack of opportunity. On being apprenticed, at the age of fifteen, to a stone mason at Langholm, he found leisure not only to gain an acquaintance with Latin, French, and German, but to gratify his literary tastes by a wide variety of reading. In his early manhood he was much given to the writing of verse: a poem of some length on Eskdale appeared in 1784 in the *Poetical Museum*, published at Hawick; under the signature of "Eskdale Tam" he contributed verses to Ruddiman's *Weekly Magazine*; and he addressed an epistle in rhyme to Burns, which was published in Currie's *Life* of the poet. But these poetical effusions were of comparatively little value. In 1780 Telford went to Edinburgh, where he was employed in the erection of houses in the "new" town, and occupied much of his spare time in learning architectural drawing. Two years later he proceeded to London, finding employment in the erection of Somerset House. Having in 1784 superintended the erection of a house for the commissioner at Portsmouth dockyard, he next repaired the castle of

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[1] Konkoly, *Practische Anleitung zur Anstellung astron. Beobachtungen*, Brunswick, 1883.

[2] *Monthly Notices R.A.S.*, November 1878.

Sir W. Pulteney, member for Shrewsbury, who conceived such a high opinion of his talents that he got him made surveyor of public works for the county of Salop. His earliest bridge was that across the Severn at Montford, finished in 1792. In the following year he was appointed engineer of the Ellesmere Canal, which led to his being employed for the chief canals subsequently constructed in Great Britain, including the Caledonian (1804), the Gloucester and Berkeley (1818), the Grand Trunk (1822), the Macclesfield (1824), and the Birmingham and Liverpool Junction (1825). He was consulted in 1806 by the king of Sweden regarding the construction of the Gotha Canal between Lake Wener and the Baltic, and, his plans having been adopted, he visited the country in 1810 to superintend some of the more important excavations. In 1803 he had been appointed engineer for the construction of 920 miles of roads in the Highlands of Scotland, a great part through very difficult country. Of the numerous bridges built in this line of roads mention may be specially made of that across the Tay at Dunkeld. Subsequently he perfected the road communication between London and Scotland and the northern towns of England. An undertaking of equal magnitude and importance with that in the Highlands of Scotland was a system of roads through the more inaccessible parts of Wales, which involved the erection of the magnificent suspension bridge across the Menai Straits, begun in 1820, and the Conway bridge, begun in 1822. For the Austrian Government Telford built the Polish road from Warsaw to Brest. While the fame of Telford rests chiefly on his road and canal engineering, and the erection of the numerous bridges and aqueducts which this involved, he also did good work in harbour construction. In 1790 he was employed by the British Fishery Society to inspect the harbours on the north-east coast of Scotland; and, besides constructing the important fishing harbour at Pulteneytown, Wick, he greatly improved those at the other principal fishing stations. His important works of this kind were, however, his improvement of the harbours at Aberdeen and Dundee, and the construction of the St Katherine's docks at London. In 1828-30 he drained the north level of the eastern Fen district, an area of 48,000 acres. The erection of the Dean Bridge, Edinburgh, and of the Broomielaw Bridge, Glasgow, and the improvement (1833-34) of Dover harbour were the principal achievements of his later years. He died on 2d September 1834, and was buried in Westminster Abbey.

Telford was never married. For twenty-one years he lived at the Salopian coffee house, afterwards the Ship Hotel, Charing Cross. He was a fellow of the Royal Societies of London and of Edinburgh, and was annually elected president of the Institution of Civil Engineers from its commencement. He received the Swedish order of knighthood "of Gustavus Vasa."

See Telford's *Memoirs*, written by himself and edited by John Rickman (1838); also Smiles's *Lives of the Engineers*.

TELL. The story of William Tell's skill in shooting at and striking the apple which had been placed on the head of his little son by order of Gessler, the tyrannical Austrian bailiff of Uri, is so closely bound up with the legendary history of the origin of the Swiss Confederation that they must be considered together. Both appear first in the 15th century, probably as results of the war for the Toggenburg inheritance (1436-50); for the intense hatred of Austria, greatly increased by her support of the claims of Zurich, favoured the circulation of stories which assumed that Swiss freedom was of immemorial antiquity, while, as the war was largely a struggle between the civic and rural elements in the Confederation, the notion that the (rural) Schwyzers were of Scandinavian descent at once separated them from and raised them above the German inhabitants of the towns.

The Tell story is first found in a ballad the first nine stanzas of which (containing the story) were certainly written before 1474. There is no mention made of the names of the bailiff or of his master, or of the hat placed on a pole. Tell is called "the first Confederate," and his feat is treated as the real and only reason why the Confederation was formed and the tyrants driven out of the land. It is probably to this ballad that Melchior Russ of Lucerne (who began his *Chronicle* in 1482) refers when, in his account (from Justinger) of the evil deeds of the bailiffs in the Forest districts, he excuses himself from giving the story. He goes on to narrate how Tell, irritated by his treatment, stirred up his friends against the governor, who seized and bound him and was conveying him by boat to his castle on the Lake of Lucerne, when a storm arose, and Tell, by reason of his great bodily strength, was, after being unbound, given charge of the rudder on his promise to bring the boat safely to land. He steers it towards a shelf of rock, called in Russ's time Tell's Platte, springs on shore, shoots the bailiff dead with his crossbow, and goes back to Uri, where he stirs up the great strife which ended in the battle of Morgarten. In these two accounts, which form the basis of the Uri version of the origin of the Confederation, it is Tell and Tell only who is the actor and the leader. We first hear of the cruelties of Austrian bailiffs in the Forest districts in the *Bernese Chronicle* of Conrad Justinger (1420). No names or details are given, and the dates are different in the two recensions of the *Chronicle* as "olden days before Bern was founded" (*i.e.*, before 1191) and 1260. Several details, but only one name, are added in the *De Nobilitate et Rusticitate Dialogus* (cap. 33) of Felix Hemmerlin, a canon of Zurich, who wrote it after 1451 and before 1454; in this last year he was imprisoned by the Schwyzers, whom he had repeatedly insulted and attacked in his books. According to him, the men of Schwyz and of Unterwalden were the first to rise, those of Uri following suit much later. But neither Justinger nor Hemmerlin makes any allusion to Tell or his feat.

The Tell story and the "atrocities" story are first found combined in a MS. known as the *White Book of Sarnen*. They are contained in a short chronicle written between 1467 and 1476, probably about 1470, and based on oral tradition. Many details are given of the oppressions of the bailiffs: we hear of Gessler, of the meeting of Stoupacher of Schwyz, Fürst of Uri, and a man of Nidwald at the Rütli,—in fact, the usual version of the legend. To give an instance of tyranny in Uri, the author tells us the story of the refusal of "der Thäll" to do reverence to the hat placed on a pole, of his feat of skill, and of his shooting the bailiff, Gessler, from behind a bush in the "hollow way" near Küssnacht. Tell is represented as being one of those who swore at the Rütli to drive out the oppressors; but the narrative of his doings is merely one incident in the general movement which began quite independently of him. The chronology is very confused, but the events are placed after Rudolph's election to the empire in 1273. This is the only account in which Tell is called "der Thäll," which name he himself explains by saying, "If I were sharp (*witzig*) I should be called something else and not der Tall," *i.e.*, the simpleton or slow-witted man. The only other known instances of the Uri version of the legend relating to the origin of the Confederation are the Latin hexameters of Glareanus (1515), in which Tell is compared to Brutus as "assertor patriæ, vindex ultorque tyrannum," and the *Urnerspiel* (composed in 1511-12), a play acted in Uri, in which Russ's version is followed, though the bailiff, who is unnamed, but announces that he has been sent by Albert of Austria, is slain in the "hollow way." Tell is the chief of the Rütli leaguers, and it is his deed which is the immediate occasion of the rising against the oppressors, which is dated in 1296. Mutius

(1540) is the latest writer who, in his description of the origin of the Confederation, does not mention Tell and his act. The two stories are now firmly bound together; the version contained in the *White Book* is the accepted one, though small additions in names and dates are often made.

The task of filling up gaps, smoothing away inconsistencies, rounding off the tale, was accomplished by Giles **Tschudi** (*q.v.*), whose recension was adopted, with a few alterations, by Von Müller in his *History of the Confederation* (1780). In the final recension of Tschudi's *Chronicle* (1734-36), which, however, differs in many particulars from the original draft still preserved at Zurich, we are told how Albert of Austria, with the view of depriving the Forest lands of their ancient freedom, sent bailiffs (among them Gessler) to Uri and Schwyz, who committed many tyrannical acts, so that finally on 8th November 1307, at the Rütli, Werner von Stauffacher of Schwyz, Walter Fürst of Uri, Arnold von Melchthal in Unterwalden, each with ten companions, among whom was William Tell, resolved on a rising to expel the oppressors, which was fixed for New Year's day 1308. A few days later (November 18) the Tell incident takes place (described according to the *White Book* version), and on the appointed date the general rising. Tschudi thus finally settled the date, which had before varied from 1260 to 1334. He utterly distorts the real historical relations of the Three Lands, though he brings in many real historical names, their owners being made to perform historically impossible acts, and introduces many small additions and corrections into the story as he had received it In particular, while in his first draft he speaks of the bailiff as Gryssler—the usual name up to his time, except in the *White Book* and in Stumpff's *Chronicle* of 1548—in his final recension he calls him Gessler, knowing that this was a real name. Later writers added a few more particulars,—that Tell lived at Bürglen and fought at Morgarten (1598), that he was the son-in-law of Fürst and had two sons (early 18th century), &c. Johannes von Müller gave a vivid description of the oath at the Rütli by the three (Tell not being counted in), and threw Tschudi's version into a literary form, adding one or two names and adopting that of Hermann for Gessler, calling him of "Bruneck." Schiller's play gave the tale a world-wide renown.

The story was, on the ground of want of evidence, regarded as suspicious by Guilliman in a private letter of 1607, and doubts were expressed by the brothers Iselin (1727 and 1754) and by Voltaire (1754); but it was not till 1760 that the legend was definitely attacked, on the ground of its similarity to the story of Tokko (see below), in an anonymous pamphlet by Freudenberger, a Bernese pastor. This caused great stir; it was publicly burnt by order of the Government of Uri, and many more or less forged proofs and documents were produced in favour of Tell. The researches of J. E. Kopp[1] first cleared up the real early history of the league, and overthrew the legends of the *White Book* and Tschudi. Since then many writers have worked in the same direction. Vischer (1867) has carefully traced out the successive steps in the growth of the legend, and Rochholz (1877) has worked out the real history of Gessler as shown in authentic documents. The general result has been to show that a mythological marksman and an impossible bailiff bearing the name of a real family have been joined with confused and distorted reminiscences of the events of 1245-47, in which the names of many real persons have been inserted and many unauthenticated acts attributed to them.

The story of the skilful marksman who succeeds in striking some small object placed on the head of a man or child is very widely spread: we find it in Denmark (Tokko), Norway (two versions), Iceland, Holstein, on the Rhine, and in England (William of Cloudesley). How it came to be localized in Uri we do not know; possibly, through the story of the Scandinavian colonization of Schwyz, the tale was fitted to some real local hero.

The alleged proofs of the existence of a real William Tell in Uri in the 14th century break down hopelessly. (1) The entries in the parish registers are forged. (2) As to the Tell chapels—(*a*) that in the "hollow way" near Küssnacht was not known to Melchior Russ, and is first mentioned by Tschudi (1570). (*b*) That on Tell's Platte is also first mentioned in Tschudi. The document which alleges that the chapel was built by order of a "landsgemeinde" held in 1388, at which 114 men were present who had been personally acquainted with Tell, was never heard of till 1759. The procession in boats to the place where the chapel stands may be very old, but is not connected with Tell till about 1582. (*c*) The chapel at Bürglen is known to have been founded in 1582. Other documents and statements in support of the Tell story have even less claim to credit. It has been pointed out above that with two exceptions the bailiff is always called Gryssler or Grissler, and it was Tschudi who popularized the name of Gessler, though Grissler occurs as late at 1765. Now Gessler is the name of a real family, the history of which from 1250 to 1513 has been worked out by Rochholz, who shows in detail that no member ever played the part attributed to the bailiff in the legend, or could have done so, and that the Gesslers could not have owned or dwelt at the castle of Küssnacht; nor could they have been called Von Bruneck.

In the *Urnerspiel* the name of the bailiff's servant who guarded the hat on the pole is given as Heintz Vögely, and we know that Friedrich Vögeli was the name of one of the chief military officers of Peter von Hagenbach, who from 1469 to 1474 administered for Charles the Bold, duke of Burgundy, the lands (Alsace, &c.) pledged to him by Sigismund of Hapsburg. Now Hagenbach is known to have committed many cruelties like those attributed to the bailiffs in the legend, and it has been plausibly conjectured that his case has really given rise to these stories, especially when we find that the Confederates had a hand in his capture and execution, that in a document of 1358 Hagenbachs and Gesslers appear side by side as witnesses, and that the Hagenbachs had frequent transactions with the Hapsburgs and their vassals.

Among the vast number of books and pamphlets on the Tell story, the two most to be recommended are W. Vischer, *Die Sage von der Befreiung der Waldstätte*, Leipsic, 1867, and E. L. Rochholz, *Tell und Gessler*, with a volume of documents 1250-1513, Heilbronn, 1877. Convenient summaries of the controversy will be found in any modern book on Swiss history, and more particularly in G. von Wyss, *Ueber d. Gesch. d. drei Länder—Uri, Schwyz, u. Unterwalden—in den Jahren 1212-1315*, Zurich, 1858; Alf Huber, *Die Waldstätte bis zur festen Begründung ihrer Eidgenossenschaft, mit einem Anhange über die geschichtliche Stellung des Wilh. Tell*, Innsbruck, 1861; Albert Rilliet, *Les Origines de la Confédération Suisse, Histoire et Légende*, Geneva, 1869. (W. A. B. C.)

TELLER, Wilhelm Abraham (1734-1804), was the son of the Leipsic clergyman, Romanus Teller, who edited the earlier volumes of the *Englisches Bibelwerk* (in 19 vols., 1749-70), an adaptation for German readers of the exegetical works of Willet, Ainsworth, Patrick, Poole, Henry, and others. Teller was born at Leipsic on 9th January 1734, and studied philosophy and theology in the university there. Amongst the men whose influence mainly determined his theological position and line of work was J. A. Ernesti. His writings present rationalism in its course of development from Biblical supernaturalism to the borders of deistical naturalism. His first learned production was a Latin translation of Kennicott's *Dissertation on the State of the Printed Hebrew Text of the Old Testament* (1756), which was followed the next year by an essay in which he expounded his own critical principles. In 1761 he was appointed pastor and professor of theology in the university of Helmstädt. Here he pursued his exegetical, theological, and historical researches, the results of which appeared in his *Lehrbuch des christlichen Glaubens* (1764). This work threw the entire theological world into commotion, as much by the novelty of its method as by the heterodoxy of its matter, and more by its omissions than by its positive teaching, though everywhere the author seeks to put theological doctrines in a decidedly modern form. In consequence of the storm of indignation the book provoked, Teller eagerly accepted an invitation from the Prussian cultus minister to the post of prebendary of Köln on the Spree, with a seat in the Berlin consistory (1767). Here he found himself in the company of the rationalistic theologians of Prussia—Sack, Spalding, and others—and became one of the leaders of the rationalistic party, and one of the chief contributors to Nicolai's *Allgemeine Deutsche Bibliothek*. Teller was not long in making use of his freer position in Berlin. In 1772 appeared the most popular of his books, *Wörterbuch zum Neuen Testament* (6th ed., 1805). The object of this work is to recast the language and ideas of the New Testament and give them the form of 18th-century illuminism. Thus Heb. xiii. 8 signifies the permanence of Christ's teaching, and, as the New Testament has no word for Christianity, "Christ" may mean sometimes His person and at others His doctrine or the Christian religion; Col. i. 15 signifies the priority of Christ to all other Christians. By this lexicon Teller had put himself amongst the most advanced rationalists, and his opponents charged him with the design of overthrowing positive Christianity altogether. The edict of Wöllner (1788), and Teller's manly action as consistorialrath in defiance of it, led the Prussian Government to pass upon him the sentence of suspension for three months, with forfeiture of his stipend. He was not, however, to be moved by such means, and (1792) issued his work *Die Religion der Vollkommeneren*, an exposition of his theological position, in which he advocated at length the idea, subsequently often urged, of "the perfectibility of Christianity,"—that is, of the ultimate transformation of Christianity into a scheme of simple morality, with a complete rejection of all specifically Christian ideas and methods. This book represents the culminating point of German illuminism, and is separated by a long process of development from the author's *Lehrbuch*. Teller died on 9th December 1804. In addition to the above works he wrote *Anleitung zur Religion überhaupt und zum Allgemeinen des Christenthums insbesondere* (1792); and, besides his contributions to the *Allgemeine Deutsche Bibliothek*, he edited a popular and practically useful *Magazin für Prediger* (1792-1801).

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[1] *Documents for the History of the Federal Alliances*, 1835 and 1851, and his *History*, part ii., 1847.

See Gass, *Geschichte der protestantischen Dogmatik*, iv. pp. 206-222; Tholuck, art. "Teller," in Herzog-Plitt's *Realencykl.*; Doring, *Deutsche Kanzelredner des 18ten und 19ten Jahrh.*, p. 506 *sq.*; Pusey, *Causes of the Late Rationalistic Character of German Theology* (1828), p. 150.

TELLEZ, Gabriel (*c.* 1570-1648), Spanish dramatist, better known as Tirso de Molina (his *nom de plume*), was born about the year 1570, and about 1613 entered the order of the Brothers of Charity at Toledo. In 1645 he became prior of the monastery of the order at Soria, where he died in 1648.

His dramatic works are said to have numbered nearly 300, but of these only a small proportion are now extant. A selection of the best of them was edited by Hartzenbusch in 1839-42 (Madrid, 12 vols.). See Drama, vol. vii. p. 421, and Spanish Literature, vol. xxii. p. 359.

TELLICHERRI, a seaport town of India, in Malabar district of Madras, situated in 11° 44′ 53″ N. lat. and 75° 31′ 38″ E. long. It is a healthy and picturesque town, built upon a group of wooded hills running down to the sea, and is protected by a natural breakwater of rock. The town with its suburbs occupies about 5 square miles, and was at one time defended by a strong mud wall. The citadel or castle still stands to the north of the town. The East India Company established a factory here in 1683 for the pepper and cardamom trade. For two years (1780-82) the town withstood a siege by Hyder's general Sardár Khán, and in the subsequent wars with Mysore Tellicherri was the base of operations for the ascent of the Ghâts from the west coast. In 1881 the population was 26,410.

TELLURIUM. See Selenium and Tellurium.

TELPHERAGE. See Traction.

TEMESVÁR, a royal free city and capital of the county of Temes, is the chief town of south-eastern Hungary. It lies on the navigable Béga Canal and the river Béga, in 45° 47′ N. lat. and 21° 14′ E. long. The inner town is fortified and separated from the suburbs by a glacis, now partly converted into a park. Temesvár is the seat of the Roman Catholic bishop of Csanád and of a Greek bishop, as also of several Government departments of great importance, and of one of the fifteen army corps of the Austrian-Hungarian army. The majority of the inhabitants follow industrial and commercial pursuits, and carry on a brisk trade in grain, flour, spirits, fruits, flax, and hemp with the neighbouring districts and with Roumania and Servia, by means of the Arad-Temesvár and the Austrian-Hungarian State Railways, as well as by the Béga Canal and by road. The town possesses many charitable and educational establishments, and is a favourite place of residence on account of its neatness and cleanliness. It has been lighted by electricity since 1883. Among the buildings specially worthy of notice are some fine old churches, a new theatre, and a synagogue in the Byzantine style. Temesvár played an important part in the Turkish wars and in that of 1848-49. The population was 37,500 in 1886.

TEMMINCK, Konrad Jacob (1778-1857), keeper of the Leyden museum of natural history, was especially distinguished as an ornithologist, and was the author of many magnificently illustrated systematic works. See Ornithology, vol. xviii. p. 11 *sq.*

TEMPE. See Thessaly.

TEMPERA, or Distemper,[1] is a method of painting in which solid pigments are employed, mixed with a water medium[2] in which some kind of gum or gelatinous substance is dissolved to prevent the colours from scaling off. Tempera is called in Italy "fresco a secco," as distinguished from "fresco buono," or true fresco, painted on freshly laid patches of stucco. The peculiarities of true fresco are described in vol. ix. p. 769 *sq.* The disadvantages of tempera painting are that it will not bear exposure to the weather; the pigments merely lie on the surface and do not sink into the stucco, as is the case with true fresco pigments; moreover, the medium used, being soluble in water, will not stand the rain. Its advantages are that the painter can work at leisure, and can also transfer or sketch his whole design on the dry finished surface; while in fresco work each portion of the design is hidden piecemeal as each new patch of stucco is applied (see Raphael, vol. xx. p. 279). Another important point is that a far greater variety of pigments can be used in tempera painting, as they are not subjected to the caustic action of wet lime. Lastly, tempera painting can be applied to any substance, such as dry plaster, wood, stone, terracotta, vellum, and paper.[3] Various media have been used for tempera work, such as the glutinous sap of the fig and other trees, various gums which are soluble in water, and size made by boiling down fish-bones, parchment, and animals' hoofs. In more recent times a mixture of egg and vinegar has been found to make a good medium, especially when it is desirable to apply the colours in considerable body or *impasto*. Painting in tempera is probably the oldest method of all, and was used in ancient Egypt very largely, as can be seen by an examination of the many existing examples on papyrus or wood and stone thinly coated with a skin of fine plaster (*gesso*). Other ancient examples have been found in Babylon and Nineveh, and for internal work it appears to have been much employed by the Greeks. To some extent tempera was used by the Romans, though in most cases a combination of fresco and encaustic (hot wax) was employed for their mural decoration (see vol. xvii. p. 42).

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[1] For some account of tempera painting in classical and mediæval times, see Mural Decoration, vol. xvii. pp. 39-47.

[2] Hence it used to be called "water-work"; see Shakespeare, *Hen. VI.*, part ii., act ii. sc. 1

[3] Miniatures and illuminated letters in mediæval MSS. were painted with very finely ground colours mixed with a tempera medium.

In mediæval times, from the 6th century in the Byzantium of Justinian down to the 14th century, most painting, whether on walls or panels, was executed in tempera, though in many cases it appears to have been the custom to put in the coloured ground in true fresco, and, when that was dry, paint on it the complete picture with a tempera medium. This was the method used in the Byzantine wall-paintings in the churches of Thessalonica, Mount Athos, and elsewhere. A similar practice existed in England and other northern countries,[1] as in the very complete series of paintings on the walls and vault of the chancel of Kempley church, Gloucestershire, dating from about 1100. Most commonly, however, in England as in France and Germany the whole painting was done in tempera, the finished surface of the plaster being first covered with a wash of old slaked lime or whitening. As a rule every inch of stone, whether carved, moulded, or plain, in the cathedrals and other churches of mediæval France, England, and other countries was covered with this thin coating of white, and then elaborately decorated with tempera painting. In those rare cases where want of money prevented the application of colour the stone-work of the interior received the coat of white, so that at any future time the colouring might be added, and also because the feeling of the Middle Ages evidently was that bare stone inside a building had an unfinished and uncomfortable look,[2] and was quite as unsuitable in a richly decorated and furnished cathedral as it would now be considered in a lady's drawing-room. The additional splendour gained by the use of minute patterns stamped in gesso, thinly laid over the surface of the stone, is described in MURAL DECORATION, vol. xvii. p. 47; see also fig. 17.

Tempera in Italy.—For panel and canvas paintings tempera continued in use till nearly the end of the 15th century, when the Flemish method of oil painting gradually took its place. In many cases with panel pictures of the latter part of the 15th century it is now difficult, if not impossible, to be sure whether they were painted in tempera or in oil, either because both methods were combined—the picture being begun in tempera and finished with oil glazings—or because an oil varnish has been laid over the tempera pictures, and so the pigments have absorbed oil out of the varnish and have thus practically become associated with an oil medium. In some cases slight peculiarities of brush-work bear witness to one medium or the other; but these appearances are often deceptive, and any real certainty on the point is unattainable. The round panel of the Madonna and St Joseph by Michelangelo may be mentioned as an example of these doubtful cases.

In the main the earlier tempera easel pictures were painted on wood,—pear, poplar, or walnut being commonly used; but a few painters preferred in some cases to use canvas.[3] The National Gallery of London possesses a very beautiful example of this,—the Entombment, attributed to Van der Weyden (see SCHOOLS OF PAINTING, vol. xxi. p. 438, fig. 29), which is most delicately and yet powerfully painted on linen without any priming. Usually both panels and canvas were prepared for tempera by being covered with a fine priming or coating of gesso (plaster). Some later painters used marble dust; others unfortunately used white lead, which has since blackened through the absorption of gases from the air.

In the case of wall paintings, both tempera and fresco[4] were used together,—the proportion of fresco work being gradually increased. In the 13th and most of the 14th century little more than the groundwork of the picture was painted in fresco, though this varied according to the custom of each painter. In the 15th century increased technical skill and rapidity of execution allowed much more complete work to be done in fresco, till at last nothing but a few finishing touches were done in tempera. For this, exceptional certainty of touch and speed of execution were required, and some weaker painters never attained to a very complete mastery over the fresco process. The brilliant series of wall paintings by Pinturicchio in the cathedral library at Siena contain a very large proportion of tempera work, in spite of which they are still in a wonderful state of preservation. Raphael's rapid advance in the mastery of fresco-work is clearly shown in his paintings in the Vatican stanze, each one of which is carried to a further stage in true fresco than the preceding. Thus the earliest painting of the series (the Disputa) is very largely executed in tempera, while some of the later ones are nearly completed in fresco, and show the most perfect skill in that difficult process. Michelangelo was specially remarkable for his great power in fresco, and carried his Sistine paintings to a very advanced stage before touching them with tempera. Sad to say, what tempera finishing touches he did apply have mostly been scraped off during the many cleanings and repairs that these works have undergone; and the same misfortune has happened to a large number of other important pictures. Tempera was specially used for paintings on canvas which were intended to be hung like tapestry, as, for example, the fine 15th-century series at Rheims and Mantegna's Triumph of Julius Cæsar at Hampton Court.[5] It was also much used for large cartoons, such as Raphael's tapestry designs, now in the South Kensington Museum. After the first half of the 16th century the increasing use of oil painting, assisted by the artistic decadence of the age, caused the gradual disuse of both fresco and tempera.

A third process, often used during the earlier Middle Ages, was a sort of compromise between tempera and fresco. A finished stucco surface was prepared as for ordinary tempera, but before each day's painting the plaster was soaked with water, so that the pigments, laid on to the wet plaster, to some extent sank below the surface, though without penetrating as deeply as they would on newly mixed stucco. (J. H. M.)

TEMPERANCE SOCIETIES.[6] The modern temperance movement may be said to date from the publication at Philadelphia, in 1785, of Dr Benjamin Rush's essay on "The Effects of Ardent Spirits on the Human Body and Mind," which was republished in the *Gentleman's Magazine* of 1786, and had a wide circulation. The distinction which he draws between distilled and fermented liquors has, however, no foundation in fact, the difference being one of degree and not of kind. In 1808 Dr Lyman Beecher and Dr B. J. Clark, both readers of Rush, took action, and the result of the work of the latter was the formation of what is believed to be the first modern temperance society. It was formed in Greenfield, Saratoga county, New York, as an anti-spirits association, and still remains a teetotal society. This example was soon followed elsewhere, the early societies all restricting their scope to advocacy of moderation in the use of distilled liquors, and placing no inhibition upon fermented drinks. One society had a byelaw requiring any member who became intoxicated to treat all the other members. The work made further progress when the American Temperance Society was founded in 1826. Three years later Prof. John Edgar of Belfast called attention to the need for similar work in Ireland; and John Dunlop nearly at the same time organized a temperance society in Glasgow. In 1830 the first English temperance society was founded at Bradford. The habitual use of fermented liquors in England was a prolific source of drunkenness, and the evil was greatly increased by the passing of the Beer Act in October 1830. Hence some of the reformers began to abstain from all forms of alcohol. This new departure found its leader in Joseph Livesey of Preston, a man of singular zeal and benevolence, who with six others signed a pledge of total abstinence on 1st September 1832. The reformers were soon divided over the fierce "battle of the pledges." Some were willing to pledge themselves to abstain, but not to refrain from providing alcoholic drink for their visitors. After the formation of the distinctive total abstinence organizations, the moderation societies died of inanition. It should be mentioned here that the Society of Bible Christians, founded at Salford in 1809, adopted the rule of abstinence from flesh meat and intoxicants, and that a number of the "radical reformers" were abstainers from a desire to diminish the public revenue, which they regarded as devoted to wrong purposes by the Government of the day. In Ireland Father Theobald Mathew became president of the Total Abstinence Society in Cork in 1838, and the "pledge" was taken from his hands by crowds; before he died in 1856 between three and four million persons are said to have received it from him in the course of his journeys. J. S. Buckingham secured the appointment of a committee of the House of Commons, which sat in June 1834, to inquire into drunkenness. The adjective "teetotal" was first used in September 1833 by Richard Turner, a reformed drunkard, to express the thoroughgoing principle of total abstinence, but whether he coined the word, or whether it was merely a stuttering pronunciation of "total," or an old dialect word has been disputed; Prof. Skeat (*Etym. Dict.*, *s.v.* "Teetotal") believes it is an emphasized form of "total," formed on the principle of reduplication. The early teetotallers were earnest missionaries. In consequence of their efforts societies and leagues multiplied, periodicals were established, and, notwithstanding many failures and apparent retrogressions, the temperance movement progressed. One of the chief forms of thrift amongst the artisan class was that of the friendly society, the meetings of which were usually held at the public-house, large sums being spent (sometimes by rule) on liquor. In 1835 the Independent Order of Rechabites was formed at Salford, and has since had a prosperous career as a working-class insurance company on temperance principles. The Sons of Temperance and the Total Abstinent Sons of the Phœnix are similar organizations. The sickness and death-rate among members of these bodies is much below that of the ordinary friendly societies. The beneficial effect of abstinence upon health and longevity is shown by the experience of the United Kingdom Temperance Provident Institution, the example of which has led several large insurance companies to add a special section for teetotallers. The statistics of these offices show that the mortality of the ordinary insured is considerably heavier than that of the abstainers. A vehement controversy arose at an early period as to the use of sacramental wine, and the nature of the wines mentioned in Scripture was discussed in innumerable pamphlets. The result has been that in a number of cases the wine now used for sacramental purposes is understood to be unfermented. The cosmopolitan character of the movement was shown by the meeting of the World's Temperance Convention at London in 1846. The Scotch United Presbyterian Abstinence Society, originated in 1845, was one of the first of the church societies; and there are now few, if any, religious denominations either in England or America in which such organizations are wholly wanting. The Church of England Temperance Society has two sections, one pledged to the temperate use of intoxicants and the other to total abstinence This method of organizing has found imitators. The enactment of the Maine Liquor Law in America in 1851 (see vol. xv. p. 299) led to the formation, in 1853, of the United Kingdom Alliance, which has for its object the suppression of the liquor traffic by legislation, and with a view to this suggests that a power of local veto should be placed in the hands of the ratepayers. This proposal took parliamentary form in the Permissive Bill of Sir Wilfrid Lawson, which was ultimately withdrawn and replaced by a "local option" resolution, which has been thrice affirmed by the House of Commons. Temperance hotels, temperance cafés, British workmen public-houses, cocoa houses, coffee palaces, teetotal clubs, have arisen in many places as social aids of the temperance movement.

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[1] A fine example of 14th-century tempera painting in Sweden is illustrated in vol. xvii. plate I.

[2] Nothing could be more opposed to the spirit of the Middle Ages than the modern rage for cutting off plaster and scraping old stone-work, under a mistaken notion of æsthetic honesty.

[3] In order to ensure an even surface some painters prepared their panels by covering them with linen or vellum, over which the gesso priming was laid.

[4] "Fresco" here means "fresco buono," or true fresco.

[5] See vol. xvii. p. 38.

[6] The manner and degree in which the law has in recent years regulated the sale of intoxicants is described under LIQUOR LAWS (vol. xiv. p. 688).

In 1868 the Good Templar order was introduced into England from the United States, where it had come into existence several years earlier. In England it made rapid progress, until it was seriously checked by a dispute arising out of the Negro question; but the two sections have again reunited (1887). Good Templary is the freemasonry of temperance, with ritual, passwords, grips, &c., closely modelled on those of the old secret societies. It has had a remarkable extension in Great Britain, the United States, the British colonies, and in Scandinavia, its aggregate membership now reaching over 623,000. One of its results has been the foundation of a temperance orphanage at Sunbury-on-Thames. Side by side with the general movement there has been a special movement against the use of alcohol as medicine, and the tendency of medical teaching now favours at least restriction of its use as a therapeutic agent. The London Temperance Hospital for the non-alcoholic treatment of disease was opened in October 1873. The importance of training the young was early recognized by the leaders of temperance reformation, and the labours of Dr R. B. Grindrod of Manchester and Mrs Carlile of Dublin led to the formation of bands of hope, which are now found in connexion with many places of worship. The juvenile temples of the Good Templar order also work in the same direction. The Woman's Christian Temperance Union, founded in the United States in 1874, is one of the latest forms of temperance activity. A branch was organized in Great Britain in 1876; and in 1883 the World's Women's Temperance Union came into existence.

The temperance movement has now branched out into a multitude of organizations in the United Kingdom, of which the Railway Temperance Union, the post-office temperance societies, and associations connected with the army and navy are types. The organizations of a more general character are the United Kingdom Alliance, which is very active in the dissemination of teetotal doctrines generally, the National Temperance League, the Scottish Temperance League, the British Temperance League, the Scottish Permissive Bill Association, the Irish Temperance League, and the Irish Association for the Prevention of Intemperance. There are also large district and county societies. Next to these come the secret orders, of which the Rechabites, Sons of Temperance, Sons of the Phœnix are large benefit societies. The Independent Order of Good Templars is non-beneficiary, and seeks in its "lodges" to provide social attractions, and at the same time to train the members in temperance work; it is probably the largest voluntary association in the world. There are societies in connexion with the various religious bodies, of which the Church of England Temperance Society, the Catholic League of the Cross, the Baptist Total Abstinence Society, are prominent instances.

The oldest organization in America is the Sons of Temperance (1842), now numbering about 80,000 members. The Independent Order of Good Templars (1851) is the largest, its membership approaching 100,000. Both these, as also the Royal Templars of Temperance (1877) and the Templars of Honour and Temperance (1845), are mutual benefit societies. The Woman's Christian Temperance Union, the National Temperance Society and Publication House (New York), and the National Prohibition Party are active in educational work. The Woman's Christian Temperance Union is the outgrowth of "the Women's Crusade" (1872), a remarkable uprising among the women of Ohio and Pennsylvania against the liquor traffic. The organization was effected in 1874, and has since spread throughout the United States, its membership now (1887) numbering 207,000. Its influence has been widely felt in legislatures and in elections in which prohibitory laws have been voted upon. With the exception of the Church Temperance Society of the Protestant Episcopal Church, which has the "double basis," all the temperance societies of the United States are based on the doctrine of total abstinence; and, with the additional exception of the Father Mathew Total Abstinence Societies of the Roman Catholic Church, they all advocate the principle of prohibition. Amendments embodying this idea have been inserted in the State constitutions (by popular vote) of Maine, Kansas, and Rhode Island. In Vermont and Iowa the legislature has enacted statutory prohibition, which is still in force. In other States local prohibition prevails to a large extent, chiefly in Georgia, Mississippi, Massachusetts, Tennessee, Kentucky, and Arkansas.

Bibliography.—The literature of the subject is very extensive and may most conveniently be classed under the following heads. (1) HISTORY: P. T. Winskill, *History of the Temperance Reformation*; *One Hundred Years of Temperance* (New York, 1886); Dorchester, *Liquor Problem in all Ages* (New York); Willard, *Woman and Temperance* (Hartford); Shaw, *Great Temperance Reforms* (Toronto). (2) THEOLOGY: Dawson Burns and F. R. Lees, *Temperance Bible Commentary*; J. Smith, *The Church and the Temperance Reformation*; Samson, *Divine Law as to Wines* (Philadelphia). (3) GENERAL: A. Gustafson, *The Foundation of Death*; R. B. Grindrod, *Our Nation's Vice*; D. Burns, *Bases of the Temperance Reformation*; Grindrod, *Bacchus*; B. Parsons, *Anti-Bacchus*; Powell, *Bacchus Dethroned*; Baker, *The Curse of Britain*; J. Dunlop, *Philosophy of Drinking Usages* (1839); *The Political Prohibitionist* (New York, 1887); Pitman, *Alcohol and the State* (New York). (4) POLITICAL ECONOMY: F. R. Lees, *Argument for the Prohibition of the Liquor Traffic*; W. Hoyle, *Our National Resources*; Hargreaves, *Our Wasted Resources* (New York). (5) SCIENCE: J. Livesey, *The Malt Liquor Lecture*; P. Burne, *Teetotaller's Companion*; W. B. Carpenter, *Physiology of Temperance and Total Abstinence*; A. A. Reade, *Study and Stimulants*; Miller, *Alcohol, its Place and Power*; Id., *Nephalism*; B. W. Richardson, *Cantor Lectures on Alcohol*; Hargreaves, *Alcohol and Science* (New York). (6) FICTION: novels and tales embodying teetotal principles have been written by Mrs Henry Wood, Mrs H. B. Stowe, Mrs. C. L. Balfour, Mr John Habberton, Mr Edward Jenkins, Mrs S. C. Hall, Mrs Ellis, and many others. (7) PERIODICALS: the temperance periodicals issued in Great Britain now number about fifty.

TEMPLARS, KNIGHTS. Perhaps the most renowned of the three great military orders founded in the 12th century for the defence of the Latin kingdom of Jerusalem is that of the Knights Templars (*pauperes commilitones Christi templique Salomonici*), though abolished long before its rivals. It differed from the Hospitallers and the Teutonic Knights in having been a military order from its very origin, inasmuch as its earliest members banded themselves together for the express purpose of giving armed protection to the numerous pilgrims who, after the first crusade, flocked to Jerusalem and the other sacred sites in the Holy Land. Walter Map has preserved the legendary story of their first achievements, from which it would appear that their earliest efforts were confined to the immediate neighbourhood of Jerusalem; and the memory of their original aim may perhaps be traced from fifty to seventy years later, when they conducted Henry of Saxony from their own quarters on Mount Moriah to the banks of Jordan, or when on the fall of the Holy City (1187) they protected the vanguard of the Christians on its way from Jerusalem to Tripoli. The three orders were distinguished from each other by their garb. The Hospitallers wore black mantles with white crosses, the Templars white mantles with a red cross, the Teutonic Knights white mantles with a black cross.[1]

The Templars almost from their foundation had their quarters in the palace of the Latin kings, which had been the mosque of Mount Moriah. This palace was also known as Solomon's temple, and it was from this *templum Salomonis* that the Templars took their name.

About the year 1118 a Burgundian knight, Hugh de Paganis, bound himself and eight comrades by a vow to the patriarch of Jerusalem to guard the public roads, to live as regular canons, and to fight for the King of Heaven in chastity, obedience, and self-denial. Baldwin II. granted them quarters on Mount Moriah and recommended their cause to St Bernard. Under his patronage the papal legate, Matthew, bishop of St Albano, presided at the council of Troyes in January 1128 for the purpose of drawing up or confirming the statutes of the new order. The seventy-two statutes then drawn up met with the approval of Pope Honorius II. and the patriarch of Jerusalem, and became the groundwork of the later and more elaborate "*Règle du Temple.*" Long before St Bernard's death (1153) the new order was established in almost every kingdom of Latin Christendom. Henry I. granted them lands in Normandy. They seem to have been settled in Castile by 1129, in Rochelle by 1131, in Languedoc by 1136, at Rome by 1138, in Brittany by 1141, and in Germany at perhaps a still earlier date. Alphonso I. of Aragon and Navarre, if we may trust the Spanish historians, bequeathed them the third of his kingdom (Mariana, x. c. 9). Raymond Berengar, count of Barcelona, and Alphonso's successor in Aragon, whose father had been admitted to the order, granted them the strong castle of Monçon (1143), and established a new chivalry in imitation of theirs. Louis VII. in the latter years of his reign gave them a piece of marsh land outside Paris, which in later times became known as the Temple, and was the headquarters of the order in Europe. Stephen of England granted them the manors of Cressing and Witham in Essex, and his wife Matilda that of Cowley, near Oxford. Eugenius III., Louis VII., and 130 brethren were present at the Paris chapter (1147) when Bernard de Balliol granted the order 15 librates of land near Hitchin; and the list of English benefactors under Stephen and Henry II. includes the noble names of Ferrers, Harcourt, Hastings, Lacy, Clare, Vere, and Mowbray.

Sprea
of the
order.

After the council of Troyes Hugh de Paganis came to England and induced a number of English knights to follow him to the Holy Land. Amongst these was Fulk, count of Anjou, who would thus seem to have been a Templar before assuming the crown of Jerusalem in 1131. Hugh de Paganis died about the year 1136 and was succeeded by Robert de Craon, who is said to have been Anselm's nephew. Everard de Barris, the third master, was conspicuous in the second crusade. In the disastrous march from Laodicea to Attalia his troops alone kept up even the show of discipline; and their success prompted Louis VII. to regulate his whole army after the model of the Templar knights. In the French king's distress for money the Templars lent him large sums, ranging from 2000 silver marks to 30,000 solidi. When Conrad III. of Germany reached Jerusalem he was entertained at their palace (Easter 1148); and in the summer of the same year they took part in the unsuccessful siege of Damascus. The failure of this expedition was ascribed by a contemporary writer to their treachery,—a charge to which Conrad would not assent. This is the first note of the accusations which from this time were of constant recurrence.[2]

Ear
gra
mas

Henceforward for 140 years the history of the Templars is the history of the CRUSADES (*q.v.*). In 1149 the Templars were appointed to guard the fortress of Gaza, the last Christian stronghold on the way towards Egypt. Four years later the new master, Bernard de Tremelai, and forty of his followers, bursting into Ascalon, were surrounded by the Saracens and cut off to a single man. William of Tyre has preserved the scandal of the day when he hints that they met a merited fate in their eagerness to possess themselves of the city treasure. Next year

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[1] William of Tyre, xii. c. 7, viii. 3, xviii. 3-6; James de Vitry, *Hist. Hieros.* 60-67.

[2] *Hist. Pontific.* ap. Pertz, xx. 535-536.

Relations with Núr al-Dín.

the rumour went abroad that they had sold a noble half-converted Egyptian prince, who had fallen into their hands, to chains and certain death for 60,000 aurei. In 1166 Amalric, the Latin king of Jerusalem, hanged twelve Templars on a charge of betraying a fortress beyond the Jordan to an emir of Núr al-Dín of Damascus. The military power of Núr al-Dín (1145-1173) was a standing menace to the Christian settlements in the East. Edessa had fallen to the prowess of his father (1144-45); Damascus was conquered by the son (1153), who four years earlier had carried his depredations almost to the walls of Antioch, and in 1157 laid siege to the Christian town of Paneas near the sources of the Jordan. In the disastrous fight that followed for the safety of the fortress of the Hospitallers, Bertrand de Blanquefort, the master of the Templars, and Odo de St Amand, one of his successors, were taken prisoners. Bertrand was released later when Manuel was preparing to march against Núr al-Dín. The Templars do not seem to have opposed Amalric's early expeditions against Egypt. It was Geoffrey Fulcher, the Templar correspondent of Louis VII., who brought back (1167) to Jerusalem the glowing accounts of the splendour of the caliph's court at Cairo with which Gibbon has enlivened his great work. Nor was the order less active at the northern limits of the Latin kingdom. Two English Templars, Gilbert de Lacy and Robert Mansel, "qui Galensibus præerat," starting from Antioch, surprised Núr al-Dín in the neighbourhood of Tripoli and put him barefooted to flight. But jealousy or honour led the Templars to oppose Amalric's Egyptian expedition of 1168; and the wisdom of their advice became apparent when the renewed discord on the Nile led to the conquest of Egypt by Asad al-Dín Shírkúh, and thus indirectly to the accession of Saladin, in 1169. In 1170 they beat Saladin back from their frontier fortress of Gaza; and seven years later they shared in Baldwin IV.'s great victory at Ascalon.

Relations with Saladin.

Meanwhile Saladin had possessed himself of Emesa and Damascus (1174-75), and, as he was already lord of Egypt, his power hemmed in the Latin kingdom on every side. In July 1173 Amalric was succeeded by his son Baldwin IV., a boy of twelve. Raymond III., count of Tripoli, a man suspected of being in league with the Saracens, was appointed regent, although in 1176 the masters of the Templars and the Hospitallers united in offering this office to the newly arrived Philip of Flanders. The construction of the Templar fortress at Jacob's ford on the upper Jordan led to a fresh Saracen invasion and the disastrous battle of Paneas (1179), from which the young king and the Holy Cross escaped with difficulty, while Odo de St Amand, the grand-master, was carried away captive and never returned.

During Odo's mastership the Old Man of the Mountains sent to Amalric offering to accept the Christian faith if released from the tribute he had paid to the Templars since (according to the reckoning of M. Defrémery) somewhere about 1149. The Templars murdered the envoys on their return (*c.* 1172). Amalric demanded that the offenders should be given up for justice. Odo refused to yield the chief culprit, though he was well known, and invoked the protection of the pope. Amalric had to vindicate his right by force of arms at Sidon, and died while preparing to take stronger measures. The connexion between the Templars and the Old Man was still vital eighty years later when the two grand-masters rebuked the insolence of the Assassin envoys in the presence of Louis IX. Odo de St Amand was succeeded by Arnold de Torroge, who died at Verona on his way to implore European succour for the Holy Land. The power of Saladin was now (1184) increasing daily; Baldwin IV. was a leper, and his realm was a prey to rival factions. There were two claimants for the guardianship of the state,—Raymond III. of Tripoli and Guy de Lusignan, who in 1180 had married Sibylla, sister of the young king. Baldwin inclined to the former, against the patriarch and Arnold de Torroge.

Fall of Latin kingdom.

There is something Homeric in the story of the fall of the Latin kingdom as related by the historians of the next century. A French knight, Gerard de Riderfort or Bideford, coming to the East in quest of fortune, attached himself to the service of Raymond of Tripoli, looking for the hand of some wealthy widow in reward. But on his claiming the hand of the lady of Botron he was met with a refusal. Angered at this, Gerard enrolled himself among the Templars, biding his time for revenge, and was elected grand-master on the death of Arnold. Baldwin IV. died (1185), leaving the throne to his young nephew Baldwin V., the son of Sibylla, under the guardianship of Raymond, whose office was not of long duration, as the little king died in September 1186. This was Gerard's opportunity. The Templars carried the body of their dead sovereign to Jerusalem for burial; and then, unknown to the barons of the realm, Gerard and the patriarch crowned Sibylla and her husband Guy. The coronation of Guy was the triumph of Reginald of Châtillon, once prince of Antioch, and Saladin's deadliest foe. It was at the same time the overthrow of Raymond's ambition; and both Latin and Arabic writers are agreed that the Christian count and the Mohammedan sultan now entered into an alliance. To break this friendship and so save the kingdom, the two grand-masters were sent north to make terms with Raymond. But the rash valour of the Templars provoked a hopeless contest with 7000 Saracens. The grand-master of the Hospitallers was slain; but Gerard made his escape with three knights to Nazareth (1st May 1187). In this emergency Raymond became reconciled with Guy; and Gerard placed the temple treasures of Henry II. at his king's disposal. Once more it was the Templars' rashness that led to the disastrous battle of Hittin (4th July). Gerard and the king fell into the hands of Saladin, but were released about a year later; Raymond of Tripoli made his escape through treachery or fortune; and 230 Templars fell in or after the battle, for the fight was scarcely over before Saladin ordered all the Templars and Hospitallers to be murdered in cold blood. One after another the Christian fortresses of Palestine fell into the hands of Saladin. Jerusalem surrendered on 2d-3d October 1187, and the treasures of the temple coffers were used to purchase the redemption of the poorer Christians, part of whom the Templar warriors guarded on their sad march from the Holy City to Tripoli. Part of their wealth was expended by Conrad of Montferrat in the defence of Tyre; but, when this prince refused to admit Guy to his city, both the Templars and the Hospitallers from the neighbouring parts flocked to the banner of their released king and accompanied him to the siege of Acre (22d August 1189). In his company they bore their part in the two years' siege and the terrible famine of 1190-91; and their grand-master died in the great battle of 4th October 1189, refusing to survive the slaughter of his brethren.

Fall of Jerusalem.

Siege of Acre.

On the fall of Acre Philip Augustus established himself in the palace of the Templars, who are, however, stated to have sympathized with Richard. This king sold them the island of Cyprus for 100,000 besants; but, unable to pay the purchase money, they transferred the debt and the principality to Guy of Lusignan. The English king consulted them before deciding on any great military movement; and in June 1192 they advocated the bold plan of an advance on Egypt rather than on Jerusalem. In the disputes for the Latin kingdom of the East the Templars seem to have supported Guy, and, like Richard, were credited with having had a hand in the murder of Conrad

John de Brienne.

of Montferrat (April 1192). It was in the disguise of a Templar and in a Templar galley that Richard left the Holy Land. When Acre was recovered, the Templars, like the Hospitallers, received their own quarters in the town, which from this time became the centre of the order. On the death of Henry of Champagne (1197) they vetoed the election of Raoul de Tabarie; after the death of his successor Amalric they refused to renew the truce with Saladin's brother, Saif al-Dín, and led an expedition against the Saracens before the arrival of the new king, John de Brienne, at whose coronation in 1210 William de Chartres, the grand-master, was present. Seven years later, with the aid of Walter de Avennis and of the Teutonic Knights, they commenced the building of their fortress of Castle Pilgrim, near Acre, on a rocky promontory washed by the Mediterranean on every side except the east. This wonderful structure, whose ruins are still to be seen, was fortified with a strong wall, founded on the substructure of a yet more extensive one running from sea to sea, and was flanked by lofty towers of huge squared stones. Within was a spring of pure water, besides fishponds, salt-mines, woods, pastures, orchards, and all things fitted to furnish an abode in which the Templars might await the day of their restoration to Jerusalem.

Fifth crusade.

It was from this castle that in May 1218 the fifth crusade started for the expedition against Egypt. The Templars were the heroes of the siege of Damietta, at which William de Chartres was slain. "First to attack and last to retreat," they saved the Christian army from annihilation on 29th August 1219; and when the city surrendered (5th November) the only one of its twenty-eight towers that had begun to give way had been shaken by their engines. On the other hand, it was largely owing to their objections that John de Brienne refused the sultan's offer to restore Jerusalem and Palestine.

From the very first the Templars seem to have been opposed to Frederick II., and when he landed at Acre (7th September 1228) they refused to march under the banners of an excommunicated man, and would only accompany his host from Acre to Joppa in a separate body. They were accused of notifying Frederick's intended pilgrimage to the Jordan to the sultan, and they were certainly opposed to Frederick's ten years' peace with Al-Kámil, the sultan of Egypt, and refused to be present at his coronation in Jerusalem. Frederick was not slow to avenge himself: he left Jerusalem abruptly, publicly insulted the grand-master, demanded the surrender of their fortresses, and even laid siege to Castle Pilgrim. He left Acre on 3d May 1229, and on landing in Apulia gave orders to seize the estates of the order and chase all its members from the land.

Seventh crusade.

Long before the expiration of Frederick's peace Europe was preparing for a fresh crusade against the now divided realm of the Ayyubids. Theobald of Navarre and his crusaders reached Palestine about August 1239. The Templars shared in the great defeat near Jaffa, an engagement which their temerity had done much to provoke (13th November 1239). If the king ever accepted the overtures of Ṣáliḥ of Damascus, he was supporting the policy of Hermann of Perigord, the grand-master, who towards the summer of 1244 wrote a triumphant letter to England, telling how he had engaged this sultan and Násir of Kerak to make an alliance against the sultan of Egypt and restore the whole of Palestine from the Jordan to the sea. Theobald, however, before leaving the Holy Land (27th September 1240), signed a ten years' truce with Ṣáliḥ of Egypt. The Hospitallers seem to have been won over to his view, and when Richard of Cornwall arrived (11th October) he had to decide between the two rival orders and their opposing policies. After some hesitation he concluded a treaty with the sultan of Egypt, much to the annoyance of the Templars, who openly mocked his efforts. On his departure the three orders came to open discord: the Templars laid siege to the Hospitallers in Acre and drove out the Teutonic Knights "in contumeliam imperatoris." They were successful on all sides. The negotiations with Damascus and Kerak were reopened, and in 1244 Hermann of Perigord wrote to the princes of Europe that after a "silence of fifty-six years the divine mysteries would once more be celebrated in the Holy City."

Khárizmian invasion.

It was in this moment of danger that the sultan of Babylon called in the barbarous Khárizmians, whom the Mongol invasions had driven from their native lands. These savages, entering from the north, flowed like a tide past the newly built and impregnable Templar fortress of Safed, swept down on Jerusalem, and annihilated the Christian army near Gaza on St Luke's day (18th October) 1244. From this blow the Latin kingdom of the East never recovered; 600 knights took part in the battle; the whole army of the Templars, 300 in number, was present, but only 18 survived, and of 200 Hospitallers only 16. The masters of both orders were slain or taken prisoners. Despite the admirable valour of the Templars, their policy had proved the ruin of the land. Jerusalem was lost to Christendom for ever; and, though the Khárizmians melted away in the course of the next three years, they left the country so weak that all the acquisitions of Theobald and Richard fell an easy prey to the sultan of Babylon.

Louis IX.'s crusade

Recognizing the fact that the true way to Jerusalem lay through Egypt, Louis IX. led his host to the banks of the Nile, being accompanied by the Templars. Their master, William de Sonnac, attempted in vain to restrain the rash advance of the count of Artois at the battle of Mansúra (8th February 1250), which only three Templars survived. St Louis, when captured a few weeks later, owed his speedy release to the generosity with which the order advanced his ransom-money. Shortly after his departure from Acre (April 1254) they consented to an eleven years' truce with the sultans of Egypt and Damascus.

Successes of Beybars

A new enemy was now threatening Mohammedan and Christian alike. For a time the Mongol advance may have been welcomed by the Christian cities, as one after another the Mohammedan principalities of the north fell before the new invaders. But this new danger stimulated the energies of Egypt, which under the Mameluke Beybars (see vol. vii. p. 755) encroached year after year on the scanty remains of the Latin kingdom. The great Frankish lords, fearing that all was lost, made haste to sell their lands to the Templars and Hospitallers before quitting Palestine for ever. In 1260 the former purchased Sidon and Beaufort; next year the Hospitallers purchased Arsuf. In 1267, by a skilful adaptation of the banners of both orders, Beybars nearly surprised Antioch. The Templar fortress of Safed surrendered with its garrison of 600 knights, all of whom preferred death to apostasy (June 1266). Beaufort fell in April 1268, Antioch six weeks later; and, though the two orders still made occasional brilliant dashes from their Acre stronghold, such as that to Ascalon in 1264 and that with Prince Edward of England to destroy Ḳáḳún in 1271, they became so enfeebled as to welcome the treaty which secured them the plain of Acre and a free road to Nazareth as the result of the English crusade of 1272.

But, though weak against external foes, the Templars were strong enough for internal warfare. In 1277 they espoused the quarrel of the bishop of Tripoli, formerly a member of the order, against his nephew Bohemond, prince of Antioch and Tripoli, and commenced a war which lasted three years. In 1276 their conduct drove Hugh III., king of Cyprus and Jerusalem, from Acre to Tyre. In the ensuing year, when Mary of Antioch had sold her claim to the crown to Charles of Anjou, they welcomed this prince's lieutenant to Acre and succeeded for the moment in forcing the knights of that city to do homage to the new king. Thirteen years later (26th April 1290) Tripoli fell, and next year Acre, after a siege of six weeks, at the close of which (16th May) William de Beaujeu, the grand-master, was slain. The few surviving Templars elected a new master, and, forcing their way to the sea-shore, sailed for Cyprus, which now became the headquarters of the order. A futile attempt against Alexandria in 1300 and an unsuccessful effort to form a new settlement at Tortosa about the same time (1300-2) are the closing acts of their long career in the western parts of Asia.

For more than a hundred years the Templars had been one of the wealthiest and most influential factors in European politics. If we confine our attention to the East, we realize but a small part of their enormous power. Two Templars were appointed guardians of the disputed castles on the betrothal of Prince Henry of England and the French princess in 1161. Other Templars were almoners of Henry III. of England and of Philip IV. of France. One grand-master was godfather to a daughter of Louis IX.; another, despite the prohibition of the order, is said to have been godfather to a child of Philip IV. They are reported to have reckoned a pope (Innocent III.) among their members and to have refused admission to a king and his nephew (Philip IV.). They were summoned to the great councils of the church, such as the Lateran of 1215 and the Lyons council of 1274. Frederick II.'s persecution of their order was one of the main causes of his excommunication in 1239; and his last will enjoined the restoration of their estates. Their property was scattered over every country of Christendom, from Denmark to Spain, from Ireland to Cyprus. Before the middle of the 13th century Matthew Paris reckons their manors at 9000, Alberic of Trois-Fontaines at 7050, whereas the rival order of St John had barely half the latter number. Some fifty years earlier their income from Armenia alone was 20,000 besants. Both in Paris and in London their houses were used as strongholds for the royal treasure. In the London temple Hubert de Burgh and the Poitevin favourites of Henry III. stored their wealth; and the same building was used as a bank into which the debtors of the foreign usurers paid their dues. From the English Templars Henry III. borrowed the purchase money of Oléron in 1235; from the French Templars Philip IV. exacted the dowry of his daughter Isabella on her marriage with Edward II. To Louis IX. they lent a great part of his ransom, and to Edward I. of England no less than 25,000 *livres Tournois*, of which they remitted four-fifths. James de Molai, the last grand-master, came to France in 1306 with 150,000 gold florins and ten horse-loads of silver. In the Spanish peninsula they occupied a peculiar position, and more than one king of Aragon is said to have been brought up under their discipline.

Such were the power and wealth of the Templars at the time when Philip IV. of France accused them of heresy and worse offences, had them arrested (13th October 1307), and forced them to confess by tortures of the most excruciating kinds. Five years later (26th May 1312) the order was suppressed by decree of the council of Vienne and its goods transferred to the hospital of St John.

The order consisted of (1) knights, (2) chaplains, and (3) men-at-arms (*armigeri*, *clientes*, and *servientes*). The knights were either bound for life or for a fixed period, and were the only members entitled to wear the white mantle. Married brethren were admitted; but no woman might enter the order. Each knight might keep three horses and one man-at-arms, who, like his master, might be bound for life or only for a time. Like Augustinian canons, they were to attend daily services; but the soldier outwearied with his nightly duties might on certain conditions absent himself from matins with the master's consent. Two regular meals were allowed for each day; but to these might be added, at the master's discretion, a light collation towards sunset. Meat might be eaten thrice a week; and on other days there was to be a choice of vegetable fare so as to suit the tenderest stomach. Brethren were to eat by couples, each keeping an eye on his fellow to see that he did not practise an undue austerity. Wine was served at every meal, and at those times silence was strictly enjoined that the words of Holy Writ might be heard with the closest attention. Special care was to be taken of aged and ailing members. Every brother owed the most absolute obedience to the master of the order, and was to go wherever his superior bade him without delay, "as if commanded by God." All undue display in arms or harness was forbidden. Parti-coloured garments were forbidden; black or dusky-brown (*burellus*) was to be worn by all except the knights. All garments were to be made of wool; but from Easter to All Souls a linen shirt might be substituted for one of wool. The hair was to be worn short, and a rough beard became one of the distinguishing marks of the order. Hunting and hawking were unlawful; and the very allusion to the follies or secular achievements of earlier life was forbidden. A lion, however, being the type of the evil one, was legitimate prey. Strict watch was kept on the incomings and outgoings of every brother, except when he went out by night to visit the Sepulchre of our Lord. No letter, even from the nearest relative, might be opened except in the master's presence; nor was any member to feel annoyance if he saw his relative's gift transferred at the master's bidding to some other brother. The brethren were to sleep in separate beds in shirts and breeches, with a light always burning in the dormitory. Those who lacked a mattress might place a piece of carpet on the floor; but all luxury was discouraged. The order recognized two governing bodies,—the first, a meeting for ordinary business, to which only the wiser members were summoned; the second, one for extraordinary affairs, such as the granting of lands or the reception of new members, on which occasions the master might summon the whole community. Even at these last assemblies the master seems to have decided on the final action (c. 59). A term of probation was assigned to each candidate before admission; and a special clause discouraged the reception of boys before they were of an age to bear arms. Lastly, the brethren of the Temple were exhorted to shun the kiss of every woman, whether maid or widow, mother, aunt, or sister.

Administration.

The general spirit of the Templar statutes remained unaltered to the end, though the increasing wealth of the order gave rise to a number of additional rules. The grand-master was always head of the society; his instructions were binding on every member, and the very laws were at his discretion. But he could not declare war, alienate the society's estates, or even admit a member without the consent of his chapter. He was elected by thirteen brothers, chosen by a peculiar method of co-optation, and all, if possible, belonging to different nations. Next to him in dignity came the seneschal, on whom the duties of the absent master devolved. The marshal had charge of the steeds and accoutrements; he also commanded the knights and men-at-arms, the latter of whom seem in time of war to have been at the disposal of the turcopolier. The commander of the kingdom guarded the treasure-house, to which even the grand-master might not have a key; the commander of the city of Jerusalem had charge of the True Cross in time of war. There were twelve or perhaps more commanders or preceptors of the different provinces and kingdoms of Europe and Asia,—Jerusalem (kingdom and city), Acre, Tripoli, Antioch, France, England, Poitou, Aragon, Portugal, Apulia, and Hungary. No European preceptor could cross the sea without the grand-master's leave; but all ought to be present at the election to this office. The privileges and duties of every member were strictly prescribed, from the number of horses he might ride and the amount of food he might eat to the colour of his clothes. The order seems to have owned a fleet, part of which, if not all, was under the authority of the commander of the kingdom. Besides the knights and men-at-arms, the society reckoned chaplains in its ranks; and it was the habit of confession to these priests that seems to have stirred the wrath of the Dominicans and the Franciscans, who played a very conspicuous part in the overthrow of the order, especially in England. For grievous offences, such as desertion to the Saracens, heresy, or losing the gonfalon, a Templar might be expelled (*perdre la maison*); for minor offences, such as disobedience or lowering the banner in battle, he suffered a temporary degradation (*perdre son abit*). By a mutual agreement the Templars and Hospitallers, despite their long and deadly feud, were bound not to receive ejected members of the rival order; and the Templar cut off in battle and defeat from all hope of rejoining his own ranks might rally to the cross of St John. As Acre was the headquarters of the order in the East, so Paris was its centre in the West (Matt. Paris, v. 478). Every member before admission must declare himself free of debt, sound of body, and affiliated to no other religious society; he must also take a vow of obedience and chastity, at the same time renouncing his private property and dedicating his future life to the Holy Land. The order prided itself specially on the splendour of its religious services, the abundance of its alms, and its reckless valour for the Christian faith. At the time of its suppression it was calculated to number 15,000 members. Three MSS. of its ancient statutes, written in Old French, are still extant at Dijon, at Paris, and at Rome. Of these the first was transcribed about 1200, the last two from 1250 to 1300. They have been published by M. Maillard de Chambure (Paris, 1840).

Suppression of the order.

A scheme for the union of the three great military orders into one had received the sanction of Gregory X. and Louis IX., of Nicholas IV. and Boniface VIII. The recovery of the Holy Land was the dream of the last pope's highest ambition; and when he died a prisoner in the hands of Philip IV. of France this king continued to advocate the plan for his own purposes. His gold or influence secured the election of Clement V. as pope (5th June 1305). According to a slightly later tradition, before consenting to the new pope's appointment he exacted from him an oath to assist in carrying out six propositions, one of which he would not disclose as yet. This sixth condition, if it ever existed, must have been the suppression of the Templars; and, whether false or true, Villani's story emphasizes a popular and almost contemporary opinion. It is known that Philip was urging Clement in this direction before the latter's coronation at Lyons on 14th November 1305, and all through the two succeeding years. On 6th June 1306 the pope summoned the grand-master from Cyprus to France. James de Molai obeyed the call, and, hearing of the charges against his order, demanded a prompt investigation. In this demand he was supported by the leading Templars of the realm. Clement, who disbelieved the accusations, fenced with the question. But, though only a very short time previously Philip had spoken of his special love for the order, and though it had sheltered him from the fury of the Paris mob in 1306, he was now determined on its destruction. Its wealth would fill the royal coffers, and the rumours of the day afforded a ready engine for its overthrow.

Accusations.

For perhaps half a century there had been strange stories circulating as to the secret rites practised by the order at its midnight meetings. It was said that on his initiation each member had to disavow his belief in God and Christ, to spit upon the crucifix, to submit to indecent ceremonies, and to swear never to reveal the secrets of the society or disobey the mandates of a grand-master, who claimed full power of absolution. When the mass was celebrated the consecrating words "Hoc est corpus" were omitted; on Good Friday the holy cross was trampled under foot; and the Christian duty of almsgiving had ceased to be observed. Even the vaunted chastity of the order towards women had, it was said, been turned into a sanction for more horrible offences. These evil practices were part of the secret statute law of an order which in its nightly assemblies worshipped hideous four-footed figures,—a cat or a calf. In England the very children at their play bade one another beware of a Templar's kisses. Stranger stories yet were rife in this country and gravely reported before bishops and priests,—of children slain by their fathers because they chanced to witness the nightly orgies of the society; of one prior's being spirited away at every meeting of the general chapter; of the great preceptor's declaring that a single hair of a Saracen's beard was worth more than the whole body of a Christian man. In France they were said to roast their illegitimate children and smear their idols with the burning fat.

Suppression of order in France.

For nearly two years Philip waited for Clement to fulfil his bargain. A certain Templar from the prisons of Toulouse now offered to put the king in possession of a secret that would be worth a realm. Acting on the evidence of this informer, Philip issued orders (14th September 1307) for the arrest of all the Templars in France on the night of Friday, 13th October. He seems to have written to the neighbouring princes urging them to act in the same way. James de Molai was seized with sixty of his brethren in Paris. On Saturday they were brought before the university of Paris to hear the enumeration of their crimes; and on Sunday the Paris mob was gathered in the royal gardens, where preachers were inveighing against the iniquities of the order. The inquisitors began their work at once; and inhuman tortures forced the most horrible avowals from the lips of many. In Paris alone thirty-six Templars died under torture.[1] Of 140 Templars examined at Paris between 19th October and 24th November 1307, the experience of some of whom extended over nearly half a century, there is hardly one who did not admit the dishonouring of the crucifix at his reception. Very many confessed to other charges, even of the worst description. Clement V., although he suspended the inquisitors' powers on 27th October (Loiseleur, 159), before the end of the next month wrote to Edward II. to arrest all the English Templars, who were accordingly seized on 10th January 1308. About the same time they were arrested in Sicily (24th January) and in Cyprus (27th May). As Clement did not move fast enough, Philip went to Poitiers with 700 armed men, and the pope was at his mercy. It was agreed that the prisoners, their lands, and their money should be nominally placed in the hands of Clement's commissioners. The power of the inquisitors was restored (5th July); and the property forfeited was to be devoted to the recovery of the Holy Land. Clement now gave orders for fresh diocesan inquiries into the guilt of the Templars. He had already heard the confessions of seventy-two at Poitiers (29th June to 1st July). The grand-master and the three preceptors were re-examined at Chinon, and renewed their old confessions (20th August). Lastly, the bull *Regnans in Cœlo* summoned a great council at Vienne for 1st October 1310, when the question of the guilt of the order might be considered. The diocesan councils were only empowered to inquire into the conduct of individuals.

The trial.

The trial began on 11th April 1310. On 23d April Reginald de Pruino protested against the unfairness of the proceedings. On Tuesday, 12th May, fifty-four Templars were burnt by order of the archbishop of Sens, and a few days later four more. Next day the terror spread (19th May). Forty-six Templars withdrew their defence and the commissioners decided (30th May) to adjourn till November. The second examination lasted from 18th December 1310 to 5th June 1311. Meanwhile (c. April 1311) Clement and Philip had come to terms. The pope condemned the Templars. The council of Vienne met in October 1311. A discussion arose as to whether the Templars should be heard in their own defence. Clement, it is said, broke up the session to avoid compliance; and when seven Templars offered themselves as deputies for the defence he had them cast into prison. Towards the beginning of March Philip came to Vienne, and he was seated at the pope's right hand when that pontiff delivered his sermon against the Templars (3d April 1312), whose order had just been abolished, not at the general council, but in private consistory (22d March). On 2d May 1312 he published the bull *Ad Providam*, transferring the goods of the society, except for the kingdoms of Castile, Aragon, Portugal, and Majorca, to the Knights of St John. The order was never formally pronounced guilty of the crimes laid to its charge; its abolition was distinctly, in the terms of Clement's bull *Considerantes Dudum*, "non per modum definitivæ sententiæ, cum eam super hoc secundum inquisitiones et processus super his habitos non possemus ferre de jure sed per viam provisionis et ordinationis apostolicæ" (6th May 1312).

The individual members of the order seem to have been left to the judgment of provincial councils. They were divided into three classes,—(1) those who confessed at once; (2) those who persisted in denial of the charges; (3) those who, having confessed at first, withdrew their confessions later on the plea that they had been extracted by torture. The penalties for the three classes were respectively (1) penitence, (2) perpetual imprisonment, (3) death by fire. The cases of the grand-master, the visitor of France, and the masters of Aquitaine and Normandy were reserved for the pope's decision. Early in 1314 they were forced to make a public confession in Notre Dame, and had already been condemned to perpetual imprisonment when the grand-master and the preceptor of Normandy publicly proclaimed their entire innocence. The king, without consulting the church, had them burnt "in the little island" of the Seine "between the Augustinians and the royal garden."

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The opinion that the monstrous charges brought against the Templars were false and the confessions were only extracted by torture is supported by the general results of the investigation (in almost every country outside France), as we have them collected in Raynouard, Labbe, and Du Puy. In Castile, where the king flung them into prison, they were acquitted at the council of Salamanca. In Aragon, where they held out for a time in their fortresses against the royal power, the council of Tarragona proclaimed in their favour (4th November 1312). In Portugal the commissioners reported that there were no grounds for accusation. At Mainz the council pronounced the order blameless. At Treves, at Messina, and at Bologna, in Romagna and in Cyprus, they were either acquitted or no evidence was forthcoming against them. At the council of Ravenna the question as to whether torture should be used was answered in the negative except by two Dominicans; all the Templars were absolved,—even those who had confessed through fear of torture being pronounced innocent (18th June 1310). Six Templars were examined at Florence, and their evidence is for its length the most remarkable of all that is still extant. Roughly speaking, they confess with the most elaborate detail to every charge,—even the most loathsome; and the perusal of their evidence induces a constant suspicion that their answers were practically dictated to them in the process of the examination or invented by the witnesses themselves.[2] In England, where perhaps torture was not used, out of eighty Templars examined only four confessed to the charge of denying Christ, and of these four two were apostate knights. But some English Templars would only guarantee the purity of their own country. That in England as elsewhere the charges were held to be not absolutely proved seems evident from the form of confession to be used before absolution, in which the Templars acknowledge themselves to be defamed in the matter of certain articles that they cannot purge themselves. In England nearly all the worst evidence comes at second or third hand or through the depositions of Franciscans and Dominicans. Yet it can hardly be doubted that the "spuitio super crucem" did form a part of the initiation ceremony. Even the English Templars admitted that the statutes of the order were one and the same all the world over; and there is no setting aside the consistent evidence of almost every French Templar as to his guilt in this matter. Of the other charges the most revolting may have originated in the abuse and misinterpretation of a licence primarily intended for military emergencies. Such at least is the form it seems to take in the evidence of John Senand (ap. Mich., ii. p. 137). A debased mind might misinterpret this concession and translate it into coarser words, till (this part of the initiation ceremony being probably conducted in private, as, most certainly, was the spitting on the cross) there might be two formularies current in the order, of which the second was plainly immoral, whereas the first was perfectly harmless unless coupled with a *sous-entendre*. So too with regard to the *spuitio*. One Templar says plainly that he took it for a joke,—*pro trufa*; others regarded it as an imitation of St Peter's denial; a modern writer has suggested that the custom was intended as a symbol of absolute obedience (ap. Mich., ii. 260). There is little doubt that most members looked upon the ceremony with disgust. Some salved their consciences by the excuse that they were denying Jesus and not Christ; another when shown the crucifix denied his belief in the painted figure. Nearly all declared that they had spat near but not upon the cross, and denied Christ "non corde sed ore." Men who could thus play with their own consciences at their initiation might well, when their lives were in peril, clothe a falsehood in the garb of truth by denying "spuitio super crucem" instead of confessing to "spuitio juxta crucem."

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[1] Michelet, *Procès*, i. 36; Gruelle, 35, &c.

[2] See the evidence in full ap. Loiseleur, pp. 173-212.

The other charges stand upon a somewhat similar footing. The power of lay absolution might easily be developed out of the harmless words with which the master or preceptor dismissed his chapter. The cordulæ which Templars were accused of wearing in honour of their idol take a very different appearance as the "zones of chastity" or "belt of Nazareth" worn in accordance with St Bernard's precept. With regard to the charge of idolatry the evidence is very conflicting. In France and at Florence a large proportion of the members confessed to indecent kissing (*oscula inhonesta*) at their initiation; but hardly a single English Templar admitted the charge, and one French witness suggested an almost ludicrous explanation of the rumour. Here also a simple ceremony of respect or humiliation seems to have been expanded into one of shamelessness; but the evidence is too strong to admit of its being explained away, at least in France.

Doctrinal errors.

Not a few witnesses confessed that they had been called upon to declare Christ a false prophet, who suffered for His own sins and not for the race, and to believe only in a superior God of the heavens (*Deum cœli superiorem*). One Florence witness admits that the idol was worshipped as God and Saviour. It was this head, according to one of the witnesses, that could make the order rich and cause the earth to bud and the trees to blossom. A Carcassonne Templar spoke of the idol (Raynouard, 241) as a *friend of God*, who converses with God when he wishes. On such evidence M. Loiseleur holds that the Templars were members of a secret religion, which combined the heretical teachings of the Bogomilians and the Luciferians. The former, "the friends of God," believed in a Supreme Deity, whose eldest son Satanael was the creator of our world after his revolt against his father, and whose younger son Jesus was made man to counteract the evil deeds of his brother. They did not venerate the cross, regarding it as the instrument of Christ's passion. The Luciferians, on the other hand, worshipped the eldest son, who had power over all the riches of this world. M. Loiseleur has shown some remarkable coincidences, verbal and otherwise, between the creed of these two sects and that of the Templars, who, according to him, borrowed from the former their belief in the Supreme Deity and from the latter their devotion to the God of this earth. It seems, however, doubtful whether he is justified in combining the several items of such scattered evidence into a complete doctrinal system. His argument might be turned against himself; for, if these heresies were so widely spread in mediæval Europe, are they not for that reason those most likely to be ascribed to an unpopular order!

On the whole it may perhaps be admitted that the charges of "spuitio" and "osculatio inhonesta" were current, at least sporadically, for fifty years before the suppression of the order.[1] They may have become more general in the time of Thomas Beraud, the grand-master (who died 1273), according to the evidence of the preceptor of Aquitaine. On the death of William de Beaujeu (1291) there were two rivals for the office of grand-master,—Hugh de Peraud, the visitor of France, and James de Molai. The latter in 1291, at a general chapter, had declared his intention of extirpating certain practices in the order of which he did not approve[2]; while, if we may trust the French witnesses, the most vigorous initiator according to the new method was Hugh de Peraud. This exactly fits in with the account[3] that the errors were introduced after William de Beaujeu's death. In other words, it is probable that the party of Hugh de Peraud between 1290 and 1307 made a desperate effort to enforce the new ceremonies and the new doctrines throughout France and England. The custom of "spuitio," at all events, was very ancient, and Hugh de Peraud devoted his energies to the propagation of the "osculatio inhonesta." This would explain the omission of all allusion to the latter ceremony when the English Templars were absolved; for they would not confess to a practice of which they were innocent. This theory likewise goes a long way towards interpreting both the confession and the denial of James de Molai and the general acquittal of the Templars in nearly all the councils outside France. (T. A. A.)

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TEMPLE. The temple is an institution common to religions of natural growth which have reached a certain stage, and in most languages bears a name expressing that it is the house or palace erected by men as a habitation for their god[4] (Greek, *ναός*; Hebrew, *hēkal*, "palace," or *bēth ĕlōhīm*, "house of God"; Latin, *ædes sacræ*). In this connexion the term "house of God" has quite a different sense from that which we connect with it when we apply it to a Christian place of worship. A temple is not a meeting-place for worshippers; for many ancient temples were open only to priests, and as a general rule, the altar, which was the true place of worship, stood not within the house but before the door. The temple is the dwelling-house of the deity to which it is consecrated, whose presence is marked by a statue or other sacred symbol; and in it his sacred treasures, the gifts and tribute of his worshippers, are kept, under the charge of his attendants or priests. Again, a temple implies a sanctuary; but a sanctuary or holy spot does not necessarily contain a temple. A piece of land may be reserved for the deity without a dwelling-house being erected to him upon it, and a sacred tree, stone, or altar, with the holy precinct surrounding it, may be recognized as a place where the worshipper can meet his god and present his offerings, although no temple is attached. Indeed the conception of a holy place, separated from profane use, is older than the beginnings of architecture; and natural objects of worship, such as trees and stones, which need no artificial protection or official keeper, are older than images enshrined under roofs and protected by walls and doors. All antique religion is essentially altar-worship (see SACRIFICE), and for ritual purposes the altar always continued to be the true centre of the sanctuary. But the altar is only a modification of the sacred stone (comp. PRIEST, vol. xix. p. 726), and it has already been observed that, even in later times, the chief altar of a sanctuary stood outside the temple. In the oldest and most primitive forms of religion the sacred stone is at once the place where gifts are offered and the material sign of the presence of the deity; thus the temple with its image belongs to a later development, in which the significance of the sacred stone is divided between the altar outside the door and the idol, or its equivalent, within. But in many very ancient sanctuaries the place of a temple is taken by a natural or artificial grotto (*e.g.*, the Phœnician Astarte grottoes, the grotto of Cynthus in Delos), or else the temple is built over a subterranean opening (as at Delphi); and, while this may be in part explained as connected with the cult of telluric deities, or the worship of the dead, it seems not unreasonable to think that in their origin cave temples may date back to the time when caves were commonly used as human habitations, that the altar in front of the temple had its prototype in altars at the mouths of sacred caves, which were approached with holy fear and not entered by ordinary worshippers, and that thus some of the main features of the ancient temple were fixed from the first by the analogy

Meaning.

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[1] See Mich., ii. 6-11. [2] Mich., ii. 139, 247. [3] Mich., ii. 132.

[4] *Templum* properly denotes a spot inaugurated for the observation of auspices by the augurs. But at Rome most *ædes sacræ* were also *templa*, and so the terms came to be used as synonymous.

of more primitive sanctuaries. The influence of the cave temple seems at least to be undeniable in that widespread type of sanctuary in which, besides the court for the worshippers and an outer chamber, there was a dark and mysterious inner room, an adytum or Holy of Holies. This type is found in Egypt (see ARCHITECTURE, vol. ii. p. 388 and plate VII.), among the Semites, as in the temple at Jerusalem and in that of Hierapolis (*De Dea Syr.*, § 31), and also among the Greeks and Romans. In Greece the adytum was not a universal feature, though large temples usually had an antechamber as well as the cella or proper chamber of the god. But, where an oracle was given, or mysteries were celebrated, an adytum was always found, and one of its names was μέγαρον, which seems to be a transcription of a Semitic word for a cave (*meghara*). Certain adyta in Greece were actually subterranean; and the association of oracles with caves is well known.

The architectural features and plan of temples in various parts of the world have been illustrated at length in the article ARCHITECTURE, and need not detain us here, but some further notice of the successive temples at Jerusalem is called for by the unique interest of the subject, while a glance at the topographical problems connected with this holy site is necessary to supplement the article JERUSALEM.

Solomon's temple.

1. *The Temple of Solomon.*—There were temples among the Hebrews before the time of Solomon, whether private, like that of Micah (Judges xvii. 5), or public, like that of Shiloh, where the ark was housed for a time (see TABERNACLE). In this, as in other matters, the Israelites must have learned from the Canaanites, who had large temples in the time of the Judges. The "hold" (vault?) of the temple of El-Berith at Shechem was the place of refuge for a thousand men (Judges ix. 46 *sq.*), and at Gaza there was a vast temple with a roof supported on two middle pillars (Judges xvi. 29). Solomon's enterprise was not therefore absolutely novel, and in point of size his temple can hardly have surpassed those just mentioned. But his subjects were much behind the Canaanites and Philistines in the constructive arts, and as Solomon had to call in the aid of Tyrian craftsmen it cannot be questioned that the design was derived from Tyrian architecture. The general plan, indeed, of the house or "palace" (*hēkal*) of Jehovah, with an adytum (*debīr*, E.V. "oracle"), an outer chamber, and an altar before the door, is, as we have seen, common to many countries, especially in temples which had an oracle, as was the case with Solomon's temple, built to contain the ark. But all the distinctive features are Phœnician, or at least characteristic of the northern Semites, of whose art the Phœnicians were then the leading exponents. For the general arrangements the temple of Hierapolis (Mabbōg), described by Lucian, offers a complete parallel. Like that of Solomon, it faced the east, and had two cellæ and a pronaos. The interior was enriched with gold work. Before the door stood a brazen altar within a walled court. The walled court is a constant feature in the Phœnician and Syrian temples, known to us from their remains or from coins,[1] and the golden decorations, the portico, and the brazen altar appear in the ancient temple of Byblus and in other Phœnician shrines (*C.I.S.*, Nos. 2, 143). The chief motives in the internal decoration of Solomon's temple were the palm tree and the cherub. The former is one of the commonest Phœnician symbols, and the Phœnician associations of the latter are clear from Ezek. xxviii. The cherub, in fact, is only a variety of the sphinx, and the way in which the palm and winged animal figures were combined in Phœnician decoration is shown in a fragment of alabaster preserved in the Louvre and here figured (fig. 1) after Perrot (*op. cit.*, iii. 131). Two cherubs with outstretched wings stood in the adytum to form a baldachin over the ark. Baldachins over the image or symbol of the deity existed in other temples of the northern Semites (Donaldson, *op. cit.*, pp. 73, 76 *sq.*, 99), and in many Phœnician works of art (*e.g.*, on the stele of Byblus) the figure or symbol of a deity is overshadowed by the winged disk (an Assyrian symbol of godhead) arranged as a sort of canopy (Ménant, *Glyptique Oriental*, ii. 231, 238).

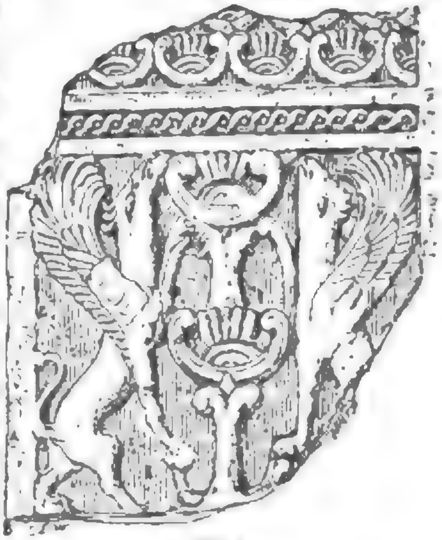

Fig. 1.

The adytum of the temple was a cube of 20 cubits each way; the outer chamber was of the same breadth, but 40 cubits long and 30 high.[2] The portico was of the breadth of the main building and 10 cubits deep. That the two chambers were separated by a solid wall and not by a mere wooden partition may be taken as certain if, with Stade, we understand 1 Kings vi. 31 to say that the doorway of the adytum was pentagonal, *i.e.*, that instead of a horizontal lintel a rude arch of two blocks was introduced to distribute the pressure of the superincumbent wall. In this case it is not likely that the exterior walls of the adytum were carried up to a height of 30 cubits, so as to allow of a continuous roof. The reduction of the dimensions to English feet is approximately determined by the Siloam inscription, which gives a round number of 1200 cubits for a measured length of 1760 feet. The Hebrew cubit, therefore, was the short cubit of antiquity, and for practical purposes may be taken as equal to the Greek cubit of 18 inches, used by Josephus for the measurements of Herod's temple. Thus the roof-beams of the temple had a span of 30 feet, a length sufficient to make it probable that the wooden pillars spoken of in 1 Kings x. 12 (comp. 2 Kings xviii. 16) were employed to support them. The roof of the temple at Gaza rested on pillars, as we have seen, and wooden pillars seem to have been used within the temple at Golgus (Cesnola, *Cyprus*, p. 139), which was smaller than that of Jerusalem. A peculiar feature in Solomon's temple was that all its sides except the front were surrounded by three stories (each 5 cubits high) of small chambers, 5 cubits wide on the ground floor, 6 on the first floor, and 7 on the second, the increasing breadth being evidently got by reducing the thickness of the walls by 1 cubit at each floor.[3] Thus, allowing for the walls, the external measurements of the house cannot have been much less than 45 cubits by 90. The aspect of the façade can only be conjecturally determined. Several Phœnician temples, known from coins, show on their façade a high-pitched gable (Byblus, Tripolis), and that of Tripolis has also a flat-roofed wing on each side of the gable and portico, which would answer to the ends of the side chambers in

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[1] See T. L. Donaldson, *Architectura Numismatica* (London, 1859); Renan, *Mission de Phénicie*; Perrot and Chipiez, *Hist. de l'Art*, vol. iii.

[2] The description of the temple in 1 Kings is often obscure and the text is not always sound. Cp. Stade's essay in *Z. f. ATliche Wiss.*, 1883, p. 129 *sq.*

[3] In such small chambers the winding stair (1 Kings vi. 8) can hardly have been more than a vertical post with footholds nailed to it (Prof. J. H. Middleton).

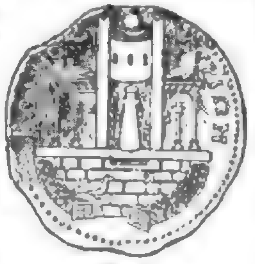

Fig. 2

our temple. But perhaps the closest analogy to the frontispiece of Solomon's temple is the often-cited one of the temple at Paphos, of which a representation from a coin is annexed (fig. 2). Here the portico between the side wings is flanked by two slender towers, and in the end of the nave above the door there are square-topped windows. Solomon's temple had "windows of beams" (or "with horizontal lintels") "framed in," which, as Professor J. H. Middleton observes, is naturally explained on the analogy of the windows between the beams in the wooden gables of Coptic churches. This is the obvious position of openings for light in buildings the type of which was derived from wooden constructions, and we know that the oldest Phœnician temples were, at least in great part, of wood (Utica; Pliny, *H.N.*, xvi. 79; comp. Jos., *C. Ap.*, i. 17, 18, and Solomon's house of the forest of Lebanon). That Solomon's temple had towers cannot be proved, for the height of the porch is not given in Kings, and the 120 cubits of 2 Chron. iii. 4 is obviously an excessive figure, due to a mistake of the writer or of a copyist. But the fact that in Ezekiel's ideal temple the door-posts of the porch are 5 cubits broad makes the existence of slender turrets like those of Paphos on each side of the portal probable. Another feature of Solomon's temple is exactly reproduced at Paphos. On each side of the door the coin shows a fantastic pillar standing free. Solomon erected two such pillars of bronze, 18 cubits high (1 Kings vii. 15 *sq.*), with capitals of "lily work," *i.e.*, adorned with lotus flowers, like the Phœnician capital from Cyprus figured by Perrot (*op. cit.*, p. 116). Such twin pillars or twin stelæ in stone are of constant occurrence in Phœnician sacred art, and are still familiar to us as the Pillars of Hercules. In Solomon's temple both the oracle and the outer cella had folding doors. In the second and third temples the inner door was replaced by a vail (*pārōkheth*), and a vail also hung before the outer door (Mal. i. 10; 1 Mac. i. 22, iv. 51; *B. J.*, v. 5, § 4 *sq.*). The Chronicler (2 Chron. iii. 14) introduces a vail in the first temple. This feature also seems to be common to the temple with other Semitic shrines (comp. *C.I.S.*, No. 86, פרכת, Assyr. *parakku*. Syriac *prakkē*, "shrines," and the Kaaba at Mecca).[1]

The temple had an inner court of its own (1 Kings vi. 36), but the outer or great court (1 Kings vii. 12) was the court of the palace as well as of the sanctuary. Details as to the position of the courts and buildings must be reserved till we speak of the site, but it may be noticed that Jer. xxxvi. 10 speaks of the "higher court," to which the "new gate" of the temple belonged. This new gate in the higher court can hardly be different from the "higher gate" built by Jotham (2 Kings xv. 35), or from the "higher gate" of Benjamin, which, in Jer. xx. 2, is not the city gate of that name, but a gate "in" (not "by" as E.V.) "the house of the Lord." From its name this gate must have been on the north side or at the north-east angle of the temple area, so that the ground rose to the north or north-east. The upper court may be merely the upper part of the great court near the "higher gate" leading to the palace (2 Chron. xxiii. 20), or may be the same as the "new court" of 2 Chron. xx. 5. But one cannot be sure that the Chronicler is not transferring to Jehoshaphat's time a new court of the second temple. We know, however, that the kings of Judah made from time to time considerable changes in and about the temple.

2. *The Temple of Zerubbabel.*—After the captivity an altar of stone took the place of the brazen altar, or rather perhaps of the altar of Ahaz (2 Kings xvi. 10 *sq.*). The altar was erected immediately after the return (Ezra iii. 2); but the rebuilding of the temple was long delayed, and the work was not completed till 520 B.C. (see HAGGAI). It was much inferior to the first temple in magnificence, though not perhaps in size (Haggai ii. 3). The proposed breadth of 60 cubits and height of 60 cubits spoken of in Ezra vi. 3 would indeed imply that it was larger than the first temple, but in view of the testimony of Haggai (*loc. cit.*) it seems unlikely that these dimensions were realized by Zerubbabel.

The first temple resembled other temples of antiquity in being built to contain a visible symbol of the presence of the deity, namely, the ark, which stood in the inner chamber. In the second temple the adytum was empty, but the idea that the Godhead was locally present in it still found expression in the continuance of the altar service, in the table of showbread (a sort of continual *lectisternium*) that stood in the outer chamber, and above all in the annual ritual of the day of atonement, when the high priest entered the Holy of Holies to sprinkle the blood of the expiatory sacrifice on behalf of the people. Not only in this point but in all others the ritual of the second temple was dominated by the idea of priestly mediation, and the stated sacrifices of the priests on behalf of the people, which replaced the old stated oblations of the kings, became the main feature of the altar service. The first temple was primarily the royal chapel, and the kings did as they pleased in it; the second temple was the sanctuary of the priests, whose chief now became the temporal as well as the spiritual head of the people. In the time of Ezekiel not only laymen but uncircumcised foreigners entered the sanctuary and acted as servants in the sacred offices (Ezek. xliv. 7); in the second temple the laity were anxiously kept at a distance from the holy things, and even part of the court around the altar was fenced off by a barrier, which only the priests were allowed to cross (Joseph., *Ant.*, xiii. 13, § 5). Being no longer hemmed in by the royal buildings, as the first temple had been (Ezek. xliii. 8), its precincts could be expanded to suit the necessities of the enormous host of ministers of various ranks demanded by the growing complexity of the ritual, which, in matters of music and the like, was immensely developed as time went on (comp. PSALMS). Herod's temple, with the dependent buildings, was a little city enclosed in its own fortifications. But long before his time the temple was a sort of priestly citadel, the fortress as well as the sanctuary of the hierocracy; and the sacred offerings which flowed to Jerusalem from Jews in all parts of the world were lavishly expended on enlarging and strengthening it (Jos., *B. J.*, v. 5, § 1). The name of Simon II. (*c.* 200 B.C.) is associated in Ecclus. l. 1 *sq.* with important works of fortification on the circuit of the temple. Twice ruined in the wars with the Seleucids, these bulwarks were twice rebuilt, by Judas and Jonathan Maccabæus (1 Mac. vi. 7; Jos., *Ant.*, xiii. 5, § 11). The works were further strengthened by Simon (1 Mac. xiii. 52), and at the time of Pompey's siege (63 B.C.) constituted an almost impregnable fastness, strengthened on its weakest or northern side by great towers and a deep ditch (*Ant.*, xiv. 4, § 2). Twenty-six years later the temple was again besieged by Herod, who, attacking, like Pompey, from the north, had to force three lines of defence,—the city wall and the outer and inner temple (*Ant.*, xiv. 16, § 2).

Of the temple as it was in the Greek or the Hasmonean period we have two descriptions by Hellenistic Jews, Pseudo-Aristeas (comp. SEPTUAGINT) and Pseudo-Hecatæus (Jos., *C. Ap.*, i. 22). In such a matter we may suspect even notorious literary forgers of carelessness and exaggeration rather than of absolute untruth. Pseudo-Aristeas describes the temple as surrounded by a triple circuit of walls more than 70 cubits high, and as further protected by the adjoining Acra, which overlooked the place of sacrifice. Comparing the account of Herod's siege, we may perhaps take the third circuit to be the wall of the town, which is represented as lying below the temple on the same hill. The upper city on the western hill is ignored, which seems to show that the account was written before the Hasmonean period (comp. JERUSALEM, vol. xiii. p. 641), as has been argued on other grounds in SEPTUAGINT. The Acra, which is often mentioned in the history of the Maccabee wars, seems to have been on the same site as the Baris or castle of the Hasmonean priest-princes, where they put on their priestly robes before doing sacrifice (*Ant.*, xv. 11, § 4). That the Baris was close to the temple appears both from this circumstance and from the fact that Antigonus was charged with setting fire to the porticoes of the temple during the siege by Herod (*Ant.*, xiv. 16, § 2),—an accusation which would have had no plausibility unless the destruction of the porticoes had been useful to isolate the castle. Pseudo-Hecatæus gives the temple precincts a length of 500 feet and a breadth of 100 cubits. The explanation of these numbers will appear in the sequel.

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[1] Cp. also the vail of Assyrian tissue given by Antiochus to the temple at Olympia (Pausan., v. 12, § 4), which Ganneau (*Quarterly Statement*, April 1878) boldly identifies with the vail of the temple that Antiochus Epiphanes carried off from Jerusalem (1 Mac., i. 22; Jos., *Ant.*, xii. 5, § 4).

Herod's temple.

3. *The Temple of Herod.*—In the eighteenth year of his reign (20-19 B.C.) Herod the Great began to rebuild the temple and its precincts from the foundation, doubling the old area (*Ant.*, xv. 11; *Bell. Jud.*, i. 21). The works included the reconstruction, on the old site, of the Baris, which now received the name of Antonia, and is generally reckoned by Josephus as forming part of the temple precincts. Apart from the Antonia, the temple area formed a quadrangular plateau supported by retaining walls of great height and strength, and surrounded by porticoes. Three of the porticoes were double walks, 30 cubits broad, with monolith pillars 25 cubits high, and cedar roofs; the fourth or southern portico (the Stoa Basilica) had four rows of Corinthian pillars and three walks, respectively 30, 45, and 30 cubits in breadth. The middle walk was twice the height of the aisles, and the latter were 50 feet high. As regards the size of this enclosure, we are told by Josephus that the Stoa Basilica was a stadium or 600 feet long (*Ant.*, xv. 11, § 5); and in *Ant.*, xx. 9, § 7, the same length is assigned to the eastern colonnade, which was known as Solomon's Porch (comp. John x. 23; Acts iii. 11 and v. 12), because it, and it alone, rested on an ancient substructure held to be the work of Solomon. The whole circuit of the porticoes was therefore 4 stadia,[1] or with the Antonia 6 stadia (*B.J.*, v. 5, § 2). The Antonia lay on the north side (*Ant.*, xv. 11, § 4) and communicated by stairs with the north and west porticoes at the north-west angle of the enclosure. Fergusson and others suppose that it touched the temple only at this angle, thence stretching north and west. But in this case the Antonia, which, as we shall see below, lay just north of Wilson's arch, would have been built over the hollow of the Tyropœon valley, a supposition absurd in itself and inconsistent with *B.J.*, v. 5, § 8, which says that it stood on a cliff. Again, the tower 70 cubits high that stood at the south-east angle of the Antonia overlooked the whole temple, just as we know from Pseudo-Aristæus that the old Acra overlooked the altar. But, if the south-east angle of the Antonia had been, as Fergusson supposes, at the north-west angle of the temple porticoes, the view from the tower would have been intercepted by the lofty porch in front of the Holy Place. The Antonia, therefore, had its south face along part of the north face of the temple enclosure, and to gain a circuit of 6 stadia for temple and Antonia together we must assign to the latter the length of a stadium from north to south. This is not too much, for Josephus describes it as a little town in itself (*B.J.*, v. 5, § 8).

The Antonia, the porticoes, and the space immediately within them (the outer court, or, as modern writers call it, the court of the Gentiles) were not holy ground. But in the middle of the enclosure there was a platform raised 15 cubits above the court of the Gentiles and fenced off by a barrier, with inscriptions, one of which still exists (*Palestine E. F. Quarterly Statement*, 1871, p. 132), forbidding aliens to pass on pain of death. The platform was approached by steps on all sides but the west (*B.J.*, v. 1, § 5, and 5, § 2), and was surrounded by a wall, rising 25 cubits above the inner level, and pierced by four gates on the north side and as many on the south. On the west there was no gate, but on the east—that is, in front of the fane—there were two, one within the other; for the eastern end of the platform was walled off to form a separate court for the women, at a somewhat lower level. One of the northern and one of the southern gates belonged to the court of the women, but it was also entered directly from the east by a very splendid gate of Corinthian brass, much more costly than the others, though they were overlaid with silver and gold. An enormous gate, 40 cubits wide and 50 high (gate Nicanor), connected the women's court with the higher part of the platform, or court of the men of Israel. The beautiful gate of Acts iii. 2 is variously identified with the first or second of these eastern portals. The walls of the platform were lined within with chambers, in front of which ran a splendid colonnade; and the gateways were connected with the colonnade by small lofty halls (*exedræ*), which from without had a tower-like aspect. It is doubtful whether all the gates had *exedræ*; but, on the other hand, there was such a hall also at the west end where no gate opened. In the court of the men—*i.e.*, in the upper and western part of the platform just described—stood the fane or temple proper raised twelve steps above the court. For the ground plan of the Holy Place and the Holy of Holies the ancient dimensions of Solomon's temple were preserved, and the external size demanded by the scale of the surroundings was gained by increasing their height, placing a lofty second story above them, making their walls and those of the surrounding chambers (corresponding to the chambers in the first temple) enormously thick, and placing at the front or east end a porch 100 cubits wide and 100 cubits high. The open doorway of this porch was overlaid with gold, as was also the door of the fane and the wall round it. To the ornament of the entrance belonged also a golden vine with clusters of grapes as big as a man. In front of the fane beneath the steps was the great altar of stone, 50 (or, according to the *Middoth*, 32) cubits square and 15 high; it was ascended by a flight of steps from the south. The part of the court round the fane and the altar was fenced off for the use of the priests, and other Israelites were admitted only when the sacrificial ritual required the presence of the sacrificer.

Besides the descriptions in Josephus, we have for Herod's temple a mass of details and measurements in the Mishnic treatise *Middoth*. Josephus was himself a priest, while the Mishnah was not written till a century after the destruction of the temple, though it uses traditions that go back to Levites who had served in the temple. The two sources differ in many measurements, and the *Middoth* appears to be possessed of detailed traditions only for the inner temple. The state of the evidence is not such as to allow a plan of the temple to be formed with architectural precision. The above account rests almost entirely on Josephus, who, apart from certain exaggerations in detail, gives a satisfactory general account, such as could be written from memory without notes and drawings.

Herod's gigantic and costly structures were still in building, forty-six years after their commencement, when our Lord began His ministry (John ii. 20), and the works were not completed till the procuratorship of Albinus (62-64 A.D.). In 66 the great revolt against Rome broke out, and in August 70 Jerusalem was taken by Titus and the temple perished in a great conflagration.[2]

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[1] This measurement (*Ant.*, xv. 11, § 3) has often been taken to refer to Solomon's temple. But this view is not demanded by the words of Josephus, and is inconsistent with the other measurements he gives and with *B.J.*, v. 5, § 1, which states that the plateau was levelled up by Solomon only on the east. This from the lie of the contour lines makes a plateau 600 feet square impossible. The Mishnah makes the "mountain of the house" a square of 500 cubits, apparently borrowing from Ezekiel.

[2] On 10 Ab; but Jewish tradition celebrates 9 Ab as the day of the destruction of the temple.

Topography.

4. *Topography.*—It is not disputed that the site of the temple lay within the great Haram platform (see JERUSALEM), now a Moslem holy place, and it is generally agreed also that the south-west corner of that platform is the south-west corner of Herod's outer plateau, parts of the southern and western retaining walls being confidently ascribed by experts to his age. But if Herod's temple (excluding the Antonia) was only 600 feet square it can have occupied but a small part of the Haram area, which measures about 1500 feet from north to south and 922 feet along the south wall. Moreover, the highest part of the hill, where the Dome of the Rock now stands, must have been outside and north of the temple enclosure. But this affords no good reason to doubt the accuracy of Josephus's measurements in a matter in which his memory could hardly fail him, and where his tendency would be rather to exaggerate than to diminish. There is no evidence that the eastern wall of the Haram is as old as Herod, much less as old as Solomon; for the supposed Phœnician letters found on stones belonging to it are not letters at all, and may be of any date.[1] Moreover, there are various evidences of later building about the east wall of the Haram; the so-called Golden Gate is certainly a later construction, and Justinian's church rested on new substructures to the south and east (Procopius, *De Æd.*, v. 6), which implies an extension eastward of the old platform. And this is confirmed by the fact that in the neighbourhood of the south-east angle the platform does not rest on solid substructures such as Josephus speaks of, but on the vaults known as Solomon's stables. Again, though the temple of Solomon lay above the town, there is no evidence that it was on the very top of the hill; on the contrary, buildings of the dimensions given in 1 Kings might have been placed on the hill-top without the need for such great substructures as are spoken of in 1 Kings vii. 10; and we have seen in speaking of the courts of the first temple that the ground appears to have risen to the north, the upper court being on that side.[2]

If we accept the measurements of Josephus we have to break with mediæval tradition, both Moslem and Christian, which associates the Sakhra or rock under the dome on the top of the hill with the sacred site of the Jews. So much weight has been laid on this circumstance by writers of eminence that it is necessary here to go into some particulars and show that earlier tradition goes quite the other way. It is a Talmudic legend that in the Holy of Holies the place of the lost ark was taken by a stone called the "foundation stone." Further this stone was identified with Jacob's stone at Bethel (comp. Rashi on Gen. xxviii. and Breithaupt's notes). Both Mohammedans and Christians transferred these legends to the Sakhra, which the former accordingly venerated as "a gate of heaven" (Ibn 'Abd Rabbih, *'Iḳd*, iii. 369). Mohammedan sources enable us to trace back this identification to the Moslem Jew Wahb ibn Monabbih, who enriched Islam with so many Jewish fables and died a century after Jerusalem was taken by the Arabs (Tabari, i. 571 *sq.*; Ibn al-Fakíh, p. 97 *sq.*). Eutychius, on the other hand, who is the first Christian writer to apply the Jewish legend to the Moslem Sakhra, avers that the tradition was communicated to 'Omar by the Christian patriarch Sophronius on the taking of Jerusalem, and guided the caliph in the choice of a site for his mosque. Eutychius wrote nearly three hundred years after this event; and, though it is known from earlier authorities (Arculphus, Theophanes) that the first Moslem mosque was built on what was pointed out as the site of the temple, it is equally certain, and was known to Eutychius himself, that that mosque lay to the south of the Sakhra (Eutychius, ii. 289), which was not embraced in the precincts of the Moslem sanctuary till the reign of 'Abd al-Malik, who built the dome, as an inscription with the date 691 still testifies (*Ibid.*, p. 365). This is confirmed by the excellent Arabian historian Ibn Wádih (ii. 311). 'Abd al-Malik's motive was political, as both historians attest; Mecca being in the hands of a rival, he resolved to set up another place of pilgrimage to supplant the Kaaba, and recommended it to the faithful as the point from which the Prophet made his miraculous ascent from Jerusalem to heaven (Ibn Wadih, *ut supra*). There is nothing of the Jewish legend here; that, as we have seen, was supplied by Wahb in the next generation, and on his foundation there grew up a mass of other fables for which it is enough to refer to Ibn al-Fakíh, p. 93 *sq.* From all this it may be taken as certain that at the time of 'Omar it was towards the south-west angle of the Haram, on the site of the original mosque, that tradition supposed the temple to have stood; indeed Eutychius is guilty of self-contradiction when he first says that Sophronius indicated the Sakhra to 'Omar as the site on which to build his mosque, and then adds that it was not part of the Moslem sanctuary till a generation later. Finally, the extension of the Haram to the north so as to bring the Dome of the Rock into the centre of the sacred area was the work of 'Abd al-Malik's son Walíd (Eutychius, ii. 378).

Thus far we have met with nothing but confirmation of Josephus's measurements and the site they imply; but there are other topographical indications which supply confirmation more decisive. And first let us compare what is related of the outer gates of Herod's temple with existing remains. On the north was the gate Tadi of the Mishnah, which Josephus mentions only incidentally. This, like the gate Shushan on the east, which he does not mention at all, must have been of minor importance; the chief accesses were necessarily from the lower city to the south and the upper city to the west beyond the Tyropœon valley. The south wall, says Josephus, had gates in the middle (*Ant.*, xv. 11, 5). The Mishnah names them the two gates of Huldah, which may mean "tunnel (weasel-hole) gates." There is a double gate in the substructure of the south wall, 350 feet from the south-west angle, and from it a double tunnel leads up to the platform. This double gate exactly fits Josephus's description. There is also a triple gate, 600 feet from the south-west angle, which those who suppose the wall to have been more than 600 feet long regard as the second Huldah gate. But this view does not give us two gates in the middle of the wall, especially as the old wall cannot have enclosed Solomon's stables. In the west side the Mishnah places one gate (Kiponus), while Josephus recognizes four. But these accounts are at once reconciled if we accept Josephus's measurements. For of his four gates the most southerly is necessarily the one which opened on a flight of steps descending and then reascending across the Tyropœon to the upper city opposite. Now at the south-west corner of the platform there are still remains of a great arch (Robinson's arch), which must have belonged to a bridge connecting the upper city with the south portico of the temple. Thus one of the four gates is fixed. The second gate led to Herod's palace (at the extreme north of the upper city) by means of an embankment crossing the Tyropœon (*Ant.*, xv. 11, § 5). Comparing *B. J.*, ii. 16, § 3, vi. 6, § 2, and v. 4, § 2, we see that the embankment also carried the city wall (the so-called first wall). Of this approach there are remains at Wilson's arch, 600 feet north of Robinson's arch[3]; thus, if Josephus's measurements are correct, the two western accesses were at the extreme ends of the western portico. Josephus's other two gates led to the suburbs outside the first wall, and therefore lay north of Wilson's arch, and were not gates of the temple enclosure proper but of the Antonia, which Josephus habitually reckons as part of the outer temple.[4] Of them the Mishnah would naturally take no account, and as naturally it would neglect the gate that led to the palace as being not a public entrance. But further, according to Josephus's account of the whole circumference of the temple with Antonia, the latter extended a stadium north of the north-west angle of the temple portico, *i.e.*, 600 feet north of Wilson's arch; and, if we measure off this distance on a plan of the rock contours and then draw a line at right angles to represent the north face of the Antonia, we find that this line runs across the narrowest part of the saddle from which the temple hill is assailable. The breadth of the Antonia from east to west cannot have been more than about 300 feet if, as is to be presumed, the gate Tadi was opposite the twin gates of Huldah; but with this breadth it would entirely cover the dangerous saddle.

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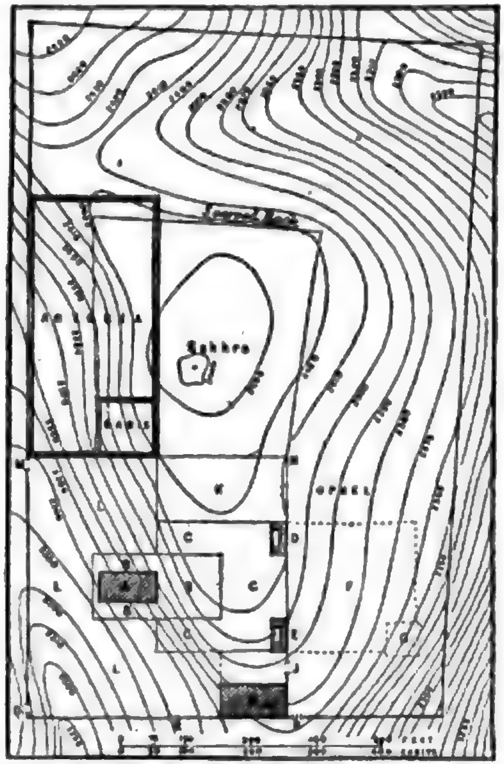
[1] They are represented in the *Recovery of Jerusalem* (p. 143) and in the *Atlas* of plates of Jerusalem published by the Palestine Exploration Fund.

[2] That the temple was built on the threshing-floor of Ornan is naturally assumed by the Chronicler, who likes to minimize the number of old Hebrew sanctuaries; but the old history knows nothing of a consecration of the site before the ark was placed there.

[3] The adjoining remains of ancient buildings unquestionably mark the site of the council hall where the Sanhedrim met, and which was close to the first wall and the temple but outside the latter (*B. J.*, v. 4, § 2; vi. 6, § 3).

[4] One of the suburban gates may be Warren's gate, in the substructures of the Antonia wall, about 170 feet north of Wilson's arch. The other is sometimes identified with Barclay's gate between Wilson's arch and Robinson's arch. But this would not lead into the suburb.

Every attempt to reconstruct the area and situation of the temple as it was before Herod must be more or less conjectural, and an analysis of the possibilities would take up so much space that it seems better simply to offer a plan which appears to satisfy the main conditions of the problem.



A. Temple. B, B, B. Inner court. C, C, C. Great court. D, E. Porches of the king's house. F. Palace of Solomon. G. Great tower of prison court. H. House of the forest of Lebanon. J. Water gate. K. North court. L, L, L. New space taken in by Herod. MNPQ. Herod's enclosure. NP. Solomon's portico. PQ. Stoa Basilica or royal portico. P. Triple gate. Q. Robinson's arch. R. Double gate (Huldah gates). M. Wilson's arch.

According to this plan the area of the temple enclosure was doubled by Herod, his additions being in the parts where the work of levelling up was heaviest, and where neither the convenience of worshippers nor reasons of defence called on earlier builders to extend the plateau. It is certain that the substructures of the south-west angle, raised to a dizzy height above the Tyropœon, are Herod's (*Ant.*, xv. 11, § 5), and Josephus also speaks of an extension to the north (*B.J.*, v. 5, § 1). But, on the other hand, the Baris already adjoined the temple, a condition which is satisfied by giving the older north court K (corresponding to the new court of Chronicles, and perhaps also to the upper court of the first temple) a length from east to west of 300 feet and a breadth from north to south of 150. The old east face of the plateau is, as Josephus says, 600 feet long, but this length was gained after the time of Nehemiah by taking in the site of the armoury or house of the forest of Lebanon (H) and the street in front of the water gate (J). For the proof that the water gate stood at a re-entrant angle between the retaining walls of the armoury and the palace and faced east as shown in the plan reference must be made to an article in the *Journal of Philology* (vol. xvi.). The rocky boss between these two walls was in Nehemiah's time surrounded by an outwork, which to the north joined the wall of Ophel,—that is, of the swelling mass of hill which lies out to the north-east of the palace. From the lower city (south of the Haram area) a stair near the wall led up to the plateau H (Neh. iii. 19; xii. 37). The armoury was 150 feet long and 75 broad; the plan allows the same dimensions for the open space within the water gate. The great court C, C, C is arranged in accordance with 1 Kings vii. 12, in such a way that it is at once the court of the palace and that of the temple, enclosing the inner court B. The dimensions of the inner court are not given in 1 Kings, but as the temple was twice the size of the tabernacle the court was probably also double the court of the tabernacle. This gives a length of 300 feet and a breadth of 150, as in the plan. The part of the court in front of the temple is 150 feet square, which agrees with the dimensions given in Ezek. xl. 23, 27. The great court is a square of 300 feet. This gives room on the east face for two porches D and E leading to the palace and each 75 feet long. Both porches are described in 1 Kings vii. 6, 8, and the dimensions of one are given. It is also expressly stated that the porch was before (*i.e.*, on the east side of) the pillars that decorated its front, and that it led into the inner court of the palace, so that the arrangement in the plan is fully justified. In the time of Jeremiah (xxxviii. 14) there were three entries from the palace to the temple; the third was probably into the north court, the palace having been extended northwards. It is evident that before the time of Herod the palace had disappeared. It was on a lower level than the temple, and when it was cleared away the great substructures on the line PE stood out as the boundary of Solomon's building. North of E the substructures were less considerable, the rock at the north end of this porch being but 20 feet under the present level of the plateau. In Herod's time, as can be seen at Robinson's arch, the level of the plateau was the same as at present (2420 feet), but in older times there was a fall between the upper and lower court, and K was probably 10 feet above C, C, C. In that case D was on the natural level of the ground, while (unless the great court was on two levels) E stood on a retaining wall 10 feet high at the north end of the porch and nearly twice as lofty at the south end. The plan shows the temple thrown out on very lofty substructures, so as to be practically inaccessible on all sides and overhang the Tyropœon in the most striking way.[1] The whole group of buildings formed a complete defence to the city of David on its northern or vulnerable side. It will be observed that in Herod's temple the Huldah gates at R led directly to the altar, the position of which seems never to have been changed, and also that the plan explains the statement of Hecatæus that the temple was 150 feet broad. His length of 500 feet from east to west is 50 feet too much unless he includes some remains of the old palace. The Baris is shown as standing on the south-west corner of the existing platform of the Dome of the Rock.

A word may be said in conclusion on the ancient line of wall to the west of the temple, which, as has been shown from Neh. iii. in the article JERUSALEM, ran along the eastern side of the Tyropœon. A bridge connected the temple with the upper city in the time of the later Hasmoneans, and, as the palace (on the site of Herod's palace) and the Baris were the points which it was most important to connect, it no doubt corresponded to the northern bridge already spoken of, at Wilson's arch M. But at that date it must have led, not directly to the temple, but to a lower point on the slope south of the Baris. In Nehemiah's time there was no bridge, but the gate of Ephraim probably corresponded to the east end of the bridge near the south-west angle of the Baris. In that case the wall, as is natural, ran close under the western substructures of the temple and probably served as a buttress to them in the part of its course south of the gate of Ephraim, which in Neh. xii. 38 is called "the broad wall." The throne of the Persian governor, beside the gate of Ephraim (see JERUSALEM, vol. xiii. p. 640), stood so close to the Baris that we may conclude that there was already a castle on its site, held for the great king. The position assigned to the gate of Ephraim, which, according to 2 Kings xiv. 13, was 600 feet from the corner gate, where the north wall of the city joined the west wall, suits the fact that a line drawn east and west 600 feet north of Wilson's arch coincides with the line of scarped rock marked on the plan. Here, therefore, the old north wall ran, with the great fosse filled up by Pompey. This wall figures also in Herod's siege, but seems to have been destroyed by him.

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[1] It ought, however, to be observed that the contour lines in and near B, B, B are almost purely conjectural.

Literature.—The literature of the subject is immense. The results of modern surveys and diggings are given in the Palestine Exploration Fund volume on *Jerusalem* (London, 1884) and in the accompanying *Atlas*. Of other books it may suffice to name De Vogüé, *Le Temple de Jérusalem* (fol., Paris, 1864); Fergusson, *Topography of Jerusalem* (8vo, London, 1847); Id., *The Temples of the Jews* (4to, London, 1878); Thrupp, *Antient Jerusalem* (8vo, Cambridge, 1855); Lewin, *The Siege of Jerusalem by Titus* (8vo, London, 1863); and Perrot and Chipiez, *Histoire de l'Art* (Paris, 1887). (W. R. S.)

TEMPLE, SIR WILLIAM (1628-1699), English statesman, diplomatist, and author, was born in London in 1628. He came of an old English family, but of the younger branch of it, which had for some time been settled in Ireland. He was the eldest son of Sir John Temple, master of the rolls in that country. His mother was Mary Hammond, sister of a well-known Tory divine. Temple received a liberal education, calculated to produce that moderation of judgment for which he was afterwards remarkable. He was first a pupil of his uncle Dr Hammond, after which he went to the grammar-school at Bishop Stortford, and then to the Puritan college of Emmanuel at Cambridge, where he came under the influence of Cudworth. At the commencement of the civil troubles his father embraced the popular cause and was deprived of his office. Coming to England, he sat in the Long Parliament as member for Chichester, and was one of the recalcitrant members turned out by Colonel Pride. Before this event happened his son had left Cambridge, without taking a degree, and in 1647 started to travel abroad. In the Isle of Wight, while on his way to France, he fell in with Dorothy Osborne, and won her affections. Her father, Sir Peter Osborne, was governor of Guernsey and a Royalist. Her family were naturally opposed to the match, and threw difficulties in the way, which hindered its consummation for seven years. During this period Temple travelled in France, Spain, Holland, and other countries, gaining knowledge of the world and keeping up a constant correspondence with his betrothed. At length, apparently in 1654, the difficulties were surmounted and the marriage took place. In 1655 Temple and his wife went to Ireland. The next five years were spent in the house of Sir John Temple, who had made his peace with Cromwell, and had resumed his official position. His son took no part in politics, but lived the life of a student and a country gentleman.

The accession of Charles II. rescued Temple, like many others, from obscurity. In 1660 he sat in the convention parliament at Dublin as member for Carlow, and he represented the same county along with his father in the regular parliament that followed. After a short visit to England in 1661, as commissioner from the Irish parliament, he finally removed thither in 1663. There he attached himself to Arlington, secretary of state, and two years later received his first employment abroad. It was in March 1665 that the disastrous war with the United Netherlands began. Charles II. was anxious to obtain allies, especially as Louis XIV. was taking up a hostile attitude. At this juncture the bishop of Münster sent an envoy to England, offering to attack the Dutch if the English Government would supply the means. Temple was sent over to negotiate a treaty, and in this business gave evidence not only of the diplomatic skill but of the peculiar candour and frankness for which he was afterwards so distinguished. He was successful in making the treaty, but it was rendered ineffectual by the declaration of war by France, the threats of Louis, and the double-dealing of the prelate, who, after receiving a great part of the subsidy, made a separate peace with the Netherlands. As a reward for his services Temple was created a baronet, and in October 1665 became the English representative at the viceregal court at Brussels. While the war continued, Temple's duties consisted chiefly in cultivating good relations with Spain, which was a neutral in the quarrel between England and the Dutch, but was threatened by the claims of Louis XIV. on the Spanish Netherlands. Louis's designs became apparent in the spring of 1667, when he marched an army into Flanders. This event was one of those which led to the peace of Breda, and to the subsequent negotiations, which are Temple's chief title to fame. The French conquests were made at the expense of Spain, but were almost equally dangerous to the United Netherlands, whose independence would have been forfeited had Louis succeeded in annexing Flanders. While the French were taking town after town, Temple made a journey into Holland and visited De Witt. The friendship established and the community of views discovered during this interview facilitated the subsequent negotiations. Temple had for some time pressed on his Government the necessity of stopping the French advance, and had pointed out the way to do so, but it was not till December 1667 that he received instructions to act as he had suggested. He at once set out for The Hague, and in January 1668 a treaty was made between England and the United Netherlands, which, being joined shortly afterwards by Sweden, became known as the Triple Alliance. It was a defensive treaty, made against the encroachments of France. Whether we regard the skill and celerity with which the negotiations were conducted or the results of the treaty, the transaction reflects great credit on Temple. The French king was checked in mid-career, and, without a blow being struck, was obliged to surrender almost all his conquests. Pepys records public opinion on the treaty by saying that it was "the only good public thing that hath been done since the king came into England."

Unfortunately the policy thus indicated was but short-lived. In taking up a hostile attitude towards France Charles's object had apparently been only to raise his price. Louis took the hint, increased his offers, and two years later the secret treaty of Dover reversed the policy of the Triple Alliance. Meanwhile Temple had developed the good understanding with the Dutch by contracting a commercial treaty with them (February 1668), and had acted as English plenipotentiary at Aix la-Chapelle, where peace between France and Spain was made in May 1668. Shortly afterwards he was appointed ambassador at The Hague. Here he lived for two years on good terms both with De

Witt and with the young prince of Orange, afterwards William III. The treaty of Dover led to Temple's recall; but the plot was not yet ripe, and Temple nominally held his post for another year. He perceived, however, that his day was over and retired to his house at Sheen. In June 1671 he received his formal dismissal. The war with the Netherlands broke out next year, and was almost as discreditable to England as that of 1665. Want of success and the growing strength of the opposition in parliament forced Charles to make peace, and Temple was brought out of his retirement to carry through the change of front. After a negotiation of three days, carried on through the medium of the Spanish ambassador, the treaty of Westminster was made (February 1674). As a recognition of his services Temple was now offered the embassy to Spain. This he declined, as well as the offer of a far more important post, that of secretary of state, but accepted instead a renewal of his embassy to The Hague, whither he went in July 1674. In the March following he was nominated ambassador to the congress at Nimeguen; but, owing to the tortuousness of Charles's dealings, it was not till July 1676 that he entered that town. The negotiations dragged on for two years longer, for Charles was still receiving money from France, and English mediation was no more than a ruse. In the summer of 1677 Temple was summoned to England and received a second offer of the secretaryship of state, which he again declined. In the autumn of the same year he had the satisfaction of removing the last difficulties which hindered the marriage of William and Mary, an event which seemed to complete the work of 1668 and 1674. Louis still remaining obstinate in his demands, Temple was commissioned in July 1678 to make an alliance with the states, with the object of compelling France to come to terms. This treaty was instrumental in bringing about the general pacification which was concluded in January 1679.

This was Temple's last appearance in the field of diplomacy; but his public life was not yet over. A third offer of the secretaryship was made to him; but, unwilling as ever to mix himself up with faction and intrigue, he again declined. He did not, however, withdraw from politics; on the contrary, he was for a short time more prominent than ever. The state was passing through a grave crisis. Political passion was embittered by religious fanaticism. Parliament was agitated by the popish plot, and was pressing on the Exclusion Bill. The root of all the mischief lay in the irresponsibility of the cabinet to parliament and its complete subservience to the crown. To remedy this, Temple brought forward his plan for a reform of the privy council. This body was to consist of thirty members, half of whom were to be the chief officers of the crown, the other half being persons of importance, lords and commoners, chosen without reference to party. Special care was taken to select men of wealth, which Temple considered as the chief source of political influence. By the advice of this council the king promised to act. The parliament, it was supposed, would trust such a body, and would cease to dictate to the crown. The scheme was accepted by the king, but was a failure from the outset. Intended to combine the advantages of a parliament and a council, it created a board which was neither the one nor the other. The conduct of affairs fell at once into the hands of a junta of four, of whom Temple was at first one, and the king violated his promise by dissolving parliament without asking the advice of the council. Temple retired in disgust to his villa at Sheen, and appeared only occasionally at the council, where he soon ceased to exercise any influence. In 1680 he was nominated ambassador to Spain, but stayed in England in order to take his seat in parliament as member for the university of Cambridge. He took no part in the debates on the great question of the day, and acting on the king's advice declined to sit in the parliament of 1681. Early in that year his name was struck off the list of the council, and henceforward he disappeared from public life. He continued to live at Sheen till 1686, when he handed over his estate there to his son, the only survivor of seven children, and retired to Moor Park in Surrey. When William III. came to the throne Temple was pressed to take office, but refused. His son became secretary at war, but committed suicide immediately afterwards. Sir William, though occasionally consulted by the king, took no further part in public affairs, but occupied himself in literature, gardening, and other pursuits. It should not be omitted that Swift lived with him as secretary during the last ten years (with one short interval) of his life. Temple died at Moor Park on 27th January 1699.

Temple's literary works are mostly political, and are of considerable importance. Among them may be mentioned *An Essay on the Present State and Settlement of Ireland* (1668); *The Empire, Sweden, &c.*, a survey of the different Governments of Europe and their relations to England (1671); *Observations upon the United Provinces* (1672); *Essay upon the Original and Nature of Government* (1672); *Essay upon the Advancement of Trade in Ireland* (1673). Some of these were published in the first part of his *Miscellanea* (1679). In the same year apparently his *Poems* were privately printed. In 1683 he began to write his *Memoirs*. The first part, extending from 1665 to 1671, he destroyed unpublished; the second, from 1672 to 1679, was published without his authority in 1691; the third, from 1679 to 1681, was published by Swift in 1709. In 1692 he published the second part of his *Miscellanea*, containing among other subjects the essay *Upon the Ancient and Modern Learning*, which is remarkable only as having given rise to the famous controversy on the "Letters of Phalaris." His *Introduction to the History of England*, a short sketch of English history to 1087, was published in 1695. Several collections of his letters were published by Swift and others after his death.

His fame rests, however, far more on his diplomatic triumphs than on his literary work. His connexion with domestic affairs was slight and unsuccessful. He was debarred both by his virtues and his defects,—by his impartiality, his honesty, and his want of ambition,—from taking an active part in the disgraceful politics of his time. But in the foreign relations of his country he was intimately concerned for a period of fourteen years, and in all that is praiseworthy in them he had a principal hand. He cannot be called great, but he will be remembered as one of the ablest negotiators that England has produced, and as a public servant who, in an unprincipled age and in circumstances peculiarly open to corruption, preserved a blameless record.

See *Life and Works of Sir William Temple*, 2 vols. fol., 1720; 2d ed., with Life by Lady Giffard, 1731; a more complete edition, including the *Letters*, was published in 4 vols. 8vo, 1814; Burnet, *History of his own Time*; Courtenay, *Memoirs of the Life, &c., of Sir William Temple*, 2 vols., 1836; Macaulay, *Essay on Sir William Temple*. (G. W. P.)

TENANT. See LANDLORD AND TENANT.

TENASSERIM, a division of the province of British Burmah, lying between 9° 30′ and 19° 30′ N. lat. and 95° 50′ and 99° 30′ E. long. It has an area of 46,730 square miles and comprises the seven districts of Moulmein town, Amherst, Tavoy, Mergui, Shwagyin, Toungoo, and Salwin, which formed the tract south of Pegu conquered from Burmah in 1826, and were for many years generally known as the Tenasserim provinces. The southern extremity of the division approaches the insular region of Malaysia, and it is fringed along its entire western coast by a number of islands, forming in the north the Moscos and in the south the Mergui Archipelago. The eastern frontier is formed by a mountain range 5000 feet high, which acts as a water-parting between the Tenasserim and the Siamese river systems.

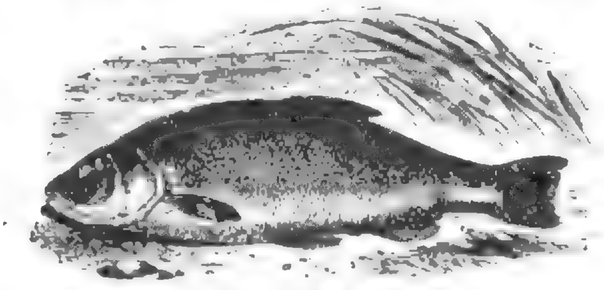
The population of the division in 1881 was 825,741 (437,900 males and 387,841 females). By religion Hindus numbered 23,145, Mohammedans 24,786, Christians 28,315, Buddhists 698,304, and Nat worshippers 51,160. The cultived area in 1885-86 was returned at 729,251 acres. The gross revenue in the same year was £184,162, of which the land-tax yielded £107,631.

TENBY, a municipal and parliamentary borough and watering-place of Pembrokeshire, South Wales, is finely situated on a long and narrow promontory of limestone rock, washed on three sides by the sea, on the west side of

Carmarthen Bay, and on a branch of the South Wales Railway, 10 miles east of Pembroke and 274 west of London (by rail). Its chief attractions as a watering-place are its picturesque appearance, its antiquarian remains, its equable and salubrious climate, and its wide stretch of firm sands. There are considerable remains of the old fortifications of the town, dating originally from the Norman Conquest, and repaired by Elizabeth, whose initials with the date 1588 are inscribed on a stone near the fine south-west gate, which with the south-west and north-west walls is in very good preservation. The remains of the castle on a lofty rock at the extremity of the promontory include the keep, a circular bastion overhanging the cliffs, and portions of the outer wall. Within the grounds, which are laid out in walks, there is a local museum; and on the summit of the hill is the Welsh memorial to the Prince Consort, a statue of Sicilian marble (1865). Opposite the castle, about 100 yards distant and accessible on foot at low water, is St Catherine's Island, on which is a strong fort begun in 1868, forming one of the land defences of Pembroke dockyard. The parish church of St Mary is a large and beautiful building, showing every variety of style from the Norman of the 12th to the Tudor of the late 16th century; it has a massive tower with a spire rising to a height of 152 feet. In the north aisle are some mediæval altar tombs and in the south aisle one of the early Tudor period. The fisheries of Tenby, for which the place was noted at a very early period, are still of importance. The trade of the port is inconsiderable. Steamers, however, ply to Bristol, Cardiff, Ilfracombe, and Weston-super-Mare. In the neighbourhood there are extensive limestone quarries. The population of the municipal and parliamentary borough (area 640 acres) in 1871 was 3810, and in 1881 it was 4750. In summer it is augmented by more than a half.

Tenby has the same derivation as Denbigh in North Wales. Anciently it was called Dynbych-y-Pyscod, the "precipice of fishes." The importance of the town dates from the settlement of the Flemings in the reign of Henry I. In 1150 Cadell, eldest son of Rhys ab Gryffith, was slain by the people of Tenby, in revenge for which the castle was taken and the town devastated by his two brothers Meredith and Rhys. During the Wars of the Roses the fortifications were restored and strengthened by Jasper, earl of Pembroke. They were again greatly strengthened by Elizabeth in apprehension of the landing of the Spaniards. At the beginning of the Civil War the town and castle were garrisoned for the king, but in 1644 it surrendered to the Parliamentarians after a siege of three days. Its privileges were extended by Humphrey, duke of Gloucester, who made the mayor an independent justice, and by Henry IV., Henry VI., Elizabeth, and Charles I. It is now governed by the Municipal Act, and the corporation are the sanitary authority. Since the 27th of Henry VIII. it has formed part of the Pembroke district of boroughs for parliamentary representation.

TENCH, the *Tinca tinca* of naturalists, is one of the commonest and most widely spread freshwater fishes of Europe. It is generally distributed in all suitable localities throughout England, but is limited to a few lakes and ponds in the south of Scotland and in Ireland. As the tench is of comparatively uncommon occurrence in unenclosed waters, its place among the indigenous fishes of Great Britain has been denied, and it has been supposed to have been introduced from the Continent. In central Europe, however, where it is undoubtedly indigenous, it thrives best in enclosed, preserved waters, with a clayey or muddy bottom and with an abundant vegetation; it avoids clear waters with stony ground, and is altogether absent from rapid streams. The tench belongs to the family of carps (*Cyprinidæ*), and is distinguished from the other members of that family by its very small scales, which are deeply embedded in a thick skin, whose surface is as slippery as that of an eel. All the fins have a rounded outline; the short dorsal fin is without a spine, but the males possess a very thick and flattened outer ray in the ventral fins. The mouth is rather narrow and provided at each corner with a very small barbel. Tench if kept in suitable waters are extremely prolific, and as they grow within a few years to a weight of 3 or 4 lb, and are then fit for the table, they may be profitably introduced into ponds which are already stocked with other fishes, such as carp and pike. They live on small animals or soft vegetable substances, which they root up from the ground. The albino variety especially, which is known as the "golden tench," can be recommended for ornamental waters, as its bright orange colours render it visible for some distance below the surface of the water. This variety, which seems to have been originally bred in Silesia, is not less well-flavoured than the normally coloured tench, and grows to the same size, viz., to 6 and even 8 lb.



Tench (*Tinca tinca*).

TENDER. See PAYMENT.

TENERIFFE. See CANARY ISLANDS, vol. iv. p. 798.

TENIERS, DAVID (1610-1690), the younger, a Flemish painter, almost ranking in celebrity with Rubens and Van Dyck, was born in Antwerp on 15th December 1610. His father, David Teniers the elder (1582-1649), whose style he followed with a vastly superior power of conception, had been a pupil of Elsheimer in Rome and of Rubens in Antwerp. Besides these influences, we can also distinctly trace that of Adrian Brouwer at the outset of his career. Although the young painter's general system often reminds us of Rubens, several of his works also betray a vivid recollection of Brouwer in type as well as general arrangement. There is no evidence, however, that either Rubens or Brouwer interfered in any way with Teniers's education, and Smith may be correct in supposing that the admiration which Brouwer's pictures at one time excited alone tempted the younger artist to imitate them. The only trace of personal relations having existed between Teniers and Rubens is the fact that the ward of the latter, Anne Breughel, the daughter of John (Velvet) Breughel, married Teniers in 1637. Admitted as a "master" in the guild of St Luke in 1632, Teniers had even before this made the public acquainted with his works. The Berlin museum possesses a group of ladies and gentlemen dated 1630. No special signature positively distinguishes these first productions from those of his father, and we do not think it correct to admit with some writers that he first painted religious subjects. Dr Bode, in a most remarkable study of Brouwer and his works, expresses the opinion that Teniers's earliest pictures are those found under the signature "Tenier" (with the omission of the final *s*). Tenier is in reality a Flemish version of a thoroughly Walloon name, "Taisnier," which the painter's grandfather, a mercer, brought with him when he came from Ath in 1558, and Bode's supposition is greatly strengthened by the circumstance that not only David the elder but his brother Abraham and his four sons were all inscribed as "Tenier" in the ledgers of the Antwerp guild of St Luke. Some really first-rate works—the Prodigal Son and a group of Topers in the Munich gallery, as well as a party of gentlemen and ladies at dinner, termed the Five Senses, in the

Brussels museum—with the above signature are remarkable instances of the perfection attained by the artist when he may be supposed to have been scarcely twenty. His touch is of the rarest delicacy, his colour at once gay and harmonious. Both Waagen and Smith express the opinion that the works painted from 1645 to 1650 speak most highly of the master's abilities. We may venture to add that a considerable number of earlier productions would have been sufficient to immortalize his name. He was little over thirty when the Antwerp guild of St George enabled him to paint the marvellous picture which ultimately found its way to the Hermitage Gallery in St Petersburg,—the Jubilee Meeting of the Civic Guards, in honour of their old commander, Godfrey Sneyders. Correct to the minutest detail, yet striking in effect, the scene, under the rays of a glorious sunshine, displays an astonishing amount of acquired knowledge and natural good taste. This painting, one of forty among many of the master's earlier and later productions,[1] leads us to mention another work of the same year (1643), now in the National Gallery, London (No. 952), an equally beautiful repetition of which, dated 1646, belongs to the duke of Bedford. A hundred and fifty figures are resting after a pilgrimage to some holy shrine or some miraculous well. The hungry travellers are waiting for the meal which is being prepared for them in several huge caldrons. Truth in physiognomy, distribution of groups, the beautiful effect of light and shade, command our warmest admiration. A work like this, says Waagen, stamps its author as the greatest among painters of his class. That, however, a subject of the kind should have been accepted as a "feast" (see the National Gallery *Catalogue*) may tend to prove how little, from the first, Teniers thought of dramatizing. Frankness in expression and freedom in attitude certainly guided his preference in the choice of a model, and we may even suppose him to have occasionally exaggerated both. He seems anxious to have it known that, far from indulging in the coarse amusements of the boors he is fond of painting, he himself lives in good style, looks like a gentleman, and behaves as such. He never seems tired of showing the turrets of his château of Perck, and in the midst of rustic merry-makings we often see his family and himself received cap in hand by the joyous peasants. We may also observe that he has a certain number of favourite models, the constant recurrence of which is a special feature of his works. We even meet them in a series of life-size portrait-like figures in the Doria Pamphili Gallery in Rome,[2] as well as in a picture belonging to Mr H. R. Hughes, and the man here represented as a fishmonger is unmistakably the painter's brother, Abraham Teniers, judging from the portrait Edelinck has left us of this artist.

Teniers was chosen by the common council of Antwerp to preside over the guild of painters in 1644. The archduke Leopold William, who had assumed the government of the Spanish Netherlands, being a great lover of art, employed Teniers not only as a painter but as keeper of the collection of pictures he was then forming. With the rank and title of "ayuda de camara," Teniers took up his abode in Brussels shortly after 1647. Immense sums were spent in the acquisition of paintings for the archduke. A number of valuable works of the Italian masters, now in the Belvedere in Vienna, came from Leopold's gallery after having belonged to Charles I. and the duke of Buckingham. De Bie (1661) states that Teniers was some time in London, collecting pictures for the duke of Fuensaldaña, then acting as Leopold's lieutenant in the Netherlands. Paintings in Madrid, Munich, Vienna, and Brussels have enabled art critics to form an opinion of what the imperial residence was at the time of Leopold, who is represented as conducted by Teniers and admiring some recent acquisition. No picture in the gallery is omitted, every one being inscribed with a number and the name of its author, so that the *ensemble* of these paintings might serve as an illustrated inventory of the collection.[3] Still more interesting is a canvas, now in the Munich gallery, where we see Teniers at work in a room of the palace, with an old peasant as a model and several gentlemen looking on. When Leopold returned to Vienna, Teniers's task ceased; in fact, the pictures also travelled to Austria, and a Flemish priest, himself a first-rate flower painter, Van der Baren, became keeper of the archducal gallery. Teniers nevertheless remained in high favour with the new governor-general, Don Juan, a natural son of Philip IV. The prince was his pupil, and De Bie tells us he took the likeness of the painter's son. Honoured as one of the greatest painters in Europe, Teniers seems to have made himself extremely miserable through his aristocratic leanings. Shortly after the death of his wife in 1656 he married Isabella de Fren, daughter of the secretary of the council of Brabant, and strove his utmost to prove his right to armorial bearings. In a petition to the king he reminded him that the honour of knighthood had been bestowed upon Rubens and Van Dyck. The king at last declared his readiness to grant the request, but on the express condition that Teniers should give up selling his pictures. The condition was not complied with; but it may perhaps account for the master's activity in favour of the foundation in Antwerp of an academy of fine arts to which artists alone should be admitted, whereas the venerable guild of St Luke made no difference between art and handicraft: carvers, gilders, bookbinders, stood on an even footing with painters and sculptors, however great their talent.[4] There were great rejoicings in Antwerp when, on 26th January 1663, Teniers came from Brussels with the royal charter of the academy, the existence of which was due entirely to his personal initiative.

Teniers died in Brussels on 25th April 1690.[5] A picture in the Munich gallery (No. 906), dated 1680, represents him as an alchemist, oppressed with a burden of age beyond his years. From this date we hear more of his doings as a picture-dealer than as a painter, which most probably gave birth to the legend of his having given himself out as deceased in order to get higher prices for his works. David, his eldest son, a painter of talent and reputation, died in 1685. One of this third Teniers's pictures—St Dominic Kneeling before the Blessed Virgin, dated 1666—is still to be found in the church at Perck. As well as his father, he contributed many patterns to the celebrated Brussels tapestry looms. Cornelia, the painter's daughter, married John Erasmus Quellin, a well-known artist (1634-1715).

Smith's *Catalogue Raisonné* gives descriptions of over 700 paintings accepted as original productions of Teniers. Few artists ever worked with greater ease, and some of his smaller pictures—landscapes with figures—have been termed "afternoons," not from their subjects, but from the time spent in producing them. The museums in Madrid, St Petersburg, Vienna, Munich, Dresden, Paris, London, and Brussels have more than 200 pictures by Teniers. In the United Kingdom 150 may be found in private hands, and many other examples are to be met with in private collections throughout Europe. Although the spirit of many of these works is as a whole marvellous, their conscientiousness must be regarded as questionable. Especially in the later productions we often detect a lack of earnestness and of the calm and concentrated study of nature which alone prevent expression from degenerating into grimace in situations like those generally depicted by Teniers. His education, and still more his real and assumed position in society, to a great degree account for this. Brouwer knew more of taverns; Ostade was more thoroughly at home in cottages and humble dwellings; Teniers throughout triumphs in broad daylight, and, though many of his interiors may be justly termed masterpieces, they seldom equal his open-air scenes, where he has, without constraint, given full play to the bright resources of his luminous palette. In this respect, as in many others, he almost invariably suggests comparisons with Watteau. Equally sparkling and equally joyous, both seem to live in an almost ideal world, where toil, disease, and poverty may exist, but to be soon forgotten, and where sunshine seems everlasting. But his subjects taken from the Gospels or sacred legend are absurd. An admirable picture in the Louvre shows Peter Denying his Master, next to a table where soldiers are smoking and having a game at cards. He likes going back to subjects illustrated two centuries before by Jerome Bosch—the Temptation of St Anthony, the Rich Man in Hell, incantations, and witches—for the simple purpose of assembling the most comic apparitions. His villagers drink, play bowls, dance, and sing; they seldom quarrel or fight, and, if they do, seem to be shamming. His powers certainly declined with advancing age; the works of 1654 begin to look hasty. But this much may be said of Teniers, that no other painter shows a more enviable ability to render a conception to his own and other people's satisfaction. His works have a technical freshness, a straightforwardness in means and intent, which make the study of them most delightful; as Sir Joshua Reynolds says, they are worthy of the closest attention of any painter who desires to excel in the mechanical knowledge of his art.

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[1] The Hermitage *Catalogue* ascribes to Abraham Teniers the portrait of a bishop. This painting is, however, by David, and represents the celebrated bishop of Ghent, Anthony Triest, with his brother Francis, a Franciscan monk.

[2] Under the name of Weeninx.

[3] It was not until recently that the MS. inventory of this collection was discovered among the papers of the prince of Schwartzenberg in Vienna. It was published in 1883 by Adolf Berger. In 1658 Teniers published 243 etchings after the best Italian works of Leopold William's collection, which, with the portraits of the archduke and Teniers, were brought together as a volume in 1660, under the title *El Teatro de Pinturas*.

[4] The separation was only obtained in 1773.

[5] The date is often wrongly given as 1694 or 1695.

As an etcher Teniers compares very unfavourably with Ostade, Cornelis, Bega, and Dusart. More than 500 plates were made from his pictures; and, if it be true that Louis XIV. judged his "baboons" (*magots*) unworthy of a place in the royal collections, they found admirable engravers in France—Le Bas and his scholars—and passionate admirers. The duke of Bedford's admirable specimen was sold for 18,030 livres (£1860) in 1768. The Prodigal Son, now in the Louvre, fetched 30,000 livres (£3095) in 1776. Smith's highest estimates have long since been greatly exceeded. The Archers in St Petersburg he gives as worth £2000. The Belgian Government gave £5000 in 1867 for the Village Pastoral of 1652, which is now in the Brussels museum; and a picture of the Prodigal Son, scarcely 16 by 28 inches, fetched £5280 in 1876.

Although Van Tilborgh, who was a scholar of Teniers in Brussels, followed his style with some success, and later painters often excelled in figure-painting on a small scale, Teniers cannot be said to have formed a school. Properly speaking, he is the last representative of the great Flemish traditions of the 17th century.

See T. Smith, *A Catalogue Raisonné of the Works of the most Eminent Dutch, Flemish, and French Painters*; John Vermoelen, *Notice historique sur David Teniers et sa famille*; L. Galesloot, *Quelques renseignements sur la famille de P. P. Rubens et le décès de David Teniers* and *Un procès de David Teniers et la corporation des peintres à Bruxelles*; Alph. Wauters, *Histoire des environs de Bruxelles* and *Les tapisseries bruxelloises*; F. T. Van der Branden, *Geschiedenis der Antwerpsche Schilderschool*; Max Rooses, *Geschichte der Malerschule Antwerpens*; W. Bode, *Adriaen Brouwer, ein Bild seines Lebens und seines Schaffens*. (H. H.)

TENIMBER. See Timor Laut.

TENISON, Thomas (1636-1715), archbishop of Canterbury, was the son of Rev. John Tenison, rector of Mundsley, Norfolk, by Mary, daughter of Thomas Dowson of Cottenham, Cambridgeshire, where he was born on 29th September 1636. He was educated at the free school, Norwich, whence he entered Corpus Christi College, Cambridge, as a scholar on Archbishop Parker's foundation. He graduated B.A. in 1657, M.A. in 1660, was chosen fellow in 1662, and became B.D. in 1667. For a short time he studied medicine, but in 1659 was privately ordained. In 1667 he was presented to the living of Holywell-cum-Needingworth, Huntingdonshire, by the earl of Manchester, to whose son he had been tutor, and in 1670 to that of St Peter's Mancroft, Norwich. In 1680 he received the degree of D.D., and was presented by Charles II. to the important cure of St Martin's-in-the-Fields. Tenison, according to Burnet, "endowed schools, set up a public library, and kept many curates to assist him in his indefatigable labours." Being a strenuous opponent of the Church of Rome, and "Whitehall lying within that parish, he stood as in the front of the battle all King James's reign." In 1678, in a *Discourse of Idolatry*, he had endeavoured to fasten the practices of heathenish idolatry on the Church of Rome, and in a sermon which he published in 1681 on *Discretion in Giving Alms* was attacked by Andrew Pulton, head of the Jesuits in the Savoy. Tenison's reputation as an enemy of Catholicism led the duke of Monmouth to send for him before his execution in 1685, when Bishops Ken and Turner refused to administer the Eucharist; but, although Tenison spoke to him in "a softer and less peremptory manner" than the two bishops, he was, like them, not satisfied with the sufficiency of Monmouth's penitence. Under William, Tenison was in 1689 named a member of the ecclesiastical commission appointed to prepare matters towards a reconciliation of the Dissenters, the revision of the liturgy being specially entrusted to him. A sermon which he preached on the commission was published the same year. He appears to have been better satisfied with the religious sentiments of Nell Gwynn on the approach of death than with those of the duke of Monmouth, for in 1691 he preached her funeral sermon, in which he represented her as truly penitent,—a charitable judgment which did not meet with universal approval. The general liberality of Tenison's religious views commended him to the favour of William, and, after being made bishop of Lincoln in 1691, he was promoted to the primacy in December 1694. He attended Mary during her last illness and preached her funeral sermon in Westminster Abbey. When William in 1695 went to take command of the army in the Netherlands, Tenison was appointed one of the seven lords justices to whom his authority was delegated. Along with Burnet he attended William on his deathbed, and it was from their hands that he received the Eucharist. He crowned Queen Anne, but during her reign was not in much favour at court. He was a commissioner for the Union in 1706. A strong supporter of the Hanoverian succession, he was one of the three officers of state to whom on the death of Anne was entrusted the duty of appointing a regent till the arrival of George I., whom he crowned on 31st October 1714. Tenison died at London on 14th December of the following year. Besides the sermons and tracts above mentioned, and various others on different points of the Popish controversy, Tenison was the author of *The Creed of Mr Hobbes examined* (1670) and *Baconia, or Certain Genuine Remains of Lord Bacon* (1679).

The *Memoirs of the Life and Times of the Most Rev. Father in God, Dr Thomas Tenison, late Archbishop of Canterbury*, appeared without date not long after his death. See also Burnet's *History of his own Time* and Macaulay's *History of England*.

TENNANT, William (1784-1848), author of *Anster Fair*, was born in 1784 at Anstruther in Fifeshire, the birthplace of two other contemporary Scottish worthies, Thomas Chalmers and John Goodsir. He was lame from childhood, like his more famous contemporaries Byron and Scott, and this probably determined his father, who was a small merchant and farmer, to educate him for a scholarly career. But the paternal means failed before he had completed his curriculum at St Andrews, and he was obliged to return home and act for some eight years of his early manhood as clerk to one of his brothers, a corn-factor. The corn-factor's clerk, however, under the impulse of a genius for language and a strong delight in literature, besides Greek and Latin and Hebrew, mastered, during his leisure, Italian and German, and not only read, but set himself to imitate, Ariosto and Wieland. And, strange to say, this poor youth, in a remote country town, anticipated the fashion of mock-heroic verse, which was set for England by "the ingenious brothers Whistlecraft," and which gave Byron the hint for his *Don Juan*. *Anster Fair*, a fantastic poem in *ottava rima*, amazingly fluent, brimming over with high spirits, rich almost to excess in diction and fanciful imagery, was written by Tennant in 1811, when his brother's business had failed and he did not know where to look for employment. Its publication in 1812 brought the poet into notice, and employment was found for him as schoolmaster of the parish of Dunino, near St Andrews. From this he was promoted (1816) to the school of Lasswade, near Edinburgh; from that (1819) to a mastership in Dollar academy; from that (1831), by Lord Jeffrey, who had written an admiring review of *Anster Fair*, to the professorship of Oriental languages in St Andrews. Tennant never fulfilled the promise of his first poem, which reads as if it had been dashed off in a fit of careless and happy inspiration, and never flags in its humorous glee from the first stanza to the last. *The Thane of Fife* (1822), in which he essayed the same vein, evidently cost him more pains, shows the same high reach of humorous imagination, and is indeed, as he claimed for it, "bold in its style and rare, fantastic, and sublime." But the subject was more remote from general interest; the mock-epic machinery, with all his wealth of grotesque description, was too far-fetched for the popular taste; and the poem fell flat. A third poem, in the Scotch dialect, *Papistry Stormed* (1827), though full of the most spirited description, was also in a vein of humour that found few sympathizers. He wrote also two historical dramas, *Cardinal Beaton* (1823) and *John Baliol* (1825). His last published work was a series of *Hebrew Dramas* (1845), founded on incidents in Bible history. He died near Dollar, on 15th February 1848.

A Memoir of Tennant by M. F. Conolly was published in 1861.

TENNENT, SIR JAMES EMERSON (1794-1869), English politician and traveller, the third son of William Emerson, a merchant of Belfast, was born there on 7th April 1794. He was educated at Trinity College, Dublin, of which he became LL.D. After travelling in Greece, where he made the acquaintance of Lord Byron, whose sentiments in regard to the Greek cause he fully shared, he studied for the bar and was called at Lincoln's Inn in 1831. He published a *Picture of Greece* (1826), *Letters from the Ægean* (1829), and a *History of Modern Greece* (1830). On his marriage to the daughter and heiress of William Tennent, a wealthy merchant at Belfast, he adopted by royal licence the name of his wife in addition to his own. He entered parliament in 1832 as member for Belfast. In 1841 he became secretary to the India Board, and in 1845 he was knighted and appointed colonial secretary of Ceylon, where he remained till 1850. The result of his residence there appeared in *Christianity in Ceylon* (1850) and *Ceylon, Physical, Historical, and Topographical* (2 vols., 1859). On his return he became member for Lisburn, and under Lord Derby was secretary to the Poor Law Board from February to November 1852. From then till 1867 he was permanent secretary to the Board of Trade, and on his retirement he received a baronetcy from Lord Palmerston. In his early years his political views had a Radical tinge, and, although he subsequently joined the Tories, his Conservatism was of a mild type. He withdrew from the Whigs along with Lord Stanley and Sir James Graham, and afterwards adhered to Peel. He died in London on 6th August 1869.

Besides the books above mentioned, he wrote *Belgium in 1840* (1841) and *Wine, its Duties and Taxation* (1855), and was a contributor to magazines and a frequent correspondent of *Notes and Queries*.

Plate II.

Boundaries.

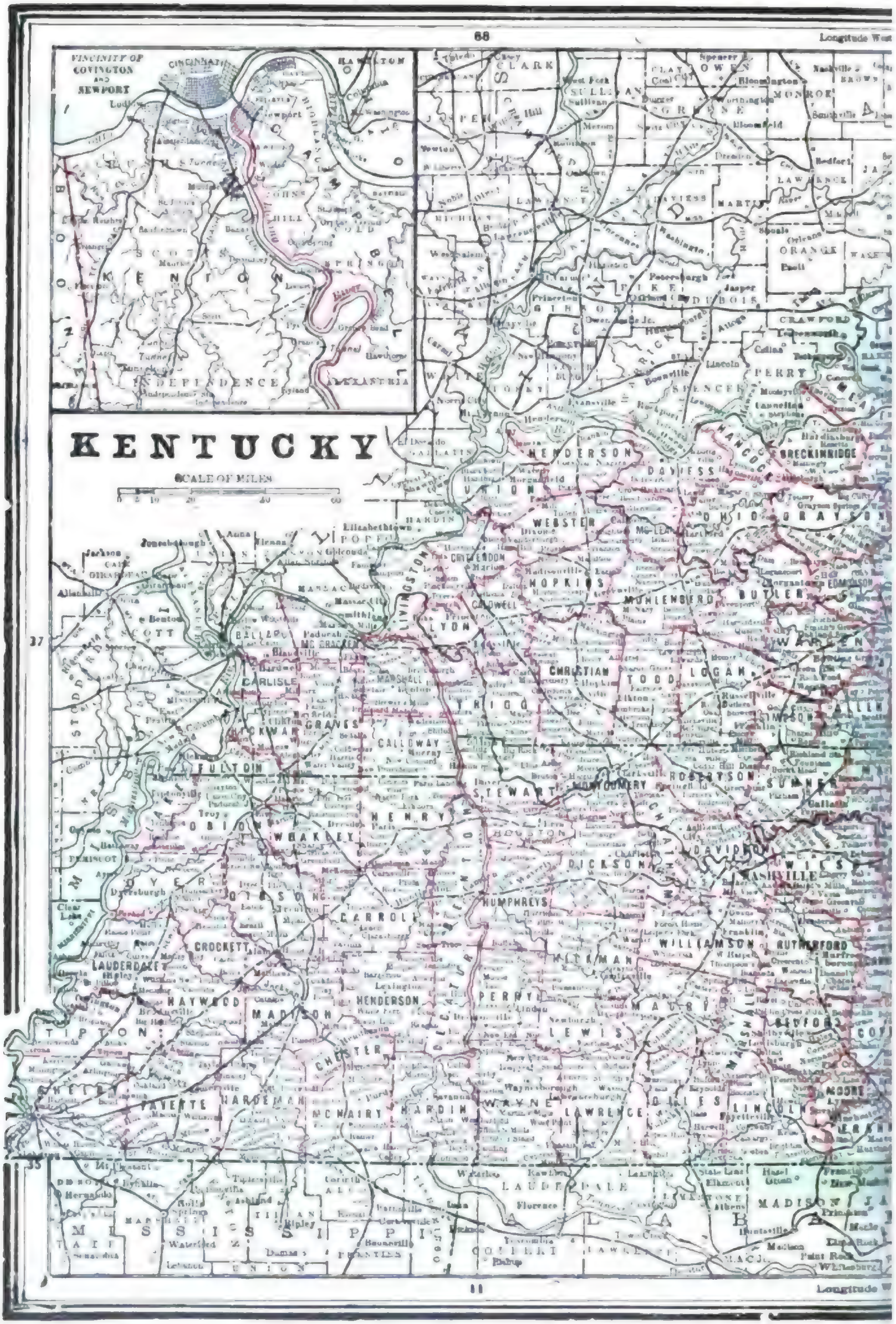
TENNESSEE, one of the United States of North America, the third added (June 1796) to the original thirteen, its predecessors having been Vermont (1791) and Kentucky (1792). Tennessee is bounded on the E. by the Unaka Mountains, which divide it from North Carolina, on the S. by the line of lat. 35° N., dividing it from Georgia, Alabama, and Mississippi; on the W. by the Mississippi river, dividing it from Arkansas and Missouri; and on the N. by a line which erroneous surveys have caused to vary greatly from the intended boundary,—the line of lat. 36° 30′ N.—the variations all being measured to the north of that parallel. The actual boundary commences at the north-east corner of the State 7 miles north of 36° 30′, and continues at that distance as far as the frontier of Virginia and Kentucky, where it diminishes to 5 miles; thence to about its intersection with 86° 30′ W. it increases to 11 miles; thence a deflexion southwards to a point about 2 miles from the Cumberland reduces it to 10 miles; there it suddenly shoots north again to 12 miles, which distance is increased to 12½ by the time it strikes the Tennessee; on the other side of that river it becomes very nearly coincident with the normal 36° 30′; and to that line it adheres with very slight aberrations until it strikes the Mississippi. The eastern boundary has one deviation from the stipulated line: it runs along the culminating ridge of the Unakas till within 26 miles of the Georgia frontier, when it turns due south, giving to Tennessee a triangular piece of territory which should belong to North Carolina. The area of the State was 41,750 square miles in 1880. Its extreme length is 432 miles and its width 109.

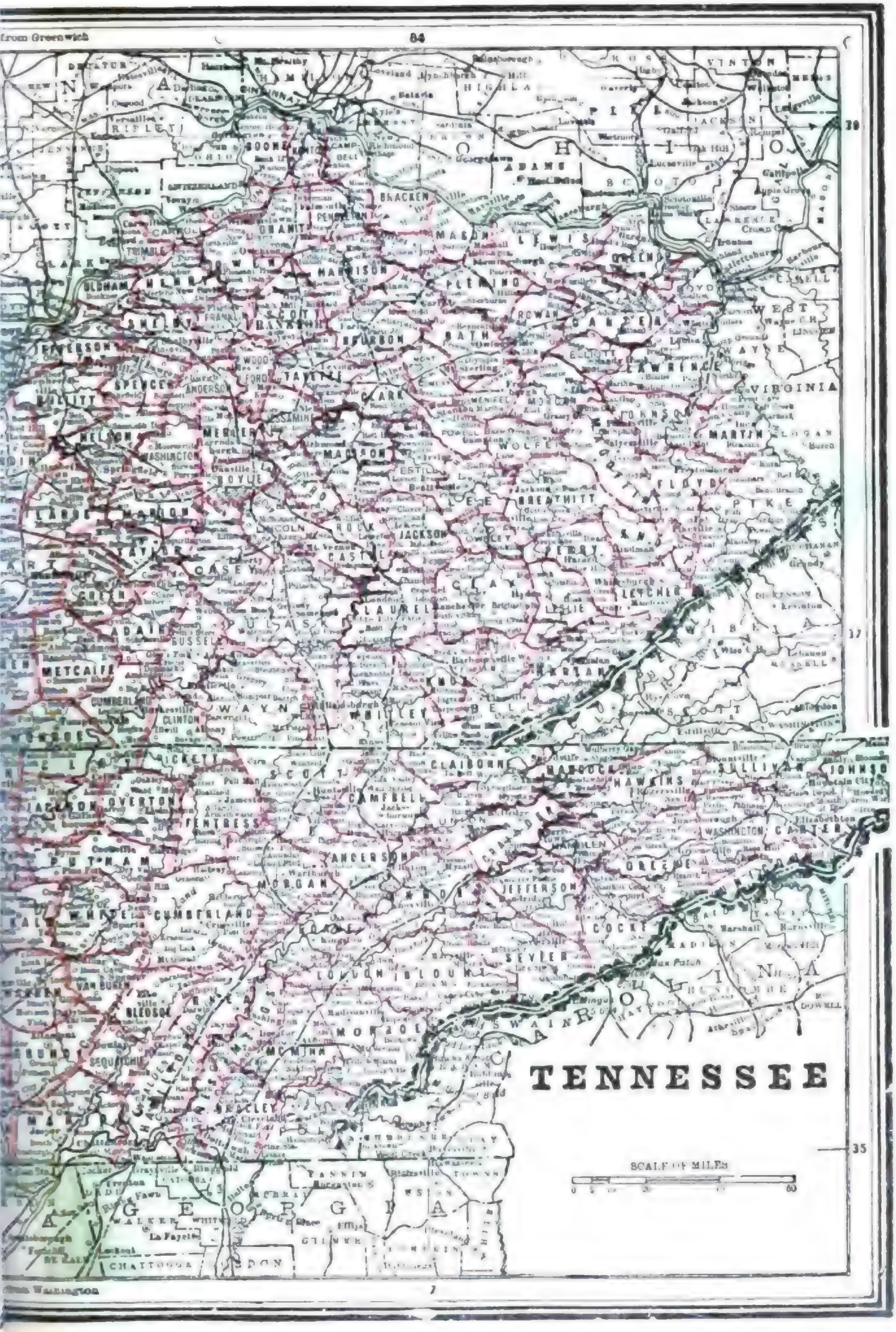
Geology.

Configuration and Geology.—Commencing at the eastern frontier, the State of Tennessee is divided into several districts, having distinct characteristics and separated by well-marked natural boundaries, whose general direction from north-east to south-west corresponds with the trend of the main valleys (see the geological sketch map inserted on pl. II.).

1. The mountain region of East Tennessee is a long narrow belt of very irregular surface, comprised between the Unaka Range and a disjointed chain of lower mountains, the principal of which are called the Chilhowee Range, and the whole of which may be considered as constituting the secondary mountain system of the State. The intervening space is occupied by broken masses forming hills, mountains, and valleys, some parallel to the principal ranges, some crossing the space at right angles to them. This region varies in width from 28 miles to about 7. All the rocks of this region and the next to it belong to what constitute in England the Silurian and Cambrian systems, the former being found in the western and the latter in the eastern part of the district. It has been contended that some metamorphic rocks near the crest of the mountains belong to the Archaic (Huronian and Laurentian) system; but the preponderance of geological opinion now assigns them to the same formations as the neighbouring rocks, the difference in structure being due to metamorphic action. The lowest of these, called in Tennessee the Ocoee group, is believed to be coeval with the Potsdam group of the American system,—the Lower Silurian and perhaps the Upper Cambrian of the British Isles. It consists chiefly of slates and conglomerates, with the sandstones of the Chilhowee group above. Above these last are the Knox dolomite group, with its shales and limestone more separated from the other two groups and perhaps not exactly corresponding to any other recognized formations. The crystalline metamorphic rocks are mainly syenitic and micaceous gneiss, with micaceous, hornblendic, and talcose schists. Occasional small dykes of diorite, greenstone, and basalt traverse these rocks, sometimes interstratified, but oftener breaking through them.

2. The rocks of the first division are tilted at very high angles; those of the second division, the eastern valley of the Tennessee, are fractured and distorted at nearly every conceivable angle, and, in consequence, it is the edges of the uplifted strata which here form the surface. The strata have been eaten away to form valleys, or left standing as


KENTUCKY
SCALE OF MILES
0 5 10 20 40 60
VINCINITY OF COVINGTON AND NEWPORT
CINCINNATI
Newport
Ludlow
KENTON
CAMPBELL
BOONE
INDEPENDENCE
ALEXANDRIA
88
Longitude West
37
35
CLARK
OWEN
SULLIVAN
GREENE
MONROE
BROWN
LAWRENCE
ORANGE
DAVIESS
MARTIN
KNOX
PIKE
DUBOIS
GIBSON
CRAWFORD
PERRY
SPENCER
WARRICK
VANDERBURGH
POSEY
Evansville
Henderson
HENDERSON
UNION
DAVIESS
HANCOCK
BRECKINRIDGE
WEBSTER
McLEAN
OHIO
GRAYSON
CRITTENDEN
HOPKINS
MUHLENBERG
BUTLER
EDMONSON
CALDWELL
LIVINGSTON
LYON
CHRISTIAN
TODD
LOGAN
WARREN
TRIGG
SIMPSON
ALLEN
BALLARD
McCRACKEN
Paducah
MARSHALL
CARLISLE
HICKMAN
GRAVES
CALLOWAY
FULTON
POPE
HARDIN
GALLATIN
MASSAC
ALEXANDER
PULASKI
JOHNSON
UNION
SCOTT
MISSISSIPPI
STODDARD
NEW MADRID
PEMISCOT
DUNKLIN
STEWART
MONTGOMERY
ROBERTSON
SUMNER
HOUSTON
DICKSON
DAVIDSON
NASHVILLE
WILSON
OBION
WEAKLEY
HENRY
BENTON
HUMPHREYS
DYER
GIBSON
CARROLL
CROCKETT
LAUDERDALE
HAYWOOD
MADISON
HENDERSON
DECATUR
PERRY
HICKMAN
WILLIAMSON
RUTHERFORD
MAURY
MARSHALL
BEDFORD
TIPTON
SHELBY
FAYETTE
HARDEMAN
CHESTER
McNAIRY
HARDIN
WAYNE
LEWIS
LAWRENCE
GILES
LINCOLN
MOORE
FRANKLIN
DE SOTO
MARSHALL
TATE
MISSISSIPPI
TIPPAH
ALCORN
TISHOMINGO
PRENTISS
UNION
LAUDERDALE
COLBERT
LIMESTONE
MADISON
ALABAMA
TENNESSEE
Florence
Athens
Huntsville
Corinth
11
Longitude W

from Greenwich
84
TENNESSEE
SCALE OF MILES
0
60
39
37
35
from Washington
7
O H I O
WEST VIRGINIA
VIRGINIA
NORTH CAROLINA
GEORGIA
BOONE
KENTON
CAMPBELL
BRACKEN
PENDLETON
MASON
LEWIS
GREENUP
BOYD
CARTER
FLEMING
ROWAN
BATH
HARRISON
BOURBON
SCOTT
OLDHAM
HENRY
SHELBY
JEFFERSON
SPENCER
ANDERSON
BULLITT
NELSON
WASHINGTON
MERCER
BOYLE
MARION
TAYLOR
CASEY
GREEN
ADAIR
METCALFE
RUSSELL
CUMBERLAND
CLINTON
WAYNE
PULASKI
LAUREL
WHITLEY
KNOX
BELL
HARLAN
CLAY
LESLIE
LETCHER
PERRY
BREATHITT
WOLFE
LEE
OWSLEY
JACKSON
ROCKCASTLE
MADISON
CLARK
ESTILL
MENIFEE
MORGAN
JOHNSON
MARTIN
FLOYD
PIKE
LAWRENCE
ELLIOTT
SWITZERLAND
TRIMBLE
CLAIBORNE
HANCOCK
HAWKINS
SULLIVAN
JOHNSON
CARTER
WASHINGTON
GREENE
COCKE
JEFFERSON
GRAINGER
CAMPBELL
ANDERSON
MORGAN
ROANE
LOUDON
BLOUNT
SEVIER
MONROE
MCMINN
BRADLEY
POLK
MEIGS
RHEA
BLEDSOE
SEQUATCHIE
MARION
VAN BUREN
WARREN
WHITE
CUMBERLAND
PUTNAM
OVERTON
FENTRESS
PICKETT
JACKSON
SCOTT
HAMILTON
SWAIN
MADISON
BUNCOMBE
FANNIN
WALKER
DADE
CHATTOOGA
LOGAN
MINGO
WISE
LEE
SCOTT
RUSSELL
DICKENSON
BUCHANAN
CABELL
WAYNE
LINCOLN
ADAMS
SCIOTO
LAWRENCE
PIKE
JACKSON
BROWN
CLERMONT
HAMILTON
CINCINNATI
DEARBORN
RIPLEY
JENNINGS
DECATUR
Gallipolis
Ironton
Catlettsburg
Maysville
Portsmouth
Lexington
Frankfort
Louisville
Knoxville
Chattanooga
Cleveland
Greeneville
Jonesborough
Asheville
La Fayette
Ringgold
Jasper
Sparta
Cumberland Gap
Middlesborough
Pikeville
Prestonsburg
Jackson
Hazard
Manchester
London
Somerset
Danville
Harrodsburg
Bardstown
Winchester
Richmond
Mount Sterling
Paris
Cynthiana
Georgetown
Versailles
Elizabethton
Rogersville
Tazewell
Jacksboro
Clinton
Kingston
Maryville
Madisonville
Athens
Dayton
Pikeville
Jamestown
Livingston
Cookeville
McMinnville
Crossville

ridges, giving the whole tract a deeply channelled character, the ridges consisting of sandstone and dolomite and the valleys of friable schists. These all trend in the prevalent direction of the Appalachian upheaval, from north-east to south-west. The rivers take the same directions, except when they break through transverse fissures in the ridges, or work round their terminations where they give way to the outcropping of other rocks; in these cases the current runs at right angles to their prevalent direction. All these formations belong to the Silurian period, the oldest cropping out to the eastward, the later members appearing to the westward. In some spots the Subcarboniferous rocks which once covered the entire valley have escaped the erosive action which swept the rest away. The whole district is a valley of denudation which has been excavated by the Tennessee and its tributaries,—some breaking through the Unaka barrier, and others descending from Virginia along the longitudinal valleys above described.

3. Rising in a steep elevation at from 800 to 1200 feet above the average level of the eastern valley of the Tennessee is the plateau popularly called the Cumberland Mountain. This mass, superincumbent on the Silurian system, consists of four very distinctly marked formations, —(i.) the Devonian black shale, (ii.) the Subcarboniferous silicious beds, (iii.) the Mountain Limestone, (iv.) the Coal-measures. These can easily be distinguished one above another on the face of the eastern escarpment; but on the western side the first two extend in a wide plain far beyond the base of the plateau, constituting the fourth district. The Mountain Limestone is shaly at the bottom, and more solid at the top, where it abounds in silicious concretions. The Coal-measures consist of thick slabs of sandstone and conglomerate with the seams of coal interstratified between them. In its southern portion the plateau is divided longitudinally by the narrow valley of the Sequatchie river, which cuts deep into the subjacent Silurian beds. The portion east of this valley, known as Walden's Ridge, has its strata much disturbed and tilted, conformably with the Silurian rocks below; the western portion, on the contrary, has all its strata nearly horizontal. This formation, averaging about 40 miles in width, is divided by a stratum of conglomerate 80 feet thick into the upper and lower Coal-measures, the former of which are much the more productive, but cover a less area, large portions of it having been carried away by denudation. These coal-seams are believed to average an aggregate thickness of 8 feet and to cover an area of 5000 square miles.

4, 5, 6. The Subcarboniferous area, the central basin, and the western valley of the Tennessee can best be considered together. They consist of the Subcarboniferous silicious beds, together with the basins formed by their erosion. On the western face of the Carboniferous belt the Mountain Limestone has been carried away with the harder rocks of the Coal-measures above it, but the underlying silicious beds have resisted all erosive forces and are spread out over an extended area on both sides of the Mississippi. In Tennessee they form a margin round the central basin and are styled by local geologists the "highland rim." They consist of two strata, a lower one distinguished by the absence of lime and iron, and an upper one which contains both these materials in abundance. Both members consist mainly of a peculiar gravel, formed of silicious concretions embedded in a stiff retentive clay. The upper stratum has in addition considerable horizontal beds of limestone; it contains abundant fossils of a large coral, *Lithostrotion canadense*, by which it is easily recognized, is very fertile, and possesses inexhaustible beds of limonite. The lower stratum is destitute of both fossils and minerals and is of but little account for agriculture. Excavated from this formation is the central valley of Tennessee (No. 5), surrounded on all sides by an escarpment of about 200 feet in depth, by which descent is made from the "rim" into the valley. All the members of the Silurian period, except the three lowest, are represented in this valley, which has been formed by the erosive action of the rivers within its borders: its higher strata were carried off northwards by the Cumberland and its tributaries, westward by the Duck, and southward by the Elk, the last two being tributaries of the Tennessee. A channel of erosion along the lower portion of the Duck river connects this valley with another (No. 6) much narrower—the western valley of the Tennessee—where again the Silurian beds have been reached by the removal of the Subcarboniferous formations above them. Again, south of the main basin, the portion drained by the Elk is nearly separated from the rest by a number of detached hills of the Subcarboniferous formation, marking the watershed which divides the headwaters of the Elk from those of the Duck.

7, 8, 9, 10. A little west of the Tennessee river the Palæozoic rocks disappear under the Cretaceous formations (No. 7), and these in their turn are covered successively by the Tertiary, Quaternary, and recent formations (Nos. 8, 9, and 10). The tract of ground covered by these four formations constitutes the Mississippi slope of western Tennessee, all of whose rivers run westward and discharge into the Mississippi. The dip of the strata is very slight, and the surface inclines with a very gentle slope.

In general terms, the territory embraced in Tennessee may be described as a great mountain chain on the east, from the foot of which extends a gently inclined plane, interrupted by an elevation, the Cumberland or Carboniferous plateau, and a depression, the central valley.

Rivers. *Rivers.*—The Cumberland and the Tennessee are the principal channels of inland navigation, while the Mississippi, washing the whole western frontier of the State, is its outlet to the Gulf of Mexico. The headwaters and embouchure of the Cumberland are in Kentucky, but much the greater part of its navigable stream is in Tennessee. From its confluence with the Ohio, at Smithland, Kentucky, to Nashville, a distance of 200 miles, it is generally navigable for eight months in the year, and during high water it is sometimes accessible to light-draft steamboats more than 300 miles further. The Tennessee rises in Virginia, crosses east Tennessee in a south-western direction, and enters Alabama a little above Bridgeport; in that State it assumes successively a westerly and a northerly direction, and then re-enters Tennessee and crosses the State northwards to its confluence with the Ohio at Paducah, Kentucky. Its navigable waters are divided by obstructions into three portions,—(1) from the mouth to Florence, Alabama, 300 miles, where navigation is arrested by the Muscle shoals; (2) thence through Alabama, about 100 miles, when the river breaks through the Cumberland Mountain; and (3) from Chattanooga to Kingston, about 100 miles further.

Agriculture. *Agriculture.*—In 1880 the number of farms was 165,650, embracing 8,496,556 acres of improved land, valued at $206,749,837. The principal productions are Indian corn, wheat, oats, cotton, tobacco, potatoes, pea-nuts, and hay, particulars of which for different years are shown in the following table:—

Product.	1860.	1870.	1880.	1884.
Indian corn	52,089,926 bush.	41,343,614 bush.	62,764,429 bush.	66,723,000 bush.
Wheat	5,459,268 "	6,188,916 "	7,331,353 "	9,320,000 "
Oats	2,267,814 "	4,513,315 "	4,722,190 "	7,680,000 "
Cotton	296,464 bales.	181,842 bales.	330,621 bales.	318,807 bales.
Tobacco ..	43,448,097 lb.	21,465,452 lb.	29,365,052 lb.	31,392,000 lb.
Potatoes ..	3,766,677 bush.	2,330,020 bush.	3,724,382 bush.	2,390,000 bush
Hay	143,499 tons.	116,582 tons.	186,698 tons.	217,316 tons.

In 1884 1,250,000 bushels of pea-nuts were produced, as against 800,000 in 1883. In recent years considerable attention has been given to the cultivation of fruit and vegetables.

The live stock statistics in different years are shown in the table which follows next:—

Year.	Horses.	Cattle.	Sheep.	Pigs.	Mules and Asses.
1860	290,882	764,732	773,317	2,347,321	126,345
1870	247,254	643,696	826,783	1,828,690	102,983
1880	266,119	783,674	672,789	2,160,495	173,498
1885	288,604	801,823	603,780	2,122,646	187,306

Minerals. *Minerals.*—The chief minerals found in the State are coal, iron, copper, zinc, lead, and manganese. Of coal the output was 494,491 tons in 1880 and 1,100,000 tons in 1885; in the latter year there were also 268,400 tons of coke. In 1880 there were produced 89,933 tons of iron ore (326,040 tons in 1885), 153,880 lb of copper ingots, and 792,621 cubic feet of marble and limestone. Of zinc 17,415 tons were produced in 1884. Besides the minerals already mentioned, Tennessee yields millstone grit, hydraulic rock, barytes, fire-clay, gold, and petroleum.

Manufactures. *Manufactures.*—Since 1875 the manufacturing industries of the State have grown immensely. From 1880 to 1885 the number of establishments increased from 4326 to 4425, the capital invested from $20,092,845 to $40,763,650, and the value of the manufactured products from $37,074,886 to $75,216,211. In 1880 cotton was manufactured in the State to the value of $934,014 (in 1885 to $2,719,768), carriages and waggons $1,253,721, flour and grist-mill products $10,784,804, foundry and machine-shop products $1,191,531, iron and steel $2,274,203, leather $2,051,087, lumber $4,015,310, and cotton-seed oil, cotton seed, and cake to the value of $1,235,000.

Population. *Population.*—The population of the State, which in 1860 was 1,109,801 and in 1870 1,258,520, was in 1880 1,542,359 (males 769,277, females 773,082). Of this last total 403,151 were Negroes. In 1887 the total population was estimated to number about 1,800,000, giving a density of 43 inhabitants to the square mile, as against 36·9 in 1880. The growth of the principal cities is shown by the following table:—

	1870.	1880.		1870.	1880.
Memphis	40,226	33,592	Knoxville......	8,682	9,693
Nashville	25,865	43,350	Jackson	4,119	5,377
Chattanooga ..	6,093	12,892			

The considerable decline in the population of Memphis is accounted for by two epidemics of yellow fever in 1878 and 1879 (see MEMPHIS). Chattanooga is still increasing at a very rapid rate in consequence of the vast development of the mineral resources of east Tennessee. Knoxville is also growing from the same cause, but not so rapidly as Chattanooga.

Education. *Education.*—Provision for common school education was made before the Civil War, but was limited to white children. A State bank was established for the purpose of regulating the currency, and a portion of its capital was reserved as a school fund; its profits were also to be used for school purposes. The fund on which interest is now paid is $2,512,500. A bill is now (1887) before the State legislature to increase the permanent State fund to $5,000,000. Besides this, the proceeds of a tax of 15 per cent. on property and a poll tax of $1 per annum are applied to the same purpose. Moreover, each county has the power of imposing a school tax on its people, and many incorporate cities and towns add still further to it by special taxes within their limits. All children between six and twenty-one (eighteen until 1885) are entitled to free education in the public schools. In 1875 the school population numbered 426,612, of whom there were 199,058 pupils enrolled. In 1886 the corresponding figures were 609,028 and 373,877, and in 1887 623,450 and 383,537. Besides the common schools numerous private schools exist. Higher education is provided for in several institutions, such as Vanderbilt university (Methodist) at Nashville, the university of the South (Episcopalian) at Sewanee or Cumberland Mountain, the south-western Presbyterian university at Clarksville, and others; the university of Tennessee at Knoxville is supported by State grants, and is not under the direction of any one denomination. Many smaller establishments entitled universities exist in various parts of the State.

Administration. *Administration, &c.*—The legislative and executive functions of government are carried on by a governor, a State senate, and a house of representatives, whose respective duties and prerogatives correspond almost exactly to those of the president, senate, and representatives of the United States. Both the senators (33) and the representatives (99) are elected for two years. The president of the senate, who is elected by the senators, succeeds as governor in case of the death of the elected governor during his term of office. The governor has the power of veto on the Acts of the legislature. In case of its exercise, the Act is returned to the legislature, when, if it passes by a constitutional majority in both houses, it becomes law in spite of the veto.

The judiciary administration is carried on by courts of four designations,—the county criminal courts, the circuit courts, the chancery courts, and the supreme court of the State. The county courts consist of the magistrates, who assemble at the county seat four times a year to transact county business. They elect a chairman out of their own body, who by virtue of such election becomes the financial agent of the county. In counties large enough to justify it, a county judge is elected, who exercises criminal jurisdiction. There are fourteen circuit courts, each having jurisdiction in several counties; in these all common-law cases are adjudicated, except in those counties where there is a criminal judge. There are eleven chancery divisions, for each of which a chancellor is elected, who tries all cases in equity in his division. All these judges are elected for eight years. The judges of the supreme court, five in number, are elected by the people at large, but not more than two can be taken from any one of three divisions of the State, viz., the eastern, middle, and western. Their jurisdiction is purely appellate: they revise the decisions of the other courts, and their decisions are final, except where a question arises as to the interpretation of the United States constitution.

History. *History.*—At the time of its first settlement and occupation by Europeans Tennessee was part of the territory granted to the colony of North Carolina by Charles II. It was then, however, a hypothetical claim, the boundaries of which were chiefly determined by 36° 30′ and 35° N. lat. The eastern boundary of North Carolina was the Atlantic Ocean; on the other side the western territory extended according to one theory to the Mississippi, according to another theory to the Pacific Ocean. When the English settlers began to cross the Appalachian chain, they found the French established on the Mississippi and its tributaries,—the Ohio, the Tennessee, and the Cumberland. The Spanish claim of an indefinite extension of their possessions in Florida was also a constant menace to the advance of the earliest English colonists in the direction of South Carolina and Georgia. The most important effort of transmontane colonization by the British prior to 1760 was the establishment of Fort London on the Little Tennessee river in 1756 or 1757. But in 1760 this post was captured by the Cherokees and its garrison massacred; and the same fate befell a number of colonists who had settled between Fort Chissel (on New River, Virginia) and Fort London. Early in 1761 Colonel Grant completely routed the Cherokees and compelled their French and Spanish allies to withdraw to Louisiana and Georgia.

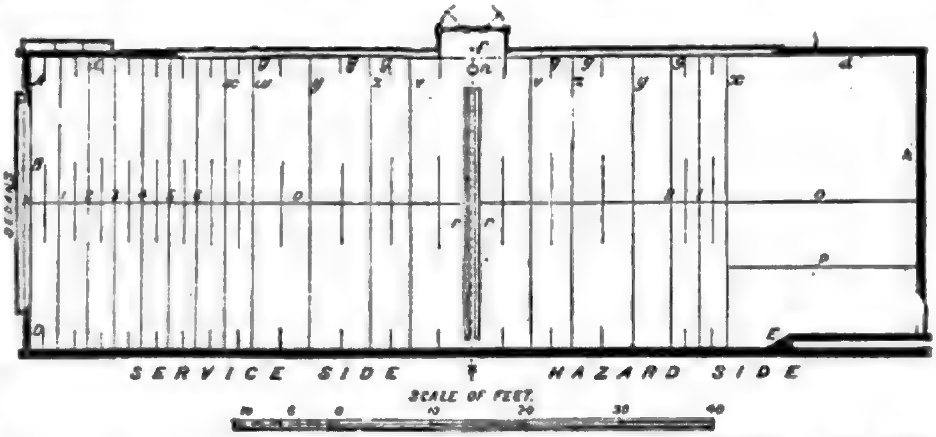
Eight years later the stream of emigration began to set westwards, mainly by two routes, of which one led through Cumberland Gap to the valley of the Cumberland river, whilst the other followed the course of the Tennessee round the southern border of the Cumberland plateau into the western Tennessee valley. A body of emigrants from Virginia settled on the banks of the river Holston, in what is now Hawkins county, and formed the nucleus of a rapidly increasing colony, which was mainly recruited from Virginia and North Carolina. The chief settlements were on the Watauga river, extending thence to the Nolichucky, both tributaries of the Tennessee. The colonists adopted a code of laws for themselves based upon those of Virginia, and entrusted their execution to a bench of five magistrates. Their first trouble related to the title to their lands. They supposed themselves to be settling in Virginia; but they were really in North Carolina, and therefore outside of the territory which had been ceded to the British crown by the six nations of Indians. A further obstacle was a royal proclamation dated nine years before forbidding private persons to purchase titles from the Indians. Though the Cherokees had no longer fixed habitation in the country, they still claimed the whole valley for hunting grounds. The dilemma was solved by a lease negotiated for eight years. The next difficulty arose with the British Government in alliance with the hostile Indians. But out of those troubles the colonies on the Watauga, Holston, and Nolichucky emerged as a populous and powerful community.

When it was proposed to liquidate the debts incurred by both the States and the Federal Government for war expenses by the sale of public lands, an Act of Cession was passed in 1784 by the North Carolina legislature ceding their lands west of the mountains, including those of the Watauga settlers, to the Federal Government. But in the following year the North Carolina legislature repealed the Act of Cession, and the whole matter was thus indefinitely postponed. The Watauga community now declared itself independent of North Carolina; that State had relinquished its sovereignty over them and the Federal Government had not accepted it. At this time the transmontane territory consisted of Washington, Sullivan, and Greene counties. It also embraced all the settlements on the Cumberland, comprising the existing counties of Davidson, Sumner, Montgomery, Robertson, and Williamson. Davidson county had been organized by the influence of James Robertson (one of the earliest arrivals from North Carolina, in 1769), who had moved to the site of the future city of Nashville. But Davidson county took no part in these proceedings. The State organized by the seceding counties in August 1784 was called the State of Franklin; its constituent counties returned to their allegiance to North Carolina on 1st March 1788. A second Act of Cession was passed in 1790, by which the defunct State of Franklin became part of the territory of the United States south of the Ohio, including what now constitutes Kentucky and Tennessee. The northern portion became a State, under the name of Kentucky, in 1792, and the southern portion took rank as the State of Tennessee in 1796, being received into the Union the same year. The settlement of middle Tennessee was much retarded so long as the path of access to it from east Tennessee was through Cumberland Gap and down the Ohio. The broader route round the south of the Cumberland plateau by the Tennessee river was too unsafe for general use on account of the powerful Indian tribes—the Creeks and the Cherokees. This obstacle was finally removed by General Jackson's crushing defeat of the Creeks in 1814, and a large cession of their territory.

The position of Tennessee during the Civil War was the same as that of the other middle and southern States. While secession was in agitation, it refused to secede; but when actual hostilities commenced it joined the Southern confederacy. Even then, however, west and middle Tennessee sympathized with the South, whilst eastern Tennessee sided with the North. Each division sent very large contingents to the army which it favoured. A large portion of the State was, during the later years of the war, in the occupation of the Northern army, and many great battles were fought on its soil, notably those of Fort Donelson, Murfreesborough (Stone River), Franklin, and Nashville. Tennessee suffered more from the exhaustion attendant on the close of the war, and from the rigorous government which accompanied the period of reconstruction, than any other State except Virginia.

See *Geology of Tennessee*, Nashville, 1869; Elliott, "The Age of the Southern Appalachians," in *Amer. Jour. of Sc.*, April 1883; Bradley, "On the Silurian Age of the Southern Appalachians," *ib.*, April 1875; Haywood, *The Civil and Political History of the State of Tennessee from its earliest Settlement up to the Year 1796*, Knoxville, 1823; Ramsay, *Annals of Tennessee to the End of the Eighteenth Century*; Parton, *Life of Andrew Jackson*, New York, 1860; Kirke, *The Rear Guard of the Revolution*, New York, 1886; *Reports* of Tennessee Hist. Soc. and of Bureau of Agriculture, Mines, and Immigration. (D. F. W.)

TENNIS. This, the oldest, perhaps, of all existing ball-games, is at once the most difficult to learn, on account of the intricacy of its laws, and the most interesting when learnt, because of the great variety of its combinations and the difficulty of solving rapidly the problems which are constantly presented to the player. It derives an additional claim to attention from numberless historical associations. Of the origin of tennis it is not possible to speak with certainty; but it may be confidently assumed that it sprang from some very simple sport. It first appeared in Europe in the Middle Ages, when we find it played in open courts, in the parks or ditches of the feudal castles of France and Italy. It was at first the pastime of kings and nobles, but afterwards became popular with all classes. The French seem to have borrowed it from the Italians, and to have contributed some of its refinements; and the English took it from the French. Though mentioned in the Arthurian romances, the game was certainly not known in England in the time of Arthur. The name *tennis* is supposed to be derived from the exclamation "Tenez!" employed by early French players in serving the ball. In Italy the game is called "giuoco della palla"; in France, "jeu de paume," which also means the tennis court; in Germany it is called by the generic title of "Ballspiel"; in Spain, "juego al ble" or "jugar al ble." It is clear from the French name that the ball was originally struck with the palm of the hand. This was afterwards protected by a glove, as is still the practice in the Basque country. Upon the glove strings and cross-strings were next stretched, to give a faster impulse; and the addition of a short handle made an easy transition to the racket. In the time of Henry VII. the hand still sometimes met the racket, even in the royal court at Windsor.



Plan of tennis court. *A*, *D*, walls on each side of dedans; *d*, *d*, gallery walls; *h*, grille wall; *f*, net post; *g*, *g*, gallery post; *v*, *v*, first galleries; *y*, *y*, second galleries; *x*, *x*, last galleries; *s*, *s*, doors; *o*, *o*, half-court line; *r*, *r*, openings under net for ventilation and warming; 1, 2, 3, 4, 5, 6, mark chases.

One of the first improvements in the game consisted in the building of closed courts, first with walls, then with walls and roof. It is still played in the open air in some places in France, and "pallone," a rude and violent variety of the game, is yet seen in Italy. There are twenty-seven courts in England and one in Dublin.

As now played, tennis in France is virtually the same as in England, though there are a few differences of detail. The court is rectangular (see the annexed plan). An inner wall runs round three sides, to the height of 7 feet, from which a sloping roof, called the penthouse, reaches to the outer wall. The surrounding passage thus enclosed (not shown in plan) is 7 feet wide. Opposite to the long penthouse is the main wall, in which there is at one point a projection called the *tambour*, *E*, which deflects the ball across the court. In the inner wall, below the penthouse, there are several openings, the one at the end, on the service side, being called the *dedans*, *B*, the others the *galleries*. At the further end of the court is the *grille*, a square opening adjacent to the main wall. Across the court, halfway between the two ends, is stretched a net *n*, 3 feet high in the middle and 5 feet at the sides. The game may be played by two, or by three, or by four players, one against one, one against two, or two against two. At the commencement the players toss or "spin" a racket, to decide which shall serve first, calling "rough" (for the knotted side) or "smooth." The party which wins the "spin" has the choice of the service or the "first stroke," the latter term meaning the return of the service. The server then begins at the "dedans" end of the court, technically called the "service side," pitches the ball in the air, and strikes it with his racket so that it shall drop on the side penthouse or on the wall above it, and then from the penthouse upon the floor on the other side of the net (called the "hazard side"), within the "service court" bounded by the "service line" *x* and the "pass line" *p*. If he fail to do this, a "fault" is called, or a "pass" if the ball has gone beyond the pass line. If he serves a second fault, his adversary scores a point, called a "stroke." A pass counts for nothing, but annuls a previous fault.[1] It now becomes the duty of the adversary, called the "striker-out," to return the ball by striking it with his racket in such a manner that it shall pass back over the net to the service side. The server must now strike it again and return it to the hazard side; and the player who first returns the ball into the net or "out of court" (*i.e.*, to the roof, or above the play line on the walls) loses the stroke, which is scored to his antagonist. But, if a player fail or refuse to strike the ball in the air (a "volley") or on its first bound and before it touches the floor a second time, then, except on the hazard side beyond the service line, a "chase" is made or reckoned on the floor, according to the lines on or between which the ball has dropped the second time. This chase is a stroke in abeyance. When one has been made it is called by the marker, but does not affect the score until one of the players has scored 40, when they change sides, and the player who has allowed the chase to be made must then endeavour to win it, *i.e.*, to place the second bound of the ball returned by him better, *i.e.*, nearer to the end wall, than the point at which the chase was marked. As often as his adversary returns his stroke, he must again endeavour to do this, until he succeeds or fails. If he succeed, he scores the stroke; if not, it is scored to his adversary. If two chases have been made at any stage of the score, even at the beginning of a game, then the players must change sides and play for the chases, as above described. A player who succeeds in sending the ball into the grille, the dedans, or the last division of the gallery—called the "winning gallery"—on the hazard side, scores at all times a stroke. The minutiæ of the game and the mode of scoring cannot be more succinctly described than in the annexed laws.[1]

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[1] In the Manchester Club this law (8) has been wisely abolished.

LAWS.

Single-Handed Game.

1. The balls shall be not less than 2¼ in. and not more than 2⅝ in. in diameter, and shall be not less than 2½ oz. and not more than 2¾ oz. in weight.

Note.—There is no restriction as to the shape or size of the rackets.

2. (*a*) The choice of sides at the beginning of the first set is determined by a spin.
(*b*) In subsequent sets of a series, the players shall begin each set on the side on which they finished the set before it.

3. The ball served must be struck with the racket, and may be delivered from any part of the service side.

4. The ball served must touch the service penthouse before touching any other part of the court, except the rest of the side penthouse and the service wall; and it must drop in the service court or on one of the lines which bound it.

5. The service is good,
(*a*) if the ball served touch in its descent any part of the service penthouse so as to rise again from it, or
(*b*) if the ball served strike the service wall and afterwards touch in its descent any part of the service penthouse, even though it do not rise again from it, or
(*c*) if the ball served drop in the winning gallery.

6. A fault may not be returned.

7. A pass may not be returned; but a ball served, which has not gone across the pass line on the penthouse, may be volleyed, although if untouched it might have dropped in the pass court. If a pass touch the striker-out, or if a service before it has dropped touch him when standing with both feet in the pass court, and not having attempted to strike the ball, it is still counted a pass.

8. A pass annuls a previous fault.

9. If the striker-out declare himself not ready for a service, and have made no attempt to return it, that service is counted for nothing, though it be a fault. It annuls a previous fault. The striker-out, having been asked if he is ready, and having declared himself ready, may not similarly refuse a second service.

10. The server continues to serve until two chases be made, or one chase when the score of either player is at forty or advantage (see law 25). The players then change sides, the server becoming striker-out and the striker-out becoming server.

11. The return is good if the ball in play be struck with the racket so that it pass the net without touching a gallery post or anything fixed or lying in an opening on the side from which it is struck, and without going out of court.

12. The return is not good,
(*a*) if not in accordance with the terms of law 11, or
(*b*) if the ball be struck more than once, or be not definitely struck, or
(*c*) if the ball in play, having passed the net, come back and drop on the side from which it was struck, unless it should have touched a gallery post or anything fixed or lying in an opening on that side of the court which is opposite to the striker.

13. A ball which is no longer in play may not be returned.

14. The server wins a stroke (except as provided in law 9),
(*a*) if a good service enter the winning gallery or the grille, or
(*b*) if the striker-out fail to return a good service (except when it makes a chase; see laws 17-19), or
(*c*) if the striker-out fail to return the ball in play (except when it makes a chase; see laws 17-19), or
(*d*) if he himself return the ball in play so that it enter the winning gallery or grille, or fall on or beyond the service line, or
(*e*) if he serve or return the ball in play so that it drop or fall upon a ball or other object which is on or beyond the service line, or
(*f*) if he win a chase (see law 20), or
(*g*) if the striker-out lose a stroke (see law 16).

15. The striker-out wins a stroke (except as provided in law 9),
(*a*) if the server serve two consecutive faults (except as provided in law 31 (*b*)), or
(*b*) if the server fail to return the ball in play (except when it makes a chase; see laws 17-19), or
(*c*) if he himself return the ball in play so that it enter the dedans, or
(*d*) if he win a chase, or
(*e*) if the server lose a stroke (see law 16).

16. Either player loses a stroke,
(*a*) if he lose a chase (see law 21),
(*b*) if the ball in play (except as provided in law 7) touch him or anything which he wears or carries, except his racket in the act of returning the ball, or
(*c*) if he touch or strike the ball in play with his racket more than once, or do not definitely strike it.

17. When a ball in play on either side of the net, not being that on which the striker is standing,
(*a*) falls on any part of the floor, except on or beyond the service line, or
(*b*) enters any gallery, except the winning gallery, or
(*c*) touches a gallery post,
it is marked a chase
(α) at that line on the floor on which it fell, or
(β) better or worse than that line on the floor which is nearest to the point at which it fell, or
(γ) at that gallery the post of which it touched,
except as provided in laws 18 and 19.

Note (*a*).—A ball in play which touches the net post and drops on the side opposite to the striker is marked a chase at the line on the side on which it drops.

Note (*b*).—A ball in play which enters a gallery is marked a chase at that gallery which it enters, notwithstanding that it may have touched an adjacent gallery post without touching the floor in the interim.

Note (*c*).—The gallery lines on the floor correspond and are equivalent to the galleries of which they bear the names.

18. When a ball in play
(*a*) drops or falls in the net, on the side opposite to the striker, or
(*b*) drops on the floor, on the side opposite to the striker, and, bounding over the net, falls on that side of it from which it was struck, whether it touch the net in its bound or not,
it is marked a chase at the line on the side opposite to the striker.

19. When a ball in play drops or falls upon a ball or other object which is on the floor (except when it is on or beyond the service line; see law 14 (*e*)), it is marked a chase at the point at which that ball or other object was when the ball in play dropped or fell upon it.

20. Either player wins a chase,
(*a*) if he serve or return the ball so that it enter a winning opening, or
(*b*) if he serve or return the ball so that it fall better than the chase for which he played, or enter a gallery or touch a gallery post better than the gallery or the gallery line at which the chase was for which he played, or
(*c*) if he serve or return the ball so that it drop or fall upon a ball or other object which is at a point on the floor better than that at which, or at the gallery corresponding to which, the chase was for which he played, or
(*d*) if his antagonist fail to return the ball in play, except when it falls worse than the chase in question.

21. Either player loses a chase,
(*a*) if he fail to return the ball in play, except when it falls worse than the chase in question, or
(*b*) if he return the ball in play so that it fall worse than the chase, or enter a gallery or touch a gallery post worse than the gallery or the gallery line at which the chase was for which he played, or
(*c*) if he return the ball in play so that it drop or fall upon a ball or other object which is at a point on the floor worse than that at which the chase was for which he played.

22. When a ball in play
(*a*) falls at a point on the floor neither better nor worse than that at which, or at the gallery corresponding to which, the chase was for which the striker played, or
(*b*) enters that gallery or the gallery corresponding to that gallery line, or touches the post of that gallery, or falls on the gallery line corresponding to that gallery, at which the chase was for which the striker played, or
(*c*) drops or falls upon a ball or other object which is at a point on the floor neither better nor worse than that at which, or at the gallery corresponding to which, the chase was for which the striker played,
it is marked chase-off: it is not scored as a stroke won by either player; the chase is annulled, and the striker has not to play for it again.

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[1] Reprinted from the present writer's *Annals of Tennis*, 1878, by the kind consent of the publisher Mr H. Cox.

23. As soon as two chases are marked, or one chase when the score of either player is at forty or advantage (see law 25), the players change sides. The player who made the first chase now defends it, while the other plays to win it; and so with the second chase, except when only one has been marked.

24. If by an error three chases have been marked, or two chases when the score of either player is at forty or advantage (see law 25), the last chase in each case is annulled.

25. On either player winning his first stroke, the score is called fifteen for that player; on either player winning his second stroke, the score is called thirty for that player; on either player winning his third stroke, the score is called forty for that player; and the fourth stroke won by either player is scored game for that player, except as below.

If both players have won three strokes, the score is called deuce, and the next stroke won by either player is scored advantage for that player. If the same player win the following stroke, he wins the game; if he lose the following stroke, the score is again called deuce; and so on, until either player win the two strokes immediately following the score of deuce when the game is scored for that player.

26. The player who first wins six games wins a set, except as below.

If both players win five games, the score is called games all, and the next game won by either player is scored advantage game for that player. If the same player win the following game, he wins the set; if he lose the following game, the score is again called games all; and so on, until either player win the two games immediately following the score of games all, when he wins the set.

Note.—Players often agree not to play advantage sets, but to decide the set by one game after arriving at the score of games all.

27. Every chase is marked, and every stroke scored, by the marker, who is entitled to consult the dedans when he is in doubt. A player who is dissatisfied with the marker's decision is entitled to appeal to the dedans. A majority of the dedans confirms or reverses the marker's decision. An appeal must be made before a recommencement of play.

Note.—The dedans should not give a decision unasked on a question of marking a chase or stroke, but may, and should, correct inaccurate scoring of chases, strokes, games, or sets.

Three-Handed and Four-Handed Games, sometimes called Double Games.

28. The partners serve and strike-out in alternate games, unless it shall have been previously agreed to the contrary.

Note.—It is usually, but not always, agreed that the striker-out may leave to his partner such services as pass him.

The former laws apply to these as well as to single games, the advantages and disadvantages attaching to a single player under the former laws here attaching to a pair of players.

Odds.

29. (*a*) A bisque or a half-bisque may not be taken after the service has been delivered.

(*b*) The server may not take a bisque after a fault; but the striker-out may do so.

Note.—A bisque is a stroke which may be claimed by the recipient of odds at any time during a set, subject to the provisions of laws 29 and 30.

30. A player who wishes to take a bisque or a half-bisque, there being a chase or two chases marked, may take it either before or after changing sides; but he may not, after changing sides, go back to take it.

31. (*a*) When the odds of round services are given, the ball served by the giver of the odds must touch the grille penthouse after touching the service penthouse and before dropping in the service court or on one of the lines which bound it.

(*b*) Neither faults nor failure in complying with the above condition are counted against the giver of the odds; but the recipient of the odds may decline to return such services as do not touch both the penthouses; if, however, he attempt and fail to return any such service, it is counted against him.

32. Half-court: the players having agreed into which half-court on each side of the net the giver of the odds shall play, the latter loses a stroke if the ball returned by him drop in either of the other half-courts.

But a ball returned by the giver of the odds which
(*a*) drops on the half-court line, or
(*b*) drops in his half-court and touches the dedans post before falling, or
(*c*) drops in his half-court and falls in the dedans, even though on the other side of the dedans post, or
(*d*) touches the dedans post before dropping,
is counted for the giver of the odds.

And a return boasted against any wall by the giver of the odds which
(*e*) drops in his half-court, or
(*f*) drops on the half-court line, or
(*g*) touches the dedans post before dropping, or
(*h*) touches any penthouse, battery, or wall before dropping in his half-court, dropping on the half-court line, or touching the dedans post,
is also counted for the giver of the odds.

Note.—It is, of course, evident that the giver of these odds may make a chase, or win a chase or a stroke, with a ball which drops in his half-court, or on the half-court line, but falls in the other half-court.

33. When the odds of "touch no walls" or "touch no side walls" are given, a ball returned by the giver of the odds which on falling makes a nick is counted for the striker.

Directions to the Marker.

It is the duty of the marker
to call the faults, and the passes;
to call the strokes, when won, or when he is asked to do so;
to call the games and sets at the end of each, or when asked to do so;
to mark the chases, when made;
to call the chases when there are two in the order in which they were made, or the chase when there is one with the score at forty or advantage; and then
to direct the players to change sides;
to call the chase or chases again, in order as above, when the players have changed sides, and each chase as a player has to play for it;
not to call *play* or *not play* in doubtful cases before the conclusion of the rest, unless asked to do so;
to decide all doubtful and disputed strokes, subject to an appeal to the dedans;
to warn the players of any balls lying on the floor in their way, or to their danger or disadvantage, and to remove all such balls;
to collect the balls into the ball-basket; and
to keep the ball-troughs constantly replenished in the dedans and last gallery, and the latter especially in three-handed and four-handed games. (J. MA*.)

TENNIS, LAWN. Lawn-tennis is a modern adaptation of the first principle of tennis, in the simplest form, to a ball-game played on grass with rackets. The balls are of india-rubber, hollow, and covered with white cloth. The rackets are lighter and broader than those used at tennis. The court for the single-handed game, one player against one, is shown in fig. 1, that for the three or four-handed game in fig. 2. The dimensions of the courts, the size and weight of the balls, the mode of scoring, and other details are given in the laws of the game (see below). The only requisites for the game are the balls, rackets, net and posts, and a hard level surface of grass. It may be, and often is, played upon surfaces of wood, asphalt, cement, gravel, or other substance. The grass requires constant mowing, rolling, and in dry weather watering, to keep it

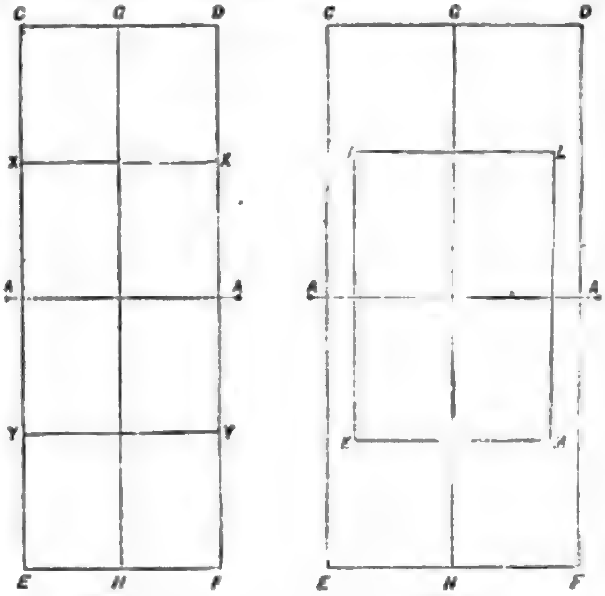

Fig. 1. Fig. 2.

Lawn-tennis courts. Fig. 1, for single game; fig. 2, for double game.

in order. In the winter months it should be sedulously weeded, sown where necessary, and swept and rolled whenever the weather permits.

The choice of sides depends upon a toss or spin of a racket, as in tennis. The winner chooses the service or the preferable side, as he pleases. The server begins the game by striking the ball with his racket so that it passes (without touching) over the net, which is hung across the court from the posts A, A. The ball served must drop in the space which is diagonally opposite to him on the other side of the net,—a space bounded by the net, the side line, the half-court line, and the service line. His adversary, called the "striker-out," must return the ball before it touches the ground a second time; and the server must similarly return it again; and so on, until one or other player fails to return it over the net so that it shall drop on the ground anywhere on the side of the net furthest from him, and within or upon any of the lines which bound that space, technically called his adversary's *court*. When one player thus fails, he loses a stroke, which the other is deemed to win, and it is added to the score of the latter. The score is kept as at tennis, but there are no chases.

Activity and condition have great value in lawn-tennis, though there is room for much skill in placing the ball in the corners with hard, low strokes, and in intercepting and returning the ball by the volley while in the air, before it reaches the ground. But in matches temper, endurance, and quickness of movement count for very much.

Lawn-tennis, in one form or another, has been played for many centuries out-of-doors. The present variety of the game was first introduced, in a form which was soon shown to be impracticable, about the year 1874. It was then taken up by the All England Club at Wimbledon, who in 1877 remodelled the size and shape of the court, and the laws, and altered the system of scoring to that which obtains in the parent game. Thereupon, with the consent of the M.C.C. at Lord's, who lent the authority of their name to the movement, the code of laws which now prevails, and has been occasionally amended only in a few details, was promulgated by the All-England Club. The championship of the game, which is open to gentlemen amateurs only, was instituted at Wimbledon by the A.E.C. in 1877. A lady's championship and a championship for pairs (gentlemen) have also been instituted, and are annually competed for on the grounds of the A.E.C. at Wimbledon. Lawn-tennis, in the short time which has elapsed since its introduction, has achieved immense popularity. Prize-meetings are held annually at Bath, Cheltenham, Dublin, Edinburgh, Manchester, Liverpool, and many other places in the United Kingdom; the game is also played with as great enthusiasm in the United States, Canada, Australia, and India. In all those countries prize-meetings are held and championships are instituted.

LAWS.[1]

Single-Handed Game.

1. For the single-handed game the court is 27 feet in width and 78 feet in length. It is divided across the middle by a net, the ends of which are attached to the tops of two posts A and A (see fig. 1), which stand 3 feet outside the court on each side. The height of the net is 3 feet 6 inches at the posts and 3 feet at the centre. At each end of the court, parallel to the net, and at a distance of 39 feet from it, are drawn the base lines CD and EF, the extremities of which are connected by the side lines CE and DF. Half-way between the side lines, and parallel to them, is drawn the half-court line GH, dividing the space on each side of the net into two equal parts, called the right and left courts. On each side of the net, at a distance of 21 feet from it, and parallel to it, are drawn the service lines XX and YY.

2. The balls shall be not less than 2½ inches nor more than $2\frac{9}{16}$ inches in diameter, and not less than 1⅞ oz. nor more than 2 oz. in weight.

3. In matches where umpires are appointed their decision shall be final; but where a referee is appointed an appeal shall lie to him from the decision of an umpire on a question of law.

4. The choice of sides and the right of serving during the first game shall be decided by toss, provided that, if the winner of the toss choose the right to serve, the other player shall have the choice of sides, and *vice versa*.

5. The players shall stand on opposite sides of the net. The player who first delivers the ball shall be called the server, the other the striker-out.

6. At the end of the first game the striker-out shall become server and the server shall become striker-out; and so on alternately in the subsequent games of the set.

7. The server shall stand with one foot beyond (*i.e.*, further from the net than) the base line, and with the other foot upon the base line, and shall deliver the service from the right and left courts alternately, beginning from the right.

8. The ball served must drop within the service line, half-court line, and side line of the court which is diagonally opposite to that from which it was served, or upon any such line.

9. It is a fault if the service be delivered from the wrong court, or if the server do not stand as directed in law 7, or if the ball served drop in the net or beyond the service line, or if it drop out of court or in the wrong court; it is not a fault if the server's foot which is beyond the base line do not touch the ground at the moment at which the service is delivered.

10. A fault may not be taken.

11. After a fault, the server shall serve again from the same court from which he served that fault, unless it was a fault because served from the wrong court.

12. A fault may not be claimed after the next service has been delivered.

13. The service may not be volleyed, *i.e.*, taken before it touches the ground.

14. The server shall not serve until the striker-out is ready. If the latter attempt to return the service, he shall be deemed to be ready.

15. A ball is in play from the moment at which it is delivered in service (unless a fault) until it has been volleyed by the striker-out in his first stroke, or has dropped in the net or out of court, or has touched either of the players or anything that he wears or carries, except his racket in the act of striking, or has been struck by either of the players with his racket more than once consecutively, or has been volleyed before it has passed over the net, or has failed to pass over the net before its first bound (except as provided in law 17), or has touched the ground twice consecutively on either side of the net, though the second time may have been out of court.

16. It is a let if the ball served touch the net, provided the service be otherwise good, or if a service or fault be delivered when the striker-out is not ready, or if either player be prevented by an accident beyond his control from serving or returning the ball in play. In case of a let, the service or stroke counts for nothing, and the server shall serve again.

17. It is a good return although the ball touch the net, or, having passed outside either post, drop on or within any of the lines which bound the court into which it is returned.

18. The server wins a stroke if the striker-out volley the service, or fail to return the service or the ball in play (except in the case of a let), or return the service or ball in play so that it drop outside any of the lines which bound his opponent's court, or otherwise lose a stroke, as provided by law 20.

19. The striker-out wins a stroke if the server serve two consecutive faults, or fail to return the ball in play (except in the case of a let), or return the ball in play so that it drop outside any of the lines which bound his opponent's court, or otherwise lose a stroke, as provided by law 20.

20. Either player loses a stroke if the ball in play touch him or anything that he wears or carries, except his racket in the act of striking, or if he touch or strike the ball in play with his racket more than once consecutively, or if he touch the net or any of its supports while the ball is in play, or if he volley the ball before it has passed the net.

21. On either player winning his first stroke, the score is called 15 for that player; on either player winning his second stroke, the score is called 30 for that player; on either player winning his third stroke, the score is called 40 for that player; and the fourth stroke won by either player is scored game for that player, except as below.

If both players have won three strokes, the score is called deuce; and the next stroke won by either player is scored advantage for that player. If the same player win the next stroke, he wins the game; if he lose the next stroke, the score is again called deuce; and so on until either player win the two strokes immediately following the score of deuce, when the game is scored for that player.

22. The player who first wins six games wins a set, except as below.

If both players win five games, the score is called games all; and the next game won by either player is scored advantage game for that player. If the same player win the next game, he wins the set; if he lose the next game, the score is again called games all; and so on until either player win the two games immediately following the score of games all, when he wins the set.

Note.—Players may agree not to play advantage sets, but to decide the set by one game after arriving at the score of games all.

23. The players shall change sides at the end of every set; but the umpire, on appeal from either party before the toss for choice, may direct the players to change sides at the end of every game if in his opinion either side have a distinct advantage, owing to the sun, wind, or any other accidental cause; but, if the appeal be made after a match has been begun, the umpire may only direct the players to change sides at the end of every game of the odd and concluding set.

24. When a series of sets is played, the player who was server in the last game of one set shall be striker-out in the first game of the next.

Odds.

25. A bisque is one stroke, which may be claimed by the receiver of the odds at any time during a set, except as below.

A bisque may not be taken after the service has been delivered.

The server may not take a bisque after a fault; but the striker-out may do so.

26. One or more bisques may be given in augmentation or diminution of other odds.

27. Half-fifteen is one stroke given at the beginning of the second and every subsequent alternate game of a set.

28. Fifteen is one stroke given at the beginning of every game of a set.

29. Half-thirty is one stroke given at the beginning of the first game, two strokes at the beginning of the second game; and so on, alternately, in all the subsequent games of a set.

30. Thirty is two strokes given at the beginning of every game of a set.

31. Half-forty is two strokes given at the beginning of the first game, three strokes at the beginning of the second game; and so on, alternately, in all the subsequent games of a set.

32. Forty is three strokes given at the beginning of every game of a set.

33. Half-court: the players having agreed into which court the giver of the odds shall play, the latter loses a stroke if the ball, returned by him, drop outside any of the lines which bound that court.

Three-Handed and Four-Handed Games.

34. The above laws shall apply to the three-handed and four-handed games, except as below.

35. For the three-handed and four-handed games the court is 36 feet in width. Within the side lines, at a distance of 4½ feet from them, and parallel to them, are drawn the service side lines IK and LM. The service lines are not drawn beyond the points I, L, K, and M, towards the side lines. In other respects, the court is similar to that which is described in law 1.

36. In the three-handed game the single player shall serve in every alternate game.

37. In the four-handed game, the pair who have the right to serve in the first game may decide which partner shall do so, and the opposing pair may decide similarly for the second game. The partner of the player who served in the first game shall serve in the third; and the partner of the player who served in the second game shall serve in the fourth; and so on in the same order in all the subsequent games of a set.

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[1] Printed by permission of the All England Lawn-Tennis Club.

38. The players shall take the service alternately throughout each game. No player shall receive or return a service delivered to his partner. The order of service and of striking-out once arranged shall not be altered, nor shall the strikers-out change courts to receive the service, before the end of the set.

39. The ball served must drop within the service line, half-court line, and service side line of the court which is diagonally opposite to that from which it was served, or upon any such line.

40. It is a fault if the ball served do not drop as provided in law 39, or if it touch the server's partner or anything that he wears or carries.

41. If a player serve out of his turn, the umpire, as soon as the mistake is discovered by himself or by one of the players, shall direct the player to serve who ought to have served; but all strokes scored and any fault served before such discovery shall be reckoned. If a game shall have been completed before such discovery, then the service in the next alternate game shall be delivered by the partner of the player who served out of his turn; and so on in regular rotation. (J. MA*.)

TENT. A tent is a portable habitation or place of shelter consisting in its simplest form of a covering of some textile substance stretched over a framework of cords and poles, or of wooden rods, and fastened tightly to the ground by pegs. Throughout the greater part of the interior of Asia the pastoral tribes have of necessity ever been dwellers in tents,—the scantiness of water, the consequent frequent failure of herbage, and the violent extremes of seasons compelling a wandering life. Tents have also been used in all ages by armies in campaign. In ancient Assyrian sculptures discovered by Layard at Nineveh the forms of tent and tent-furnishings are similar to those which still prevail in the East, and it appears that then as now it was a custom to pitch tents within the walls of a city. The ordinary family tent of the Arab nomads of modern times is a comparatively spacious ridged structure, averaging from 20 to 25 feet in length, but sometimes reaching as much as 40 feet. Its covering consists of a thick felt of black goat hair (cp. Cant. i. 5), or sometimes of alternate stripes of black and white disposed horizontally. The ridge or roof is supported by nine poles (*awamid*) disposed in sets of three, the central set being loftier than those at each end, whereby a slope outward is formed which helps to carry off rain. The average height inside at the centre is 7 feet and at the sides 5 feet, and the cloths at the side are so attached that they can easily be removed, the sheltered end being always kept open. Internally the tent is separated by a partition into two sections, that reserved for the women containing the cooking utensils and food. The *jourt* or tent of the Kirghiz of Central Asia is a very capacious and substantial structure, consisting of a wooden frame for sides, radiating ribs for roof, and a wooden door. The sides are made up of sections of laths, which expand and contract in lozenges, on the principle of lazy tongs, and to their upper extremities ribs are lashed at regular intervals. Over this framework a heavy covering of felt is thrown, which is either weighted down with stones or, when necessary, stitched together.

In Western countries tents are used chiefly in military encampments, by travellers and explorers, and for temporary ceremonial occasions and public gatherings. The material of which they are composed is commonly a light linen canvas or navy duck; but for tents of small size stout cotton canvas is employed, being light, strong, elastic, and sufficiently waterproof. These tents vary in size from a low-pitched covering, under which a couple of men can with difficulty creep, up to spacious marquees, in which horticultural and agricultural shows are held, and which can accommodate thousands of persons.

The marquee is distinguished from the tent by being a ridged structure, devoted to show and social uses; but the humblest tent made—the *tente d'abri* or shelter tent of the French army—is also ridged in form. The *tente d'abri* affords sleeping accommodation for six men, and consists of a rope stretched over three low poles and fixed into the ground. Four separate squares of canvas buttoned together are thrown over the rope and pegged to the ground on each side so as to form a low ridge. Two other squares are used for covering the ends, being thrown over the slanting rope ends by which the poles are pegged to the ground. Each of the six men using the tent carries one of the squares of canvas besides his quota of the poles, rope, and pegs. The Gipsies and travelling tinkers of England have an equally unpretentious tent, which consists of a framework of hazel rods bent so as to form a series of low ridges, the ends being stuck into the ground, and over this frame blankets or other coverings are thrown and pegged down. The simplest, but at the same time the least convenient, of ordinary tents is the conical, consisting of a central pole with ropes and canvas radiating from it in an unbroken slope to the ground. This form, however, covers much ground in proportion to the accommodation it affords, as the space round the circumference is of little value. A tent, therefore, which has sides or a fall is a much more convenient structure. The counterpart of the conical is the pyramidal tent, the four equal sides sloping to the ground; and this form with a fall or sides makes the square tent, which is both convenient in shape and firm in structure. Small tents are also made, modified from the Arab form, with a central pole and two lower lateral poles. In the umbrella tent the roof is supported by a set of ribs which radiate from the pole, precisely as the ribs of an umbrella spread out from the stick. In the balloon expapsion tent, invented in 1877 by Captain Newburgh Stewart, R.N., the use of tent pole, pegs, and ropes is entirely avoided, the canvas being supported by light ribs of elastic wood resting on the ground, and the structure is kept taut by hauling ropes descending from the apex and secured by a holdfast driven into the ground. When from the nature of the surface such fastening cannot be obtained, a heavy weight of any kind hung to the hauling rope is sufficient to moor the tent, and except in stormy weather the weight may be hung high up, thus leaving the whole interior of the tent clear. As further provision against stress of weather there are four iron holdfasts at the sides, which may be skewered into the ground by long iron pins. Captain Stewart claims that his tent possesses much greater stability and capacity than the ordinary army tent, that it is much more easily and expeditiously pitched and taken down, and that it is very much lighter. In the latter important respect he calculates that by the adoption of his pattern a regiment at present carrying eighty tents of the Indian service pattern would save no less than twenty tons of transport.

TEPLITZ, or **Töplitz**, one of the most frequented watering-places in the north of Bohemia, is picturesquely situated about 30 miles south of Dresden, in the plain of the Biela, which separates the Erzgebirge from the Bohemian Mittelgebirge. The main interest of the little town centres in the bathing season, which reaches its height in August; and the arrangements for the convenience and amusement of visitors are very complete. There is a large curhaus, and numerous handsome bath-houses are situated both in Teplitz and in the immediately adjoining village of Schönau. The environs are laid out in pretty and shady gardens and promenades, the finest being in the park which surrounds the château of Prince Clary, the superior of the town. The other chief buildings are the Roman Catholic and Protestant churches, the Jewish synagogue with a conspicuous dome, and the theatre. The saline-alkaline springs of Teplitz, ten to twelve in number, ranging in temperature from 90° to 117° Fahr., are classed among what are called "indifferent" waters. Used until lately almost exclusively for bathing, they are prescribed for gout, rheumatism, and some scrofulous affections, and their reputed efficacy in alleviating the effects of gun-shot wounds had gained for Teplitz the sobriquet of "the warriors' bath." Military baths are maintained in the town by the Governments of Austria, Prussia, and Saxony, and there are also bath-houses for the poor. Teplitz is much visited for the after-cure, after Carlsbad and similar spas. The number of patients in 1883 was 6000 and the passing visitors were almost as numerous. The presence of a bed of lignite in the neighbourhood has encouraged the industrial development of Teplitz, which carries on manufactures of cotton and woollen goods, india-rubber, chemicals, hardware, &c. In 1880 the united population of Teplitz and Schönau was 16,750.

The thermal springs are fabled to have been discovered as early as 762, but the first authentic mention of the baths occurs in the 16th century. The town is mentioned in the 12th century, the name being derived from a Slavonic word meaning "warm bath." Teplitz figures in the history of Wallenstein, and is also interesting as the spot where the monarchs of Austria, Russia, and Prussia first signed the triple alliance against Napoleon in 1813. It is a curious fact that on the day of the earthquake at Lisbon (1st November 1775) the main spring at Teplitz ceased to flow for some minutes.

TERAMO, a town of Italy, capital of the province of Teramo (formerly Abruzzo Ulteriore I.) and an episcopal see, stands on the left bank of the Tordino where it is joined by the Vezzola, 12 miles from the coast and 876 feet above sea-level. It is connected by a branch line with Giulianova on the railway from Ancona to Brindisi. The picturesque valley of the Tordino is here dominated by the peaks of the Gran Sasso d'Italia (9522 feet). The town is traversed by one straight wide street with large houses, but for the most part it consists of narrow dirty lanes; the modern suburbs are good. The cathedral (1317-55) has been greatly modernized; the church of San Agostino is in the later Gothic style. The antiquities include remains of a gateway, a theatre, and baths, as well as numerous inscriptions There are manufactures of wool and silk, and of straw hats and pottery. The population of the town in 1881 was 8634, with its suburbs 13,988 (commune, 20,309).

Teramo is the ancient *Interamna Prætutiana*, capital of the Prætutii. In the Middle Ages it was known as Aprutium (whence Abruzzo); the intermediate form of the present name was Teramne.

TERAPHIM (תרפים), a Hebrew word found only in the plural, which the Authorized Version sometimes simply transcribes (Judges xvii. 5, xviii. 14 *sq.*; Hosea iii. 4), but elsewhere translates by "images" (Gen. xxxi. 19 and often elsewhere), "image" (1 Sam. xix. 13), "idols" (Zech. x. 2), "idolatry" (1 Sam. xv. 23) The etymology of the word is quite obscure (see Gesenius, *Thesaurus*, p. 1519 *sq.*), but it appears that the teraphim were a kind of idols (Gen. xxxi. 30), with something of a human figure (1 Sam. xix. 13); and, though their use was condemned by the prophets (1 Sam. xv. 23; cp. 2 Kings xxiii. 24), they were long commonly used in popular worship, both domestic (1 Sam. xix. 13, in the house of David and Michal) and public (Judges xviii.). They are associated with the ephod, which in this connexion seems to mean a plated image, and Hosea speaks of ephod and teraphim as essential elements in the religious usages of northern Israel. Like the ephod, they were specially associated with divination, and in particular with the sacred lot (Zech. x. 2; Ezek. xxi. 21 [26]) From the last passage it appears that teraphim were used by the Babylonians as well as by the Hebrews. These statements and references cover all that is known about the teraphim; the fables of the rabbins are collected in Buxtorf, *Lex. Talmud.*, 2660 *sq.*

TERBURG, Gerard (1608-1681), subject painter, was born in 1608, at Zwolle, in the province of Overyssel, Holland. His father, also an artist, sent him to study in Rome, where he adopted a style distinguished by great finish and accuracy. He practised for a time in Paris with much success, visited England, it is said, and then returned to Holland. In 1648 he was at Münster during the meeting of the congress which ratified the treaty of peace between the Spaniards and the Dutch, and executed his celebrated little picture, painted upon copper, of the assembled plenipotentiaries,—a work which, along with the Guitar Lesson, now represents the master in the national collection in London. At this time Terburg was invited to visit Madrid, where he received employment and the honour of knighthood from Philip IV. It is said that, in consequence of an intrigue, he was obliged to return to Holland. He seems to have resided for a time in Haarlem; but he finally settled in Deventer, where he became a member of the town council, as which he appears in the portrait now in the gallery of The Hague. He died at Deventer in 1681.

Terburg is excellent as a portrait painter, but still greater as a painter of *genre* subjects. He depicts with admirable truth the life of the wealthy and cultured classes of his time, and his work is free from any touch of the grossness which finds so large a place in Dutch art. His figures are well drawn and expressive in attitude; his colouring is clear and rich; but his best skill lies in his unequalled rendering of texture in draperies, which is seen to advantage in such pictures as the Letter in the Dutch royal collection, and in the Paternal Advice (known as the Satin Gown)—engraved by Wille—which exists in various repetitions at Berlin and Amsterdam, and in the Bridgewater Gallery. Terburg's works are rare; only about eighty have been catalogued.

TERCEIRA. See Azores, vol. iii. p. 171.

TEREDO, a genus of Lamellibranchiate *Mollusca*, of the order *Isomya*, sub-order *Sinupallia*, family *Pholadacea* (see Mollusca, vol. xvi. p. 685) The animals included in this genus are commonly known as "ship-worms," and are notorious for the destruction which they cause in ships' timbers, the woodwork of harbours, and piles or other wood immersed for a long period in the sea. They inhabit long cylindrical holes, which they excavate in the wood, and usually occur in great numbers, crowded together so that often only a very thin film remains between the adjacent burrows. Each burrow is lined with a layer of calcareous substance secreted by the mollusc; this lining is not usually complete, but stops short a little distance from the inner end of the burrow, where the boring process continues to take place. In some burrows, however, the lining is complete, either because the animal has reached its full size or because some cause prevents it continuing its tunnel; in such cases the calcareous tube has a hemispherical termination. The burrows are usually driven in the direction of the grain of the wood, but not invariably so. When a knot or nail or the tube of a neighbour is reached, the course of the burrow is altered so as to bend round the obstruction. One burrow is never found to break into another.

The adult *Teredo*, when removed from its burrow and calcareous tube, is from a few inches to 3 feet in length, according to the species to which it belongs, and is cylindrical and worm-like in appearance. The anterior end, which lies at the bottom of the burrow, is somewhat enlarged and bears a pair of shells or valves, which are not connected by the usual ligament, but are widely separated dorsally. The valves are triangular in shape and very concave on the side which is in contact with the animal. In front their edges are widely separated, and the mantle tube, which is elsewhere closed, has here a slight median aperture, through which the short sucker-like foot can be protruded. The next portion of the body behind the shell-bearing part is naked, except for the shelly lining of the burrow, which is secreted by this part. Anteriorly this portion contains part of the body proper; posteriorly it forms a tube divided internally by a horizontal partition into two chambers. In the lower chamber are the elongated gill plates, which have the typical lamellibranchiate structure. In the upper chamber anteriorly is the rectum. A thick muscular ring terminates this region of the body, and bears two calcareous plates shaped like spades or battledores. The expanded parts of these plates are free and project backwards; the handle is fixed in a deep socket or pit lined by epidermis. These calcareous plates are called pallets (Fr. *palmules*). Behind the pallets the tubular body bifurcates, forming two siphons similar to those of other Lamellibranchs; the siphons can be contracted or expanded within wide limits of length. The principal organs of the body—stomach, heart, generative organs, and nephridia—are situated in the anterior part of the body, forming a visceral mass, which extends some distance behind the valves. The heart is above the intestine and not perforated by it. The two valves are connected by an anterior adductor muscle.

From its resemblance to *Pholas*, *Teredo* is placed by conchologists in the family *Pholadidæ*, among the *Isomya*; but it is still undecided which part of the body corresponds to the posterior adductor. According to Quatrefages, it is a muscular band passing transversely between the handles of the pallets. His discussion of this point is connected with another, namely, the nature of the long tubular portion of the body behind the valves. Deshayes limits the extent of the mantle to the part covered by the shell, and considers all the rest of the animal as formed by the siphons; the branchiæ and part of the other viscera in this view are contained in the siphons. Quatrefages argues that the siphons commence at the point where their retractor muscles are inserted, namely, at the muscular ring corresponding to the pallets. This reasoning is plausible; but it is difficult to accept the view that the retractor muscles of the siphons and the posterior adductor muscle are so closely connected as Quatrefages thinks; in other *Isomya* the retractors of the siphons and the posterior adductor are distinct and separate. Deshayes believes that the single adductor between the valves results from the fusion of the two muscles usually separate. Jeffreys believes that the posterior adductor is really present between the posterior parts of the valves; but the opinion of a conchologist on a question of morphology is not of very great weight. In other *Isomya* the visceral (parieto-splanchnic) ganglia are attached to the ventral surface of the posterior adductor. In *Teredo* these ganglia are situated at the posterior end of the body proper, some distance behind the shells, and immediately behind the generative organ. It is here probably that the rudiment of the posterior adductor, if it exists, is to be sought; or, if it does not exist, it is here that it originally was placed.

It is evident that the anatomy of *Teredo* has not yet been investigated from the point of view of modern morphology; but as far as can be judged at present the body proper extends back some distance behind the shells, to the posterior limit of the visceral mass. The part between this and the pallets is a tubular prolongation of the mantle chamber containing the extended gill laminæ, and beyond the pallets are the separate siphons. Besides the visceral ganglia a cerebral and a pedal pair are present. The stomach is provided with a large crystalline style. The function of the pallets is to form an operculum to the calcareous tube when the siphons are withdrawn into it. In some species the external or narrower end of the calcareous tube is provided with transverse laminæ projecting into the lumen; and in some the external aperture is divided by a horizontal partition into two, one for each siphon.

The *Teredo*, according to Quatrefages, is diœcious, though Gwyn Jeffreys believes it to be hermaphrodite. As in the case of the oyster, the ova are retained in the branchial chamber during the early stages of their development. The segmentation of the ovum is unequal, and leads to the formation of a gastrula by epibole. By the growth of a preoral lobe provided with a ring of cilia, and by the formation of a mouth and an anus, the trochosphere stage is reached. A pair of thin shells then appear on the sides of the larva, connected by a hinge on the dorsal median line, and the foot grows out between mouth and anus. By the time the larvæ "swarm," or leave the branchial cavity of the parent to live for a time as free-swimming pelagic larvæ, the valves of the shell have grown so large as to cover the whole of the body when the velum is retracted; the foot is also long, cylindrical, and flexible, and can be protruded far beyond the shell. The valves of the shell at this stage are hemispherical in shape, so that the whole larva when its organs are retracted is contained in a globular case.

Concerning the later changes of the larva and the method by which it bores into wood nothing or little is known from direct observation. Much has been written about the boring of this and other marine animals, but even yet the matter cannot be said to be satisfactorily elucidated. Osler, in a paper in *Phil. Trans.*, 1826, argued that the *Teredo* bores by means of its shells, fixing itself by the surface of the foot, which it uses as a sucker, and then rasping the wood with the rough front edges of the shell-valves. This view was founded on the similarity of the arrangement of the shells and muscles in *Teredo* to those occurring in *Pholas*, in which the method of boring described was actually observed. W. Thompson, in a paper in the *Edinb. New Phil. Journ.*, 1835, supported the view that the excavation is due to the action of a solvent secreted from the surface of the animal. Albany Hancock, again (*Ann. and Mag. Nat. Hist.*, vol. xv.), thinks that the excavating power of *Teredo* is due to silicious particles embedded in the anterior portion of the integument, in front of the valves. But the actual existence of either silicious particles or acid secretion has been denied by others. Jeffreys believes that the foot is the organ by which the animal burrows. In the larger number of Lamellibranchs the foot is doubtless a burrowing organ, and it is difficult to see how the limpet hollows out the rock to which it is attached if not by means of the surface of its foot. At the same time it is difficult to explain how the soft muscular foot can penetrate into hard wood. The process is of course slow, and Jeffreys supposes that particles are detached one by one from the moistened surface to which the foot is applied. In any case the valves are covered by an epidermis, which could scarcely be there if they were used in burrowing.

Teredo grows and burrows at an extremely rapid rate: spawning takes place in the spring and summer, and before the end of the year the animals are adult and their burrows of large size. Quatrefages relates that at Guipuzcoa (N. Spain) a ferry-boat was sunk accidentally in the spring, and was raised four months afterwards, when its timbers were already rendered useless by *T. pedicellata*. How long the animals live is not accurately known, but Quatrefages found that they nearly all perished in the winter. This cannot be generally the case, as the size of the tubes varies so greatly. In Holland their greatest ravages are made in July and August. Iron ships have nothing to fear from their attacks, and the copper sheathing now almost universally used protects wooden hulls. A great deal of loss is, however, caused by *Teredo* in harbour works and shipping stages, and the embankments in Holland are continually injured by it. The most efficient protection is afforded by large-headed nails driven in in close proximity. Soaking wood in creasote is not a certain safeguard; Jeffreys found at Christiania in 1863 that a large number of harbour piles previously soaked in creasote had been completely destroyed by *T. navalis*. Coal tar and the silicate of lime, used for coating stonework, have been suggested as protective coverings, but they do not seem to have been adequately tested.

Species of *Teredo* occur in all seas. The animal was known to the ancients and is mentioned by Theophrastus, Pliny, and Ovid. In 1715 it is mentioned by Valisnieri, in 1720 by Deslandes. In 1733 great attention was drawn to it on account of the discovery that the wooden dykes of Holland were being rapidly destroyed by ship-worms, and that the country was in danger of inundation. Three treatises were published concerning the animal, by P. Massuet, J. Rousset, and Godfrey Sellius. The work of the last-named, which was the best, described the anatomy of the creature and showed that its affinities were with bivalve molluscs. The truth of Sellius's view was not grasped by Linnæus, who placed *Teredo* together with *Serpula* in the genus *Dentalium*; but its proper position was re-established by Cuvier and Lamarck. Adanson, unaware of the work of Sellius, in 1757 believed himself to be the first to discover the molluscan affinities of *Teredo*. It will not be necessary to give here a definition of the genus taken from any systematist; it will be sufficient to point out that the long cylindrical body with its two small anterior polygonal valves, the absence of a ligament and accessory valves, the muscular ring into which are inserted the calcareous pallets, and the continuous calcareous tube lining the hole bored by the animal are the diagnostic features.

Jeffreys, in his *British Conchology*, gives the following species as British:—*Teredo norvegica*, Spengler; *T. navalis*, Linn.; *T. pedicellata*, Quatrefages; *T. megotara*, Hanley. *T. norvegica* occurs chiefly on the west coast of Great Britain. It was taken by Thompson at Portpatrick in Wigtownshire, and occurred in Jeffreys's time in abundance at Milford Haven. This species has been described by Gmelin and a number of British authors as *T. navalis*, Linn. It is distinguished by having the base of the pallets simple, not forked, and the tube semi-concamerated at its narrower posterior end. The length does not usually exceed a foot. It is the *T. navium* of Sellius. *T. navalis* has been identified from the figures of Sellius, to which Linnæus referred; Sellius called it *T. marina*. It occurs on all the western and southern coasts of Europe, from Christiania to the Black Sea, and is the species which causes so much damage to the Dutch embankments. The pallets of this species are small and forked, and the stalk is cylindrical. The tube is simple and not chambered at its narrow end. *T. pedicellata* was originally discovered by Quatrefages in the Bay of Los Pasages on the north coast of Spain; it has also been found in the Channel Islands, at Toulon, in Provence, and in Algeria. In *T. megotara* the tube is simple and the pallets like those of *T. norvegica*; it occurs at Shetland and Wick, and also on the western shore of the Atlantic, where its range extends from Massachusetts to South Carolina. *T. malleolus*, Turton, and *T. bipinnata*, Turton, belong to the West Indies, but are often drifted in floating timber to the coasts of Europe. Other occasional visitants to the British shores are *T. excavata*, *bipartita*, *spatha*, *fusticulus*, *cucullata*, and *fimbriata*. These were described by Gwyn Jeffreys in *Ann. and Mag. Nat. Hist.*, 1860. *T. fimbriata* is stated to be a native of Vancouver's Island. A kind of ship-worm, the *Nausitora dunlopei* of Perceval Wright, has been discovered in India, 70 miles from the sea, in a stream of perfectly fresh water, namely, the river Kumar, one of the branches of the Ganges. *T. corniformis*, Lam., is found burrowing in the husks of cocoa-nuts and other woody fruits floating in the tropical seas; its tubes are extremely crooked and contorted for want of space. Fossil wood and palm-fruits of Sheppey and Brabant are pierced in the same way.

Twenty-four fossil species have been recognized in the Lias and succeeding beds of Europe and the United States. The sub-genus *Teredina*, Lam., is a fossil of the Eocene of Great Britain and France.

Literature.—See, besides the works already mentioned, Godfrey Sellius, *Historia Naturalis Teredinis seu Xylophagi Marini*, 1733; Adanson, *Histoire Naturelle du Sénégal*, Paris, 1757; Quatrefages, *Annales des Sci. Nat.*, 1848-50;

Forbes and Hanley, *Brit. Mollusca*, 1853; B. Hatschek, *Entwicklung v. Teredo: Arbeiten aus dem Zool. Inst. Wien*, 1880; Deshayes, *Mollusques d'Algérie*; Sir E. Home, "Anatomy of *Teredo*," in *Phil. Trans.*, vol. xcvi.; Frey and Leuckart, *Beiträge zur Kenntniss wirbelloser Thiere*, 1847; Woodward, *Manual of Mollusca*, London, 1851. (J. T. C.)

TEREK (Russ. *Terskaya oblast*), a Russian government of Caucasia, situated to the north of the main Caucasus chain. It is bounded by Stavropol on the N., by the Caspian Sea and Daghestan on the E., by Tiflis and Kutais on the S., and by Tchernomorsk and Kuban on the W. It has an area of 23,548 square miles. From Mt Elburz to Kazbek the southern boundary coincides with the main snow-covered range of the Caucasus and thus includes its highest peaks; further east it follows a sinuous line so as to embrace the secondary chains and their ramifications. Nearly one-third of the area is occupied by hilly tracts, the remainder being undulating and flat land belonging to the depression of the Terek; one-half of this last, on the left bank of the river, is occupied by sandy deserts, salt clay steppes, and arid stretches unsuited for cultivation. Granites, syenites, diorites, and Palæozoic schists constitute the nucleus of the Caucasus mountains; Jurassic and Cretaceous formations rise to great heights in the secondary chains; and a series of Tertiary formations, covered by Quaternary deposits, cover a wide area in the prairies and steppes. A group of mineral springs occurs about PYATIGORSK (*q.v.*).

The climate is continental. The mean annual temperatures are 49°·6 Fahr. at Pyatigorsk (1850 feet above the sea; January 39°, July 70°) and 47°·7 at Vladikavkaz (2230 ft.; January 23°, July 69°), but frosts a few degrees below zero are not uncommon. The mountain slopes receive an abundance of rain (37 in.), but the steppes suffer much from drought (rainfall between 10 and 20 in.). Nearly the whole of the government belongs to the drainage area of the Terek, but the north-west corner is watered by the upper tributaries of the Kuma. The Terek rises at the height of about 8000 feet in the glaciers of the Kazbek on the southern slope of the main chain of the Caucasus, which it pierces by the Darial gorge to the south of Vladikavkaz after having received several *dons* or streams (Ree, Guzel, Fiag, Ar). In 53 miles it descends nearly 6000 feet. A few miles above Vladikavkaz it is 2068 feet above sea-level, at Mozdok 441 feet, and it is 29 feet below the Black Sea at Kizlyar. From Vladikavkaz it pursues a north-easterly direction before taking its eastward course; it seems most probable that at a recent epoch (Post-Pliocene) it joined the Kuma and perhaps the Manytch instead of flowing into the Caspian. In the lower part of its course it flows at a higher level than that of the neighbouring plains, and is kept in its bed by dams. Inundations are frequent and cause great destruction. The delta begins at Dubovka (50 miles from the Caspian), and at this part the river frequently changes its bed. The Old Terek is no longer navigable, the chief current being directed northwards into the New Terek. Several canals made by the Cossacks supply water for the irrigation of the neighbouring fields. Its chief tributaries are the Sunja on the right, and the Tcherekh, the Baksan, and the Malka, in its upper course, on the left. The population of the government in 1884 was 615,660; of 606,500 inhabitants returned in 1883, 238,230 were Little and Great Russians, 1230 Georgians, 18,500 Armenians, 4300 Germans, 2570 Poles, 4780 Jews, 23,630 Ossets, 194,480 Tchetchens and Ingushis, 72,160 Kabardians, 9130 mountaineers of the Avarian stem, 25,360 Kumyks, 1770 Tatars, 6270 Nogais, 2470 Kalmucks, and 1620 Persians. Out of these 239,500 were reckoned as belonging to the Greek Orthodox Church, 336,460 were Mussulmans, 17,730 Gregorian Armenians, and the remainder Protestants, Catholics, and Jews. Owing to the great fertility of the soil in the well-watered districts, agriculture is the chief occupation. In 1882 the crops, although below the average, yielded 967,000 quarters of corn, 268,000 bushels of potatoes, 6,750,000 gallons of wine, and tobacco to the value of £18,000. Cattle breeding is extensively carried on in the steppes, and there were in the same year 118,630 horses, 582,800 cattle, and 1,226,400 sheep; murrains, however, are frequent, and cause great loss. Manufactures occupy only 3371 persons, and their yearly production hardly reaches £300,000 in value. Petty trades are rapidly spreading in the villages. Trade suffers from want of good roads. The railway from Russia to the Caucasus has not yet (1887) got beyond Vladikavkaz. The military and other chief roads have an aggregate of only 1800 miles. The exports are limited to corn, wine, cattle, and some raw produce.

The government is divided into six districts, the chief towns of which, with their populations in 1883, were Vladikavkaz (32,340), the capital, Georgievsk (4250), Groznyi (6280), Kizlyar (8780), Mozdok (8330), and Pyatigorsk (11,120).

TERENCE. P. Terentius Afer (185?-159 B.C.) holds a unique position among Roman writers. No writer in any literature has gained so great a reputation who has contented himself with so limited a function. He lays no claim to the position of an original artist painting from life or commenting on the results of his own observation. His art has no relation to his own time or to the country in which he lived. The chief source of interest in the fragmentary remains of Nævius, Ennius, Pacuvius, Accius, and Lucilius is their relation to the national and moral spirit of the age in which they were written. Plautus, though, like Terence, he takes the first sketch of his plots, scenes, and characters from the Attic stage, is yet a true representative of his time, a genuine Italian, writing before the genius of Italy had learned the restraints of Greek art. The whole aim of Terence was to present a faithful copy of the life, manners, modes of thought and expression which had been drawn from reality a century before his time by the writers of the New Comedy of Athens. The nearest parallel to his literary position may be found in the aim which Virgil puts before himself in his *Bucolics*. He does not seek in that poem to draw Italian peasants from the life, but to bring back the shepherds of Theocritus on Italian scenes. Yet the result obtained by Virgil is different. The charm of his pastorals is the Italian sentiment which pervades them. His shepherds are not the shepherds of Theocritus, nor are they in any sense true to life. The extraordinary result obtained by Terence is that, while he has left no trace in any of his comedies of one sketching from the life by which he was surrounded, there is perhaps no more truthful, natural, and delicate delineator of human nature, in its ordinary and more level moods, within the whole range of classical literature. His permanent position in literature is due, no doubt, to the art and genius of Menander, whose creations he has perpetuated, as a fine engraver may perpetuate the spirit of a great painter whose works have perished. But no mere copyist or verbal translator could have attained that result. Though without claims to creative originality, Terence must have had not only critical genius, to enable him fully to appreciate and identify himself with his originals, but artistic genius of a high and pure type. The importance of his position in Roman literature consists in this, that he was the first writer who set before himself a high ideal of artistic perfection, and was the first to realize that perfection in style, form, and consistency of conception and execution. Living in the interval between Ennius and Lucilius, whose original force and genius survive only in rude and inartistic fragments, he produced six plays, which have not only reached our time in the form in which they were given to the world, but have been read in the most critical and exacting literary epochs, and still may be read without any feeling of the need of making allowance for the rudeness of a new and undeveloped art.

While his great gift to Roman literature is that he first made it artistic, that he imparted to "rude Latium" the sense of elegance, consistency, and moderation, his gift to the world is that through him it possesses a living image of the Greek society in the 3d century B.C., presented in the purest Latin idiom. Yet Terence had no affinity by birth either with the Greek race or with the people of Latium. He was more distinctly a foreigner than any of the great classical writers of Rome. He lived at the meeting-point of three distinct civilizations,—the mature, or rather decaying, civilization of Greece, of which Athens was still the centre; that of Carthage, which was so soon to pass away and leave scarcely any vestige of itself; and the nascent civilization of Italy, in which all other modes were soon to be absorbed. Terence was by birth a Phœnician, and was thus perhaps a fitter medium of connexion between the genius of Greece and that of Italy than if he had been a pure Greek or a pure Italian; just as in modern times the Jewish type of genius is sometimes found more detached from national peculiarities, and thus more capable of reproducing a cosmopolitan type of character than the genius of men belonging to the other races of Europe.

Our knowledge of the life of Terence is derived chiefly from a fragment of the lost work of Suetonius, *De Viris Illustribus*, preserved in the commentary of Donatus. Confirmation of some of the statements contained in the *Life* is obtained from later writers and speakers, and also from the prologues to the different plays, which at the same time throw light on the literary and personal relations of the poet. These prologues were among the original sources of Suetonius; but he quotes or refers to the works of various grammarians and antiquarians—Porcius Licinus, Volcatius Sedigitus, Santra, Nepos, Fenestella, Q. Cosconius—as his authorities. The first two lived within a generation or two of the death of Terence, and the first of them shows a distinct animus against him and his patrons. But, notwithstanding the abundance of authorities, there is uncertainty as to both the date of his birth and the place and manner of his death. The doubt as to the former arises from the discrepancy of the MSS. His last play, the *Adelphi*, was exhibited in 160 B.C. Shortly after its production he went to Greece, being then, according to the best MSS., in his twenty-fifth ("nondum quintum atque vicesimum egressus[1] annum"), according to inferior MSS., in his thirty-fifth year. This uncertainty is increased by a discrepancy between the authorities quoted by Suetonius. Cornelius Nepos is quoted for the statement that he was about the same age as Scipio (born 185 B.C.) and Lælius, while Fenestella, an antiquarian of the later Augustan period, represented him as older. As the authority of the MSS. coincides with that of the older record, the year 185 B.C. may be taken as the most probable date of his birth. In the case of an author drawing originally from life, it might seem improbable that he should have written six comedies, so true in their apprehension and delineation of various phases of human nature, between the ages of nineteen and twenty-five. But the case of an imitative artist, reproducing impressions derived from literature, is different; and the circumstances of Terence's origin and early life may well have developed in him a precocity of talent. His acknowledged intimacy with Scipio and Lælius and the general belief that they assisted him in the composition of his plays are more in accordance with the statement that he was about their own age than that he was ten years older. Terence, accordingly, more even than Catullus, Tibullus, or Lucan, is to be ranked among those poets who are the "inheritors of unfulfilled renown." He is said to have been born at Carthage, brought to Rome as a slave, and carefully educated in the house of M. Terentius Lucanus, by whom he was soon emancipated. A difficulty was felt in ancient times as to how he originally became a slave, as there was no war between Rome and Carthage between the Second and Third Punic Wars, and no commercial relations between Africa and Italy till after the destruction of Carthage. But there was no doubt as to his Phœnician origin. He was admitted into the intimacy of young men of the best families, such as Scipio, Lælius, and Furius Philus, and he enjoyed the favour of older men of literary distinction and official position, such as C. Sulpicius Gallus, Q. Fabius Labeo, and M. Popillius. He is said to have owed the favour of the great as much to his personal gifts and graces as to his literary distinction; and in one of his prologues he declares it to be his ambition, while not offending the many, to please the "boni."

Terence's earliest play was the *Andria*, exhibited in 166 B.C., when the poet could have been only about the age of nineteen. A pretty, but probably apocryphal, story is told of his having read the play, before its exhibition, to Cæcilius (who, after the death of Plautus, ranked as the foremost comic poet), and of the generous admiration of it manifested by Cæcilius. A similar instance of the recognition of rising genius by a poet whose own day was past is found in the account given of the visit of Accius, on his journey to Asia, to the veteran Pacuvius. The next play exhibited by Terence was the *Hecyra*, first produced in 165, but withdrawn in consequence of the bad reception which it met with, and afterwards reproduced in 160. The *Heauton-timoroumenos* appeared in 163, the *Eunuchus* and *Phormio* in 161, and the *Adelphi* in 160 at the funeral games of L. Æmilius Paulus.

After bringing out these plays Terence sailed for Greece, either to escape from the suspicion of publishing the works of others as his own, or from the desire to obtain a more intimate knowledge of that Greek life which had hitherto been known to him only in literature, and which it was his professed aim to reproduce in his comedies. The latter is the more probable motive, and we recognize in this the first instance of that impulse to visit the scenes familiar to them through literature which afterwards acted on many of the great writers of Rome. From this voyage to Greece Terence never returned. According to one account he was lost at sea, according to another he died at Stymphalus in Arcadia, and according to a third at Leucadia, from grief at the loss by shipwreck of his baggage, containing a number of new plays which he had translated from Menander. The old grammarian quoted by Suetonius states that he was ruined in fortune through his intimacy with his noble friends. Another account speaks of him as having left behind him property consisting of gardens, to the extent of twenty acres, close to the Appian Way. It is further stated that his daughter was so well provided for that she married a Roman knight.

The tone of the prologues to Terence's plays is for the most part apologetic, and indicates a great sensitiveness to criticism. He constantly speaks of the malevolence and detraction of an older poet, whose name is said to have been Luscius Lavinius or Lanuvinus. The chief charge which his detractor brings against him is that of *contaminatio*, the combining in one play of scenes out of different Greek plays. Terence justifies his practice by that of the older poets, Nævius, Plautus, Ennius, whose careless freedom he follows in preference to the "obscura diligentia" of his detractor. He recriminates upon his adversary as one who, by his literal adherence to his original, had turned good Greek plays into bad Latin ones. He justifies himself from the charge of plagiarizing from Plautus and Nævius. In another prologue he contrasts his own treatment of his subjects with the sensational extravagance of others. He meets the charge of receiving assistance in the composition of his plays by claiming, as a great honour, the favour which he enjoyed with those who were the favourites of the Roman people.

We learn from these prologues that the best Roman literature was ceasing to be popular, and had come to rely on the patronage of the great. A consequence of this change of circumstances was that comedy was no longer national in character and sentiment, but had become imitative and artistic. The life which Terence represents is that of a well-to-do-citizen class whose interests are commonplace, but whose modes of thought and speech are refined, humane, and intelligent. His characters are finely delineated and discriminated rather than boldly conceived, as they are in Plautus. Delicate irony and pointed epigram take the place of broad humour. Love, in the form of pathetic sentiment rather than of irregular passion, is the chief motive of his pieces. His great characteristics are humanity and urbanity, and to this may be attributed the attraction which he had for the two chief representatives of these qualities in Roman literature,—Cicero and Horace. It was through the comedies of Terence that the finer influences of the Epicurean philosophy—the friendliness, the tolerance, the consideration for the feelings of others, inferiors as well as equals, inculcated by that philosophy—entered into Roman life and literature. The dissolving influence of that school on the severer personal morality of the older Roman republic also entered into Roman life through the same medium. But it was a great gain to the strong but rude Roman character to learn, as it could from every line of Terence, lessons not only of courtesy and social amenity but of genuine sympathy and consideration

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[1] Ritschl reads *ingressus*, which would make him a year younger.

Terence's pre-eminence in art was recognized by the critics of the Augustan age:

"Vincere Cæcilius gravitate, Terentius arte."

The art of his comedies consists in the clearness and simplicity with which the situation is presented and developed, and in the consistency and moderation with which his various characters play their part. But his great attraction to both ancient and modern writers has been the purity and charm of his style, whether employed in narrative or dialogue. This charm he derived from his familiarity with the purest Latin idiom, as it was habitually used in the intimate intercourse of the best Roman families, and also with the purest Attic idiom, as it had been written and spoken a century before his own time. The fine Attic flavour is more perceptible in his Latin than in the Greek of his contemporaries. He makes no claim to the creative exuberance of Plautus, but he is entirely free from his extravagance and mannerisms. The superiority of his style over that of Lucilius, who wrote his satires a generation later, is almost immeasurable. The best judges and the greatest masters of style in the best period of Roman literature were his chief admirers in ancient times. Cicero frequently reproduces his expressions, applies passages in his plays to his own circumstances, and refers to his personages as typical representations of character.[1] Julius Cæsar characterizes him as "puri sermonis amator." Horace, so depreciatory in general of the older literature, shows his appreciation of Terence by the frequent reproduction in his *Satires* and in his *Odes* of his language and his philosophy of life. Quintilian applies to his writings the epithet "elegantissima," and in that connexion refers to the belief that they were the work of Scipio Africanus. His works were studied and learned by heart by the great Latin writers of the Renaissance, such as Erasmus and Melanchthon; and Casaubon, in his anxiety that his son should write a pure Latin style, inculcates on him the constant study of Terence. Montaigne applies to him the phrase of Horace:

"Liquidus puroque simillimus amni."

He speaks of "his fine expression, elegancy, and quaintness," and adds, "he does so possess the soul with his graces that we forget those of his fable."[2] It is among the French, the great masters of the prose of refined conversation, that his merits have been most appreciated in modern times. Sainte-Beuve, in his *Nouveaux Lundis*, devotes to him two papers of delicate and admiring criticism. He quotes Fénelon and Addison, "deux esprits polis et doux, de la même famille littéraire," as expressing their admiration for the inimitable beauty and naturalness of one of his scenes. Fénelon is said to have preferred him even to Molière. Sainte-Beuve calls Terence the bond of union between Roman urbanity and the Atticism of the Greeks, and adds that it was in the 17th century, when French literature was most truly Attic, that he was most appreciated. M. Joubert is quoted[3] as applying to him the words "Le miel attique est sur ses lèvres; on croirait aisément qu'il naquit sur le mont Hymette."

The most famous edition of Terence is that of Bentley, published in 1726. More recent editions are those of Parry, in the *Bibliotheca Classica*, and of W. Wagner. The text has been edited by A. Flickeisen in the Teubner series of classics. A number of editions of the separate plays have been published recently both in England and in Germany. (W. Y. S.)

TERESA, ST. See THERESA, St.

TERLIZZI, a town of Italy, in the province of Bari, and 20 miles west from that town, stands in the midst of a fertile plain. It has a castle which at one time was very strong and occasionally resorted to by the emperor Frederick II. and afterwards by the Aragonese sovereigns. The walls and towers of the town still remain, but the fosse has been turned into boulevards. Terlizzi has a considerable trade, chiefly in the wine and fruit of the district. The population of the town in 1881 was 20,443 (commune, 20,592).

TERM (from the Latin *terminus*) in English law is used in two senses, the idea common to both being that of a limited and certain period of time.

(1) It denotes (or rather did denote) a fixed time during which the courts are open for legal proceedings. Terms in this sense affected only what used to be called the superior courts,—that is, the Queen's Bench, Common Pleas, and Exchequer. They were originally the leisure seasons of the year which were not occupied by great feasts or fasts of the church or by agriculture. Their origin is no doubt to be traced back to the legislation of the early Christian emperors, the principle being adopted in England through the influence of ecclesiastical judges, and still surviving in the universities and Inns of Court. Terms were regulated by many Acts of parliament, the effect of which was to confine to a comparatively short period the time during which the courts could sit *in banco*,—that is, for the decision of questions of law as distinguished from the decision of questions of fact. There were four terms, Hilary, Easter, Trinity, and Michaelmas, the average duration of each being about three weeks. All legislation on the subject previous to 1873 is now merely of historical interest, for by the Judicature Act of that year the division of the year into terms was abolished so far as related to the administration of justice.

(2) It denotes the time during which an interest in an estate for life or for years is enjoyed, also the interest itself, because such an interest must determine at a definite time If the interest be for life, it is an estate of freehold; if for years, only a personal interest in real estate, and so personalty, even though the length of the term—for instance, 1000 years—may far exceed in duration any possible life estate. A term of years is of two kinds,—the first that created by an ordinary lease reserving a rent, as of a house or a building lease; the second that created by a settlement or a will, usually without rent reserved, for the purpose of securing payment of money, such as portions to younger children, by the owner of the land. Both kinds have been considerably affected by recent legislation. For instance, the Conveyancing Act, 1881, enables a mortgagor or mortgagee in possession to make certain leases. Before 1845 provision was always made in conveyances for keeping on foot a term to attend the inheritance, as it was called,—that is, for assigning the remainder of a term to trustees for the protection of the owner of the property against rent-charges or other incumbrances created subsequently to the term, although the term had been satisfied,—that is, the purpose for which the term had been created had been fulfilled. By 8 and 9 Vict. c. 112 the assignment of satisfied terms was rendered unnecessary. The Conveyancing Acts, 1881 and 1882, give power to enlarge the unexpired residue of a long term in certain cases into the fee simple.

In Scotland terms are the days at which rent or interest is payable. They are either legal or conventional: the legal are Whitsunday and Martinmas; the conventional are fixed by agreement between the parties. A recent Act (44 and 45 Vict. c. 39) makes uniform the law as to removal terms in burghs. Terms as times of court sittings were defined by 6 Anne c. 53, which fixed four terms—Martinmas, Candlemas, Whitsuntide, and Lammas—for the now obsolete Court of Exchequer. By 19 and 20 Vict. c. 56, s. 26, the winter and summer sittings of the Court of Session are to be held to correspond with the Exchequer terms.

TERMINI, or TERMINI IMERESE (*Thermæ Himerenses*), a town on the north coast of Sicily, at the mouth of a river of the same name, in the province of Palermo, and

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[1] See *Ep. ad Fam.*, i. 9, 19, and *Phil.*, ii. 15.

[2] *Essays of Montaigne* (trans. by Ch. Cotton), chap. lxvii.

[3] By E. Negretti, in his *Histoire de la Littérature Latine.*

23 miles east-south-east of that town. None of its modern buildings are of any special interest; in the Piano de San Giovanni above the town the substructure of a Roman villa has been excavated, and there are also traces of an amphitheatre. Termini is one of the busiest provincial towns of Sicily; the surrounding district being exceedingly fertile and the harbour good, there is a considerable export trade in grain, fruit, tartar, and other products. The macaroni of Termini is in high repute. The tunny and sardine fisheries are extensive, and there is a school of navigation. The warm saline springs (110° Fahr.), sung by Pindar, are still largely resorted to, there being a well-appointed bath establishment, founded by Ferdinand I. The population of the town in 1881 was 22,370, with its suburbs 22,733 (commune, 23,148).

For the ancient history of Termini see HIMERA. The castle of Termini, which Robert of Naples besieged in vain in 1338, was destroyed in 1860.

TERMITES. See ANT, vol. ii. p. 99.

TERMONDE. See DENDERMONDE.

TERN (Norsk *Tærne*, *Tenne*, or *Tende*; Swedish *Tärna*; Dutch *Stern*[1]), the name now applied generally to a group of sea-birds, the *Sterninæ* of modern ornithology, but, according to Selby, properly belonging, at least in the Farne Islands, to the species known by the book-name of Sandwich Tern, all the others being those called Sea-Swallows—a name still most commonly given to the whole group throughout Britain from their long wings, forked tail, and marine habit. In Willughby's *Ornithologia* (1676), however, the word Tern is used for more than one species, and, though it does not appear in the older English dictionaries, it may well have been from early times as general a name as it is now.

Setting aside those which are but occasional visitors to the British Islands, six species of Terns may be regarded as indigenous, though of them one has ceased from ordinarily breeding in the United Kingdom, while a second has become so rare and regularly appears in so few places that mention of them must for prudence sake be avoided. This last is the beautiful Roseate Tern, *Sterna dougalli*; the other is the Black Tern, *Hydrochelidon nigra*, belonging to a genus in which the toes are only half-webbed, of small size and dark leaden-grey plumage. It is without doubt the *Sterna* of Turner, and in former days was abundant in many parts of the fen country,[2] to say nothing of other districts. Though nearly all its ancient abodes have been drained, and for its purposes sterilized these many years past, not a spring comes but it shows itself in small companies in the eastern counties of England, evidently seeking a breeding-place. All around the coast the diminution in the numbers of the remaining species of Terns within the last 50 years is no less deplorable than demonstrable.

The Sandwich Tern, *S. sandvicensis* or *S. cantiaca*—named from the place of its discovery, though it has long since ceased to inhabit that neighbourhood—is the largest of the British species, equalling in size the smaller Gulls and having a dark-coloured bill tipped with yellow, and dark legs. Through persecution it has been exterminated in all its southern haunts, and is become much scarcer in those to which it still resorts. It was, however, never so abundant as its smaller congeners, the so-called Common and the Arctic Tern,—two species that are so nearly alike as to be beyond discrimination on the wing by an ordinary observer, and even in the hand require a somewhat close examination.[3] The former of these has the more southern range, and often affects inland situations, while the latter, though by no means limited to the Arctic circle, is widely distributed over the north and mostly resorts to the sea-coast. Yet there are localities where, as on the Farne Islands, both meet and breed, without occupying stations apart. The minute diagnosis of these two species cannot be briefly given. It must suffice here to state that the most certain difference, as it is the most easily recognizable, is to be found in the tarsus, which in the Arctic Tern is a quarter of an inch shorter than in its kinsman. The remaining native species is the Lesser Tern, *S. minuta*, one of the smallest of the genus and readily to be distinguished by its permanently white forehead. All the species already mentioned, except the Black Tern, have much the same general coloration—the adults in summer plumage wearing a black cap and having the upper parts of the body and wings of a more or less pale grey, while they are mostly lighter beneath. They generally breed in association, often in the closest proximity—their nests, containing 3 eggs at most, being made on the shingle or among herbage. The young are hatched clothed in variegated down, and remain in the nest for some time. At this season the parents are almost regardless of human presence and expose themselves freely.

At least half-a-dozen other species have been recorded as occurring in British waters, and among them the Caspian Tern, *S. caspia*, which is one of the largest of the genus and of wide distribution, though not breeding nearer to the shores of England than on Sylt and its neighbouring islands, which still afford lodging for a few pairs. Another, the Gull-billed Tern, *S. anglica*, has also been not unfrequently shot in England. All these species are now recognized, though the contrary was once maintained, as inhabitants of North America, and many go much further.

An excellent synopsis of the Sub-family *Sterninæ* has been given by Mr Howard Saunders in the Zoological *Proceedings* (1876, pp. 638-672). He recognizes 5 genera,—*Hydrochelidon* (with 3 species), *Sterna* (with 38), *Nænia*, a very aberrant form consisting of but one species, the Inca Tern, peculiar to the western coast of South America, and *Gygis*, composed of 2 species of purely white birds and restricted to the southern hemisphere; his fifth genus is *Anous*, to which belong the various species of NODDY (vol. xvii. p. 531). Often confounded with these last are the two species called in books Sooty Terns (*S. fuliginosa* and *S. anæstheta*), but by sailors "Egg-birds" or "Wide-awakes" from their cry. These crowd at certain seasons in innumerable multitude to certain islands within the tropics, where they breed, and the wonderful assemblage at present known as "Wide-awake fair" on the island of Ascension has been more or less fully described from very ancient times. Dampier in his voyage to New Holland in 1699 particularly described and figured the Sooty Tern (*Voyages*, iii. p. 142), discriminating it from the Noddy, from which it had not before been distinguished. (A. N.)

TERNATE, a small island in the East Indian Archipelago, off the west coast of JILOLO (*q.v.*), in 0° 48′ N. lat. and 127° 19′ E. long. It is nearly circular in form, with an area of about 25 square miles, and consists almost entirely of a very remarkable volcano (5600 feet) formed of three superimposed cones. Frequent and destructive eruptions have taken place. Cocoa-nuts, sago, tobacco, cotton, sulphur, and saltpetre are the chief productions of the island. The clove, which had been extirpated by the early Dutch rulers to enhance its value by restricting its cultivation to the Banda Islands, Amboyna, &c., is beginning again to be grown, as also is the nutmeg. The inhabitants are nearly all Mohammedan Malays. The town of Ternate, with a population of about 9000, is the seat of a native sultan and of a Dutch resident; the harbour is commanded by a fort. The residency, which includes a part of the eastern coast of Celebes (see CELEBES), the greater part of Jilolo, and numerous smaller islands, has an area of 26,900 square miles and a population estimated at about 290,000.

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[1] "Starn" was used in Norfolk in the 19th century as a name for the bird commonly known as the Black Tern, thus confirming Turner, who, in 1544, describes what seems to have been the same species as "nostrati lingua sterna appellata." In at least one instance the word has been confounded with one of the old forms of the modern STARLING (vol. xxii. p. 457). To Turner's name, repeated by Gesner and other authors, we owe the introduction by Linnæus of *Sterna* into scientific nomenclature. "Ikstern" is another Dutch form of the word.

[2] It was known there as Carr-Swallow, Carr-Crow (corrupted into "Scarecrow"), and Blue Dar (*qu.* = Daw ?).

[3] Linnæus's diagnosis of his *Sterna hirundo* points to his having had an "Arctic" Tern before him; but it is certain that he did not suspect that specific appellation (already used by other writers for the "Common" Tern) to cover a second species. Some modern authorities disregard his name as being insufficiently definite, and much is to be said for this view of the case. Undoubtedly "*hirundo*" has now been used so indiscriminately for one species or the other as to cause confusion, which is perhaps best avoided by adopting the epithets of Naumann (*Isis*, 1819, pp. 1847, 1848), who, acting on and confirming the discovery of Nitzsch (who first detected the specific difference), called the southern species *S. fluviatilis* and the northern *S. macrura*. Temminck's name *S. arctica* applied to the latter a year later has been most generally used for it, notwithstanding.

TERNI, a town of Italy, in the province of Perugia, is situated in the fertile valley of the Nera, between two branches of that river, about 5 miles below the point where it is joined by the Velino. It has a station, three-quarters of a mile off, on the railway line between Rome and Ancona, 69 miles to the north of the former city and 19 south by west from Spoleto. Terni is an episcopal see, and the seat of a sub-prefecture and a chamber of commerce. Its public buildings include the cathedral (17th century), the church of S. Francesco (partly dating from the 13th century), a gymnasium, and a theatre. Terni manufactures leather and cloth, and has some trade in wine and silk. For the traveller its chief interest lies in its antiquities (remains of an amphitheatre of the time of Tiberius, a temple, a theatre, baths, and numerous inscriptions) and in the proximity of the falls of Velino (*Cascate delle Marmore*). Alike in volume and in beauty these take a very high place among European waterfalls; the cataract has a total descent of about 650 feet, in three leaps of 65, 330, and 190 feet respectively. They owe their origin to M'. Curius Dentatus, who in 272 B.C. first opened an artificial channel by which the greater part of the Lacus Velinus in the valley below Reate was drained. The population of the town in 1881 was 9415, with its suburbs 10,371 (commune, 15,853).

Terni is the ancient *Interamna* ("inter amnes"), originally belonging to Umbria and founded, according to a local tradition, in the year 672 B.C. It early became a flourishing municipium, and it did not permanently suffer through being portioned out among his soldiers by Sulla. Its inhabitants had frequent litigations and disputes with their neighbours at Reate in connexion with the regulation of the Velinus, the waters of which are so strongly impregnated with carbonate of lime that by their deposits they tend to block up their own channel. The first interference with its natural course was that of M'. Curius Dentatus already referred to. In 54 B.C. the people of Reate appealed to Cicero to plead their cause in an arbitration which had been appointed by the Roman senate to settle disputes about the river, and in connexion with this he made a personal inspection of Lake Velinus and its outlets. In the time of Tiberius there was a project for regulating the river and its outlets from the lake, against which the citizens of Interamna and Reate energetically and successfully protested (Tac., *Ann.*, i. 79). Similar questions arose as the river formed fresh deposits during the Middle Ages and during the 15th and 16th centuries. A branch of the Via Flaminia passed from Narnia to Forum Flaminii, and is given instead of the direct line in the Antonine and Jerusalem itineraries. The emperor Tacitus and his brother Florianus were probably natives of Interamna, which also has been claimed as the birthplace of Tacitus the historian, but with less reason. Terni was the scene of the defeat of the Neapolitans by the French on 27th November 1798.

TERPANDER, a Lesbian poet and musician, settled in Sparta about the end of the Second Messenian War (668 B.C.). According to some accounts, he was invited thither by command of the Delphian oracle to compose the differences which had arisen between different classes in the state. His innovations in music were considered to have inaugurated a new era of musical art in Greece; but we are very imperfectly informed as to their nature. On the strength of a fragment (No. 5 in Bergk), which may or may not be genuine,—"rejecting the four-toned song, we will sing to thee new hymns with the seven-voiced lyre,"—Strabo says that he increased the number of strings in the lyre from four to seven; others take the fragment to mean that he developed the citharœdic nomos (sung to the accompaniment of the cithara or lyre) by making the divisions of the ode seven instead of four. We possess six short fragments of poetry in the Dorian dialect bearing the name of Terpander. They are from hymns to the gods Zeus, Apollo, Apollo and the Muses, the Dioscuri, &c., and are written in a slow spondaic movement or in dactyls. They present no remarkable features and are probably spurious.

Bergk, *Poetæ Lyrici Græci*, iii. (4th ed.) pp. 7-12, Leipsic, 1882.

TERRACINA, a town of Italy, in the province of Rome, and about 60 miles to the south-east of that city, at the south-east extremity of the Pontine marshes, where the Monti Lepini (see ITALY, vol. xiii. p. 438, and LATIUM) descend into the sea. The ancient town (Volscian *Anxur*, Roman *Tarracina*) stood on the white hillside ("impositum saxis late candentibus Anxur"), along the foot of which, by the seashore, ran the Via Appia. The modern town stands mainly on the level ground. The most conspicuous building is the cathedral, which is believed to occupy the site of a temple of Jupiter Anxurus; it is enriched both externally and internally with beautiful old columns and Roman mosaics. Above the town, on the summit of the cliff, are the remains of a palace of Theodoric (*c.* 500), afterwards a mediæval castle. The ancient harbour, constructed by Antoninus Pius and once very important, is now silted up; a new mole affords shelter to coasting vessels. Fishing is carried on, and there is some trade in the produce of the district. The population of the town in 1881 was 6294 (commune, 8572).

Anxur finally became Roman in 400 B.C., and a colony was established there in 329. Its strategic position early gave it military importance; and its pleasant situation and its mineral waters led many Romans to build villas and seek seaside quarters there.

TERRA-COTTA.[1] Strictly speaking this name is applicable to all objects made of baked clay, from the rudest brick to the finest piece of pottery, but it usually has a more limited meaning, to denote fictile objects which do not come under the head of pottery, such as statuettes and busts; and in its architectural use it specially implies the finer sorts of decorative clay-work, to the exclusion of common building bricks. In ancient times, especially among the Greeks and Romans, terra-cotta was employed for an immense variety of purposes, from the commonest objects of everyday use to the most elaborate and ambitious works of art, such as colossal statues and groups. Though the natural colour and surface of the burnt clay are generally very pleasing in tone and texture, it seems to have been universally the custom in classical times to cover the terra-cotta completely with a thin white coating, which formed an absorbent ground for the further application of colour. For internal work, except in rare instances, these colours were mixed with a tempera medium, and applied after the clay had been fired. They were therefore not true ceramic colours; and pigments of great variety and brilliance could be employed, as they had not to undergo the severe ordeal of the kiln. For external work, such as that shown in fig. 5, only earth pigments such as ochres and lime were used, and the colours were fired.

No branch of archæology has during the last dozen years or so developed so rapidly as that of Greek terra-cotta figures; on this most fascinating subject an astonishingly large mass of literature has been published in Germany and France.[2] The discovery of this new world of Greek art began practically in 1873, with the first excavations in the tombs of Tanagra, a Bœotian town on the high road from Athens to the north, which brought to light a number of very beautiful terra-cotta statuettes.[3] Subsequent excavations at Corinth, Smyrna, Cyme, Tarentum, the Cyrenaica, and many other places also yielded a vast number of terra-cotta figures of various dates and styles. By far the greater number belong to the second half of the 4th century B.C.; but examples of an earlier

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[1] An Italian word meaning literally "baked earth."

[2] See list at the end of the present article.

[3] See *Bull. Com. Inst. Arch.*, 1874, p. 120. Many thousand tombs have been opened at Tanagra, partly cut in the rock and partly built of masonry. The statuettes were either arranged round the body or packed in large vases. The costume of the female figures is the same as that described by classical writers as being peculiar to the neighbouring city of Thebes. The finest of the Tanagra figures are from 6 to 9 inches high.

Early terra-cottas.

date are not wanting, not only of figures in the round, but also of reliefs, which appear to have been largely used for the decoration of the flat surfaces of walls and friezes. The earliest of all date from a quite prehistoric period, and are mostly small idol-like figures of the rudest possible form, having an almost shapeless trunk with stick-like projections for the limbs, and the breasts and eyes roughly indicated by round dots. They are usually decorated with coarse stripes or cheques in ochre colours. Examples of these have been found at Hissarlik (Troad), in Cyprus and other islands, and in the citadel of Tiryns in 1884-85 by Dr Schliemann and Dr Dörpfeld. Later but still very archaic figures, 2 or 3 inches high, have been exhumed in many parts of the Ægean Islands; some of these are stiff seated figures of deities,—links between Oriental and Hellenic art, like the statues of the Sacred Way at Branchidæ (south of Miletus). Comparatively few specimens exist of the best period of Greek art—the 5th century.[1] A relief in the Louvre (about 18 by 12 inches) with a pierced background, dating from the first half of the 5th century, represents two female mourners at a sepulchral stele,—one standing and the other seated; under the foot of the latter is inscribed **ΑΛΕΚΤΡ**. On the other side of the stele are two youths (the Dioscuri) standing by a horse. The whole design is simple, but very graceful, and the modelling is skilfully treated in very low relief. The colouring—blue, red, white, and dark brown—is well preserved. This relief was pressed in a mould, and was intended to be attached to a wall, probably that of a tomb, as a votive offering to the dead.[2]

Tanagra statuettes.

In most cases the terra-cotta figures and reliefs occur in or close by tombs, but it is only in comparatively rare instances that the subjects represented have any reference to death. Another large class have been found in the vicinity of temples, and are probably votive offerings, such as the small statuettes of horses from the acropolis of Athens, now in the Louvre. In other cases, as at Halicarnassus, great quantities of small figures were buried under a temple, probably to purify the site, as was done in Egypt under the later dynasties, when many hundred figures of bronze were sometimes buried under one building. Owing to the fact that the statuettes found scattered in and round tombs have frequently their heads broken off, Pottier and Reinach have suggested that they were brought as offerings to the dead and their heads were broken off by the mourners at the side of the tomb. Rayet believes that this practice was a sort of survival of the custom of sacrificing female and boy slaves at the tombs of the dead. In many cases, however, the figures are intact, and it is probable that many of the tombs were broken open and rifled long ago, which would explain the mutilated and scattered condition of the figures. The tombs of Tanagra have yielded by far the richest finds of these figures, the specimens being very remarkable for their beauty. These exquisite statuettes do not (in most cases) represent deities or heroic personages, but the homely every-day life of the Greeks, treated with great simplicity and evident realism: they are in plastic art what in painting would be called *genre*,[3] and in their strong human interest and naturalistic pathos bring us in closer contact with the life and personalities of the past than any more ambitious style of art could possibly do. Moreover, they prove more clearly even than the great plastic works in bronze and marble how deeply a feeling for beauty and a knowledge of art must have penetrated the whole mass of the people. Their immense number shows that they must have been far from costly, within the reach of every one, and certainly not the production of any famous sculptors. Nevertheless, sketchy as they are in treatment and often faulty in detail, they are in pose, in motive, and in general effect works of the highest beauty, full of the most inimitable grace, and evidently the production of men in whom the best qualities of the sculptor were innate by a sort of natural birthright. Several small figures from Myrina (Mysia) have the artist's name inscribed on them; but signatures of this sort are rare.[4]

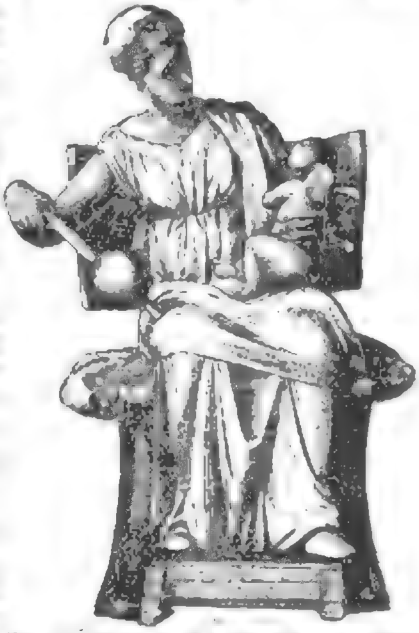

Fig. 1.—Statuette of a girl and infant Eros from Tanagra. (St Petersburg.)

It is impossible to describe the many subjects treated. Only a few examples can be mentioned. Among single figures the most frequent are those of girls standing or seated in an immense variety of pose, and with plentiful drapery arranged in countless methods, showing the great taste with which a Greek lady could dispose the folds of her ample pallium, whether it hung in graceful loops or was wound closely round the figure or formed a hood-like veil over the head. In some the lady holds a leaf-shaped fan, or is looking in a circular mirror, or holds a ball ready for the game. Many have a strange broad hat, probably of straw, which does not fit on the head, but must have

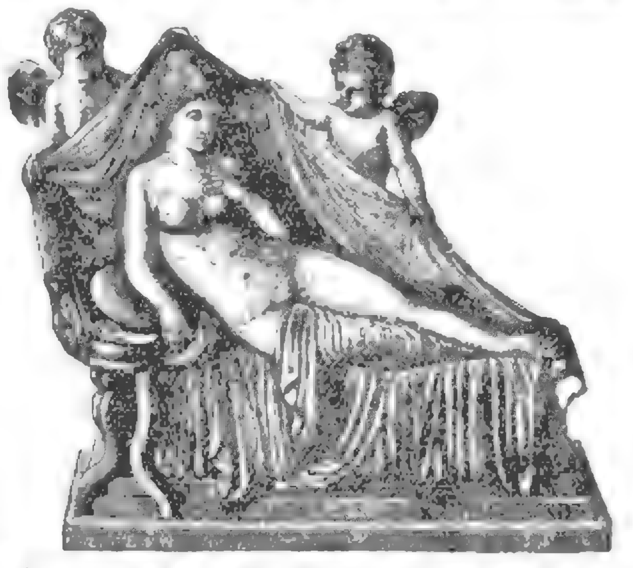

Fig. 2.—Aphrodite and cupids. The pendant hung round the neck of Aphrodite is gilt. (South Kensington Museum.)

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[1] A good example of a terra-cotta relief of the first part of the 5th century B.C. is figured in vol. ii. p. 352.

[2] Some very beautiful fragments of reliefs in terra-cotta are preserved in the museums of the Louvre, of Copenhagen, and the Kircheriano in Rome. These represent on a small scale parts of Phidias's Panathenaic frieze, which have all the appearance of being works of the 5th century B.C., but may possibly be forgeries or Roman copies; see Waldstein, *Art of Pheidias*, Cambridge, 1885.

[3] In some the most homely sort of *genre* is represented,—a girl milking a cow, a cook or a barber at his work, &c. Even portrait figures occur, as, for example, a wonderfully lifelike group of a man and his wife in the collection of Mr Ionides, recently lent to the South Kensington Museum.

[4] See *Gaz. des B.-Arts*, xxxiii., 1886, p. 278.

been fastened by a pin to the hair or veil. One very beautiful motive is that of a girl playing with an infant Eros, who flies to her for shelter, and is received with welcome half tinged with dread. Fig. 1 shows a very lovely statuette of this kind, now in the Hermitage Palace. A favourite subject is taken from a game in which one girl carries her playmate on her back,—a motive which, though difficult to treat in sculpture, is managed very gracefully in terra-cotta. Other very lovely groups are Aphrodite suckling the baby Eros, or with more than one cupid hovering round her. A very beautiful example (see fig. 2) occurs in the South Kensington Museum (from the Castellani sale). It represents a half-nude figure of Aphrodite reclining on a couch, with two cupids behind holding up a veil, which was coloured blue to form a background to the creamy white of Aphrodite's body.

Technical methods.

The Tanagra and other figures are all formed of thin pieces of soft clay pressed into a mould, usually formed in two halves and then stuck together; and they are made hollow so as not to warp and crack in the firing, and have a hole at the back for the escape of moisture during that process. The head is solid and was formed in a separate mould, as were also any accessories, such as fans or mirrors, and arms if they extend away from the body. Replicas of the same figure are often varied by having different heads or accessories; three or four examples have been found from the same mould. After the whole was put together it was usually touched up and finished with modelling tools. The colour was applied after baking: a coating of creamy white lime or chalk all over served as the flesh tint and also as a good ground for the other colours. The hair of the females is always of a rich auburn red, such as the Venetians were so fond of painting in the 16th century; blue was touched on the eyes and crimson on the lips. Drapery, if not white, was usually rose-colour or blue, often with a fringe or bands of gold on the border. Necklaces, earrings, and other ornaments were generally gilt, the gold leaf being applied over a slightly raised surface of slip, as on the Greek vases. Similar examples have been found in tombs at Thebes, at Thespiæ, and round Athens. Some of the Attica figures are covered, not with the usual non-ceramic colours, but with a real white enamel, the vitrified surface of which is very often slightly decomposed; further coloured decoration was in some cases added over this enamel.

Asia Minor statuettes.

A number of places in the west of Asia Minor have yielded large quantities of terra-cotta figures, very similar in size and technique to those of Tanagra, but belonging for the most part to quite a different school of sculpture. Unlike the Tanagra figures, which are rather pictorial in style and deal with *genre* subjects, those from Smyrna, Cyme, Myrina, and other places in Asia Minor are thoroughly sculpturesque in design, and are frequently miniature reproductions of large statues or groups (see fig. 3). Many of them stand on moulded pedestals, while the Tanagra figures have only a thin slab of clay as a base. The average size of both classes is from 6 to 10 inches high. Very elaborate groups with three or four figures often occur. Dionysiac and Bacchanal subjects are frequently chosen, or scenes from sacred mythology, such as the labours of Heracles.[1] These also mostly date from the 4th century B.C., and the statuettes often appear to be copies from sculpture of the school of Praxiteles or Scopas. One instance is the fine nude figure of Eros as a youth leaning against a cippus, holding a bronze arrow in his hand, in the collection of M. de Branteghem, now in Rome.[2] The whole of it was gilt, which was frequently the case with the Asia Minor statuettes, but rarely so in those of Tanagra.[3] A very beautiful figure of a winged Victory in the same collection (from the Castellani sale) presents the same motive as the colossal Victory of Samothrace (in the Louvre); it supplies the missing right hand, which in the terra-cotta contains a bunch of roses. The drapery of this figure is blue, mottled, or shot with gold. Other figures, from their heights being arranged in even gradations, seem to be copies from some large pedimental sculpture. Unfortunately little is yet known of the various fabriques of these Asia Minor figures, as in most cases their *provenance* is very doubtful.[4] The Lecuyer collection possessed some groups with several figures forming important compositions. One of these shows two female mourners at a tomb, and a warrior clad in full armour with his horse. The most remarkable group (see fig. 4) is that of a soul led by Hermes Psychopompus to the bark of Charon, who is represented as a bent aged man. Hermes, a graceful nude figure, gently urges the shrinking soul—a draped female figure—to the boat, at the brink of the rush-grown Styx. The whole scene is imagined with much tender grace and real pathos, though not highly finished in its details. One of the most important terra-cotta figures yet discovered has recently been brought to England from Smyrna. It is a very beautiful copy of the Diadumenos of Polycletus, which in the details of its modelling reproduces some characteristics of the later school of Praxiteles. The forearms and the legs below the knee are lost; but in breadth

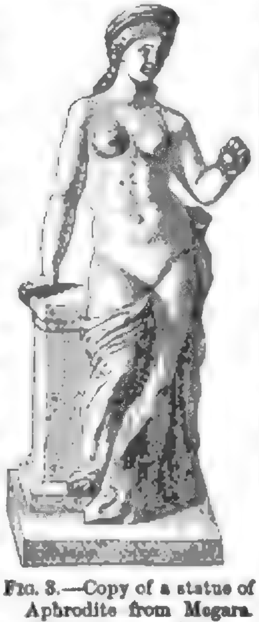

FIG. 3.—Copy of a statue of Aphrodite from Megara. (Berlin Museum.)

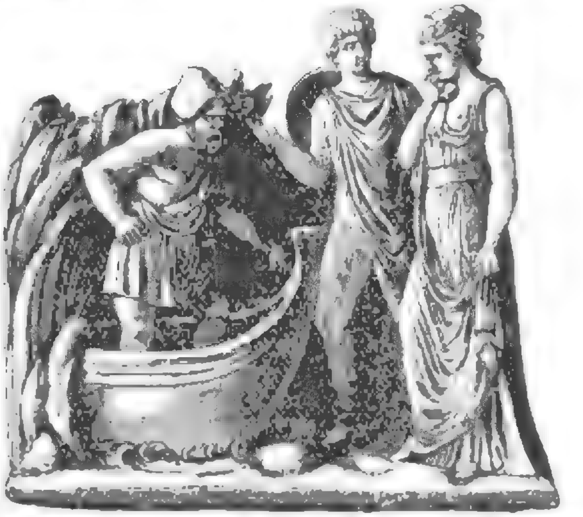

FIG. 4.—A soul about to enter Charon's bark. (Prince Liechtenstein's collection, Vienna; formerly in the Lecuyer collection.)

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[1] Fine examples of all these existed in the collection of M. Lecuyer, which is now dispersed (see Lenormant, *Coll. Lecuyer de terre-cuites*. Paris, 1884, which is well illustrated with photographs).

[2] In a few other examples objects of bronze are placed in the hands of the figures.

[3] The lovely series of little figures of dancing cupids from Tanagra, some of which are in the Louvre and others in the South Kensington Museum, were wholly gilt, but the larger statuettes of Tanagra appear to have had gold applied only for special ornaments.

[4] For many reasons both finders and dealers usually wish to keep secret where valuable finds are made. In most museums the labels simply repeat the dealer's account (for want of better information), so that the statement of the *provenance* must usually be accepted with caution.

of modelling and grandeur of style this little figure, which was only about 14 inches high when perfect, has the effect of a much larger statue, and it is a real masterpiece of Greek plastic art.[1] In the neighbourhood of Smyrna and Ephesus a large number of caricature figures have been exhumed, some of which are modelled with a wonderful feeling for humour.[2] These strange figures have attenuated limbs, large heads, flapping ears, and goggle eyes. Some play on musical instruments; others represent actors; and one in the De Branteghem collection is a caricature of a discobolus in almost the attitude of Myron's celebrated statue.

Cyrenaic statuettes.

A very different class of statuettes has recently come to light in the Cyrenaica, on the northern coast of Africa. Many of these are nude female dancers wearing an elaborate stephanos-like head-dress. They are realistic in modelling and very ungraceful in pose,—a striking contrast to the exquisite taste of the Tanagra and most of the Asia Minor figures. Recent excavations in the tombs of Corinth have produced a large number of fine terra-cottas, ranging in date over a very long period. Another and artistically very perfect class of figures is being dug up from among the tombs of Tarentum. Some of these belong to the finest period of Greek art, probably about 400 B.C., and others are even earlier. Many are not statuettes, but merely small busts of heroic style, and of the highest sculpturesque beauty. They are certainly not portraits, and do not appear to represent deities. It has been suggested that they are idealized representations of ancestors, whose commemoration, in some places, formed an important cult; but their real meaning must for the present remain uncertain. Many thousand votive figures and reliefs in clay have been found within the *temeni* of the temples of the Chthonian deities at Tarentum and elsewhere. It seems to have been customary for the priests periodically to clear out of the temples the broken or too numerous offerings which were then buried within the enclosure; whole series arranged chronologically in groups have been discovered buried in separate holes.

Tarentine busts.

Terra-cotta jewellery.

In addition to statuettes and reliefs, terra-cotta was used by the Greeks for various minor ornamental purposes. Delicately moulded necklaces and pendants for ears were stamped out in clay and then thickly covered with gold leaf; this produced a very rich effect at a small cost; many fine examples are preserved in the Louvre. Children's toys, such as miniature horses and chariots, and dolls with movable limbs of terra-cotta fastened with wooden pegs, occur in many tombs.

Use in Greek architecture.

On a larger scale terra-cotta was adapted by the Greeks to important architectural ornamentation. Many fine examples have been found at Olympia and among the ruined temples of Selinus. In some cases the main cornices of the building were simply blocked out square in stone, and then covered with moulded plaques of terra-cotta, carefully formed to fit on and round the angles of the block. The large cymatium which forms the upper member of the cornice is curved upwards, so as to prevent the rain water from dripping all along the edge; and at intervals it is pierced by ornamental clay pipes, which project like a mediæval gargoyle. In some examples from Selinus the cymatium is pierced with a beautiful open pattern of lotus leaf (see fig. 5). The greatest care was taken in fitting these applied mouldings where each plaque joined the next, and especially in making them fit closely on to the stone blocks, in which rebates were cut to receive each plaque. The whole surface of the terra-cotta is covered with elaborate painted ornaments of great beauty, in ochre colours applied on a white ground, as in the case of the statuettes. These beautiful temple decorations are well illustrated by Dörpfeld and others in *Die Verwendung von Terra-cotten*, Berlin, 1881. Though no complete examples of terra-cotta statuary now exist, it is certain that the Greeks produced it on a large scale and of the highest class of workmanship. Pliny (*H.N.*, xxxv. 36) mentions that certain statues of Hercules Musagetes and the Nine Muses were "opera figlina," executed by the painter Zeuxis. These were brought from Athens by M. Fulvius Nobilior, and placed in the temple of Hercules Musagetes, which adjoined the Porticus Octaviæ in the Campus Martius of Rome. Other and earlier examples of clay statues are mentioned by Pausanias.

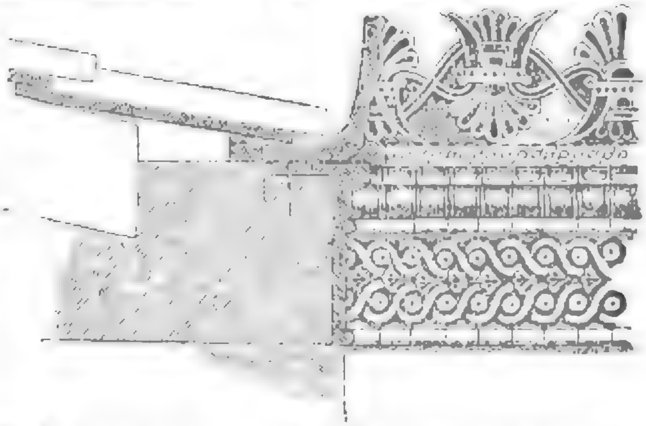

FIG. 5.—Cornice enrichments of painted terra-cotta from Selinus. This section shows the careful way in which the terra-cotta is fitted on to the stone; the colours are red and brown ochre and cream-white.

Etruscan.

Among the Etruscans the use of clay for important sculpture was very frequent,—painted terra-cotta or bronze almost excluding marble and stone. An important example was the clay quadriga on the pediment of the temple of Capitoline Jupiter, which, according to one legend, was brought from Veii by Tarquinius Superbus. This existed till the destruction of the temple by fire in 83 B.C., and was considered one of the seven precious relics on which the safety of the Roman state depended. The great statue of Jupiter in the central cella of this triple temple was also of terra-cotta, and was said to be the work of an Etruscan sculptor from Fregenæ. Vitruvius mentions "signa fictilia" as being specially Etruscan. Many other statues in the early temples of Rome were made of the same material. Among the existing specimens of Etruscan terra-cotta the chief are large sarcophagi, with recumbent portrait effigies of the deceased on the top, the whole being of clay, decorated with painting. Fine examples exist in the Louvre and the British Museum; a good specimen from the latter collection is figured in vol. viii., plate VIII. The Museo Gregoriano in the Vatican possesses some very beautiful friezes of a later date—about the 4th century B.C.—when native Etruscan art had been replaced by that of Greece. These friezes are very rich and elaborate, with heads and scroll foliage in very salient relief. Some of them have at intervals cleverly moulded heads of satyrs, painted a brilliant crimson.[3]

Magna Græcia.

Another very elaborate application of terra-cotta is shown in the numerous large asci, covered with statuettes, which are found in the tombs of Canosa (Canusium), Cales, and many parts of Magna Græcia. The statuettes are somewhat similar in style and colouring to the Tanagra figures, and date from about the same period (4th century B.C.), but are not equal to them as works of art; they are also usually crowded together in a somewhat awkward manner.[1] The British Museum is specially rich in these elaborate terra-cottas; few of the colours used appear to be true ceramic pigments.

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[1] See *Journ. of Hellenic Studies*, vol. vi., 1886, p. 243.

[2] The British Museum possesses some fine caricatures of actors from Canino, very skilfully modelled and of a peculiar fabrique.

[3] The use of this strongly glowing red is almost peculiar to Hellenic Italy; the other colours used there were much the same as those of Greece itself. The same magnificent crimson often occurs on œnochoæ, moulded into the form of satyrs' heads, which are found in the tombs of Magna Græcia.

Roman.

As in other branches of art, the Romans closely copied the Greeks in their wide application of terra-cotta for statues, reliefs, and architectural ornaments. A large number of beautiful Græco-Roman reliefs exist, many having designs evidently copied from earlier Greek sculpture. Berlin, the Louvre, the British Museum, and many places in Italy possess fine collections. Friezes with beautiful reliefs 12 to 18 inches deep often occur, little inferior in execution to the earlier Greek work. Many subjects of great interest are represented: a very fine plaque in the Louvre has the scene of Orestes taking refuge at the sacred omphalos at Delphi, which is represented as a conical stone about 3 feet high, hung round with ornamental festoons made of gold.[2] These terra-cottas belong to the early period of the empire; in the 2d century A.D. they became much coarser and less Greek in style, like all the sculpture of that time. A plaque in the Louvre, which represents a chariot-race in the circus, bears its maker's stamp, L. S. ER. At the end of the first and in the early part of the 2d century A.D. the use of terra-cotta for architectural adornment was carried to a high point of perfection in Rome. Many buildings of this period have the most elaborate decoration moulded in clay and fitted together with wonderful neatness. Not only enriched cornices and friezes were made of terra-cotta, but even Corinthian columns with their elaborate acanthus capitals. In all cases the whole surface appears to have been covered with a thin coating of "opus albarium" and then decorated with colours and even gold. The best existing examples in Rome are the Ampbitheatrum Castrense, many tombs on the Via Latina, and the barracks of the VIIth cohort of the guards (*vigiles*) in the Trastevere. But few examples exist of the large Roman terra-cotta sculpture; the best are some seated female figures from tombs, small life-size, in the Capitoline museum,—works of great beauty and very skilfully fired without cracks or warping. The British Museum also contains fine specimens of terra-cotta sculpture on a large scale, especially the torso of a nude male figure (Hercules), some terminal figures of Bacchus, and a beautiful statue of Urania (see fig. 6).

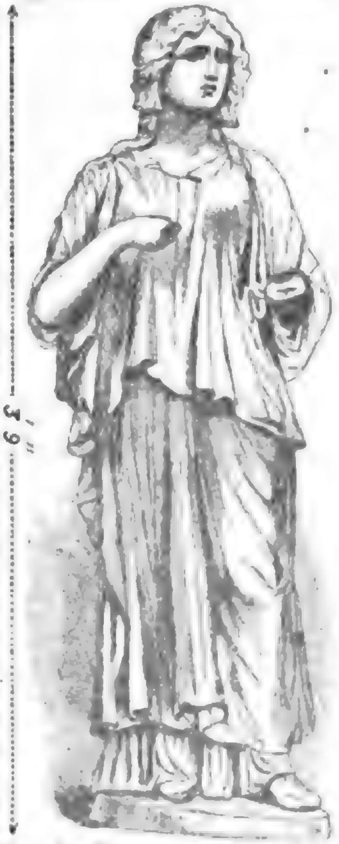

FIG. 6.—Terra-cotta statue of the Muse Urania, 1st century A.D. (British Museum.)

Mediæval.

In the 14th and more especially in the 15th century terra-cotta was adapted in various parts of Europe to the most magnificent and elaborate architectural purposes. In Germany the mark of Brandenburg is specially rich in terra-cotta work.[3] The church of St Catherine in the town of Brandenburg is decorated in the most lavish way with delicate tracery and elaborate string-courses and cornices, enriched with foliage, all modelled in clay; the town-hall is another instance of the same use of terra-cotta. At Tangermünde, the church of St Stephen and other buildings of the beginning of the 15th century are wonderful examples of this method of decoration; the north door of St Stephen's especially is a masterpiece of rich and effective moulding. In northern Italy this use of terra-cotta was carried to an equally high point of perfection.[4]

Italy.

The western façade of the cathedral of Monza is a work of the most wonderful richness and minute elaboration, wholly executed in clay, in the latter part of the 14th century. The cathedral of Crema, the communal buildings of Piacenza, and S. Maria delle Grazie in Milan are striking examples of the extreme splendour of effect that can be obtained by terra-cotta work. The Certosa near Pavia has a most gorgeous specimen of the early part of the 16th century; the two cloisters are especially magnificent. Pavia itself is very rich in terra-cotta decoration, especially the ducal palace and the churches of S. Francesco and S. Maria del Carmine. Some delicate work exists among the mediæval buildings of Rome, dating from the 14th and 16th century, as, for example, the rich cornices on the south aisle of S. Maria in Ara Cœli, *c.* 1300; the front of S. Cosimato in Trastevere, built *c.* 1490; and a once very magnificent house, near the Via di Tordinone, which dates from the 14th century. The most important application of terra-cotta in mediæval Italy was to statuary—reliefs, busts, and even groups of many life-sized figures—during the 15th and 16th centuries. Much of the Florentine terra-cotta sculpture of the 15th century is among the most beautiful plastic work the world has ever seen, especially that by Jacopo della Quercia, Donatello, and the sculptors of the next generation.[5] For life, spirit, and realistic truth, combined with sculpturesque breadth, these pieces are masterpieces of invention and manipulation. The portrait busts are perfect models of iconic sculpture (see fig. 7). In some respects the use of burnt clay for sculpture has great advantages over that of marble: the soft clay is easily and rapidly moulded into form while the sculptor's thought is fresh in his mind, and thus terra-cottas often possess a spirit and vigour which can hardly be reproduced in the laboriously finished marble These

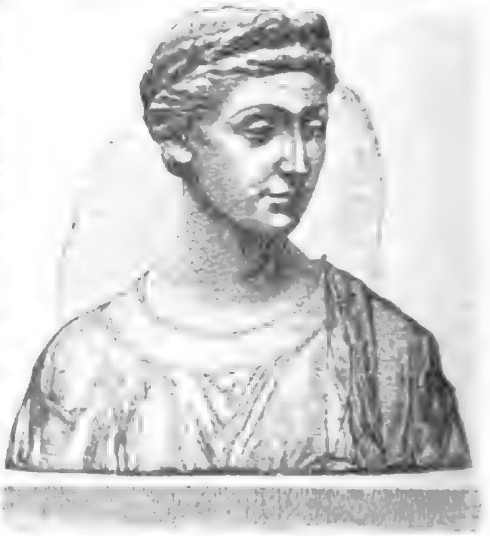

FIG. 7.—Portrait bust in terra-cotta: Florentine work of the middle of the 15th century. (South Kensington Museum.)

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[1] A very large ascus from Canosa in the British Museum is decorated with no less than five statuettes of women and Victories, two large masks of Medusa, and six projecting figures of horses.

[2] Compare a similar representation of the omphalos on a Greek vase illustrated by Jahn, *Vasenbilder*, Hamburg, 1839.

[3] See Adler, *Mittelalterliche Backstein-Bauwerke*, Berlin, 1862.

[4] See Gruner, *Terra-cotta Architecture of N. Italy*, London, 1867.

[5] The South Kensington Museum possesses a very fine collection of Florentine terra-cottas of the best period.

qualities are specially remarkable in the best works of the Della Robbia family (see Robbia). In the 16th century a more realistic style was introduced, and this was heightened by the custom of painting the figures in oil colours. Many very clever groups of this class were produced by Ambrogio Foppa (Caradosso) for S. Satiro at Milan and by Guido Mazzoni and Begarelli (1479-1565) for churches in Modena. These terra-cotta sculptures are unpleasing in colour and far too pictorial in style; but those of Begarelli were enthusiastically admired by Michelangelo.[1] Much fine France. terra-cotta work was produced in France during the 16th century, partly under Italian influence,—many sculptors from northern and central Italy having settled in France, especially under the patronage of Francis I. In the same century a similar Italian influence prevailed largely throughout Spain, and very clever works were produced there, remarkable for their vivid realism and deceptive England. pictorial style. In England the elaborate use of terra-cotta did not come into vogue till the early part of the 16th century, and then only in certain counties. Essex possesses the finest examples, such as those of the manor house of Layer Marney, built in the reign of Henry VIII. The richly moulded windows and battlements of this house are very un-English in style, and it seems probable that all the terra-cotta decorations were made in Holland or Flanders. A richly decorated terra-cotta tomb with recumbent effigy exists in the church of Layer Marney; and in the collegiate church of Wymondham in Norfolk there are very large and elaborate sedilia with lofty canopied niches, all of clay, which appear to be of the same date and fabrique as the Essex examples. Most of the terra-cotta sculpture in England, such as that by Torrigiano, of which fragments exist in Westminster Abbey, the colossal heads of the Cæsars at Hampton Court, and the recumbent effigy in the Chapel of the Rolls,[2] were the work of Italian sculptors, mostly from Florence, who were invited to England in the reigns of Henry VII. and Henry VIII.

Modern. Of late years terra-cotta for architectural purposes has been employed for some very important buildings in London, such as the natural history museum at South Kensington, the Albert Hall, and the front of the other museum in the Exhibition Road. The durability of well-fired clay, its dense texture, pleasant colour, and smooth surface make it specially suitable to an atmosphere laden with acids and soot as is that of London. The surface resists decomposition, and affords little hold to the minute particles of carbon. The great improvements which have been made in the manufacture of terra-cotta will probably lead to its more extensive use. The great difficulty is to retain the sharpness of impression given by the mould, and above all to avoid the uneven shrinkage and warping which is so liable to take place when it is fired in large pieces. Any want of truth in the lines of a long cornice becomes painfully apparent, and each moulded block of a door or window-jamb must fit accurately on to the next one, or else the line of moulding becomes broken and irregular. Terra-cotta is now made of many different colours, a rich red and a warm ochre or cream colour being the most pleasant to the eye. In order to avoid defects it is necessary that the clay should contain a large proportion of powdered silica, and that the whole mass should be thoroughly homogeneous. The method by which these ends are secured is much the same as that employed in the making of pottery (see vol. xix. p. 642 *sq.*).

Collections. The most important public collections are in the Louvre, the British Museum, the museums of Berlin and Athens, and a few fine specimens exist in the South Kensington Museum. The splendid Sabouroff collection is now in the Hermitage Palace at St Petersburg. Many museums in Italy—such as those at Florence, Perugia, Capua, Rome, and other places—contain many examples from Etruria and Magna Græcia. A large number of the finest of the Tanagra figures and the like are in private hands; some are illustrated in the works mentioned in the following list; that of Prince Liechtenstein at Vienna is one of the finest.[3]

Literature.—Léon Heuzey, "Recherches sur les figurines de femmes voilées," in *Mon. assoc. des études grecques*, Paris, 1874; Id., "Rech. sur un groupe de Praxitèle, . . . en terre cuite," in *Gaz. des B.-Arts*, September 1875; Id., "Rech. sur les terres cuites grecques," in *Mon. assoc. des étud. grec.*, 1876; Id., *Les origines des terres cuites*, Paris, 1883; Id., *Catalogue des figurines antiques du Louvre*, Paris, 1882-83; Id., "Papposilène et le dieu Bes," in *Bull. Cor. Hell.*, 1884, pp. 161-167; Frohner, *Les terres cuites d'Asie-Mineure*, Paris, 1879-81; Id., *Cat. de la Coll. Lecuyer*, Paris, 1883, and *Cat. de la Coll. Barre*, Paris, 1878; Kekulé, *Griechische Thonfiguren aus Tanagra*, Berlin, 1878; Id., *Griechische Terracotten vom Berliner Museum*, Berlin, 1878; Id., *Die antiken Terracotten von Pompeii*, Stuttgart, 1880; Rayet, *Monuments de l'art antique*, Paris, 1884, vol. ii. pp. 74-90; Id., "Sur une plaque estampée, in *Bull. Cor. Hell.*, 1879, pp. 329-333; Id., *Cat. de la Coll. Rayet*, 1880; Id., "Les figurines de Tanagra (Louvre)," in *Gaz. des B.-Arts*, 1875; Id., "L'art grec au Trocadéro," in *Gaz. des B.-Arts*, 1878; Furtwaengler, *La Coll. Sabouroff*, Paris, 1883-85, splendidly illustrated in colours; Martha, *Cat. des figurines du musée d'Athènes*, 1880; Id., "Figurines corinthiennes en terre cuite," in *Bull. Cor. Hell.*, 1879, pp. 29-42; Id., "Figurines de Tanagra," *ibid.*, 1880, pp. 71-75; Pottier, "Terres cuites Chypriotes," *ibid.*, 1879, pp. 86-94; Pottier and Reinach, "Fouilles de Myrina," *ibid.*, various articles in vols. for 1882-83; Paul Girard, "Nécropoles de la Grèce du Nord," *ibid.*, 1879, pp. 211-221; Max. Collignon, "Plaque estampée de Santorin," *ibid.*, 1881, pp. 436-438; Cesnola, *Cyprus*, London, 1877; Schliemann, *Troy*, *Mycenæ*, and *Tiryns*; E. Curtius, *Giebelgruppen aus Tanagra*, Berlin, 1878; Delauney, "Terres cuites de Tanagra," in *Revue de France*, May and June 1878. An account of the first discovery of the Tanagra figures is given by Otto Lüders in *Bull. Inst. Cor. Arch.*, 1874, p. 120; see also various articles in *Gaz. Archéol.*, *Archäol. Zeitung*, and *Mon. Inst. Arch. Rom.* (especially vol. vi.). For the earlier known terra-cottas, see Panofka, *Terracotten des K. Museums zu Berlin*, 1842; Combe, *Terra-cottas in the British Museum*, London, 1810; and Gerhard, *Monumenti figulini di Sicilia*, Berlin, 1835. Other works have been already referred to. Clever but not quite satisfactory copies of the finest Tanagra and other figures are now made in Berlin and Vienna; they cost from twenty to thirty shillings each. (J. H. M.)

TERRANOVA, or Terranuova, a seaport town of Sicily, on a hill at the mouth of the Terranova, in the province of Caltanisetta, and 41½ miles east-south-east from Girgenti. It contains a castle and several large churches, but has little to interest the traveller. Though the harbour is poor, there is a considerable trade in corn, wine, fruit, sulphur, and soda. Cloth is manufactured to a small extent. The population of the town in 1881 was 16,440, that of the commune 17,173. In and near Terranova are the remains of the ancient Gela (*q.v.*). The modern town owes its origin to the emperor Frederick II.

TERRAPIN. See Tortoise.

TERRE HAUTE, a city of the United States, in Harrison township, Vigo county (of which it is the county seat), in the western part of Indiana. It is situated in 39° 27′ N. lat. and 87° 54′ W. long., at a height of 492 feet above the sea, upon the east bank of the Wabash river, 186 miles nearly south of Chicago and 73 miles west-south-west of Indianapolis. The city stands upon level ground, about 60 feet above the ordinary surface of the river. It is regularly laid out, with wide streets, lined with shade trees; its principal buildings are the State normal school and the Polytechnic Institute. Six great railroad lines pass through Terre Haute, connecting it directly with the cities of the Mississippi valley. This fact, together with its proximity to the coal-mines of Clay county, has greatly promoted its growth as a manufacturing centre. It had in 1880 a population of 26,042, as against 16,103 in 1870.

TERSTEEGEN, Gerhard (1697-1769), German religious writer, was born at Mörs in Rhenish Prussia on 25th November 1697. After being educated at the gymnasium of his native town, he pursued for some years the calling of a ribbon-maker. In 1728 he withdrew from all secular pursuits and gave himself entirely to religious work. His writings include a collection of hymns (*Blumengärtlein*, 1729; last edition, Stuttgart, 1868), a volume of *Gebete*, and another of *Briefe*. He died at Mühlheim in Rhenish Prussia on 3d April 1769. See Hymns, vol. xii. p. 588.

TERTIARIES. See Franciscans, vol. ix. p. 700.

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[1] See Vasari, ed. Le Monnier, xii. 281.

[2] This interesting building is now threatened with destruction.

[3] Very clever forgeries of terra-cotta are being manufactured, and in many cases real specimens have genuine heads which do not belong to them. The colouring has frequently been touched up and falsified while in the dealers' hands. Even the celebrated Campana collection contained many clever forgeries of terra-cotta reliefs.

TERTULLIAN, whose full name was Quintus Septimius Florens Tertullianus, is the earliest and after Augustine the greatest of the ancient church writers of the West. Before him the whole Christian literature in the Latin language consisted of a translation of the Bible, the *Octavius* of Minucius Felix—an apologetic treatise written in the Ciceronian style for the higher circles of society, and with no evident effect for the church as a whole—and a list of the books recognized as canonical (the so-called Muratorian fragment). Whether Victor the Roman bishop and Apollonius the Roman senator ever really made an appearance as Latin authors is quite uncertain. Tertullian in fact created Christian Latin literature; one might almost say that that literature sprang from him full-grown, alike in form and substance, as Athene from the head of Zeus. Cyprian polished the language that Tertullian had made, sifted the thoughts he had given out, rounded them off, and turned them into current coin, but he never ceased to be aware of his dependence on Tertullian, whom he designated as κατ' ἐξοχὴν his master (Jer., *De Vir. Ill.*, 53). Augustine, again, stood on the shoulders of Tertullian and Cyprian; and these three North Africans are the fathers of the Western churches.

Tertullian's place in universal history is determined by (1) his intellectual and spiritual endowments, (2) his moral force and evangelical fervour, (3) the course of his personal development, (4) the circumstances of the time in the midst of which he worked.

(1) Tertullian was a man of great originality and genius, characterized by the deepest pathos, the liveliest fancy, and the most penetrating keenness, and was endowed with ability to appropriate and make use of all the methods of observation and speculation, and with the readiest wit. His writings in tone and character are always alike "rich in thought and destitute of form, passionate and hair-splitting, eloquent and pithy in expression, energetic and condensed to the point of obscurity." His style has been characterized with justice as dark and resplendent like ebony. His eloquence was of the vehement order; but it wins hearers and readers by the strength of its passion, the energy of its truth, the pregnancy and elegance of its expression, just as much as it repels them by its heat without light, its sophistical argumentations, and its elaborate hair-splittings. Though he is wanting in moderation and in luminous warmth, his tones are by no means always harsh; and as an author he ever aspired with longing after humility and love and patience, though his whole life was lived in the atmosphere of conflict. Tertullian both as a man and as a writer had much in common with the apostle Paul.

(2) In spite of all the contradictions in which he involved himself as a thinker and as a teacher, Tertullian was a compact ethical personality. What he was he was with his whole being. Once a Christian, he was determined to be so with all his soul, and to shake himself free of all half measures and compromises with the world. It is not difficult to lay one's finger upon very many obliquities, self-deceptions, and sophisms in Tertullian in matters of detail, for he struggled for years to reconcile things that were in themselves irreconcilable; yet in each case the perversities and sophisms were rather the outcome of peculiarly difficult circumstances in which he stood. It is easy to convict him of having failed to control the glowing passion that was in him. He is often outrageously unjust in the substance of what he says, and in manner harsh to cynicism, scornful to gruesomeness; but in no battle that he fought was he ever actuated by selfish interests. What he did was really done for the Gospel, as he understood it, with all the faculties of his soul. But he understood the Gospel as being primarily an assured hope and a holy law, at fear of the Judge who can cast into hell and as an inflexible rule of faith and of discipline. Of the glorious liberty of the children of God he had nothing but a mere presentiment; he looked for it only in the world beyond the grave, and under the power of the Gospel he counted as loss all the world could give. He well understood the meaning of Christ's saying that He came not into the world to bring peace, but a sword: in a period when a lax spirit of conformity to the world had seized the churches he maintained the "vigor evangelicus" not merely against the Gnostics but against opportunists and a worldly-wise clergy. Among all the fathers of the first three centuries Tertullian has given the most powerful expression to the terrible earnestness of the Gospel.

(3) The course of Tertullian's personal development fitted him in an altogether remarkable degree to be a teacher of the church. Born at Carthage of good family—his father was a "centurio consularis"—he received a first-rate education both in Latin and in Greek. He was able to speak and write Greek, and gives evidence of familiarity alike with its prose and with its poetry; and his excellent memory—though he himself complains about it—enabled him always to bring in at the right place an appropriate, often brilliant, quotation or some historical allusion. The old historians, from Herodotus to Tacitus, were familiar to him, and the accuracy of his historical knowledge is astonishing. He studied with earnest zeal the Greek philosophers; Plato in particular, and the writings of the Stoics, he had fully at command, and his treatise *De Anima* shows that he himself was able to investigate and discuss philosophical problems. From the philosophers he had been led to the medical writers, whose treatises plainly had a place in his working library. But no portion of this rich store of miscellaneous knowledge has left its characteristic impress on his writings; this influence was reserved for his legal training. His father, whose military spirit reveals itself in the whole bearing of Tertullian, to whom Christianity was above everything a "militia," had intended him for the law. He studied in Carthage, probably also in Rome, where, according to Eusebius, he enjoyed the reputation of being one of the most eminent jurists. This statement derives confirmation from the *Digest*, where references are made to two works, *De Castrensi Peculio* and *Quæstionum Libri VIII.*, of a Roman jurist named Tertullian, who must have flourished about 180 A.D. In point of fact the quondam advocate never disappeared in the Christian presbyter. This was at once his strength and his weakness: his strength, for as a professional pleader he had learned how to deal with an adversary according to the rules of the art—to pull to pieces his theses, to reduce him *ad absurdum*, and to show the defects and contradictions of his statements,—and was specially qualified to expose the irregularities in the proceedings taken by the state against the Christians; but it was also his weakness, for it was responsible for his litigiousness, his often doubtful shifts and artifices, his sophisms and *argumentationes ad hominem*, his fallacies and surprises. At Rome in mature manhood Tertullian became a Christian, under what circumstances we do not know, and forthwith he bent himself with all his energy to the study of Scripture and of Christian literature. Not only was he master of the contents of the Bible: he also read carefully the works of Hermas, Justin, Tatian, Miltiades, Melito, Irenæus, Proculus, Clement, as well as many Gnostic treatises, the writings of Marcion in particular. In apologetics his principal master was Justin, and in theology proper and in the controversy with the Gnostics, Irenæus. As a thinker he was not original, and even as a theologian he has produced but few new schemes of doctrine, except his doctrine of sin. His special gift lay

in the power to make what had been traditionally received impressive, to give to it its proper form, and to gain for it new currency. From Rome Tertullian visited Greece and perhaps also Asia Minor; at any rate we know that he had temporary relations with the churches there. He was consequently placed in a position in which he could check the doctrine and practice of the Roman Church. Thus equipped with knowledge and experience, he returned to Carthage and there laid the foundation of Latin Christian literature. At first, after his conversion, he wrote Greek, but by and by Latin almost exclusively. The elements of this Christian Latin language may be enumerated as follows:—(i.) it had its origin, not in the literary language of Rome as developed by Cicero, but in the language of the people as we find it in Plautus and Terence; (ii.) it has an African complexion; (iii.) it is strongly influenced by Greek, particularly through the Latin translation of the Septuagint and of the New Testament, besides being sprinkled with a large number of Greek words derived from the Scriptures or from the Greek liturgies; (iv.) it bears the stamp of the Gnostic style and contains also some military expressions; (v.) it owes something to the original creative power of Tertullian. As for his theology, its leading factors were—(i.) the teachings of the apologists; (ii.) the philosophy of the Stoics; (iii.) the rule of faith, interpreted in an anti-Gnostic sense, as he had received it from the Church of Rome; (iv.) the Soteriological theology of Melito and Irenæus; (v.) the substance of the utterances of the Montanist prophets (in the closing decades of his life). This analysis does not disclose, nor indeed is it possible to discover, what was the determining element for Tertullian; in fact he was under the dominion of more than one ruling principle, and he felt himself bound by several mutually opposing authorities. It was his desire to unite the enthusiasm of primitive Christianity with intelligent thought, the original demands of the Gospel with every letter of the Scriptures and with the practice of the Roman Church, the sayings of the Paraclete with the authority of the bishops, the law of the churches with the freedom of the inspired, the rigid discipline of the Montanist with all the utterances of the New Testament and with the arrangements of a church seeking to set itself up within the world. At this task he toiled for years, involved in contradictions which it took all the finished skill of the jurist to conceal from him for a time. At last he felt compelled to break off from the church for which he had lived and fought; but the breach could not clear him from the contradictions in which he found himself entangled. Not only did the great chasm between the old Christianity, to which his soul clung, and the Christianity of the Scriptures as juristically and philosophically interpreted remain unbridged; he also clung fast, in spite of his separation from the Catholic church, to his position that the church possesses the true doctrine, that the bishops *per successionem* are the repositories of the grace of the teaching office, and so forth. The growing violence of his latest works is to be accounted for, not only by his burning indignation against the ever-advancing secularization of the Catholic church, but also by the incompatibility between the authorities which he recognized and yet was not able to reconcile. After having done battle with heathens, Jews, Marcionites, Gnostics, Monarchians, and the Catholics, he died an old man, carrying with him to the grave the last remains of primitive Christianity in the West, but at the same time in conflict with himself.

(4) What has just been said brings out very clearly how important in their bearing on Tertullian's development were the circumstances of the age in which he laboured. His activity as a Christian falls between 190 and 220, a period of very great moment in the history of the Catholic church; for within it the struggle with Gnosticism was brought to a victorious close, the New Testament established a firm footing within the churches, the "apostolic" rules which thenceforward regulated all the affairs of the church were called into existence, and the ecclesiastical priesthood came to be developed. Within this period also falls that evangelical and legal reaction against the political and secular tendencies of the church which is known as Montanism. The same Tertullian who had fortified the Catholic church against Gnosticism was none the less anxious to protect it from becoming a political organization. Being unable to reconcile incompatibles, he broke with the church and became the most powerful representative of Montanism in the West.

Although Tertullian's extant works are both numerous and copious, our knowledge of his life is very vague. He cannot have been born much later than about 150. His activity as a jurist in Rome must fall within the period of Commodus; for there is no indication in his writings that he was in Rome in the time of Marcus Aurelius, and many passages seem to preclude the supposition. The date of his conversion to Christianity is quite uncertain; there is much in favour of the years between 190 and 195. How long he remained in Rome after becoming a Christian, whether he had attained any office in the church before leaving Rome, what was the date of his visit to Greece,—on these points also we remain in ignorance. It is certain that he was settled in Carthage in the second half of 197, the date of his writing his *Apologeticus* and (shortly afterwards) his two books *Ad Nationes*; we also know that he became a presbyter in Carthage and was married. His recognition of the Montanistic prophecy in Phrygia as a work of God took place in 202-203, at the time when a new persecution broke out. For the next five years it was his constant endeavour to secure the victory for Montanism within the church; but in this he became involved more and more deeply in controversy with the majority of the church in Carthage and especially with its clergy, which had the support of the clergy of Rome. As Jerome writes (*De Vir. Ill.*, 53): "Usque ad mediam ætatem presbyter fuit ecclesiæ Africanæ, invidia postea et contumeliis clericorum Romanæ ecclesiæ ad Montani dogma delapsus." On his breach with the Catholic church, probably in 207-208, he became the head of a small Montanist community in Carthage. In this position he continued to labour, to write, and to assail the lax Catholics and their clergy until at least the time of Bishop Calixtus in the reign of Elagabalus. The year of his death is uncertain. Jerome (*ut sup.*) says: "Fertur vixisse usque ad decrepitam ætatem." That he returned at last to the bosom of the Catholic church is a mere legend, the motive of which is obvious; his adherents after his death continued to maintain themselves as a small community in Carthage. Although he had left the church, his earlier writings continued to be extensively read; and in the 4th century his works, along with those of Cyprian, were the principal reading of Western Christians, until they were superseded by those of Jerome, Ambrose, Augustine, and Gregory. Jerome has included him in his catalogue of Christian "viri illustres," but only as a Catholic to whom reference should be made with caution.[1]

The works of Tertullian, on the chronology of which a great deal has been written, and which for the most part do not admit of being dated with perfect certainty, fall into three classes,—the apologetic, the polemical theological, and the ascetic. And in point of time also three periods can be readily distinguished, the years 202-203 and 207-208 constituting the divisions. Some of the things he wrote have unfortunately disappeared,—in particular the *De Spectaculis*, *De Baptismo*, and *De Virginibus Velandis* in Greek; his works in Latin on the same subjects have survived.

I. *Works dating from before 202-203.*—To this class belong the *Apologeticus* (197) and the two books *Ad Nationes*, *De Spectaculis*, *De Idololatria*, *De Cultu Feminarum Libri II.*, *De Testimonio Animæ* (written soon after the *Apologeticus*), *Ad Martyres* (perhaps the earliest of all), *De Baptismo Hæreticorum* (now lost), *De Baptismo*, *De Pœnitentia*, *De Oratione* (the last three written for catechumens), *De Patientia*, *Ad Uxorem Libri II.*, *De Præscriptione Hæreticorum*, and *Adv. Marcionem* (in its first form). The *Apologeticus*, which in the 3d century was translated into Greek, is the weightiest work in defence of Christianity of the first two centuries. Respecting its relation to the *Octavius* of Minucius Felix much has been written; to the present writer it seems unquestionable that Tertullian's work was the later. Of great moment also is the *De Præscriptione Hæreticorum*, in which the jurist is more clearly heard than the Christian. The *De Spectaculis* and *De Idololatria* show that Tertullian was already in a certain sense a Montanist before he formally went over to that creed; on the other hand, his *De Pœnitentia* proves that his earlier views on church discipline were much more tolerant than his later. To learn something of his Christian temper we must read the *De Oratione* and the *De Patientia*. The *De Baptismo* is of special interest from the archæological point of view.

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[1] Compare also the judgment of Hilary and of Vincent of Lerins, *Commonit.*, 24.

II. *Works written between 202-203 and 207-208.—De Virginibus Velandis, De Corona Militis, De Fuga in Persecutione, De Exhortatione Castitatis, Scorpiace adv. Gnosticos* (?), *Adversus Hermogenem, De Censu Animæ adv. Hermogenem* (lost), *Adv. Valentinianos, Adv. Apelleiacos* (lost), *De Paradiso* (lost), *De Fato* (lost), *De Anima, De Carne Christi, De Resurrectione Carnis*, and *De Spe Fidelium* (lost), were all written after Tertullian had recognized the prophetic claims of the Montanists, but before he had left the church.

III. *Works later than 207-208.*—To this period belong the five books *Adv. Marcionem*, his main anti-Gnostic work (in the third form—the first of the five was written in 207-208), *Ad Scapulam* (a memorial to the governor, written soon after 211), *De Pallio* (possibly this ought to be classed among the earliest writings), *Adv. Praxean* (his principal work against the Monarchians), and *Adv. Judæos*. The latest extant works of Tertullian (all after 217) are his controversial writings against the laxity of the Catholics, full of the bitterest attacks, especially upon Calixtus, the bishop of Rome; these are *De Monogamia, De Jejunio, De Pudicitia*, and *De Ecstasi Libri VII.* (lost). The arguments against the genuineness of some of the above writings do not seem to the present writer to have weight. It is uncertain whether Tertullian was the author of the *Acta Perpetuæ et Felicitatis*.

Literature.—A thoroughly adequate edition of the works of Tertullian and a full account of his fortunes as a writer are still desiderata; the best edition at present is that of Oehler (3 vols., Leipsic, 1853). The *editio princeps* is by Beatus Rhenanus (Basel, 1521); others have appeared by Gelenius (1550), Pamelius (1579), De la Barre (1580), Rigaltius (1634), Semler (1770-71), Oberthür (1780), Leopold (1839 *sq.*), and Migne (1844). The Vienna Academy is about to publish an edition by Reifferscheid. There are German translations by Besnard (1837) and Kellner (1882), and an English translation appears in Clark's Ante-Nicene Theological Library. Separate treatises of Tertullian have often been edited,—the *Apologeticus* by Havercamp (1718), Oehler (1849), and Kayser (1865); the *Ad Nationes* by Godofredus (1635); the *De Spectaculis* by Klussmann (1877); the *De Testimonio Animæ* by Lindner (1862); the *De Pallio* by Salmasius (1656); other minor writings by Hurter, &c. The testimonies of the church fathers (the most important being those of Cyprian, Eusebius, Jerome, and Vincent of Lerins) are partly brought together in the editions.

The older studies on Tertullian by Le Nourry, Tillemont, Dupin, Allix, Cave, Ceillier, Mosheim, Centner, Semler, Noesselt, are to some extent reproduced in vol. iii. of Oehler's edition. Among the more modern contributions to the subject may be mentioned those of Neander (*Antignosticus: Geist des Tertullians*, Berlin, 1825), Böhringer (*Die Kirche Christi in Biographien*, vol. iii., 2d ed., 1875), Möhler (*Patrologie*, vol. i., 1840, pp. 701-789), Kaye (*Eccles. Hist. of the 2d and 3d Centuries, illustrated from the writings of Tertullian*, 3d ed., 1845), Coenen (*Comment. de Tertull.*, Utrecht, 1825), Hesselberg (*Tertullian's Lehre*, pt. i., Dorpat, 1848), Ebert (*Gesch. d. Christl. Lit.*, 1874), Freppel (*Tertullien*, Paris, 1864), Hauck (*Tertullian's Leben u. Schriften*, 1877), Alzog (*Patrologie*, 3d ed., 1876); see also the manuals of church history, history of dogma (*e.g.*, Harnack's *Lehrb. d. Dogmengesch.*; also Schwane's, Dorner's, and others), of Roman literature (Teuffel), of Christian philosophy (Ritter, Stöckl, Erdmann, Ueberweg). Compare also Deutinger, *Geist d. Christl. Ueberlieferung*, vol. i.

On the chronology and genuineness of the works attributed to Tertullian, see Mosheim, Semler, Noesselt (*De Vera Ætate et Doctrina Scriptorum Tertulliani*, 1768; in Oehler's ed., vol. iii.), Uhlhorn (*Fundamenta Chronologiæ Tertull.*, Gottingen, 1852), Bonwetsch (*Die Schriften Tertullian's n. d. Zeit ihrer Abfass.*, Bonn, 1879), Kellner ("Zur Chron. Tert.'s," in *Theol. Quartalschr.*, 1870-71), Grotemeyer (*Ueber Tertullian's Leben u. Schriften*, Kempen, 1863-65), Harnack ("Zur Chronol. d. Schr. Tert.'s," in *Ztschr. f. Kirchengesch.*, 1878), Nöldechen ("Tert.'s Geburtsjahr," in *Ztschr. f. wiss. Theol.*, 1886). On Tertullian as a man, a citizen, and an author, see Ebert (as above), Engelhardt ("Tert.'s schriftstell. Character," in *Ztschr. f. d. hist. Theol.*, 1852), Ritter (in Braun and Achterfeld's *Bonner Zeitschrift*, Hft. 8), Hildebrand (in Jahn's *Jahrb. z. Alterthumswissensch.*, 1843), Dieringer (*Doctrina Tertulliani de Rep. et de Offic. et Jur. Civium Christianorum*, Bonn, 1850), Nöldechen ("Tert. als Mensch u. als Bürger," in *Hist. Ztschr.*, 1885), Schmidt (*De Latinitate Tert.*, Erlangen, 1870-72), Klussmann (*Curarum Tertull.*, pts. i., ii., Halle, 1881), Hauschild (*Die Grundsätze u. Mittel der Wortbildung bei Tert.*, Leipsic, 1881), and Langen (*De Usu Tert. Præpositionum*, Munster, 1869). On Tertullian as a jurist, see Blumenbach (*De Presbytero et Icto Tertulliano*, Leipsic, 1755), Wiesenhavern (*De Icto Tertulliano*, Hildesheim, 1743), Pagenstecher (*De Jurispr. Tert.*, Harderwijk, 1768), Rudorff (*Rom. Rechtsgesch.*, i. p. 196 *sq.*). On Tertullian as an apologete, see Hefele ("Tert. als Apologet," in *Beitr. zur Kirchengeschichte*, vol. i.), Jeep ("Tert. als Apologet," in *Jahrbb. f. deutsche Theol.*, 1864), Pelet (*Essai sur l'apolog. de Tert.*, Strasburg, 1868), Condamin (*De Tertulliano Vexatæ Religionis Patrono*, Bar-le-Duc, 1877), Werner (*Gesch. d. apolog. u. polemisch. Lit.*, vols. i., ii., 1861-62). On his relations to the Greek apologists, see Harnack (*Texte u. Unters. z. altchrist. Lit.-Gesch.*, vol. i.); on those to Minucius Felix, Ebert (*Tert.'s Verhältniss zu M. Felix*, Leipsic, 1868), and a number of other discussions by Hartel, Kühn, &c. His relations to Clement of Alexandria have been investigated by Münscher (in Henke's *Magazin*, vol. vi., 1796), Nöldechen (*Jahrbb. f. prot. Theol.*, 1886; *Theol. Stud. u. Krit.*, 1886); on his relations to Irenæus, Hippolytus, Melito, and the Gnostics, see Harnack (*Zur Quellenkritik der Gesch. d. Gnosticismus*, Leipsic, 1873), Lipsius (*Die Quellen der ältesten Ketzergesch.*, 1875), Harnack (*De Apellis Gnosi Monarchica*, Leipsic, 1874, and *Texte u. Untersuch.*, vol. i.), Hilgenfeld (*Ketzergesch.*, 1884), and Hagemann (*Die röm. Kirche*, 1864). His relations to the Greek element in general are treated of by Caspari in vol. iii. of his *Quellen zur Gesch. d. Taufsymbols* (1875), and those to the New Testament and primitive Christianity by Rönsch (*Das N. T. Tert.'s*, 1871), Volkmar (in Credner's *Gesch. d. NTlichen Kanon*, 1860), Westcott (*Hist. of the Canon of the N. T.*, 5th ed., 1881), Charteris (*Canonicity*, 1880), Overbeck (*Die Auffassung d. Streits zwischen Petrus u. Paulus bei den Kirchenvätern*, Basel, 1877), Barth ("Tert.'s Auffassung des Ap. Paulus," &c., in *Jahrbb. f. prot. Theol.*, vol. viii.), and Nöldechen ("Ein geflügeltes Wort bei Tert.," in *Ztschr. f. wiss. Theol.*, 1886).

On Tertullian as a Montanist, see Gottwald (*De Montanismo Tert.*, Breslau, 1843) and the accounts of Montanism by Schwegler, Baur, Ritschl, Bonwetsch, De Soyres, Salmon, Harnack, and others; also Nöldechen ("Die Krisis in Karthag. Schleierstreit," in *Ztschr. f. kirchl. Wissensch. u. kirch. Leben*, 1886). On his relation to the creed and rule of faith consult Harnack (*Patr. App. opp.*, i., 2d ed., ii. Appendix, and *Lehrb. d. Dogmengesch.*, vol. i.). His doctrine of the Eucharist has been discussed by Dieringer (in *Der Katholik* for 1864), Leimbach (*Beitr. z. Abendmahlslehre Tert.'s*, Gotha, 1874), and in the standard works on the history of the doctrine generally. For his doctrine of the resurrection, see Oehninger (*Tert. u. seine Auferstehungslehre*, Augsburg, 1878); for his psychology, see *Der Katholik* for May, August, and September 1863, Marton (*Essai sur l'origine de l'âme d'après Tert.*, Strasburg, 1860), Burckhardt (*Die Seelenlehre des Tert.*, Bautzen, 1857), Stöckl (*De Tert. Doctrina Psychol.*, Münster, 1853), and Hauschild (*Tert.'s Psychologie*, Frankfort-on-Main, 1880). On his doctrine of the original state of man, see Wendt (*Die Lehre von d. menschl. Vollkommenheit*, 1882) and Nöldechen (*Ztschr. f. wiss. Theol.*, 1885); and on his doctrine of redemption, see Bordes (*Exposé crit. des opin. de Tert. sur la rédemption*, Strasburg, 1860). The treatise *Adv. Praxean* and his anti-Monarchian polemic are discussed by Lipsius (*Jahrbb. f. deutsch. Theol.*, 1868) and Hagemann (as above), and in the church histories; his conception of the sacraments by Leimbach (*Theol. Stud. u. Krit.*, 1871). His ethical ideas are analysed by Münscher (Henke's *Magazin*, vol. vi., 1796) and Nielsen (*Tert.'s Ethik*, Copenhagen, 1879); the *De Pallio* by Kellner (*Theol. Quartalschr.*, 1870), the *De Patientia* by Nöldechen (*Ztschr. f. kirchl. Wissensch. u. kirch. Leben*, 1885), the *Adv. Judæos* by Semler, Bonwetsch (as above), and Volkmar (in Credner's *Gesch. d. NTlichen Kanon*), the spurious addition to the *De Præscriptione* by the authorities already cited for his relations to Gnosticism and by Lipsius (*Zur Quellenkritik des Epiphanios*, 1865). On the poem *Adv. Marc.*, falsely ascribed to Tertullian, see Hückstädt's monograph (Leipsic, 1875), also the *Ztschr. f. wiss. Theol.*, 1876; on the poem *De Sodoma et de Jona*, see Müller (*Rhein. Mus.*, xxii). The passages of archæological importance in Tertullian are discussed by Leimbach in *Ztschr. f. die hist. Theol.*, 1871, and by Nöldechen in *Ztschr. f. kirchl. Wissensch. u. kirchl. Leben*, 1885; see also Morcellus (*Africa Christiana*, 3 vols., Brescia, 1816), Münter (*Primordia Ecclesiæ Africanæ*, Copenhagen, 1829), and Görres ("Das Christenthum u. der Staat z. Zeit des Kaisers Septimius Severus," in *Jahrbb. f. prot. Theol.*, 1878). Some editions of individual works of Tertullian, as well as philological investigations not mentioned in the foregoing list, will be found particularized in Mayor's *Bibliographical Clue to Latin Literature*, 1875. (A. HA.)

TERUDANT, or TARUDANT. See MOROCCO, vol. xvi. p. 834.

TERUEL, a province of Spain, forming part of the ancient kingdom of Aragon, is bounded on the N. by Zaragoza, on the E. by Tarragona, on the S. by Castellon de la Plana and Valencia, on the S.W. by Cuenca, and on the W. by Guadalajara, and has an area of 2363 square miles. It is intersected from east to west by the mountain chains of Albarracin and Gudar, from which several offsets diverge on either side. The loftiest summit is the Muela de San Juan (5280 feet), which is covered with snow for a great part of the year. These sierras give rise to several large rivers, the principal being the Tagus, the Guadalaviar, the Jiloca, and the Guadalope. Notwithstanding the fertile character of the plains and an abundance of mineral wealth, the trade of the province is unimportant, and civilization in a backward state, owing to the lack of means of transport, the want of enterprise, and imperfect communication with the outer world. The chief products are corn, wine, oil, cheese, fruits, timber, flax, hemp, silk, wool, and saffron, together with cattle, sheep, and swine; while in the busier centres some slight manufacture of coarse cloth, paper, leather, soap, pottery, and esparto goods is carried on. The population of the province in 1877 was 249,000.

TERUEL, the capital and most important town of the above province, is situated on the left bank of the Guadalaviar, 142 miles east of Madrid, and on the high road from Calatayud to Valencia. It is an ancient walled city, fast falling into decay, with narrow gloomy streets and crumbling mediæval houses. Some of the numerous churches are worth seeing, with their paintings by the rarely known 17th-century artist Antonio Visquert, as is also the great aqueduct of 140 arches, raised 1555-60 by Pierre Bedel, a French architect. In the cloisters of San Pedro lie the remains of the celebrated "lovers of Teruel," Juan de Marcilla and Isabella de Segura, whose pathetic story has formed the subject of numerous dramas and poems by Perez de Montalban, Yaque de Salas, Hartzenbusch, and others. The cathedral is Churrigueresque. Teruel was raised to the dignity of a see in 1577, the bishop being suffragan of Zaragoza. The population of the city in 1877 was 9482.

TESCHEN (Polish *Cieszyn*), the chief town of a duchy in Austrian Silesia, is situated on the Olsa, a tributary of the Oder, 34 miles south-east of Troppau. It combines both Polish and German peculiarities in the style of its buildings, and contains five churches, the most interesting of which are the parish church, which formerly belonged to a Dominican monastery, and the Gnadenkirche, one of the Protestant churches built in terms of the treaty of Altranstädt in 1706. The only relic of the ancient castle is a square tower, dating from the 12th century. The manufacturing industry of the town is slight, and, since the construction of the railway *via* Oderberg, Teschen has lost much of the trade formerly commanded by its position near the borders of Silesia, Hungary, Moravia, and Galicia. A flax dressing and spinning factory, a large brewery, and several furniture factories are the chief industrial establishments in the town. The population in 1880 was 13,004.

It was at Teschen that Maria Theresa and Joseph II. signed the peace which put an end to the war of Bavarian succession in 1779. The duchy of Teschen was formerly a more or less direct apanage of the Bohemian crown. For some time it bore the name of Saxe-Teschen (Sachsen-Teschen), owing to the fact that Prince Albert of Saxony, who married an archduchess of Austria, received it as part of his wife's dowry. Prince Albert bequeathed it in 1822 to the emperor of Austria, who bestowed it on the archduke Albert.

TESSIN. See Ticino.

TEST ACTS. The principle that none but persons professing the established religion were eligible for public employment was adopted by the legislatures of both England and Scotland soon after the Reformation. In England the Acts of Supremacy and Uniformity and the severe penalties denounced against recusants, whether Roman Catholic or Nonconformist, were affirmations of this principle. The Act of 7 Jac. I. c. 2 provided that all such as were naturalized or restored in blood should receive the sacrament of the Lord's Supper. It was not, however, until the reign of Charles II. that actual receiving of the communion of the Church of England was made a condition precedent to the holding of public offices. The earliest imposition of this test was by the Corporation Act of 1661 (13 Car. II. st. 2, c. 1), enacting that, besides taking the oath of allegiance and supremacy and subscribing a declaration against the Solemn League and Covenant, all members of corporations were within one year after election to receive the sacrament of the Lord's Supper according to the rites of the Church of England. This Act was followed by the Test Act of 1672 (25 Car. II. c. 2). The immediate cause of the Test Act (the full title of which is "An Act for preventing dangers which may happen from popish recusants") was the king's declaration of indulgence, dispensing with laws inflicting disabilities on Nonconformists. This Act enforced upon all persons filling any office, civil or military, the obligation of taking the oaths of supremacy and allegiance and subscribing a declaration against transubstantiation, and also of receiving the sacrament within three months after admittance to office. The Act did not extend to peers; but in 1678 30 Car. II. st. 2 enacted that all peers and members of the House of Commons should make a declaration against transubstantiation, invocation of saints, and the sacrifice of the mass,—a special exception being made in favour of the duke of York. The provisions of the Test Act were violated by both Charles II. and James II. on the ground of the dispensing power claimed by the Stuart kings. In a well-known case of Godden *v.* Hales (11 *State Trials*, 1166), an action for penalties under the Test Act brought against an officer in the army, the judges decided in favour of the dispensing power,—a power finally abolished by the Bill of Rights. After a considerable number of amendments and partial repeals by the legislature of the Acts of 1661, 1672, and 1678, and of Acts of indemnity to protect persons under certain circumstances from penalties incurred under the Test Act, the necessity of receiving the sacrament as a qualification for office was abolished by 9 Geo. IV. c. 17, and all Acts requiring the taking of oaths and declarations against transubstantiation, &c., were repealed by the Roman Catholic Relief Act of 1829 (10 Geo. IV. c. 7). This general repeal has been followed by the special repeal of the Corporation Act by the Promissory Oaths Act, 1871 (34 and 35 Vict. c. 48), of the Test Act by the Statute Law Revision Act, 1863, and of the Act of 1678 by 29 and 30 Vict. c. 19. Religious tests remained in the English universities until 1871. To be a member of the Church of England was a necessary condition precedent for holding most university or college offices by the Act of Uniformity of 1662, and such offices were not affected by the Toleration Act of 1688 and the Roman Catholic Relief Act of 1829. In 1871 the University Tests Act abolished subscriptions to the articles of the Church of England, all declarations and oaths respecting religious belief, and all compulsory attendance at public worship in the universities of Oxford, Cambridge, and Durham. There is an exception confining to persons in holy orders of the Church of England degrees in divinity and positions restricted to persons in holy orders, such as the divinity and Hebrew professorships.

Scotland.—A religious test was imposed immediately after the Reformation. By 1567, c. 9, no one was to be appointed to a public office or to be a notary who did not profess the Reformed religion. The Scotch Test Act was 1681, c. 6, rescinded by 1690, c. 7. Renunciation of popery was to be made by persons employed in education (1700, c. 3). A motion to add, after the 18th article of union, an exemption of Scotsmen from the sacramental test in the United Kingdom was negatived by the Scottish parliament. A similar fate awaited a proposal that while a sacramental test was in force in England all persons in public office in Scotland should subscribe their adhesion to the Presbyterian Church government. By 1707, c. 6, all professors, principals, regents, masters, or others bearing office in any university, college, or school in Scotland were to profess and subscribe to the Confession of Faith. All persons were to be free of any oath or test contrary to or inconsistent with the Protestant religion and Presbyterian Church government. The reception of the communion was never a part of the test in Scotland as in England and Ireland. The necessity for subscription to the Confession of Faith by persons holding a university office (other than that of principal or professor of theology) was removed by 16 and 17 Vict. c. 89. The Act provides that in place of subscription every person appointed to a university office is to subscribe a declaration according to the form in the Act, promising not to teach any opinions opposed to the divine authority of Scripture or to the Confession of Faith, and to do nothing to the prejudice of the Church of Scotland or its doctrines and privileges.

Ireland.—An oath of allegiance was required by the Irish Act of Supremacy (2 Eliz. c. 1). The English Act of 3 Will. and M. c. 2 substituted other oaths and enforced in addition from peers, members of the House of Commons, bishops, barristers, attorneys, and others a declaration against transubstantiation, invocation of the Virgin Mary and the saints, and the sacrifice of the mass. By the Irish Act of 2 Anne c. 6 every person admitted to any office, civil or military, was to take and subscribe the oaths of allegiance, supremacy, and abjuration, to subscribe the declaration against transubstantiation, &c., and to receive the Lord's Supper according to the usage of the Church of Ireland. English legislation on the subject of oaths and declarations was adopted in Ireland by Yelverton's Act, 21 and 22 Geo. III. c. 48, § 3 (Ir.). These provisions were all repealed by the Promissory Oaths Act, 1871. The Roman Catholic Relief Act of 1793 (33 Geo. III. c. 21, Ir.) excepted Trinity College, Dublin, from its provisions, and tests existed in Dublin university until 1873. They were abolished as far as regarded certain scientific professorships in 1867 by 30 Vict. c. 9, and were finally abolished for the whole university by the University of Dublin Tests Act, 1873, except as to professors of and lecturers in divinity.

United States.—By art. 6 of the constitution, "no religious test shall ever be required as a qualification to any office or public trust under the United States." A similar provision is generally included in the State constitutions.

TESTAMENT. See Will.

TESTIMONY. See Evidence.

TETANUS (from Gr. *τείνω*, I stretch), a disorder of the nervous system, consisting in an increased reflex excitability of the spinal cord and manifesting itself by painful tonic spasm of the voluntary muscles throughout the body. The disease shows itself under various conditions. It occasionally occurs, particularly in tropical countries, without apparent cause, and has thus been known to affect numbers of persons simultaneously (*idiopathic tetanus*).

It is sometimes observed in new-born children (*trismus neonatorum*) and in parturient women (*puerperal tetanus*). But by far the greater number of cases occur in connexion with a wound or other injury, more especially in the extremities, probably implicating some of the peripheral nerves. Certain forms of injury, as punctured, lacerated, and gunshot wounds, are more liable to be followed by tetanus than others. In many cases the liability bears no proportion to the extent of the wound. Exposure to cold after injury is an important exciting cause. The symptoms of tetanus in its most usual forms generally appear during the healing process of a wound, but occasionally they arise after cicatrization is completed. Sometimes they are preceded by appearances of irritation in the wound or its neighbourhood, but this is exceptional. The earliest indications of the disease usually show themselves, no matter where the wound is situated, by stiffness about the muscles of the jaw, causing difficulty in opening the mouth, which soon increases to lockjaw or trismus. This is accompanied by spasm in neighbouring muscles, and the drawn features and exposed teeth give to the countenance the peculiar expression known as *risus sardonicus*. The rigidity extends to the muscles of the neck, back, chest, abdomen, and extremities, and the body frequently assumes a bent attitude, either backward (*opisthotonos*), forward (*emprosthotonos*), or laterally (*pleurosthotonos*). This general muscular rigidity, which at first is not constant but occasionally undergoes relaxation, is accompanied by frequently recurring convulsive seizures, which are readily excited by the slightest irritation, such as from a draught of cool air, a bright light, the closing of a door, &c. In such attacks there is great suffering and the expression of the face is indicative of agony; and the function of respiration may be seriously involved and asphyxia threaten or actually take place. The temperature of the body sometimes rises to a high degree. The attack is usually acute and after a few days either passes off or, as is more frequent, terminates fatally, either by asphyxia from tonic spasm of the respiratory muscles or from exhaustion consequent on the violence of the symptoms together with the absence of sleep. Throughout the whole course of the disease the mind is clear. In idiopathic tetanus the symptoms are less severe, the course more chronic, and recoveries more common than in those which depend upon a wound or injury. The puerperal form, with symptoms which differ in no way from those described, is rare and occurs either after parturition or after abortion. Tetanus in new-born children, also a rare form, usually shows itself a day or two after birth by obvious difficulty in the acts of sucking and swallowing; by the supervention of trismus, together with tonic contraction of the muscles of the limbs and body, sometimes accompanied by convulsive seizures; and by a peculiar low whining cry, seldom absent and very characteristic. Various opinions have been held as to the cause of this form of tetanus, some referring it to the wound produced by severance of the umbilical cord, others to pressure upon the bones of the head in parturition, &c. It has not yet been satisfactorily explained. Although sometimes recovered from, it is usually fatal.

The symptoms of poisoning by strychnine bear a strong resemblance to those of tetanus. They are, however, more acute and develop in connexion with something which has been taken; further, the absence of a wound and the fact that the spasm affects the muscles of the extremities first, and not those of the jaws, as in tetanus, serve to establish the diagnosis. In HYDROPHOBIA (*q.v.*), which in certain of its symptoms resembles tetanus, the absence of trismus, the dread of water, and the violent spasms on attempting to drink, together with the history of the case, readily enable a distinction to be made. Various other forms of nervous disease accompanied by tetanic symptoms, such as cerebro-spinal meningitis, hysteria in some forms, &c., may be still more clearly distinguished from true tetanus.

The pathology of tetanus is referred to in the article PATHOLOGY (vol. xviii. p. 391). No constant changes are observed in the body after death from tetanus. The most common are great dilatation of the blood-vessels of the spinal cord and sometimes evidence of inflammatory action, but these are probably the effects of the symptoms rather than their cause.

For the treatment of tetanus many remedies have been employed. Where a source of irritation in or about a wound can be made out, it ought to be dealt with by the surgeon. Of medicinal agents those which diminish the reflex excitability of the spinal cord and relax the spasm are to be recommended. But it is not safe to employ all substances which produce these effects. Thus tobacco and its active principle nicotine act powerfully in this way, but they are attended with danger from their poisonous properties, and the same may be said of curari, conium, calabar bean, &c., all of which have been used in tetanus. Opium carefully administered sometimes produces a markedly beneficial effect, as does also Indian hemp. Chloroform or ether inhalation greatly mitigates the severity of the spasm. Chloral hydrate and bromide of potassium or ammonium are among the most useful agents which can be employed, and they may be given separately or, still better, in combination. As adjuvants, the warm bath, the absence of all noise and excitement, and the maintenance of the strength by appropriate nutriment should not be neglected.

TETRARCH (*τετράρχης*), the ruler of a tetrarchy (*τετραρχία*), that is, in the original sense of the word. of one quarter of a region. The title of tetrarch is familiar from the New Testament as borne by certain princes of the petty dynasties which the Romans allowed to exercise a dependent sovereignty within the province of Syria. In this application it has lost its original precise sense, and means only the ruler of part of a divided kingdom, or of a region too narrow to support a higher title. After the death of Herod the Great (4 B.C.) his realm was shared among his three sons: the chief part, including Judæa, Samaria, and Idumea, fell to Archelaus (Matt. ii. 22), with the title of ethnarch; Philip received the north-east of the realm, and was called tetrarch; and Galilee was given to Herod Antipas, who bore the same title (Luke iii. 1). These three sovereignties were reunited under Herod Agrippa from 41 to 44 A.D. Another tetrarchy is mentioned in Luke iii. 1, viz., that of Lysanias in the little district of Abilene, near Damascus, in the valley of the Barada. An inscription of this Lysanias is given in *C. I. Gr.*, 4521.

See Renan, *Mém de l'Acad.*, xxvi. 2 (1870), p. 49 *sq.*

TETUAN (*Teṭṭáwin*), a town of Morocco, about 23 miles south-south-west from Ceuta and 44 south-east from Tangiers, is picturesquely situated about 9 miles inland on the steep slope of a hill, behind which rise the bold Rif Mountains. It is surrounded by walls flanked with towers, and has on the summit of the hill a castle which is the residence of the governor. The streets are narrow, unpaved, and dirty, and with few exceptions the houses are poor. Some of the numerous mosques, however, are handsome. The principal manufactures are gun-barrels, coarse woollen cloths, and woollen and silk sashes. The harbour of Tetuan, at the mouth of the Martil, allows only small vessels to cross the bar, and the roadstead is much exposed to the east. There is some export trade in cattle, grain, fruit, leather, and wool, principally to Gibraltar. The population of Tetuan is estimated at about 20,000 (5000 Jews).

Tetuan is said to have been founded in 1492 by refugees from Granada. It was taken by storm on 4th February 1860 by the Spaniards under O'Donnell, but restored to Morocco when peace was concluded.

TEUTONES, or Teutoni, a powerful German tribe, first appearing in history along with the Cimbri (*q.v.*). They are again mentioned at a later period by Pliny (*H.N.*, xxxvii. 11) and others as inhabiting a district in the north-west of Germany to the north of the Elbe. The name of Teutones was never employed either by the Germans themselves or by the Romans as a general name for the whole German nation.

TEUTONIC LANGUAGES. See Germany (vol. x. p. 514 *sq.*); also English Language, Goths (vol. x. p. 852 *sq.*), Scandinavian Languages, Frisians, and Holland (vol. xii. p. 84 *sq.*).

TEUTONIC ORDER, The, or Teutonic Knights of St Mary's Hospital at Jerusalem (*Deutscher Orden, Deutsche Ritter, Orden der Ritter des Hospitales St Marien zu Jerusalem*), is one of the three great military and religious orders to which the crusades gave birth. Its name is derived from a German hospital founded at Jerusalem in 1128, which disappeared on the capture of the Holy City by the Saracens in 1187. The pity excited in the minds of some German merchants by the sufferings of the Christian soldiers at the siege of Acre in 1190 induced them to revive the work of this society under a somewhat different form; and eight or nine years later the society, as thus resuscitated, was converted into a military order. Like the two other military orders, the Teutonic order adopted the Augustine rule of life; and, in addition to the ordinary monastic vows, the members laid upon themselves the special obligations of tending sick and wounded pilgrims and of fighting the pagans. Frederick, duke of Swabia, took the young order under his protection, and it soon received charters from the pope and emperor, entitling it to the same privileges as the Templars and Knights of St John. Whatever was the case at first, the members of the order were ultimately required to be Germans of honourable birth. Priest brothers were introduced about 1220, and afterwards half-brothers, like the *frères servants d'armes* of the other orders, who did not require to be of noble birth, and might, to some extent, continue their ordinary secular occupations. The distinguishing garb of the order consisted of a white mantle with a black cross.

Almost at once a rich stream of benefactions of all kinds began to flow into the coffers of the order, which gradually acquired extensive territories in Palestine and also in Germany and other parts of Europe. Its first seat was at Acre, and the first grand-master was a Rhenish knight named Herman Walpot of Bassenheim. The order rose to great power and influence under Herman von Salza (*q.v.*), who held the office of grand-master from about 1210 to 1239, and enjoyed the fullest confidence of both emperor and pope. He was also keen enough to see the hopelessness of the attempt to expel the Mohammedans from the Holy Land, and eagerly hailed the opportunity of transferring the activity of the order to another sphere which was afforded by the invitation to undertake a crusade against the heathen Prussians. The successful progress of this crusade, the aggrandizement thereby accruing to the order, and its subsequent decline have already been narrated in the article Prussia (vol. xx. pp. 5-6). Soon after the beginning of the struggle, in 1237, the Teutonic order absorbed the order of the Brothers of the Sword, a union which brought Courland, Semgallen, and Livonia to swell its territories. In 1291, when Acre, the last stronghold of the Franks in Palestine, fell the order removed its headquarters to Venice; but, when its centre of gravity became so obviously shifted to the extensive territories won from the Prussians, the seat of government was transferred (1309) to Marienburg (*q.v.*) on the Vistula, where a splendid castle was erected for the grand-masters. The grand-mastership of Weinrich von Kniprode (1351-82) is the most prosperous period in the history of the order. Its territorial possessions far exceeded those attained by either of the rival orders, stretching from the Oder on the west to the Gulf of Finland on the east, and containing a population of two to three million souls. Its government at first was excellent, and for a time it may be said to have played the leading rôle in the political history of northern Europe. Wherever the order spread, Christianity and German national life were introduced. Its revenues were very large, and its ranks were kept full by hosts of aspirants to a share in its pious and lucrative crusades.

So long as the order maintained its own high standard all went well with it. But its internal decay was synchronous with external events that would alone have been extremely perilous. The union of Poland and Lithuania in 1386 raised up a jealous neighbour, whose power it was wellnigh impossible in the long run to resist, while the nominal conversion of the latter to Christianity struck at the root of the order's prosperity by depriving it of its mission. When there were no more heathens within reach to convert and despoil, the chief attraction to outsiders to join its ranks disappeared. After the conversion of Prussia into a secular duchy the Teutonic order still continued to exist as an ecclesiastical organization, possessing eleven bailiwicks in different parts of Europe, with a total area of 850 square miles and 88,000 inhabitants. The headquarters were fixed at Mergentheim in Swabia. Its political importance was of course now a thing of the past, and the scattered position of the bailiwicks only emphasized its weakness. In 1801 the bailiwicks to the west of the Rhine were absorbed by France, and in 1809 the order was entirely suppressed by Napoleon, its lands going to the secular principalities within which they lay. In 1840 the order was resuscitated in Austria, where it now exists as a semi-religious knighthood, presided over by a royal archduke. Of late it has been doing something towards justifying its existence and connecting itself with its past history by engaging in the ambulance service in time of war. The bailiwick of Utrecht, which survived the decree of Napoleon, also still exists, but the Dutch representatives of the order have become Protestants. The jewel of the order consists of a black and white cross, surmounted by a helmet with three feathers.

The complete organization of the Teutonic order included a grand-master (*hochmeister*), provincial masters (*landmeister*) for the greater provinces, and commanders (*komturen*) for the smaller districts and castles. The power of these officers was not, however, absolute. The grand-master co-operated with a chapter consisting of the provincial masters and five other important functionaries, while the provincial masters in turn had to consult with the council formed by the knight commanders. The privileges enjoyed by the order in its palmy days were of the most extensive nature, and its relations to both church and state were often of a most exceptional nature.

See Voigt, *Gesch. d. Deutschen Ritterordens* (1857-59); Lohmeyer, *Gesch. v. Ost- u. West-Preussen* (vol. i., Gotha, 1881); and E. Strehlke, *Tabulæ Ordinis Theutonici* (Berlin, 1869).

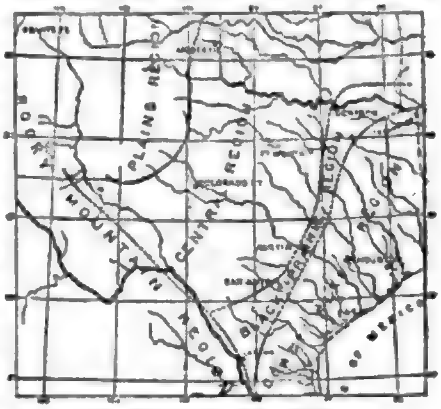
TEWKESBURY, an ancient borough and market-town of Gloucestershire, England, is situated in a fine pastoral valley at the junction of the Severn and the Upper Avon, and on the Midland and Great Western Railways, 15 miles south of Worcester and 126 north-west of London. It has three principal streets, which are regularly built and well paved. The Severn is crossed by an iron bridge with a flattened arch of 170 feet span, erected by Telford in 1824. Of the great Benedictine abbey, one of the richest foundations in England, refounded and enlarged by Sir

Robert Fitz-Hamon in the 12th century on the site of the ancient hermitage and Saxon monastery, there only remain the gate and part of the cloisters. The abbey church, consecrated in 1125, is a magnificent specimen of Early Norman. This elaborate cruciform building consists of nave and side aisles, with transepts united by a grand central tower richly arcaded. The choir terminates in an apse and is surrounded by an ambulatory. One of the most remarkable features of the building is the unique western front, the central part of which is occupied by one vast arch extending from the ground to the roof. Originally it was filled in with Norman windows, but these were removed in the 14th century, when the whole building underwent restoration in the Middle Decorated style, of which it is one of the finest existing examples. The nave was refilled by tracery windows, and stone groining was substituted for the carved wooden ceiling, a like transformation taking place in the transepts. The old Norman columns in the choir still exist; but above them rises a grand superstructure of Decorated work. The elegant clerestory windows are of the 14th century, with stained glass of the same date. The ambulatory was rebuilt some distance farther out, and from it projected a beautiful series of chapels. The elaborate tombs include those of Sir Robert Fitz-Hamon, the De Spensers, Alan prior of Canterbury, Sir Guy de Brien, and the vault of George duke of Clarence (murdered in the Tower) and his wife Isabella. Edward, prince of Wales, slain after the battle of Tewkesbury (1471) by the Yorkists, is also buried in the church, which has undergone an extensive process of restoration under the direction of Sir Gilbert Scott. In the High Street there are several ancient timbered and gabled houses. Remains of an ancient wall have been discovered adjoining the town. The principal modern buildings are the town-hall, the philharmonic hall, and the corn exchange. There is a free grammar-school and a number of charities, including the dispensary, the rural hospital, and Queen Mary's, Barnes's, Richardson's, and Russell's almshouses. Formerly Tewkesbury had a woollen trade and an important mustard manufacture, but it is now chiefly dependent on its agricultural trade. The population of the municipal borough (area, 2619 acres) in 1871 was 5409, and in 1881 5100.

The town is supposed to derive its name from Theoc, a Saxon monk, who founded a hermitage here in the end of the 7th century, which was changed into a monastery by the duke of Mercia in 715, and rebuilt by Sir Robert Fitz-Hamon in 1102. On the death of Fitz-Hamon in 1147 the manor passed to the De Clares, who became merged in the De Spensers, they in turn in the Beauchamps, and the Beauchamps in the Nevilles. At Tewkesbury took place, 4th May 1471, the battle between the Yorkists and Lancastrians which placed the crown on the head of Edward IV. During the Civil War the town was occupied by the Parliamentarians, who were driven out by the Royalists; but it was surprised and captured by the former in 1644, after which it remained in their possession. Tewkesbury was first incorporated by Elizabeth in 1574, and when James I. sold the manor to the corporation in 1609 he granted it a new charter with extended privileges. This being lost during the Civil War, a new charter was granted by Charles II. Between 1692 and 1698 the town was without a corporation, but a new charter was granted by William III., which remained the governing charter until the passing of the Municipal Act. Until 1867 Tewkesbury returned two members to the House of Commons; from 1867 to 1885 it returned one; and in 1885 it became merged in the north or Tewkesbury division of Gloucestershire.

The *Annales de Theokesberia* (1066-1263) are published in *Annales Monastici*, edited by H. R. Luard, 1864.

Plate III. Boundaries. **TEXAS**, the largest in area and the eleventh in population of the United States of America, is bounded by the Gulf of Mexico on the S.E., by Louisiana and Arkansas on the E., by Arkansas and the Indian Territory on the N., the latter extending north of its northern prolongation (the Panhandle), by New Mexico on the W. and N. of its western prolongation (the trans-Pecos region), and by Mexico on the S.W. Its area in 1880 was 262,290 square miles, or one-eleventh (nearly 9 per cent.) of the entire area of the United States. The extreme length is 740 miles, the breadth 825, and the coast line 400 miles. The boundaries, as recognized by the United States Government,[1] are—the Gulf of Mexico from the Rio Grande to the Sabine river, the Sabine river to 32° N. lat., thence the meridian of 94° 10′ to the Red river of Louisiana, thence following that river west to its intersection with the 100th meridian, thence north to lat. 36° 30′; thence west to 103° W. long., thence south to lat. 32°, thence west to its intersection with the Rio Grande, which river constitutes the south-western border of the State to the Gulf of Mexico.


Map showing geographical divisions.

Physical features and divisions. The surface features are exceedingly varied, the prevailing elements being steppes or treeless plains in the north-west, mountains west of the Pecos river, forests in the east, marshes adjacent to the coast, low prairies in the south-east, and a combination of prairies and broken hills, interspersed with forest growth and thickets of tall shrubs (chaparral), in the centre These regions are classified as follows (see map below). (1) The coast plain is the direct geographical and geological continuation of the other States which border on the Gulf of Mexico. It includes all the country east of a line concentric with the coast, drawn from Texarkana in the north-east corner of the State to near Laredo on the Rio Grande. The general direction of its slope, in common with that of the rest of the State, is from north-west to south-east. Its altitude ranges up to 500 feet. The immediate coast strip is newly made marshland; west of this and north of the Colorado river are forests; and to the south of it the country is mostly a plain. (2) The black prairie region succeeds the coast plain on the west. Its western border is sharply defined from the Red river to the Rio Grande, beginning at Denison, passing through or near the cities of Sherman, Dallas, Waco, Austin, and San Antonio, and then deflected westward to Eagle Pass. It is a gently undulating prairie, covered with a rich black soil, and varies in altitude from 300 to 700 feet. (3) The central region extends from the black prairie region on the east to the eastern escarpment of the great plains on the north-west and the trans-Pecos mountains on the south-west. This is the only region of Texas which is not the direct continuation of the physical features of some adjoining political division. A great variety of conditions is embraced within its bounds. In its north-eastern part are two long belts of stunted forest (the Cross Timbers), extending from the Red river to the Brazos, and separated by a prairie 50 miles in width. This is the most fertile portion of the entire region. West of this sub-region and north of the Colorado is a broken, arid country (the Coal-measures), having a sandy, pebbly soil, covered with a scattered growth of vegetation. West of this, between the 100th meridian and the escarpment of the plains, is the gypsum country, consisting of the so-called "red beds" of the western United States, accompanied by massive deposits of gypsum and other salts. This country is much sculptured by erosion, and in places resembles the "bad lands" of the upper Missouri country. There are also extensive intervals of prairie here. Near the centre, in the counties of San Saba, Mason, and Llano, is a rough, semi-mountainous area of older formations. The southern half of the central region is a broken country of white limestone formation, semi-tropical in climate, and covered with scraggy vegetation, its physical features graduating into those of northern Mexico. The south-western part is a rolling plain, entirely destitute of streams. Throughout the region, at intervals of many miles, low, truncated hills (*buttes*) occur, representing the remains of limestone formations now being rapidly eroded. The region, as a whole, is poorly watered. It is best adapted for cattle and sheep raising, and is the chief locality of those industries in Texas. The altitude varies from 700 to 2500 feet. (4) The plains region is the portion of the State west of the 101st meridian and north of the thirty-second parallel, commonly known as the "Staked Plain" (Llano Estacado). It is the direct southern continuation and termination of the great plains of the North American continent which extend along the eastern slope of the Rocky Mountains from British America to the Rio Pecos. The eastern edge is well marked by a steep escarpment, which, in consequence of destructive erosion, is constantly receding to the westward. The surface is smooth, and utterly devoid of forest growth or streams of water. But there are many small ponds or lakes, and in the southern part these are saline. The soil is light, rich, and porous, and is covered with a good growth of grass. Until a few years ago this region was totally unpeopled, but many portions of it are now (1887) used for grazing purposes, water being secured by means of wells or artificially constructed reservoirs. The altitude ranges from 2500 to 4000 feet. (5) The trans-Pecos or mountainous region west of the Pecos river is composed of numerous mountain peaks and ranges, with intervening valleys of many miles in width. It is poorly watered, and the population outside the immediate Rio Grande valley is very sparse. The general level of the country is from 3000 to 5000 feet.

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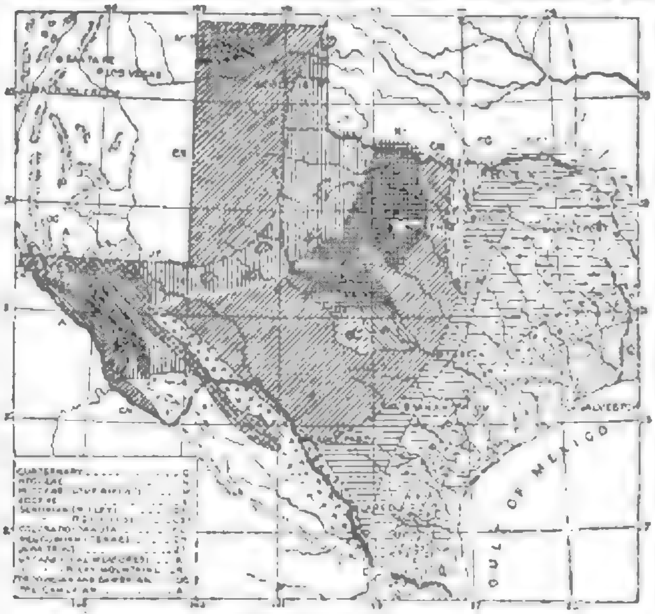
[1] The State does not recognize the South Fork of the Red river as the northern boundary, but insists upon the North Fork; it also claims the 100th meridian as laid down upon Mellish's map (100 miles east of the true meridian) as the eastern border of the Panhandle.

Rivers. The rivers are separable into several sub-systems. The Rio Grande and the Arkansas, constituting the north and south limits of the Texas drainage system, with their respective tributaries, the Pecos and the Canadian, originate in a limited district of northern New Mexico and Colorado, and ultimately reach the sea at points a thousand miles apart. The Canadian and the Pecos have cut deep cañons through the Llano Estacado. The former continues eastward through Indian Territory, and the latter southward, joining the Rio Grande between 101° and 102° W. long. on the southern border of the State. The Rio Grande and the Pecos receive no tributaries of importance in Texas, but are constant in their flow. The next and most important group comprises the Red, the Brazos, and the Colorado, all of which originate along the eastern border of the Llano. They traverse similar regions, and have a general resemblance in character of sediment, irregularity of flow, velocity, and topography of drainage basins. Their brackish water is principally derived from the sudden precipitation of rainfall along the gypsiferous escarpments of the Llano. Its volume is ordinarily small, the flow often ceasing entirely west of the black prairie region. There are periodic freshets, however, which suddenly swell the volume to enormous proportions. These freshets, laden with the rich red loam of the plains, usually reach the lower inhabited sections of the State in periods of drought, and are termed "red rises." Much of this sediment is deposited upon the flood plane of the lower valleys, and by this process the most valuable sugar and cotton lands of the coast plain have been built up. Another important group consists of the Sabine, the Trinity, the San Marcos, the Guadalupe, and the Nueces, most of which have their origin near the western border of the black prairie region. These streams have a greater volume and are more constant in flow than any others, and are usually without deep cañons or wide bottoms. Many of them, especially those south of Austin, have their origin from large springs situated along the foot of the escarpment line extending from Austin southwestward. Another subsidiary system of streams originates in the narrow Quaternary region along the coast, within the district of the greatest rainfall. Those streams are tidal, and sometimes navigable towards their mouths. Most of them are locally known as bayous. In general, the rivers of Texas are not adapted for irrigation or navigation. Neither do they afford much available water power north of Austin.

Geology. The entire geologic series, with a few exceptions, is represented in Texas. The earlier Palæozoic rocks, including the pre-Cambrian (Keweenawian; A in accompanying geological map), the Potsdam (oc), and the Ordovician (oc), up to the Trenton, underlie the State, but are only exposed in two limited districts. The first of these is in the counties of Mason, Llano, Burnet, and San Saba in the central region; the other is in the disturbed mountainous portion of the trans-Pecos region. The Cambrian was deposited horizontally upon the upturned Keweenawian, and the Ordovician appears to rest conformably upon the Cambrian (Potsdam); but there was a continental elevation of the whole region, probably commencing at the close of the Trenton epoch, which continued until the beginning of the Coal-measure epoch, for the Upper Silurian, Devonian, and sub-Carboniferous are absent, and the earlier rocks are disturbed. These earlier Palæozoic sediments present no marked stratigraphical or palæontological differences from the same formations throughout the continent, and thus show the widely distributed uniformity of conditions which then existed. At the commencement of the Carboniferous period, however, that marked difference of faunal, lithological, and stratigraphical features began which distinguishes the synchronous deposits of the later formations of the western and eastern portions of the United States. The Texas region has been the transition ground, and hence all the geologic deposits, beginning with the Carboniferous, have two faces, dependent upon their geographical position east or west of 100° W. long., and representing the sediments either of interior-continental basins or of the waters of the Atlantic during alternating periods of submergence and emergence. The Carboniferous rocks, and most of the succeeding formations, are exposed in two widely separated portions of the State, with entirely different lithological and faunal aspects. The mutual relations of these series have never been traced. The first occurs in the central region between 97° and 100° W. long., north of the Colorado river, and consists of clays, sandstones, conglomerates, limestones, and coal seams of workable thickness. It is the south-western prolongation and termination of the Coal-measures of the eastern United States. These rocks, although in general similar to them, differ in some respects from those of the same formation further east, and also exhibit a few resemblances to the strictly marine Carboniferous of the Rocky Mountain region (K^2). To the other series belongs the trans-Pecos Carboniferous (K^1). Although this is of the same geologic age as the eastern Coal-measures, it is a purely marine deposit of limestones and sandstones, and is barren of vegetable remains. It is exposed along the Guadalupe and other mountains of the trans-Pecos region, forming the most eastern outcrops of the non-coal-bearing Carboniferous of the west. The study of the areal distribution and relation of the strata intervening between the Carboniferous and the fully-identified Cretaceous in Texas has not been begun. The Permian, Triassic, and Jurassic, if they exist, have not been clearly diagnosed, although these names have been applied to the series of rocks west of the central Carboniferous region. The thickness of the sediments belonging to these undetermined strata is very great. They are mostly unfossiliferous, and the presence of stratified gypsum and other salts indicates that they were laid down in an interior basin cut off from oceanic waters and were too highly concentrated for the existence of molluscan life. Certain of these deposits, known as "red beds" or "Jura-Trias" (JT), extend beneath the Llano Estacado, across New Mexico, and into Arizona. The Cretaceous is by far the most conspicuous and extensive of the geologic formations of the State. It once covered the entire territory, but has been eroded away in many places west of the black prairie region, exposing the older formations, and is covered to the east of that region by more recent deposits. From the fact that the lowest member of the series is found resting directly upon the pre-Cambrian in Llano county, the Carboniferous in Lampasas and the counties northward, the Silurian in the trans-Pecos region, and the Jura-Trias beds in the plains region, it is evident that its beginning marked a period of continental submergence, and that this submergence, from the great thickness of pelagic sediments in it, was long continued. The lowest member of the series, the oldest known of the American Cretaceous, is unknown elsewhere in the United States, and its peculiar features give individuality to the central region. This member (CN), which may be called the Texas group, is the equivalent of the Neocomian of Europe, and many of its fossils are common to Europe and America. It is not exposed east of the central region, except (probably) in the salines of Louisiana. There was a great elevation of this deep-sea formation at its close, as is attested by the shallow water sediments of later groups deposited unconformably upon it. The Middle (cc, cs^1) and the Upper Cretaceous (cs^2 and cs^1) are also well exposed. The black prairie region is underlain by the middle and upper groups of the marine Cretaceous characteristic of the other Gulf States and known as the Rotten Limestone (cs^1) and Ripley (cs^1) groups. The Cretaceous groups of the Rocky Mountain region extend into Texas, and are exposed in the trans-Pecos region and along the lower Rio Grande. The



Geological map of Texas.

Tertiary formations, so far as recognized, are purely marine, and, like the marine Upper Cretaceous of the black prairie region, are the direct geographical continuation of the formations of the other Gulf States. They occupy the coast plain, in bands approximately concentric with the shore of the Gulf of Mexico, and represent the sediments of its receding waters. The alleged occurrence of the fresh-water Miocene, the Loup river group (M), upon the Llano Estacado has not been demonstrated. Quaternary (Q) and other recent alluvial deposits occur along the coast and the upper terraces of the three older river systems as far west as the eastern border of the central region. This is attested by the character of the deposits, accompanied by well-authenticated remains of the elephant and mastodon. These Quaternary soils are mostly the redeposited detritus of the strata of the eastern escarpment of the Llano Estacado, which is carried down by the "red rises." The surface features of the central region are the result of sub-aerial denudation. The black prairie is protected from this destructive erosive process by the tenacious character of its soil; and the coast plain is covered by a luxuriant forest growth, and is constantly extending eastward by the recession of the shore line. The final emergence of the State began in Middle Cretaceous time, and was connected with the same movements that brought up the Rocky Mountain system. The strata of Texas, except the Palæozoic groups, are soft, and yield readily to disintegration. A few eruptive sheets are found in the trans-Pecos region and along the lower Rio Grande, being remnants of the eastern edge of the great eruptive area of the Rocky Mountain region. Granitic masses occur, as extrusions from the pre-Cambrian, in the central and trans-Pecos Palæozoic deposits.

Mountains. The eastern ranges of the Rocky Mountain system are deflected towards the Gulf of Mexico after passing south of 33° N. lat., and take a south-easterly course through Texas into Mexico, the trend of their axes being generally parallel to the direction of the Rio Grande and its principal tributaries. The only true mountains in Texas are situated west of the Pecos, with the exception of a few foot-hills (*lomitas*) which re-enter the State from Mexico near Eagle Pass and follow the river to an undetermined point below Laredo. The principal ranges are the Guadalupe, Limpia, Chinali, Los Chisos, Organ, and Franklin Mountains. They are composed of older rocks, in most places; the later formations have been washed away, except where protected by eruptive flows. The most eastern and northern of these mountains are usually the highest. Guadalupe Peak is 9000 feet; Limpia Peak and the crest of the Chinalis, from 3500 to 8000 feet; Eagle Mountains, 7000; and the intervening valleys from 3500 to 5000 feet. The low buttes of the central region are miscalled mountains upon most maps. There are several well-defined escarpments extending for long distances, approximately north and south. The step of the first of these, from Austin to Eagle Pass, is from 200 to 500 feet high, and is the result of an elevation at the close of the early Cretaceous period. Near the 100th meridian another escarpment occurs, and along the eastern and southern borders of the Staked Plain still another. The western part of the coast plain has a few low hills. The rest of the State has no notable prominences.

Minerals. The mineral resources of Texas have not been mapped or studied, and hence the State ranks last in mineral products. The trans-Pecos region is rich in silver and lead ores; but the State owns the mineral rights of nearly all the land, and has hitherto declined to open them to development. Only one mine is worked here. Silver and gold have also been discovered and mined in Llano and Mason counties, but without successful results. Gold occurs throughout the marine limestones of the lowest (Texas) group of the Cretaceous, but not in sufficient quantity for profitable extraction. Rich but not abundant copper ores occur in the drift of the gypsum country. Iron ore is found in the Tertiary of eastern Texas, and is profitably reduced in a few charcoal furnaces by the aid of convict labour. At present these are remote from coal and suitable means of transportation. Magnetic iron ore occurs in the pre-Cambrian rocks of Mason county, and recent analyses show it to be equal in quality to the best Swedish ores. It is in great abundance, but remote from means of transportation and fuel. Ores of iron (sphæro-siderite) occur in the central Carboniferous formation, but their commercial value is unknown. The non-metals occur in great abundance in different portions of the State, including salt, gypsum, magnesium sulphate, natural cements, kaolin, and other clays. The unutilized beds of massive gypsum are, with the exception of those of the Sahara and the Andes, the purest and most extensive in the world. Salt is gathered from lacustral deposits or mined at El Paso, Colorado City, and along the lower Gulf coast for local use. The coals of the central Carboniferous area have been worked to some extent, but are generally of inferior quality, having from 50 to 70 per cent. of ash. Very recent discoveries of better quality have been reported. Tertiary fibrous lignite, of light specific gravity, is found in great abundance all along the junction of the coast plain and black prairie regions. It is worked to a small extent, but has no commercial value. The most important coal area is the semi-bituminous lignite belt of the trans-Pecos and lower Rio Grande regions, which is the direct geographical continuation of the late Cretaceous coals of New Mexico and Colorado. It is worked at Eagle Pass and Santa Toma, near Laredo. The beautiful marbles and other ornamental stones of the State are untouched, with the exception of the Llano county granite.

Clim The amount and regularity of the rainfall decreases inland, the mean annual varying from 52·3 inches at Galveston to 13 at El Paso in the extreme west and 23 at Mobeetie in the extreme north. The subjoined table gives the mean temperature and rainfall of certain representative localities:—

Station.	Altitude in feet.	Mean Annual Temp.	Mean Precipitation in Inches.				
			Spring.	Summer.	Autumn.	Winter.	Annual.
Coast Plain.							
Gilmer	..	..	13·36	9·93	11·57	10·93	45·79
Galveston	..	70·02	..	..	..	..	52·30
Indianola	..	70·01	..	..	..	..	38·72
Palestine	..	65·	..	..	..	..	47·00
Black Prairie Region.							
Denison	800	64·03	..	..	..	..	40·50
Austin	650	67·84	8·61	7·94	10·74	6·28	33·32
San Antonio	600	63·00	6·77	8·91	9·30	6·32	31·30
Central Region.							
Fort Belknap	1600	..	6·41	9·44	8·34	3·86	28·50
" Chadburne	2020	..	5·77	6·53	7·06	3·32	22·28
" Griffin	..	..	4·95	6·25	6·14	4·17	21·51
" Clark	1000	..	4·14	7·57	6·35	4·35	22·61
" Duncan	..	..	3·56	8·00	6·64	2·63	21·53
" Inge	845	..	5·38	9·67	6·88	3·53	25·46
" Mason	1200	..	6·36	10·44	8·23	3·96	28·98
" Makavet	2060	..	5·40	6·71	7·18	4·22	23·51
Plains Region.							
Fort Elliott	..	54·6	..	..	..	..	23·90
" Concho	..	63·6	..	..	..	..	30·90
Trans-Pecos Region.							
El Paso	3800	63·2	..	..	..	..	13·00
Fort Stockton	4950	62·8	..	..	..	..	20·00
" Davis	4700	59·8	..	..	..	..	20·38

The coast plain and the black prairie regions have abundant rainfall for agricultural purposes. It decreases, however, to the west, and varies greatly in different years, sometimes being ample; but in 1885-86 it did not average 10 inches. The precipitation is also very sudden, seldom lasting more than a few minutes at a time. Only 52 per cent. of the 20 inches of rainfall in the central region and west of it falls in the agricultural season, one-half being in summer and the remainder in autumn, so that it is equivalent to only 15 inches in regions where the rainfall occurs in more propitious seasons. This condition is, however, especially favourable for grazing. There are few statistics of the plains region; but the rainfall along its eastern escarpment is slightly greater and more regular than that of the central region. The temperature varies greatly throughout the State, both in extremes and means. Fort Ringgold on the lower Rio Grande is the hottest point in the United States, except Key West, Fla. Its mean temperature is 73·4° Fahr.; that of El Paso is 63°, and of Mobeetie 54·6°. The prevalent winds are southerly and south-easterly, and blow constantly across the State, without which its summers would be unendurable. The Rio Grande valley is not subject to frosts. Snow seldom falls south of Galveston and Austin. In the Panhandle the winters are severe.

Fl The arboreal flora of Louisiana and Arkansas extends into north-eastern Texas, conformable with the coast plain, where, immediately south of the Colorado river the great pine belt of the Atlantic and Gulf coasts terminates. The flora of the great plains region, principally consisting of nutritious grasses, enters the north-western portion of the State and extends south to the 32d parallel and east to the 101st meridian. The peculiar plants of the Rocky Mountain plateaus penetrate into the trans-Pecos region, while the north Mexican flora is found along the Rio Grande. The central region is a transition ground where these floras find representation generally in deteriorated and dwarfed species. In the coast plain occur the long and short leaf pine, with many species of oak and hickory. The black prairie region is destitute of trees, except scattered individuals of live oak and the mesquite bush (*Prosopis glandulosa*). The broad river valleys of this region, however, are well-timbered with pecan, cypress, cottonwood, and several species of oak, and have a vigorous growth of smaller shrubs. West of the black prairie region the dwarfed, stunted trees are of little value except for fuel. The river valleys have the same character of trees as further east, but the rocky highlands are covered with scraggy bushes (chaparral) of oak, juniper, and cedar. The summits of the Guadalupe and Limpia ranges, in the trans-Pecos region, are clothed with forests of the yellow (*Pinus ponderosa*), flexible (*P. flexilis*), and nut pine (*P. edulis*), all of which attain great size. Many smaller trees grow on these mountains. The valleys and several of the ranges in the last-named region, however, are destitute of trees. The entire Rio Grande valley, from El Paso to Brownsville, grows many species of cactus and other prickly, coriaceous shrubs. The grasses of the State are especially numerous in species, and are found most luxuriantly on the prairies of the lower

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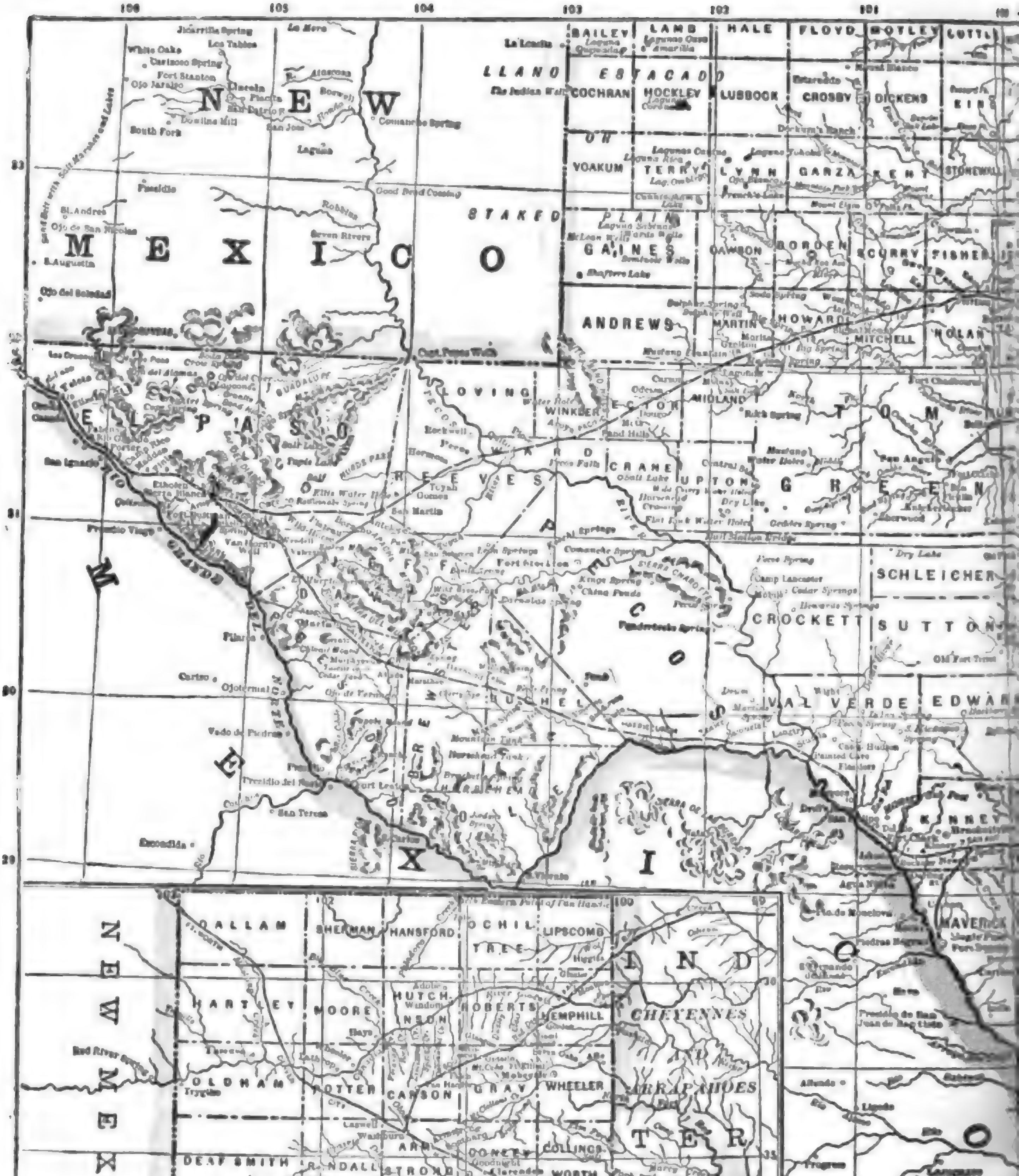
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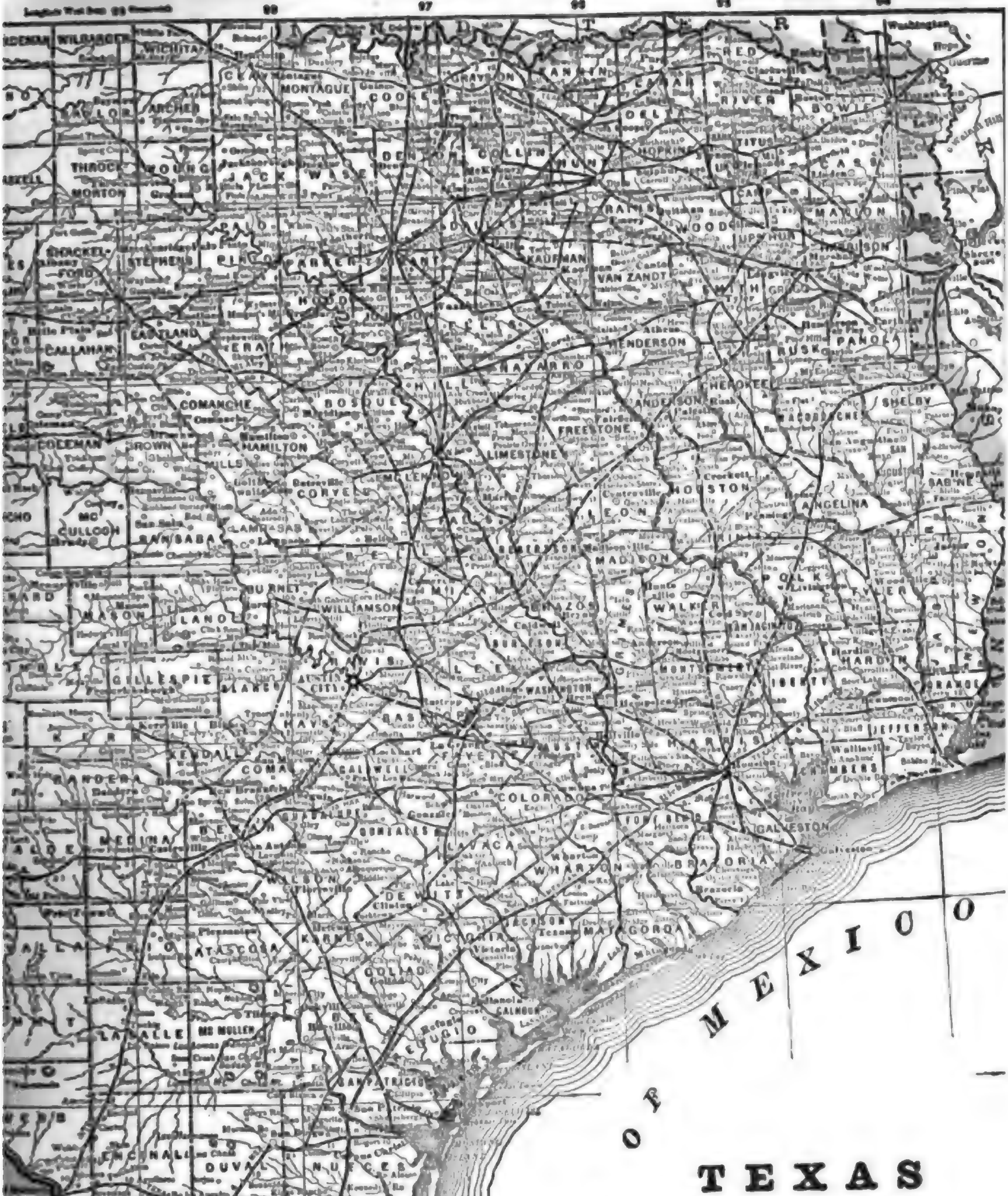
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coast the central, and the plains regions. The lumber supply of the State comes entirely from the east Texas pine forests. The cedar, juniper, and mesquite are only utilized for fuel and fencing.

Fauna. The black bear (*Ursus americanus*), panther (*Felis concolor*), and lynx (*Felis rufa*) are common to all parts of the State. The bison, wild horse, prongbuck (*Antilocapra americana*), coyote (*Canis latrans*), grey wolf (*C. lupus*), eastern prairie dog (*Cynomys ludovicianus*), and the lesser *Mammalia* of the great Rocky Mountain plains constitute the fauna of the north-western part of the State, reaching into the western part of the central region. Their southern limit is approximately the 31st parallel. The highest ranges of the trans-Pecos region possess the unique avian and mammalian fauna of the Rocky Mountains, including the black-tailed or mule deer (*Cariacus macrotis*) and Rocky Mountain sheep, with a few Mexican species. The lower valleys have a mingling of the Mexican, Rocky Mountain, and great plain faunas. Along the valley of the Rio Grande, and extending northward in places, the subtropical fauna is Mexican, including the peccary (*Dicotyles torquatus*), armadillo (*Dasypus peba*), jaguar (*Felis onca*), and ocelot (*Felis pardalis*). Among the birds are the scissor-tail (*Milvulus forficatus*), Mexican eagle (*Polyborus cheriway*), chaparral cock (*Geococcyx viaticus*), and numerous other unique forms. The fauna of the humid wooded coast plain is the south-western continuation and termination of that of the South Atlantic and Gulf States, with slight variations, and includes the Virginia deer (*Cariacus leucurus*), raccoon (*Procyon lotor*), opossum (*Didelphys virginiana*), alligator, &c. The black prairie region limits the last named fauna on the west, except in its wooded river bottoms. The central region possesses representatives of the great plains, Rocky Mountain, Mexican, and Louisiana faunas, but none of them cross it into other regions. It is a true transitional ground of most of the faunas of all temperate North America, east of the Pacific slope.

Population. The total population in 1880 was 1,591,749 (837,840 males and 753,909 females), and in 1887 it was estimated to have risen to 2,415,000, giving 9·2 inhabitants to the square mile. Of the population in 1880 1,477,133 were natives of the United States and 114,616 foreign born. There were 393,384 Negroes, 136 Chinese, 992 Indians, and 43,000 civilized aborigines (Mexicans). Of the entire population 522,133 persons were engaged in occupations as follows:—in agriculture (including stock-raising), 359,317 (68·8 per cent.); in law, medicine, and other professions, 97,651 (18·7 per cent.); in trade and transportation, 34,909 (6·7 per cent.); in manufacturing and mining, 30,346 (5·8 per cent.). At the same date there were 3153 prisoners, 2276 idiots, 1564 insane, 533 paupers, 1375 blind, and 771 deaf. 18·9 per cent. of the native whites, 24·7 of the foreigners, and 75·4 of the Negroes—or 29·7 per cent. of the entire population—were unable to read or write. The population of Texas has increased more rapidly than that of any State in the Union except Kansas. The following table shows the increase for the past few decades:—

Year.	Anglo-Americans.	Negro Descent.	Mexican Aborig'al Descent.	Indians.	Europeans.	Asiatic.	Total Population.	Per cent. increase.
1850	..	..	..	..	..	..	212,592	..
1860	420,891	182,921	..	403	..	..	604,215	184·2
1870	564,700	253,475	..	379	62,411	25	818,579	35·4
1880	1,197,237	393,484	43,000	992	114,116	136	1,591,749	94·4
1887	..	..	..	..	200,000	300	2,415,000	94·4

The population of the principal cities, according to the U.S. census of 1880 and trustworthy estimates in 1886, was as follows:—

	1880.	1886.		1880.	1886.
Galveston	[illegible]	30,000	Austin	11,013	23,000
San Antonio	20,550	35,000	Fort Worth	6,663	23,000
Dallas	10,358	32,000	Waco	7,295	20,000
Houston	16,513	23,000	Denison	3,975	12,000

84 per cent. of the total population of the State is found east of the central region—the black prairie region (northern half) being the most densely populated, and the coast plain next. Between 1880 and 1887 there was a large flow of population into the trans-Pecos and plains regions, and during the last two years mentioned a decrease in the central region. The population consists principally of white natives of the southern United States, except in the counties of Brazos, Fort Bend, Harrison, Marion, Moore, and Washington, where it is of Negro race; in the counties of Fayette, Colorado, Guadalupe, Comal, and Gillespie, where it is German; and along the Rio Grande, where it is Mexican.

Agriculture. Of the United States Texas now ranks first in the production of cotton and cattle, second in sugar, sheep, mules, and horses, eighth in rice and pigs. The eastern third of the State, containing 80 per cent. of the entire population, is agricultural; the remainder is pastoral. The chief crops are cotton and Indian corn; wheat is grown in the northern part of the black prairie and eastern part of the central regions, sugar in the lower bottom lands of the Brazos and the Colorado, rice on the coast. The chief vegetable products for 1880 were—cotton, 805,284 bales; Indian corn, 29,065,172 bushels; wheat, 2,567,737; oats, 4,893,359; sweet potatoes, 1,460,079; Irish potatoes, 228,832; barley, 72,786; rye, 25,399; sugar, 4951 hogsheads; molasses, 810,605 gallons; hay, 59,699 tons; tobacco, 221,283 pounds; rice, 62,152 pounds; orchard products, to the value of $876,844. The total value of these products was $63,076,311. Since 1882 the quantity of cotton produced annually has exceeded 2,000,000 bales, of 500 pounds each. In 1880 there were 174,184 farms in the State, with an aggregate of 12,650,314 acres of improved land. The farms are usually of large size, and garden, orchard, and dairy products are entirely secondary to plantation crops. The southern part of the coast plain and the rest of the State west of the black prairie region are peculiarly adapted to pastoral pursuits, which are entirely separated from agricultural, the cattle and sheep being allowed to roam at large, or enclosed in enormous pastures, where they subsist without other food or shelter than nature affords. In 1880 there were in the State—4,084,605 cattle, 2,411,633 sheep, 1,950,371 pigs, 805,606 horses, and 132,447 mules and asses. The sheep walks are more particularly confined to the southern half of the central region, including the lower Rio Grande valley.

Commerce. The exports are cotton, wool, and hides, most of which are shipped from Galveston or sent overland by rail. The chief imports are manufactured articles used in the State, also coal and railway material. Apart from a small retail trade along the border, there are no exports to the adjoining States. The principal seaport and commercial city is Galveston. The mileage in railways has increased from 1048 in 1872 to 5974 in 1882, and to 7034 in 1886.

Education. The founders of the State made liberal provision, by grants of land and revenue, for public education, but their intentions have not been carried out by subsequent legislation. Texas occupies the anomalous position of having the best school fund and the poorest school system in the United States. The public free school system proper consists of two normal schools for the preparation of teachers and numerous district schools, open for four months in the year. In most of the cities the State fund is supplemented by local taxation, and excellent schools are maintained. In 1886 there were 489,795 children within school age, and the cost of the maintenance of the whole system was $2,362,226. There are no schools for secondary education, except the high schools of a few cities. The State university is at Austin; it is abundantly endowed with lands, but does not receive the full benefit of its revenues. There is also a State agricultural and mechanical college, but technical training is made secondary.

Administration. The State government differs somewhat from those of the rest of the Union, owing to the fact that it has had to adapt itself to the administration of the great public domain, by which most of the public institutions are supported and works of internal improvement accomplished, and because much of the attention of the Government has been necessarily diverted to the protection of its extensive frontier. The executive government consists of a governor, comptroller, treasurer, commissioner of the general land office, and superintendent of education, elected biennially, with an attorney-general and a secretary of state, appointed by the governor. The judiciary consists of two courts of final appeal, one for criminal, the other for civil business; forty itinerant higher courts for the trial of penal offences and civil suits; courts for misdemeanours and minor civil cases in each county; and innumerable justices' courts for first hearings. The legislature consists of 32 senators elected for four years, and 115 members of the house of representatives elected for two years. It is restricted by the constitution to biennial sessions of ninety days each. The State is divided into thirteen congressional and forty judicial election districts. It is also divided into 232 counties, 75 of which have no population, or insufficient population to be organized. Each county is divided into four commissioners' precincts and a varying number of school, election, and justices' precincts. The State has always maintained a corps of troops, formerly for protection against Indians, but now for preserving order in the unorganized counties. It has institutions for the blind, deaf and dumb, and insane. The prison system is far superior to that of the other southern States, but still very imperfect. The bonded debt of the State on 1st January 1887 was $4,237,730, and its taxable wealth $600,000,000. The aggregate debt of all the counties and cities was $7,000,000. The homestead and exemption laws are unusually liberal to the debtor.

History. The upper Rio Grande valley was visited in 1580-83 by the Spaniards, who established missions among the settled Indians near El Paso and Santa Fé. The first white settlement was made by La Salle at Lavaca, on the coast, in 1685. The country was inhabited by Indians of various tribes, both savage and agricultural, most of whom are now extinct, except the so-called "Mexican" population of the Rio Grande. From 1583 to 1794 many missions were established by Roman Catholic missionaries among the Indians, who were completely alienated from their original language, religion, domestic habits, and tribal relations. After the purchase of Louisiana from the French in 1803 Anglo-American adventurers began to cross into Texas from the United States. In 1821, when Mexico threw off the Spanish yoke, Texas and Coahuila constituted a state of the republic. It was shortly after this that the first American colonists were permitted to enter the territory under Government patronage. Within ten years over 20,000 had settled between the Sabine and the Colorado. In 1830 the Mexican Government placed them under military rule, from which, with accompanying impositions, originated the war of Texan Independence. The Anglo-Americans were assisted by volunteers from the United States, and the war was terminated by the defeat of the Mexicans under General Santa Anna at San Jacinto, 21st April 1836. From 1837 to 1845 Texas was an independent republic. It was admitted to the United States on 29th December 1845, in spite of the protests of Mexico, and a war with that country immediately ensued. The new State sold to the United States Government for $10,000,000 all the territory west and north of the present boundaries between the headwaters of the Rio Grande and the Arkansas. But it reserved the control and disposal of the public lands within its borders, which have proved a magnificent source of revenue, and also the right to divide into five states, should future growth and development justify it. By a small majority the State seceded from the Union in 1861. In 1868 a new constitution was adopted, and the State readmitted into the Union. In 1874 the Kiowa and Comanche Indians, who had prevented the settlement of the central and plains regions from the earliest times, were subjugated.

See Hill, *Geolog. Knowledge of Texas* (1887)—Bull. 44, *U. S. Geolog. Survey*; *Geological Map of the United States*, by C. H. Hitchcock; *Report* on cotton production, Tenth U. S. Census, by Dr R. H. Loughridge; forestry *Reports*, Tenth U S. Census; *Mexican Boundary Survey*, vol. i.; *Proceedings of Boundary Commission*, Austin, 1886; *Trans. of Academy of Sciences, St Louis*, vols. i. and ii. (Dr Shumard); Thrall, *History of Texas*; Kendall, *Santa Fé Expedition*; Speight, *Resources, &c., of Texas*, Austin, 1882; Roemer, *Kreidebildungen von Texas*, 1852; Walcott, *Cambrian Faunas of N. America*—Bull 30, *U. S. Geolog. Survey*; Hill, "Topogr. and Geol. of Cross Timbers of Texas," in *Amer. Journ. Sci.*, April 1887; Cabe, *Zoolog. Position of Texas*; Marcy, *Exploration of Red River*; *Report* of the U S. Mexican Boundary Survey; Havard, *Report* on the flora of west and south Texas; and U. S. explorations for a route for a Pacific Railway. (R. T. H.)

TEXTILES.[1] This word is applied to all fabrics which are woven in a loom, of whatever material they may be made, and whether the woven stuff be plain or figured. The simplest and earliest process of weaving was managed thus. The ground of the future stuff was formed by a number of parallel strings called the *warp*, having their upper ends attached to a horizontal beam and drawn taut by weights hung from their lower ends. In the early Greek loom each warp thread had a separate weight (see fig. 1). On the number of the warp strings the fineness and width of the stuff depended. The strings of the *weft* were interlaced at right angles to those of the warp, and the combination of the two formed the woven stuff or *web*. The *weft* was so called from its being "wafted" in and out of the warp; it is also often called the *woof*, though more correctly the woof is the same as the web or finished stuff. The threads of the weft were wound round a sort of bobbin on a pivot which was made to revolve inside a hollow boat-shaped piece of wood pointed at both ends so as to pass easily between the threads of the warp. This is called the *shuttle*. The thread passed out through a hole in the side of the shuttle, the inner pivot revolving as the thread was delivered between the strings of the warp. In order to make the weft interlace in the warp some of the upright strings were pulled forward out of the general plane in which the warp hung; this was done in the simplest way by a reed, which divided the threads into two sets called *leaves* and thus formed an opening called the *shred*, through which the shuttle could pass, as shown in fig. 1. Another way, applicable to more complicated ornamental weaving, was to have a series of threads attached to the warp at right angles, so that the weaver could pull any of the warp threads away from the rest, thus allowing the shuttle to pass in front of or behind any special warp strings. By a very simple mechanical contrivance these threads were worked by a foot treadle, thus leaving the weaver's hands free to manage the shuttle.[2] In the simplest sort of weaving first one and then the other half of the warp threads were pulled forward, and so a plain regularly interlaced stuff was woven. The next stage was to make a cloth with coloured stripes, by using successively two shuttles containing different-coloured threads. In a chequered cloth the warp was made of two-coloured threads stretched in successive bands, and the cross stripes of the weft were woven in by the two shuttles. To form a more complicated pattern the weft must not cross the warp alternately: the design is formed by either the warp or the weft predominating on the surface in certain places. In all cases each thread of the weft must be driven home to its place after each stroke of the shuttle. In the earliest times this was done by beating the weft with a wooden sword-shaped implement[3] introduced between the strings of the warp; but later a heavy comb-shaped tool was used,[4] the teeth of which passed between the warp and drove home at one blow a longer length of the weft. An upright loom such as has been described is shown clearly in some of the wall paintings from Thebes, dating about 1600 B.C. and in other earlier ones from Beni-Hasan. A very similar loom is represented on a Greek vase of the 5th century B.C., with a picture of Penelope and the never-finished piece of stuff (see fig. 1). In this interesting painting the upper band has simple geometrical ornaments, such as occur on archaic Greek vases; the next has figures of winged men and gryphons. This sort of loom is still used in Scandinavian countries for tapestry.[6] Another form has the warp threads stretched, not upright, but horizontally,—an arrangement which is more convenient for working treadles. These two forms are called in French "la haute lisse" and "la basse lisse,"—the high and the low loom. The general principle is the same in both. Fig. 2 shows a simple form of the "basse lisse," such as was used throughout the Middle Ages, except in Iceland and in Scandinavia.[7] The clay whorls, or pierced cones, decorated with simple painting, which have been found in countless numbers on the sites of Troy, Mycenæ, and other prehistoric cities, were probably used to strain the thread as it was being spun on the distaff.[8] Other

Method of weaving.

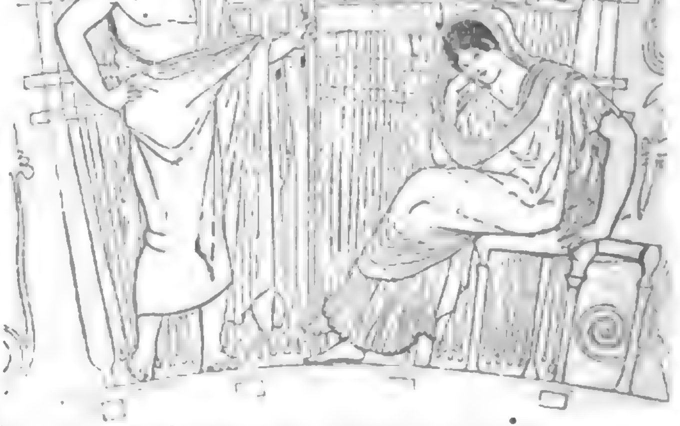

FIG. 1.—Penelope's loom, from a Greek vase of the 5th century B.C. The standing figure is that of Telemachus.[5]

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[1] This article deals mainly with the history of the textile art; for practical information as to modern processes, see WEAVING; see also EMBROIDERY, vol. viii. p. 160 *sq.*

[2] These dividing sticks are called in French "batons à deux"; in the simplest kind of weaving only one is required. The use of treadles and "spring staves" is more applicable to the low loom, in which the warp is strained in a horizontal position

[3] Lat. *spatha*.

[4] Lat. *pecten*; modern English *batten* or *lay*.

[5] See *Mon. Inst. Arch. Rom.*, vol. ix. pl. 42.

[6] See the modern Faroese loom figured by Worsaae, *Afbildninger fra det k. Museum for Nordiske Oldsager*, Copenhagen, 1854, p. 123.

[7] A fresco by Pinturicchio—911 in the National Gallery, London—has a careful representation of the mediæval low loom; the subject is the return of Ulysses to Penelope.

[8] Dr Schliemann found 22,000 in the plains of Troy alone.

heavier ones were employed to stretch the strings of the warp; this method must have been very inconvenient, as the whole warp could swing to and fro. A very obvious improvement, introduced in some countries at an early date, was to have a second beam, round which the lower ends of the warp could be wound. In Scandinavian countries the use of weights continued till modern times. In the fate-loom of the sagas these weights are heroes' skulls, while the shuttle is a sword.

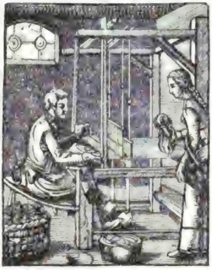

FIG. 2.—Mediæval low-warp loom, from a cut by Jost Amman; middle of the 16th century.

Pre-historic. Some simple form of weaving seems to have been practised by prehistoric man at a very early stage of development. Fig. 3 shows an example of coarse flaxen stuff from the lake-dwellings of Switzerland, dating from the Stone Age. Wool appears to have been the first substance used, as no skill is required to prepare it for spinning. Weaving was specially the duty of women, and even in the Middle Ages in Europe it was, in some countries, considered a specially feminine employment.[1] An early Christian sarcophagus in the Lateran has a symbolical relief representing God condemning the future world to labour,—tillage for the man and weaving for the woman:—He gives ears of corn to Adam and a sheep to Eve.

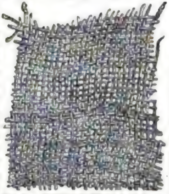

FIG. 3.—Prehistoric (Stone Age) flaxen stuff, from a lake-dwelling in Switzerland.

Ancient Egyptian. The Egyptians were famed for the beauty of their woven stuffs, and almost incredible stories are related of the fineness of their linen, such as a pallium sent by King Amasis to the Spartans, which, Herodotus (iii. 47) says, was made of yarn containing no less than 360 threads; the figures woven on this were partly of cotton and partly of gold thread. Herodotus also mentions a wonderful pallium sent by the same king to the shrine of Athene at Lindus. Few examples of the fine and richly ornamented sorts of Egyptian stuffs now exist, though we have immense quantities of the coarse linen in which mummies were wrapped. This, though coarse, is closely woven, and usually has in every inch many more threads to the warp than to the weft.[2] A few fragments of Egyptian cloth of the XVIIIth Dynasty have been found with a border of coloured bands, the blue of which is indigo and the red extract of KERMES (*q.v.*). In Egypt linen was specially employed for religious purposes, such as priestly and royal vestments, because it harbours dirt less than wool or cotton, which were also worn by the Egyptians, and it was used to bandage mummies, because it was thought not to engender worms. Though priests were allowed to wear outer garments of wool, they were obliged to put them off before entering a sacred place.

Phœnician. The Phœnicians were celebrated for their weaving, as for their skill in other arts. Their purple linen, dyed with the murex, was specially valued; Tyre and Sidon were the chief places where this was made. Babylon, Carthage, Sardis, Miletus, and Alexandria were all famous seats of textile manufacture in the time of Herodotus.

Assyrian. Though no specimens of Assyrian textiles remain, some notion of their richness of ornament and the styles of their patterns may be gained from the minute representations of rich dresses worn by kings and other important personages in the sculptured wall-reliefs from Nineveh which are now in the British Museum.[3] The stuffs worn by Asur-banipal are most elaborate in design, being covered with delicate geometrical patterns and diapers, with borders of lotus and other flowers treated with great decorative skill. A large marble slab from the same palace is covered with an elaborate textile pattern in low relief, and is evidently a faithful copy of an Assyrian carpet. Still more magnificent stuffs are represented as being worn by Assyrian captives on the enamelled wall-tiles from Rameses II.'s palace (14th century B.C.) at Tel al-Yáhúdíya (see POTTERY, vol. xix. p. 603); the woven patterns are most minutely reproduced in their different colours, and the design, special to Assyria, of the sacred tree between two guardian beasts, is clearly represented, though on the most minute scale.

Greek. Our knowledge of Greek textiles, in the almost complete absence of any existing specimens,[4] is chiefly derived from the descriptions of various classical authors. One indication of the patterns commonly used at an early period is given by the designs on much of the archaic Greek pottery, which clearly has ornament derived from textile sources. Vol. xix. p. 607, fig. 16, shows examples of these; simple bands, chequers, and zigzags would naturally be the first steps towards more elaborate patterns. Again, recent excavations at Orchomenus and Tiryns have brought to light examples of ceiling and wall decoration the motives of which are obviously derived from textile patterns. A stone ceiling at Orchomenus has in relief a carpet-like pattern, and the painted wall-stucco of the Tiryns palace has many varieties of coarse but effective textile ornament. The poems of Homer are full of descriptions of woven stuffs of the most magnificent materials and design, used both for dresses[5] and for tapestry hangings.[6] In later times the most important examples of rich woven work of which we have any record were certain peploi made to cover or shade the statues of the deities at Athens, Olympia, Delphi, and other famous shrines.[1] Euripides (*Ion*, 1141-1162) gives a glowing description of a peplos which belonged to the temple of Apollo at Delphi, on which was depicted the firmament of heaven, with Apollo Helios in his chariot, surrounded by the chief stars and constellations. At Athens a new peplos, ornamented with the battle of the gods and the giants, was woven for the gold and ivory statue of Athene in the Parthenon every fifth year, and was solemnly carried in procession at the greater Panathenæa. Similarly at Olympia a new peplos was woven by sixteen women, and displayed every fifth year at the Olympian games in honour of Hera. It appears probable that these magnificent peploi were not used as garments, which would have partly concealed the splendour of Phidias's gold and ivory statues, but were suspended over them like a mediæval baldacchino. Very possibly, however, most of the elaborate work on them was embroidery done by the needle, and not loom or textile work.

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[1] In the time of St Louis (13th century) in France some sorts of weaving, such as "tapisserie Saracenois," were done only by men.

[2] Some existing specimens have in each inch 152 threads in the warp and 70 in the weft; in modern stuffs the proportion is the other way. A coarsely woven piece of Egyptian stuff in the British Museum has a border with a man swimming, supported by a float.

[3] A very magnificent royal dress, with woven patterns of deities, kings, animals, and the sacred tree, much resembling those on the metal bowls of Assyria, is figured by Layard, *Monuments of Assyria*, series i., pl. ix.

[4] One remarkable example of tapestry from a tomb in the Crimea is supposed by Stephani to date from the 4th century B.C.; see *Comp. Rend. Com. Arch.*, 1878-79, p. 40, pl. v.

[5] *Il.*, iii. 125, viii. 288, ix. 200, x. 156, xiv. 178, xxii. 440; *Od.*, ii. 93, x. 220, xiv. 61, and many passages in books xviii. to xx. Homer describes (*Od.*, xix. 225-235) a cloth of purple wool with a hunting scene in gold thread, woven by Penelope for Ulysses.

[6] *Il.*, xvi. 224, xxiv. 230, 645; *Od.*, iv. 124, 298, vii. 337. Many Greek vases, especially those with black figures and incised lines, have representations of rich woven dresses,—*e.g.*, an amphora in the Vatican with Achilles and Ajax playing at a game like draughts, *c.* 460 B.C. A rather later vase in the British Museum has a fine figure of Demeter clad in a pallium covered with figures of chariots and winged men and horses.

Roman. The Romans under the late republic and the empire possessed immense stores of the most magnificent textiles of every description, such as the splendid collection of tapestry which Rome inherited along with the other art treasures of Attalus II. of Pergamum (2d cent. B.C.). A very costly cloth of gold was called by the Romans "attalica," after Attalus. The C. Cestius who died about the middle of the 1st century B.C., and who is buried in the existing pyramid in Rome, left orders in his will that his body was to be wrapped in certain attalica; but, as this was forbidden by a sumptuary law, his heirs sold the gold stuff and with the proceeds had two colossal bronze statues made, which were set outside the tomb. The feet of one of these have been found with an inscribed pedestal recording the above-mentioned facts. The size of the statue shows that the attalica must have been worth a very great sum. Examples of large prices given by Romans for woven stuffs are recorded by Pliny (*H.N.*, viii. 48): Metellus Scipio bought some hangings from Babylon for 800,000 sesterces, and other similar stuffs were bought by Nero for four millions of sesterces (about £3360). Costly tapestry from Babylon is mentioned by Plautus (*Stich.*, II., ii. 54), Silius Italicus (xiv. 658), and Martial (xiv. 150). Virgil (*Geor.*, iii. 25) mentions woven tapestries with figures of Britons being used at theatrical shows: "Purpurea intexti tollant aulæa Britanni." Other tapestries with scenes from the story of Theseus and Ariadne are mentioned by Catullus (*Argon.*, xlvi. 267).[2] On a very remarkable example of late Roman stuff found at Sitten (Sion) in Switzerland is woven a graceful figure of a nymph seated on a sea-monster, among scroll-work of foliated ornament, purely classical in design.[3] A large quantity of very remarkable woven stuffs has recently been found in tombs at Ekhmin (Panopolis) in Middle Egypt. More than 300 pieces have been bought for the South Kensington Museum. They are of various dates, apparently ranging from the 4th to the 6th or 7th century A.D. The earliest are of purely classical style: some have badly designed but very decorative figures of pagan deities, with their names in Greek —*e.g.* Hermes and Apollo; others have figures driving chariots drawn by two centaurs, or marine gods, or long bands of animals—bears, lions, stags, ducks, and many others. These are used to decorate linen tunics or pieces of stuff about 2 feet square The later examples appear to be Coptic vestments of various shapes, and are decorated with rude figures of St George and other Oriental saints, each with a nimbus. These ornaments are done by true tapestry weaving, the weft pattern being in brilliantly coloured wools on a flaxen warp. In some cases the colours, especially the magnificent reds and blues, are as bright as if they were new. Though in all cases the figure drawing is rude, the decorative value is very great.

Byzantine. From the 6th to the 13th century Byzantium became the capital of all the industrial arts, and in none is its influence more obvious than in that of weaving There the arts of ancient Greece and of old Rome met and were fused with the artistic notions of ancient Egypt, Assyria, Persia, and Asia Minor, and this combination produced a fresh and very active art spirit, which for many centuries dominated the whole civilized world. As regards weaving, this new development was strengthened by the introduction of silk into Europe in the reign of Justinian, and many specimens of early silk fabrics have lasted down to the present time, partly through their being safe against moths. The silken stuffs found in the tombs of Charlemagne and other kings, though perhaps not themselves as early as the 6th century, show one class of design used in Byzantium in the time of Justinian. Some of these combine the figure-subjects of ancient Rome with the stronger decorative beauty of the East. Chariot races in the circus, consuls and emperors enthroned in state, gladiatorial fights with lions, and other classical subjects occur, arranged in medallions or wreaths, set in close rows, so as to fill up the ground. Again, mixed with these classical scenes are designs of purely Assyrian origin, such as the sacred tree between two guardian beasts, closely resembling the designs of 2000 B.C. The manufacture of these rich fabrics was carried on, not only in Byzantium, but also in many towns of Greece proper, such as Athens, Thebes, and Corinth, all of which were specially famed for their silk textiles. **Persian.** During the same time, the 6th to the 12th century, Baghdad, Damascus, Ispahan, and many other towns in Persia and Syria were producing woven stuffs of the richest materials and designs; names of reigning caliphs are sometimes mingled with Arabic sentences from the Koran and other sacred books, which are introduced freely among the intricate patterns with the most richly decorative effect. By this means some existing specimens of the 8th to the 10th century can be dated. Fig. 4 shows a 16th-century example of the finest Persian damask in silk and gold,—a masterpiece of textile design.

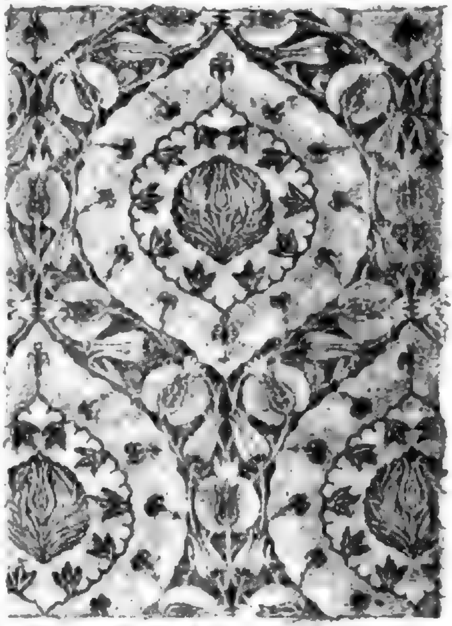

FIG. 4.—Persian damask in silk and gold. (South Kensington Museum.)

Sicilian. According to the usual story, Roger of Sicily, who in 1147 made a successful raid on the shores of Attica and took Athens, Thebes, and Corinth, carried off as prisoners a number of Greek weavers, whom he settled at Palermo and made the founders of the royal factory for silk weaving. This story is doubtful, for the Saracenic inhabitants of Sicily had apparently been producing fine silken stuffs long before the 12th century. In part, however, the story may be true; certainly an impetus was given to the weaving industry of Palermo in the 12th century, and for about two centuries Sicily became the chief seat in Europe for the production of the finest woven stuffs. A large number of examples of these beautiful fabrics still exist, showing an immense variety of designs, all of which are imagined with the highest decorative skill,—perfect masterpieces of textile art, combining freedom of invention and grace of drawing with that slight amount of mechanical stiffness which is specially suited to the requirements of the loom. One of the earliest existing specimens, which shows the existence of the fabrique before the time of Roger I., is a piece of silk stuff in which the body of St Cuthbert at Durham was wrapped when his relics were translated in 1104; this was found at the opening of his grave in 1827, and is now preserved in Durham cathedral library. The figures woven on it show an interesting combination of Western and Oriental art. Birds and conventional ornaments of purely Eastern style are mingled with designs taken from late Roman mosaics,—the whole being blended with great skill into a highly decorative pattern.[1] The Sicilian silks of the 12th to the 14th century were mostly used for ecclesiastical vestments, altar frontals, and the like; and the fact that examples have survived in almost all countries of Europe shows how important and far-reaching a trade in them must once have been carried on. The favourite designs were the sun breaking through a cloud from whence rays of light are issuing, or conventionally treated ships, fountains, islands, castles, and an immense variety of birds and beasts, such as swans, mallards, eagles, lions, cheetahs, hounds, giraffes, antelopes, and others. Some specimens have siren-like female forms, with floating hair, casting nets, leaning down from palm trees, or issuing from shells. Others, rather later in style, have winged angel-like figures. In many cases the Assyrian sacred tree and its guardian beasts occur, and very frequently borders with sham Arabic letters are introduced,—a survival of the time when real sentences were woven into the fabrics of Persia and Egypt, probably intended as a visible sign that the stuff was the genuine product of Saracenic looms. All these are perfect masterpieces of textile art, and have never since been rivalled either in beauty of design or in skilful use of gold and colours. Fig. 5 shows a characteristic example; another copied from a painting is given under MURAL DECORATION, vol. xvii. p. 46, fig. 15.

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[1] See De Ronchaud, *Le Péplos d'Athéné*, Paris, 1872, and *La Tapisserie*, Paris, 1885. The treasuries of most Greek temples appear to have contained large stores of rich woven stuffs.

[2] See also Hor., *Sat.*, ii. 6, 102-6; Ovid, *Metam.*, vi.; and Lucr., iv. 1026.

[3] This fragment is illustrated by Muntz, *La Tapisserie*, Paris, 1882, p. 53.

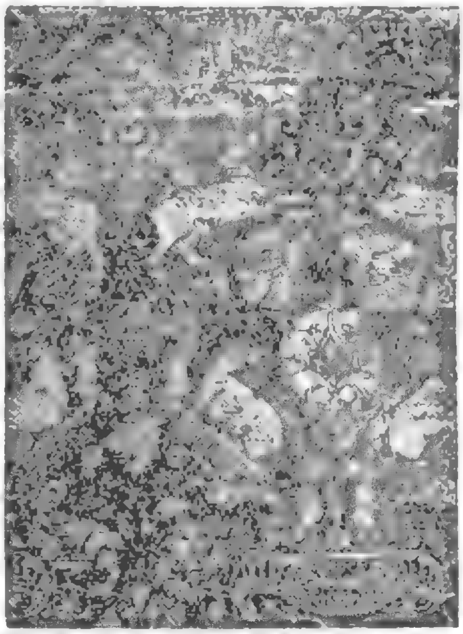
FIG. 5.—Sicilian silk stuff of the 13th century, in St Mary's church, Dantzic.

In the 14th century the chief centre of fine silk weaving was transferred from Palermo to Lucca, Florence, Milan, Venice, and other towns in northern Italy, and a different class of design, less rich in fancy, but scarcely less beautiful in effect, came into vogue. The designs of these 14th and 15th century textiles were chiefly conventional adaptations of natural foliage and flowers, arranged with great beauty of line and wealth of decorative effect; among the most beautiful is scroll-work of vines with graceful curving lines of leaf and tendril. An extremely rich design, largely employed throughout the 15th century, was made from the artichoke plant,[2] and was especially used for the rich "cut" velvets of Genoa, Florence, and Venice, in which the pattern is formed in relief by pile raised above pile, mixed with gold[3] (see fig. 6 and vol. xvii. p. 46, fig. 14). At this time Venice contained a large number of Oriental craftsmen in all the industrial arts, and very beautiful stuffs were woven there with designs of mingled Oriental and Italian style,—probably the work of Mohammedan weavers (see fig. 7).

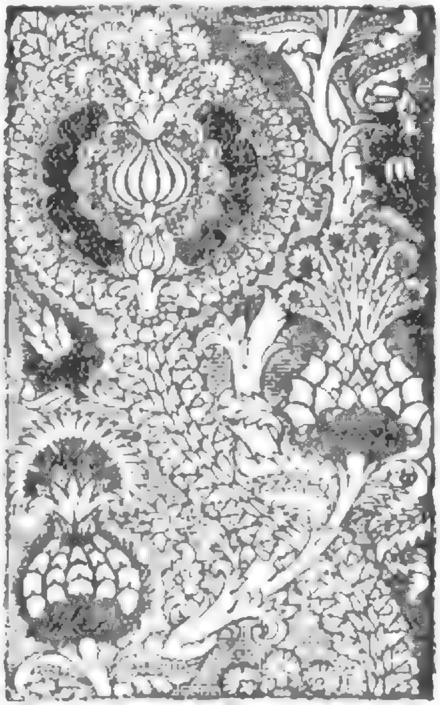
FIG. 6.—Genoese or Florentine velvet of silk and gold; 15th century.

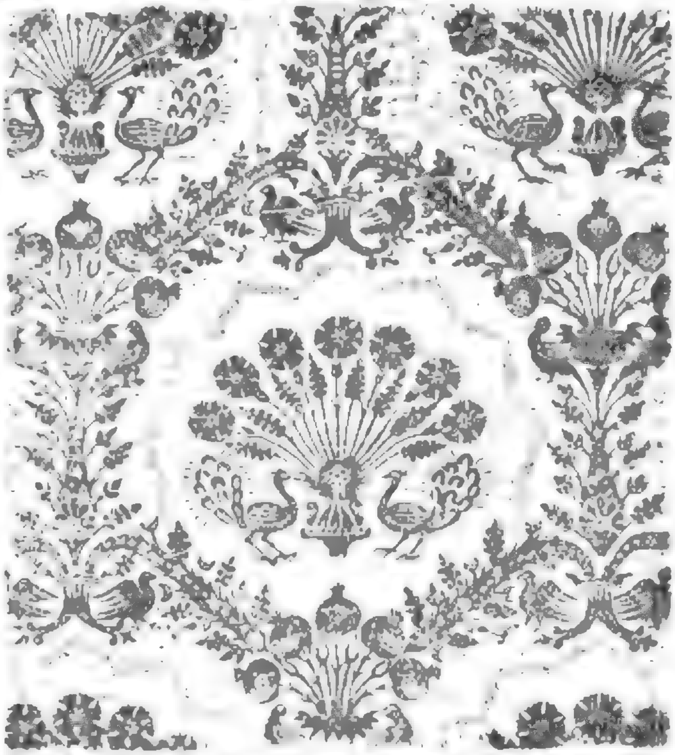
FIG. 7.—Silk stuff of Oriental design, woven at Venice in the 15th century. (South Kensington Museum.)

Gold thread

In all these Oriental, Sicilian, and early Italian stuffs gold thread is used in a very lavish and effective way. It was made very skilfully, the richest effect being produced with little metal by thickly gilding fine vellum skins with gold leaf; the vellum was then cut into very thin strips and wound round a thread of silk or hemp so closely as to look like a solid gold wire. In and since the 15th century gold thread has been made by twisting a thin ribbon of gilt silver round a silken core. In this way much less gold is required, as the silver ribbon is gilded before being drawn out to its final thinness, and it is thus liable to tarnish, owing to the partial exposure of the silver surface. In classical times attalica and other gold stuffs were made of solid gold wire beaten out with the hammer.[1] Masses of this fine gold wire[2] have been found in the tombs of Egypt, Greece, and Etruria, the metal having lasted long after all the rest of the stuff had crumbled into dust. In 1544 the grave of the wife of Honorius was opened and 36 ℔ of gold thread taken out of it and melted.

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[1] See Raine, *Saint Cuthbert*, Durham, 1828, plate iv.; in his text the author is wholly wrong as to the *provenance* of these stuffs.

[2] This is usually called the pine-apple pattern; but it was invented long before the discovery of America had introduced the pine-apple into Europe.

[3] Italian and Flemish pictures of the 14th to the 16th century often give most valuable representations of rich textiles; see Vacher, *Fifteenth Century Italian Ornament*, London, 1886, a series of coloured plates of textiles taken from Italian pictures.

Gold cloth.

Throughout the Middle Ages cloth of gold was largely employed for ecclesiastical and royal purposes. In some cases the whole of the visible surface was formed of gold thread, producing the utmost splendour of effect. Westminster Abbey still possesses a magnificent gold cope of the 15th century, in almost perfect brilliance of preservation. In the 13th and 14th centuries Cyprus and Lucca were specially famed for their gold stuffs, and the royal inventories of France and England show that the kings possessed stores of this to an immense value. The enormous sum of £11 a yard[3] is recorded to have been given for a "cloth of estate" in the private accounts of Henry VII. This was a cloth to hang over the royal throne, and must have been unusually wide, as other cloth of gold at the same time was bought for 38s. the yard. Various names were at different times given to textiles which were wholly or in part woven in gold, such as *ciclatoun* (a word of obscure origin), *baudekin* (from Baldak or Baghdad), *nak*, and *tissue*.[4] *Samite* or *examite* (ἕξ μίτοι) was so called because the weft threads were only caught and looped at every sixth thread of the warp, lying loosely over the intermediate part. Mediæval samite was sometimes made of gold; if of silk it was a variety of satin, called *satin of six*. Modern satin usually has its weft looped in less closely—*satin of eight* or *ten*.

English.

Although throughout the Middle Ages the finer stuffs used in England were to a great extent the product of foreign looms, there was no lack of native textiles, many of which were of great beauty. In the use of the needle the women of England were especially skilful, and rich English embroideries were much exported, even into Italy, from the 12th to the 14th century,[5] and were esteemed more highly than the productions of any other country. Two fine examples of early English silk and gold needlework—a stole and maniple with the inscription *Aelflæd fieri precepit: pio episcopo Fridestano*—are preserved in the Durham library. Fridestan became bishop of Winchester in 905. Other examples of native textiles have been found in the coffins of many ecclesiastics in England. Some interesting fragments are preserved in the chapter-house of Worcester cathedral; the ground is of silk, and the pattern, of conventional scroll foliage, is a characteristic example of 13th-century design. Pictures in English MSS. show that the low loom was mainly used,—this being the most convenient for ordinary weaving.[6] England was specially celebrated for its wool and woollen stuffs, and even at the present day English wool is used for the Gobelin tapestries; in the 15th and 16th centuries it was largely imported into Flanders. In the 14th century Bath produced the finest woollen cloth, and that of Worcester was equally celebrated; in the 15th century the production of woollen stuff was a great source of wealth to Norwich and other towns in the eastern counties. A special sort of woollen yarn took its name from Worstead in Norfolk, where it was made; it had a closer and harder twist than most woollen thread, and thus could be made up into cloth of special fineness, which was used for chasubles and other vestments, as is recorded in the inventories of York, Exeter, and other cathedrals.

Old English names.

Old English Names for Textiles.—A large number of names for different sorts of textiles occur in old English writings, many of them derived from the name of the place where the stuff was made or exported. *Buckram* was a woven cloth of much richness, highly prized, probably quite unlike what we now mean by the word. *Damask* or *damas* got its name from Damascus. *Fustian*, from Fostat (Old Cairo), was a cheaper stuff made of linen and cotton mixed. *Muslin*, from Mosul, was a fine cotton stuff. *Cloth of Tars* (Tarsus) is often mentioned, usually meaning a purple cloth. *Campca* or *camak* (Arab. *kamkha*, from Chinese *kimkha*, "brocade") was another richly decorated Oriental stuff. *Cendal* or *sandal* and *syndonus* were fine silk stuffs. *Taffeta* was made of silk or linen of very thin substance. *Satin* (from Low Lat. *seta*) was a glossy silk stuff made like samite. *Velvet* (from It. *velluto*, "shaggy") had a silk weft woven so as to form a raised pile, the ends of which were cut or shaved off to one even level; hence it is also called in Italy *raso*. *Diaper*, "jasper-like" (Ital. *diaspro*), was not only used to denote a regular geometrical pattern, but in some cases means also a special sort of linen or silk. Phrases such as "silk of brydges" (Bruges), "silk dornex," from Dorneck in Flanders, and "sheets of raynes" (Rheims) often occur. A large number of other similar names are to be met with in mediæval writings.[7]

Other mediæval and modern types.

Space will not allow a description of the textile work in each separate country. That of Italy and the East was by far the most important throughout the Middle Ages. Even Chinese textiles of gold and silk were imported into the west of Europe, and were sometimes used for ecclesiastical purposes. Mediæval vestments of Chinese stuff still exist, the shape and added borders of which show that they date from as early as the 14th century. These fabrics exactly resemble in design and workmanship some which are woven in China at the present day. A very interesting survival of the mediæval style of weaving exists in Sweden and other Scandinavian countries. Articles of dress, counterpanes, table-covers, and the like are woven by the peasantry in a simple, highly decorative way, with patterns which have altered little during the last three or four centuries. Though coarse in texture, many of these are of great artistic beauty; nothing but an occasional use

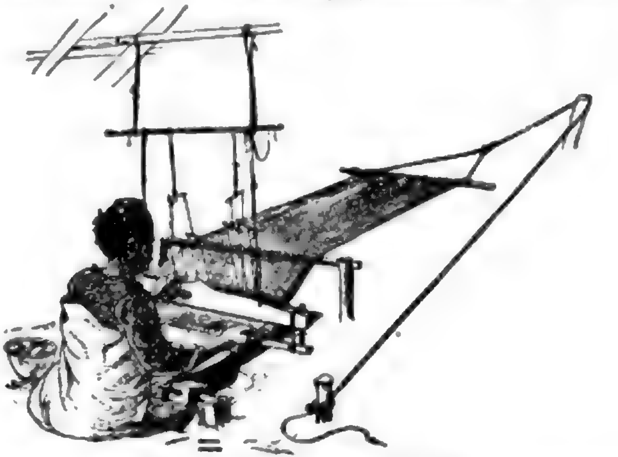

FIG. 8.—Indian hill loom, as still used.

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[1] The process of making wire by drawing it through conical apertures in a steel plate is said to have been first invented at Nuremberg in the 14th century.

[2] The Museo Gregoriano (Vatican) contains examples from Etruscan tombs.

[3] Equal to quite £50 of modern money.

[4] Hence thin paper laid between the folds of these rich stuffs to protect them was called *tissue paper*.

[5] The celebrated cope in Pienza cathedral, which once belonged to Pius II. (Piccolomini), is a magnificent example of English needlework of the 15th century.

[6] Among Chaucer's pilgrims are included "A webbe, a dyer, and a tapisser," the first a low-loom weaver, the last a weaver of tapestry on the high loom.

[7] The most extraordinary spelling often occurs in lists of textiles in mediæval documents, especially in the case of foreign names. Thus we find in the Bury Wills (printed by the Camden Society) "fuschan in Appules," meaning Naples fustian, and many similar blunders.

of harsh colours shows any sign of decadence of style. Strong marks of Oriental influence are visible in these fine patterns, but the method of weaving is purely native, —probably very like what the edicts of Louis IX. call "tapisserie nostrez." Very beautiful fabrics are still produced in India, old designs being followed, and woven in the simplest form of loom. Fig. 8 shows an example of a modern Indian loom used by the hill weavers. In such looms the richest materials, such as gold and silk, and the most elaborate patterns are woven, often by travelling weavers who can set up their whole apparatus in a very short time.

CARPETS.

Carpet weaving was essentially an Oriental art, and was the natural product of a dry mudless country, where little furniture was used and the shoes were removed on entering a building. Till the 16th century carpets were almost unknown in France and England, except for royal personages and for the sanctuaries of cathedrals and important churches. In the latter case they were usually laid in front of the high altar, and thus carried on to the floor the richness of colour which ornamented the walls and vault. Oriental carpets frequently occur in cathedral inventories among the other rich treasures of foreign or native make which adorned the building. They were first employed in England for domestic purposes by Queen Eleanor of Castile and her suite, in the latter part of the 13th century. In the palaces of Spain they were introduced much earlier, owing to the presence of the Moors in southern Spain. In many cases they were used for wall hangings, and the smaller ones to cover tables and other furniture, as is represented in many 15th-century Italian pictures. Though few examples of Oriental carpets exist earlier in date than the 15th century, yet the manufacture was carried on in the highest state of perfection centuries before. An example of the 14th century is preserved in a private collection at Vienna; it was originally made as a hanging for the Kaaba at Mecca.[1] These beautiful Oriental pile carpets are among the most perfect productions of the weaver's art, and till the 16th century were masterpieces of design and splendour of colour. Usually they were woven of wool or of camels' or goats' hair, with a separate warp and weft of flax; but many magnificent carpets were also made of silk mixed with gold thread. This extravagance of luxury produced an effect, at least as regards the use of silk, but little superior to that of fine wool or camel's hair, as the special beauty of the silken gloss is seen on the sides, not on the ends of the silk thread. Pile carpets are woven in a very different way from ordinary textiles: short tufts of wool or silk are knotted on the warp so that the ends of the threads which form the pattern project, and these are cut down by shears to a uniform surface, thus forming a sort of textile mosaic. Each row is firmly fixed by a shoot of linen weft-thread thrown across the web, and then carefully beaten down with the batten.

Various classes of ornament occur in these magnificent Oriental carpets; one variety has stiff geometrical patterns, the motives of which appear to be taken from mosaics or tiles. Another and still more beautiful sort, manufactured especially at Ispahan (see fig. 9), has elaborate flowing designs of flower forms, sometimes mixed with figures of cheetahs, lions, antelopes, and birds, in a few cases combined with human figures. Mr W. Morris, in his valuable lecture on textile fabrics (London, 1884), traces three stages of design,—first, a pure flowing style, closely resembling the early stucco mural reliefs of Cairo; secondly, a similar style blended with animal forms; and thirdly, a purely floral style, flowing in its lines and very fantastic and ingenious in its patterns; this last he thinks belongs to about the time of Shah Abbas, and lasted from about 1550 to 1650,—the culminating period of Oriental art.[2] Since then there has been a distinct degradation of style, though in many cases older patterns have been worked from and very perfect work produced. At the present day the influence of European taste is rapidly destroying this survival of the best class of design, and especially is introducing the most harsh and discordant colouring in place of the glorious rich hues of the earlier Oriental weavers.

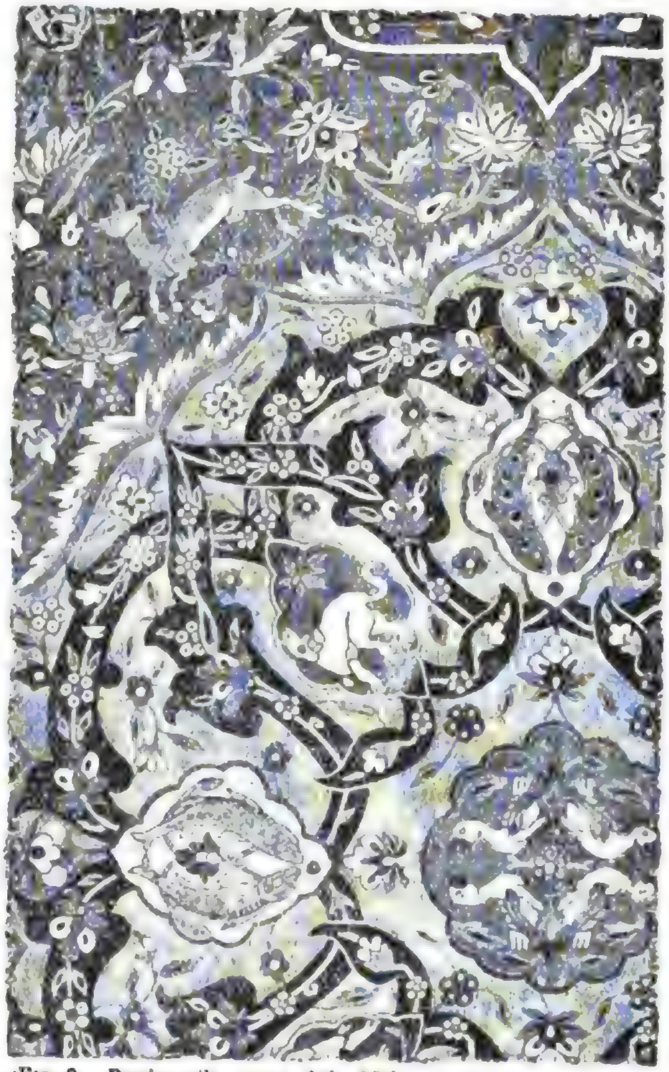

FIG. 9.—Persian pile carpet of the 15th century, woven of goats' hair and silk. (South Kensington Museum.)

Though no existing specimens can be pointed out, it appears probable that the "tapisserie Saracenois" of Louis IX.'s edicts (1226-1270) refers to pile carpets made by French weavers after the Oriental fashion.[3] The same edicts for the regulation of the textile industry mention two other classes of manufacture, "tapisserie à la haute lisse," *i.e.*, what we call tapestry, and "tapisserie nostrez," "native stuff," probably resembling the coarse but effective patterned fabrics for aprons and dresses which are still woven by the peasantry near Rome, in the Abruzzi mountains, and elsewhere in Italy, and in Scandinavia.

TAPESTRY.

The making of tapestry (Gk. τάπης), like the weaving of pile carpets, differs from ordinary fabric in that no visible weft is thrown completely across the loom, but the design is formed by short stitches knotted across the warp with a wooden needle called a *broach*. It is a sort of link between textile work and embroidery, from which it differs in having its stitches applied, not to a finished web, but to the stretched strings of a warp.[1] It is made on a high loom, and the whole process, though requiring much skill, is mechanically of the simplest kind. It is very probable that many of the woven hangings used in ancient Egypt, Greece, and other countries were true tapestry; but little is known on this point. Till after the 12th century, in northern Europe, embroidery seems to have served the place of tapestry, as, for example, in the wrongly named Bayeux tapestry (see vol. viii. p. 162); while in the south of Europe and in Oriental countries its place was supplied by the rich silken textiles and pile carpets mentioned above.

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[1] See Karabacek, *Die persische Nadelmalerei Susandschird* and *Oestr. Monatsch. f. d. Orient*, 1884, p. 49, with cut.

[2] A valuable help towards establishing the dates of carpet patterns is given by many mediæval Italian pictures, in which Oriental carpets are often represented with wonderful minuteness and appreciation.

[3] *Tapisserie* in French means all sorts of patterned stuffs.

Flemish. In the 14th century tapestry began to be largely made, especially in Flanders, where the craft of weaving became very important at an early time. The designs on the very few existing samples of 14th-century tapestry closely resemble those of contemporary wall painting. A characteristic early specimen in the Louvre has rows of medallions, each containing a scene from the life of St Martin, with two or three figures treated in a very simply decorative way. The spaces between the circles are filled up with a stiff geometrical ornament. To the end of the 14th century belongs the magnificent tapestry in Angers cathedral, on which are represented scenes from the Apocalypse; these were made at Arras, the chief seat of the tapestry manufacture, both for quantity and quality. Hence the name *arras* (Italian *arazzi*) came to mean any sort of tapestry, wherever it was made. Another magnificent series of arras work is preserved in Rheims cathedral, with designs from the history of Clovis; these date from the middle of the 15th century. In the 14th century Flanders produced enormous quantities of woven stuffs. At that time twenty-seven streets were occupied by the weavers of Ghent; in 1382 there were 50,000 weavers in Louvain; and at Ypres there is said to have been a still larger number. From about 1450 to 1500 was the golden age for tapestry, especially in Bruges and Arras, where large quantities of the most magnificent historical pieces were woven from designs supplied by painters of the Van Eyck school. The Flemish tapestries of that time are perfect models of textile art, rich in colour, strong in decorative effect, graceful in drawing and composition, and arranged with consummate skill to suit the exigencies of the loom and the æsthetic requirements of wall decoration. A very beautiful example of this class exists at Hampton Court, hung in the dark under the gallery in the great hall,—a striking contrast to the clever but artistically degraded tapestries of half a century later, which hang round the main walls of the hall. Other fine examples exist in the Cluny, Bern, and other museums, and especially in Madrid[2]—in the royal collection and in that of the duke of Alva—and elsewhere in Spain. Though very rich and varied in effect, the tapestry of the best period usually is woven with not more than twenty different tints of wool,—half tints and gradations being got by hatching one colour into another. In the 16th century about sixty colours were principally employed in the still fine but rapidly deteriorating tapestry of that period; and in the laborious but artistically worthless productions of the Gobelin factory more than 14,000 differently tinted wools are now used.

In the 16th century the art began to decline; very slight symptoms of decadence are visible in the beautiful tapestries with Petrarch's *Triumphs* in the South Kensington Museum,—most gorgeous pieces of textile art, of the richest decorative effect. These were worked very soon after 1500 (see fig. 10). The influence of Raphael and his school succeeded that of the 15th century Flemish painters, and was utterly destructive of true art value in tapestry. Raphael's cartoons, fine as they are in composition, are designed without the least reference to textile requirements, and are merely large pictures, which the weavers had to copy as best they might. This new style, which reduced the art to a feeble copyism of painting, gave the death-blow to the production of really fine tapestry. Brussels became the chief place for the manufacture after the taking of Arras by Louis XI. in 1477, and its weavers with wonderful skill imitated any sort of painting that was put before them. Cartoons were drawn by several of Raphael's pupils, such as Giulio Romano and Giovanni da Udine, and by Mabuse, Michiel Coxcie, Bernard van Orley, and other Italianized Flemish painters.

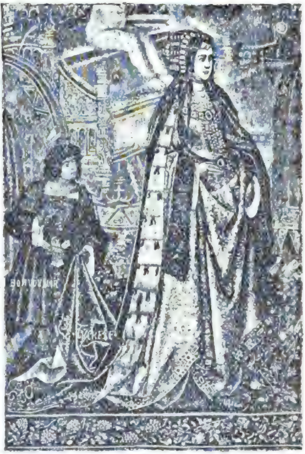

Fig. 10.—Figure of Lucretia from the Triumph of Chastity, woven at Brussels about 1507. Her dress is an Italian velvet, similar in style to that shown in fig. 6.

French. In 1539 Francis I. founded a factory for tapestry at Fontainebleau, and soon after other high looms were set up in Paris, examples from which still exist and show a rapid degradation of style. In 1603 a new factory was started in Paris under royal patronage, in the workshop of a family of dyers named Gobelin, after whom the new factory was named (see GOBELIN). The Gobelin looms were first worked by weavers from Flanders, who soon taught the mysteries of the craft to a number of French workmen. Cartoons were supplied by Simon Vouet and other distinguished French painters. In the reign of Louis XIV. a great impulse was given to the factory, and from 1667 the whole establishment became the property of the crown. Louis XIV.'s minister, Colbert, did much to encourage this and other industries. Charles Le Brun the painter was made director of the works, and a number of artists prepared the cartoons under his supervision. In the 18th century Coypel, Jouvenet, Boucher, Watteau, and many other popular painters made designs, often of great size and elaboration, for the Gobelin looms, but all in the very worst possible taste; these include large series of sacred, mythological, and historical subjects, landscapes, sea-pieces, and even portraits,—the last being perhaps the most ridiculous misuse of the textile art that could possibly be invented. Other tapestry looms were worked in the 18th century at Aubusson, Felletin, and other places in France.

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[1] In tapestry the weft stitches are put in loosely and carefully pressed home, so that the warp strings are completely hidden.

[2] See Riaño, *Tapestry of the Palace at Madrid*, London, 1875; of all countries Spain is the richest in tapestry of the 15th and 16th centuries. The royal collection contains 2000 large pieces. Rich stores also belong to the principal cathedrals, such as Toledo, which on the feast of Corpus Christi is completely hung round with tapestry outside as well as inside. In the 17th century tapestry looms were worked in Spain under royal patronage. One of Velazquez's finest pictures in the Madrid Gallery (Las Hilanderas) represents the visit of some court ladies to a tapestry fabrique, in which women are working the looms.

English.

High-warp looms appear to have been worked in England in the 15th century, though by far the greater part of the rich stores of tapestry in this country came from Flanders. One very beautiful example of English work of this time exists in St Mary's Hall at Coventry; it represents the marriage of Henry VI. Part of another series with the marriage of Henry VII. is preserved in a house in Cornwall. In the latter part of the 15th and the first half of the 16th century enormous sums were spent by the rich in England on Flemish tapestry Cardinal Wolsey's private accounts and inventories, which still exist,[1] give an astonishing picture of the wealth which he lavished on the adornment of his palace at Hampton Court. In 1522 he bought 132 large pieces of Brussels tapestry, woven with Scriptural subjects, and mostly made to order, so as to fit exactly the various wall spaces He also bought large quantities of costly Oriental carpets. In the inventories are enumerated "foot carpets," "table carpets," and "window carpets," "hanging peces," "borders with arms," and "window peces," the last being strips of tapestry woven in narrow lengths to fit the sills and jambs of windows. Among the "wall peces," in addition to the numerous sacred subjects, are mentioned mythological scenes, romances, historical pieces, and "hangings of verdures," the last being decorative work in which trees and foliage formed the main design, with accessory figures of hunting, hawking, and the like. The catalogue of Wolsey's linen napery is no less sumptuous and abundant; he possessed an immense quantity of finest linen for sheets and "board-cloths" (table-cloths), mostly patterned with "damaske diaper" or "paned losinge-wise." This example of the wealth of textile work possessed by one rich prelate will give some notion of what England and other countries possessed in the 16th century.

In the reign of James I. tapestry looms were set up at Mortlake, and the industry was carried on during the following reign under the direction of the painter Francis Crane. Charles I. introduced skilled weavers from Oudenarde in Belgium, and the whole existing series of cartoons by Raphael were copied on the Mortlake looms.[2] Most of the Mortlake tapestry has distinct marks, such as the shield of St George with F. C. (F. Crane) Some pieces are inscribed "Car. Re. Reg. Mortl." (Carolus rex regnans). Though closed during the Commonwealth, the Mortlake fabrique was again worked after the Restoration until the death of Crane in 1703. In the 18th century tapestry was woven on a small scale in Soho and at Fulham, and within recent years a new royal fabrique has been established at Windsor, where very costly and skilful weaving in the pictorial Gobelin style is carried on. The only modern tapestry which has any of the merits of the best old productions is that made on a small scale by Mr William Morris at Merton Abbey (Surrey), where work of the highest beauty has been produced. Unfortunately, however, the modern taste for feeble imitations of oil paintings has as yet shown little appreciation of this revival of the true textile art.

Italian.

As in England, by far the greater part of the tapestry used in Italy was a Flemish import. But in the 16th century, under the patronage of the dukes of Ferrara, tapestry looms were set up in Ferrara; these were, however, worked by Flemish weavers, and closely resemble contemporary tapestry woven at Brussels. Other fabriques were established in Florence by the Medici princes, and continued to be worked till the end of the 17th century. Factories for tapestry existed also at Venice, Turin, and other northern cities, but the industry was purely an exotic, and never attained to any great importance. Since the pontificate of Clement XI., in 1702,[3] a papal factory for tapestry has existed in Rome, and is still carried on in the Vatican. The papal looms have produced a large number of most costly and elaborate copies of celebrated paintings, executed with wonderful skill, but utterly worthless as works of art.

Collections.

The South Kensington Museum possesses the best and most illustrative collection of woven fabrics of various dates. The church of St Mary at Dantzic has a magnificent collection of early textiles, mostly used for vestments; these are well illustrated by Hinz, *Die Schatzkammer der Marien-Kirche zu Dantzig*, 1870. Fine examples of early tapestry exist in the cathedrals of Rheims, Bruges, Tournay, Angers, Beauvais, Aix, Sens, and in the church of St Rémy at Rheims. Other fine collections are preserved in the Louvre, the Cluny Museum, at Chartres, Amiens, Dijon, Orleans, Auxerre, Nancy, Bern, Brussels, Munich, Berlin, Dresden, Vienna, and Nuremberg.[4] In Italy the richest collections (mostly of later tapestry) are those of the Vatican, the Pitti, the Bargello, Palazzo del Tè at Mantua, Turin (royal palace), Milan (royal palace), Como (cathedral), and the museum of Naples. The Spanish collections have been already mentioned. In England, besides the South Kensington Museum, fine tapestries exist in the palaces of Windsor and Hampton Court. Those formerly in the House of Lords were destroyed in the fire of 1834. St Mary's Hall at Coventry contains the finest examples of the 15th century.

Literature.—By far the best work for its well-chosen coloured illustrations is that of Fischbach, *Textile Fabrics*, English ed., 1883; see also Dupont-Auberville, *L'ornement des tissus*, Paris, 1875-77; Michel, *Recherches sur la fabrication des étoffes*, Paris, 1852 (a very valuable work); Jubinal, *Anciennes tapisseries*, Paris, 1838-39; De Ronchaud, *Le péplos d'Athéné*, Paris, 1872; Id., *La tapisserie*, Paris, 1885; Muntz, *La tapisserie dans l'antiquité*, Paris, 1878; Lessing, *Modèles de tapis Orientaux*, Paris, 1879; Id., *Ancient Oriental Carpets*, London, 1879; Vincent Robinson, *Oriental Carpets*, London, 1882 (the illustrations are better than the text); Lady Alford, *Needlework as Art*, London, 1886 (deals partly with textiles). Though few works treat of the general history of textiles, a very large number exist about tapestry weaving. The chief are—Depping, *Règlements sur les arts . . . au XIIIme siècle*, Paris, 1837; De Montault, *Tapisserie de la cath. d'Angers*, Paris, 1863; De Farcy on the same subject, 1875; Barraud, *Tap. de la cath. de Beauvais*, Beauvais, 1853; Rock, *Textile Fabrics, S.K.M.*, London, 1870; Bock, *Cat. des tissus, &c., au Musée German.*, Nuremberg, 1869; Kinkel, *Rogier van der Weyden . . . et les tapisseries de Berne*, Zurich, 1867; Givelet, *Toiles brodées de Reims*, Rheims, 1883; Louis Paris, *Tap. de la ville de Reims*, Rheims, 1843; Loriquet, *Tap. de Notre Dame de Reims*, Rheims, 1876; Pinchart, *Tap. dans les Pays-Bas*, and other works, Brussels, 1859-64; Dehaisnes, *Tap. d'Arras avant le XVme siècle*, Paris, 1879; Proyart, *Recherches sur les tap d'Arras*, Arras, 1868; Voisin, *Tap. de la cath. de Tournay*, Tournay, 1863; Van Drival, *Tap. d'Arras*, Arras, 1864; Gorse, *Tap. du château de Pau*, Paris, 1881; De la Fons-Mellicoq, *Hautlisseurs des XIVme au XVIme siècles*, Paris, 1870; Santerre, *Tap. de Beauvais*, Clermont, 1842; Deville, *Statuts, &c., relatifs à la corp. des tap. de 1258 à 1875*, Paris, 1875; Darcel, *Gaz. d. b.-arts*, xiv. pp. 185, 278, and 414; Van de Graft, *De Tapijt-Fabrieken de XVI. en XVII. Eeuw*, Middelburg, 1869. On Italian tapestry, see De Montault, *Tap. de haute lisse à Rome*, Arras, 1879; Conti, *L'arte degli arazzi in Firenze*, Florence, 1875; Campori, *L'arazzeria Estense*, Modena, 1876; Braghirolli, *Arazzi in Mantova*, Mantua, 1879; Farabulini, *L'arte degli arazzi*, Rome, 1884; Gentili, *L'art des tapis*, Rome, 1878; and Muntz, *Tap. Italiennes*, Paris, 1880. On French and other late tapestry, see Darcel and Guichard, *Les tap. décoratives*, Paris, 1881; Lacordaire, *Hist. de tapisserie*, Paris, 1855; Guillaumot, *L'Origine . . . des Gobelins*, Paris, 1860; Perathon, *Tap. d'Aubusson, de Felletin, et de Bellegarde*, Paris, 1857; Roy-Pierrefitte, *Les tap. de Felletin*, Limoges, 1855; Durieux, *Tap. de Cambrai*, Cambrai, 1879; About and Bauer, *Tap. après les cartons de Raphael*, Paris, 1875; Houdoy, *Tap. de la fabrication Lilloise*, Lille, 1871; Vergnaud-Romagnesi, *Tap. au Musée d'Orléans*, Orleans, 1859; De St Genois, *Tap. d'Oudenarde*, Paris, 1864; Talcot, *Fabric. des tissus*, Paris, 1852; Guiffrey, *Hist. de la tapisserie*, Tours, 1886; Pine, *Tapestry of the House of Lords*, London, 1739; and De Champeaux, *Tapestry*, S.K.M. handbook, London, 1878; Ashenhurst, *Treatise on Weaving*, London, 1886. (J. H. M.)

TEZA, or TÁZÁ. See MOROCCO, vol. xvi. p. 834.

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[1] See LAW, *Hampton Court Palace*, London, 1885.

[2] See RAPHAEL, vol. xx. p. 280.

[3] An earlier fabrique was started in 1630 by Urban VIII., but it soon ceased to be worked.

[4] The large collection in the Gobelin Museum was burnt in 1871.

THACKERAY, William Makepeace (1811–1863), one of the greatest of English authors and novelists, son of Richmond Thackeray (Mrs Richmond Thackeray was born Miss Becher), and grandson of W. R. Thackeray of Hadley, Middlesex, was born at Calcutta on July 18, 1811. Both his father and grandfather had been Indian civil servants. His mother, who was only nineteen at the date of his birth, was left a widow in 1816, and afterwards married Major Henry Carmichael Smyth. Thackeray himself was sent home to England from India as a child, and went to Charterhouse, since his time removed to Godalming from its ancient site near Smithfield. Anthony Trollope, in his book on Thackeray in the *English Men of Letters* series, quotes a letter written to him about Thackeray's school-days by Mr G. S. Venables. "He came to school young," Mr Venables wrote, "a pretty, gentle, and rather timid boy." This accords with the fact that all through Thackeray's writings the student may find traces of the sensitiveness which often belongs to the creative mind, and which, in the boy who does not understand its meaning and its possible power is apt to assume the guise of a shy disposition. To this very matter Mr Venables tersely refers in a later passage of the letter quoted by Trollope: "When I knew him better, in later years, I thought I could recognize the sensitive nature which he had as a boy." Another illustration is found in the statement, which will be recognized as exact by all readers of Thackeray, that "his change of retrospective feeling about his school-days was very characteristic. In his earlier books he always spoke of the Charterhouse as Slaughter House and Smithfield. As he became famous and prosperous his memory softened, and Slaughter House was changed into Grey Friars, where Colonel Newcome ended his life." Even in the earlier references the bitterness which has often been so falsely read into Thackeray is not to be found. In "Mr and Mrs Frank Berry" (*Men's Wives*) there is a description of a Slaughter-House fight, following on an incident almost identical with that used in *Vanity Fair* for the fight between Dobbin and Cuff. In both cases the brutality of school life, as it then was, is very fully recognized and described, but not to the exclusion of the chivalry which goes alongside with it. In the first chapter of "Mr and Mrs Frank Berry," Berry himself and Old Hawkins both have a touch of the heroic. In the story which forms part of *Men's Wives* the bully whom Berry gallantly challenges is beaten, and one hears no more of him. In *Vanity Fair* Cuff the swaggerer is beaten in a similar way, but regains his popularity by one well-timed stroke of magnanimity, and afterwards shows the truest kindness to his conqueror.

In February 1829 Thackeray went to Trinity College, Cambridge, and in that year contributed some engaging lines on *Timbuctoo*, the subject for the prize poem, to a little university paper called *The Snob*, the title of which he afterwards utilized in the famous *Snob Papers*. The first stanza has become tolerably well known, but is worth quoting as an early instance of the direct comic force afterwards employed by the author in verse and prose burlesques:—

> In Africa—a quarter of the world—
> Men's skins are black; their hair is crisp and curled;
> And somewhere there, unknown to public view,
> A mighty city lies, called Timbuctoo.

One other passage at least in *The Snob*, in the form of a skit on a paragraph of fashionable intelligence, seems to bear traces of Thackeray's handiwork. At Cambridge James Spedding, Monckton Milnes (Lord Houghton), Edward Fitzgerald, W. H. Thompson (afterwards master of Trinity), and other distinguished persons were among his friends. In 1830 he left Cambridge without taking a degree, and went to Weimar and to Paris. His visit to Weimar bore fruit in the sketches of life at a small German court which appear in *Fitz-Boodle's Confessions* and in *Vanity Fair*. In 1832 he came of age, and inherited a sum which Trollope's book describes as amounting to about five hundred a year. The money was soon lost,—some in an Indian bank, some in two newspapers which in *Lovel the Widower* are referred to under one name as *The Museum*, in connexion with which our friends Honeyman and Sherrick of *The Newcomes* are briefly brought in. His first regular literary employment after the loss of his patrimony was on *Fraser's Magazine*, in which in 1837–38 appeared *The History of Mr Samuel Titmarsh and the Great Hoggarty Diamond*, a work filled with instances of the wit, humour, satire, pathos, which found a more ordered if not a fresher expression in his later and longer works. For freshness, indeed, and for a fine perception which enables the author to perform among other feats that of keeping up throughout the story the curious simplicity of its supposed narrator's character, the *Great Hoggarty Diamond* can scarce be surpassed. The characters, from Lady Drum, Lady Fanny, Lady Jane, and Edmund Preston down to Brough, his daughter, Mrs Roundhand, Gus Hoskins, and, by no means least, Samuel Titmarsh's pious aunt with her store of "Rosolio," are living; the book is crammed with honest fun; and, for pure pathos, the death of the child, and the meeting of the husband and wife over the empty cradle (a scene illustrated by the author himself with that suggestion of truth which no shortcoming in drawing could spoil), stands, if not alone in its own line, at least in the company of very few such scenes in English fiction. The *Great Hoggarty Diamond*, oddly enough, met with the fate that afterwards befell one of Lever's best stories which appeared in a periodical week by week,—it had to be cut short at the bidding of the editor. In the same year in which it appeared Thackeray married Isabella, daughter of Colonel Matthew Shawe. Of the daughters born of the marriage, one, Mrs Richmond Ritchie, has earned distinction as a novelist. Mrs Thackeray, to quote Trollope, "became ill and her mind failed her," and Thackeray thereupon "became as it were a widower till the end of his days." In 1840 came out *The Paris Sketch Book*. Much of it had been written and published at an earlier date, and in the earlier writings there are some very curious divagations in criticism. The book contains also a striking story of card-sharping, afterwards worked up and put into Altamont's mouth in *Pendennis*, and a very powerful sketch of a gambler's death and obsequies. Three years before, in 1837, Thackeray had begun, in *Fraser*, the *Yellowplush Papers*, with their strange touches of humour, satire, tragedy (in one scene, the closing one of the history of Mr Deuceace), and their sublimation of fantastic bad spelling (M'Arony for macaroni is one of the typical touches of this); and this was followed by *Catherine*, a strong story, and too disagreeable perhaps for its purpose, founded closely on the actual career of a criminal named Catherine Hayes, and intended to counteract the then growing practice of making ruffians and harlots prominent characters in fiction. There soon followed *Fitz-Boodle's Confessions and Professions*, including the series *Men's Wives*, already referred to; and, slightly before these, *The Shabby Genteel Story*, a work interrupted by Thackeray's domestic affliction and afterwards republished as an introduction to *The Adventures of Philip*, which took up the course of the original story many years after the supposed date of its catastrophe. In 1843, and for some ten years onwards according to Trollope, Thackeray was writing for *Punch*, and the list of his contributions included among many others the celebrated *Snob Papers* and the *Ballads of Policeman X*. In 1843 also came out the *Irish Sketch Book*, and in 1844 the account of the journey *From Cornhill to Grand Cairo*, in which was published the excellent poem of *The White Squall*. In 1844 there began in *Fraser* the *Memoirs of Barry Lyndon*, called in the magazine *The Luck of Barry Lyndon, a Romance of the Last Century*. *Barry Lyndon* has, with a very great difference in treatment, some resemblance to Smollett's *Count Fathom*:—the hero, that is to say, is or becomes a most intolerable scoundrel, who is magnificently unconscious of his own iniquity. The age and pressure of the time depicted are caught with amazing verisimilitude, and in the boyish career of Barry Lyndon there are fine touches of a wild chivalry, simplicity, and generosity, which mingle naturally with the worse qualities that, under the influence of abominable training, afterwards corrupt his whole mind and career. The man is so infatuated with and so blind to his own roguery, he has so much dash and daring, and is on occasions so infamously treated, that it is not easy to look upon him as an entirely detestable villain until, towards the end of his course, he becomes wholly lost in brutish debauchery and cruelty. His latter career is founded on that of Andrew Robinson Stoney Bowes, who married the widow of John, ninth earl of Strathmore. There is also no doubt a touch of Casanova in Barry Lyndon's character. Besides the contributions to *Punch* specially referred to, there should be noticed *Punch's Prize Novelists*, containing some brilliant parodies of Edward Lytton Bulwer, Lever, Mr D'Israeli (in *Codlingsby*, perhaps the most perfect of the series), and others. Among minor but admirable works of the same period are found *A Legend of the Rhine* (a burlesque of the great Dumas's *Othon l'Archer*), brought out in a periodical of George Cruikshank's, *Cox's Diary* (on which has been founded a well-known Dutch comedy, *Janus Tulp*), and the *Fatal Boots*. This is the most fitting moment for mentioning also *Rebecca and Rowena*, which towers, not only over Thackeray's other burlesques, excellent as they are, but over every other burlesque of the kind ever written. Its taste, its wit, its pathos, its humour, are unmatchable; and it contains some of the best songs of a particular kind ever written—songs worthy indeed to rank with Peacock's best. In 1846 was published, by Messrs Bradbury and Evans, the first of twenty-four numbers of *Vanity Fair*, the work which first placed Thackeray in his proper position before the public as a novelist and writer of the first rank. It was completed in 1848, when Thackeray was thirty-seven years old; and in the same year Abraham Hayward paid a tribute to the author's powers in the *Edinburgh Review*. It is probable that on *Vanity Fair* has been largely based the foolish cry, now heard less and less frequently, about Thackeray's cynicism, a cry which he himself, with his keen knowledge of men, foresaw and provided against, amply enough as one might have thought, at the end of the eighth chapter, in a passage which is perhaps the best commentary ever written on the author's method. He has explained how he wishes to describe men and women as they actually are, good, bad, and indifferent, and to claim a privilege—

> "Occasionally to step down from the platform, and talk about them: if they are good and kindly, to love and shake them by the hand; if they are silly, to laugh at them confidentially in the reader's sleeve; if they are wicked and heartless, to abuse them in the strongest terms politeness admits of. Otherwise you might fancy it was I who was sneering at the practice of devotion, which Miss Sharp finds so ridiculous; that it was I who laughed good-humouredly at the railing old Silenus of a baronet—whereas the laughter comes from one who has no reverence except for prosperity, and no eye for anything beyond success. Such people there are living and flourishing in the world—Faithless, Hopeless, Charityless: let us have at them, dear friends, with might and main. Some there are, and very successful too, mere quacks and fools: and it was to combat and expose such as those, no doubt, that laughter was made."

As to another accusation which was brought against the book when it first came out, that the colours were laid on too thick, in the sense that the villains were too villainous, the good people too goody-goody, the best and completest answer to that can be found by any one who chooses to read the work with care. Osborne is, and is meant to be, a poor enough creature, but he is an eminently human being, and one whose poorness of character is developed as he allows bad influences to tell upon his vanity and folly. The good in him is fully recognized, and comes out in the beautiful passage describing his farewell to Amelia on the eve of Waterloo, in which passage may be also found a sufficient enough answer to the statement that Amelia is absolutely insipid and uninteresting. So with the companion picture of Rawdon Crawley's farewell to Becky: who that reads it can resist sympathy, in spite of Rawdon's vices and shady shifts for a living, with his simple bravery and devotion to his wife? As for Becky, a character that has since been imitated a host of times, there is certainly not much to be said in her defence. We know of her, to be sure, that she thought she would have found it easy to be good if she had been rich, and we know also what happened when Rawdon, released without her knowledge from a spunging-house, surprised her alone with and singing to Lord Steyne in the house in May Fair. After a gross insult from Steyne, "Rawdon Crawley, springing out, seized him by the neckcloth, until Steyne, almost strangled, writhed and bent under his arm. 'You lie, you dog,' said Rawdon; 'you lie, you coward and villain!' And he struck the peer twice over the face with his open hand, and flung him bleeding to the ground. It was all done before Rebecca could interpose. She stood there trembling before him. She admired her husband, strong, brave, and victorious." This admiration is, as Thackeray himself thought it, the capital touch in a scene which is as powerful as any Thackeray ever wrote—as powerful, indeed, as any in English fiction. Its full merit, it may be noted in passing, has been curiously accented by an imitation of it in M. Daudet's *Fromont Jeune et Risler Aîné*. As to the extent of the miserable Becky's guilt in the Steyne matter, on that Thackeray leaves it practically open to the reader to form what conclusion he will. There is, it should be added, a distinct touch of good in Becky's conduct to Amelia at Ostend in the last chapter of the book, and those who think that too little punishment is meted out to the brilliant adventuress in the end may remember this to her credit. It is supreme art in the treatment of her character that makes the reader understand and feel her attractiveness, though he knows her extraordinarily evil qualities; and in this no writer subsequent to Thackeray who has tried to depict one of the genus Becky Sharp has even faintly succeeded. Among the minor characters there is not one—and this is not always the case even with Thackeray's chief figures—who is incompletely or inconsistently depicted; and no one who wishes to fully understand and appreciate the book can afford to miss a word of it.

Vanity Fair was followed by *Pendennis*, *Esmond*, and *The Newcomes*, which appeared respectively in 1850, 1852, and 1854. It might be more easy to pick holes critically in *Pendennis* than in *Vanity Fair*. Pendennis himself, after his boyish passion and university escapades, has disagreeable touches of flabbiness and worldliness; and the important episode of his relations with Fanny Bolton, which Thackeray could never have treated otherwise than delicately, is so lightly and tersely handled that it is a little vague even to those who read between the lines; the final announcement that those relations have been innocent can scarcely be said to be led up to, and one can hardly see why it should have been so long delayed. This does not of course affect the value of the book as a picture of middle and upper class life of the time, the time when Vauxhall still existed, and the haunt for suppers and songs which Thackeray in this book called the Back Kitchen, and it is a picture filled with striking figures. In some of these, notably in that of Foker, Thackeray went, it is supposed, very close to actual life for his material, and in that particular case with a most agreeable result. As for the two *umbræ* of the marquis of Steyne, it is difficult to believe that they were intended as caricatures from two well-known persons. If they were, for once Thackeray's hand forgot its cunning. Here, as in *Vanity Fair*, the heroism has been found a little insipid; and there may be good ground for finding Laura Pendennis dull, though she has a spirit of her own. In later books she becomes, what Thackeray's people very seldom are, a tiresome as well as an uninviting person. Costigan is unique, and so is Major Pendennis, a type which, allowing for differences of period and manners, will exist as long as society does, and which has been seized and depicted by Thackeray as by no other novelist. His two encounters, from both of which he comes out victorious, one with Costigan in the first, the other with Morgan in the second volume, are admirable touches of genius. In opposition to the worldliness of the major, with which Pendennis does not escape being tainted, we have Warrington, whose nobility of nature has come unscathed through a severe trial, and who, a thorough gentleman if a rough one, is really the guardian of Pendennis's career. There is, it should be noted, a characteristic and acknowledged confusion in the plot of Pendennis, which will not spoil any intelligent reader's pleasure.

Probably most readers of *The Newcomes* (1854) to whom the book is mentioned think first of the grand, chivalrous, and simple figure of Colonel Newcome, who stands out in the relief of almost ideal beauty of character against the crowd of more or less imperfect and more or less base personages who move through the novel. At the same time, to say, as has been said, that this book "is full of satire from the first to the last page" is to convey an impression which is by no means just. There is plenty of kindliness in the treatment of the young men who, like Clive Newcome himself and Lord Kew, possess no very shining virtue beyond that of being honourable gentlemen; in the character of J. J. Ridley there is much tenderness and pathos; and no one can help liking the Bohemian F. B., and looking tolerantly on his failings. It may be that both the fiendish temper of Mrs Mackenzie and the sufferings she inflicts on the Colonel are too closely insisted on; but it must be remembered that this heightens the singular pathos of the closing scenes of the Colonel's life. It has seemed convenient to take *The Newcomes* after *Pendennis*, because Pendennis and his wife reappear in this book as in the *Adventures of Philip*; but *Esmond* (1852) was written and published before *The Newcomes*. To some students *Esmond* seems and will seem Thackeray's capital work. It has not been rivalled, and only a few times approached by Mr Besant, as a romance reproducing with unfailing interest and accuracy the figures, manners, and phrases of a past time, and it is full of beautiful touches of character. But Beatrix, upon whom so much hinges, is an unpleasing character, although one understands fully why men were captivated by her insolent beauty and brilliancy; and there is some truth in Thackeray's own saying, that "Esmond was a prig." Apart from this, the story is, like the illusion of a past time in the narrative, so complete in all its details, so harmoniously worked out, that there is little room for criticism. As to Esmond's marriage with the lady whom he has served and loved as a boy, that is a matter for individual judgment. Beatrix, it has been indicated above, is wonderfully drawn; and not the least wonderful thing about her is her reappearance as the jaded, battered, worldly, not altogether unkindly, Baroness in *The Virginians*. It was just what Beatrix must have come to, and the degradation is handled with the lightest and finest touch.

In 1851 Thackeray had written *The English Humourists of the Eighteenth Century*, delivered as a series of lectures at Willis's Rooms in the same year, and re-delivered in the United States in 1852 and 1853, as was afterwards the series called *The Four Georges*. Both sets were written for the purposes of lecturing. In 1857 Thackeray stood unsuccessfully as a parliamentary candidate for Oxford against Mr Cardwell, and in the same year appeared the first number of *The Virginians*, a sequel to *Esmond*. This is a most unequal work,—inferior, as sequels are apt to be, to *Esmond* as an historical romance, less compact and coherent, prone to divagation and desultoriness, yet charming enough in its lifelikeness, in the wit and wisdom of its reflexions, and, as has been said, in its portrait of Beatrix grown old. The last number of *The Virginians* came out in 1859, and in the same year Thackeray undertook the editorship of the *Cornhill Magazine*. This was a task which, as readers of his *Roundabout* paper "Thorns in the Cushion" will remember, the kindliness and sensitiveness of his disposition made irksome to him, and he resigned the editorship in April 1862, though he continued to write for the magazine until he died. In the *Cornhill* appeared from his pen *Lovel the Widower*, previously written, with different names for some of the personages, in dramatic form; *The Adventures of Philip*; the *Roundabout Papers*; and the story, unhappily never finished, called *Denis Duval*. *Lovel the Widower*, changed from the dramatic to the narrative form, remains a piece of high comedy in which the characters are indicated rather than fully worked out, with a bold and practised touch. It contains some references to Thackeray's early and unfortunate newspaper speculations, and it was provided by the author with illustrations which as in others of his books have a value which is entirely their own in furnishing, as it were, a far completer commentary on the letterpress than could have been given by any draughtsman, however perspicacious and finished, who approached the pictorial representation of the characters from the outside. To the general statement thus indicated an exception should be made in the case of Doyle's illustrations to *The Newcomes* and to *Rebecca and Rowena*. On the other hand, not even Doyle could have matched the fun and spirit of Thackeray's own illustrations to another burlesque story, one of his best, *The Rose and the Ring*. The *Roundabout Papers*, a small storehouse of some of Thackeray's best qualities as an essayist, came out in the *Cornhill Magazine* simultaneously with *Lovel the Widower* and with *The Adventures of Philip*. Among them is one differing in form from the rest, called *The Notch on the Axe—a Story à la Mode*. It is an almost perfect specimen of the author's genius for burlesque story-telling; but it contains an odd instance, which a careful reader will not fail to discover, of the odd habit of inaccuracy of which Thackeray himself was conscious. *The Adventures of Philip* is, as has been before said, in the nature of a sequel to or a completion of *A Shabby Genteel Story*. As with the other direct sequel, it is a work of great inequality. It contains scenes of humour, pathos, satire, which rank with Thackeray's best work; some old friends from others of the novels make brief but pleasant reappearances in its pages; there are fine sketches of journalistic, artistic, and diplomatic life, and the scene from the last-named in Paris is inimitable. The Little Sister is altogether delightful; the Twysden family are terribly true and vastly diverting; the minor characters, among whom old Ridley, J. J.'s father, should be mentioned, are wonderfully hit off; nor did Thackeray ever write a better scene than that of the quarrel between Bunch, Baynes, and M'Whirter in the Paris pension. Philip himself is impossible; one cannot say that the character is ill-drawn—it is not drawn at all. It is an entirely different personage in different chapters; and it has here and there a very unpleasant touch which must have come of rapid writing. Yet so admirable are many parts of the book that it cannot be left out of the list of Thackeray's most considerable works. *Denis Duval*, which reached only three numbers, promised to be a first-rate work, more or less in the *Esmond* manner. The author died while it was in progress, on the day before Christmas day 1863. He was buried in Kensal Green, and a bust by Marochetti was put up to his memory in Westminster Abbey.

Little has yet been said of Thackeray's performances in poetry. They formed a small but not the least significant part of his life's work. The grace and the apparent spontaneity of his versification are beyond question. Some of the more serious efforts, such as *The Chronicle of the Drum* (1841), are full of power, and instinct with true poetic feeling. Both the half-humorous half-pathetic ballads and the wholly extravagant ones must be classed with the best work in that kind; and the translations from Béranger are as good as verse translations can be. He had the true poetic instinct, and proved it by writing poetry which equalled his prose in grace and feeling.

It is not necessary to discuss the precise place which Thackeray will in future hold, in respect to his immediate contemporaries. What seems absolutely certain is that the force and variety of his genius and art will always hold for him a place as one of the greatest of English novelists and essayists, and, it should be added, as by no means the least of English critics. (W. H. P.)

THALBERG, SIGISMOND (1812-1871), a celebrated pianist and composer for his instrument, was born at Geneva in 1812 (May 5 or January 7). In 1822 he was taken to Vienna, where, under the watchful care of Count Dietrichstein, his education was completed. There is some doubt as to the masters under whom he studied; but it is certain that he received instruction from Hummel, and perhaps also from Czerny, and that he took lessons in composition from Sechter. He made his first appearance as a pianist at Prince Metternich's in 1826, and published his first composition—a *Fantasia on Airs from "Euryanthe"*—in 1828, but it was not until 1830 that he was first fairly introduced to the public, with such brilliant success that from that time forward his only rival was Liszt. In 1834 he was appointed "kammervirtuos" to the emperor of Austria. He first appeared in Paris in 1837; and in 1838 he came to England, astonishing his hearers with the novel effects produced in his *Variations on God Save the Queen*, while he charmed them with his delicate touch and the purity of his expression. Thenceforward his career was a succession of triumphs. In order to disprove the popular idea that he could execute no music but his own, he played Beethoven's *Concerto in C minor* (op. 37) at the London Wednesday Concerts, held in 1846-47 at Exeter Hall, with a keen intelligence which proved his power of interpreting the works of the great masters to be at least on a level with his wonderful *technique*. Besides his pianoforte compositions, which are almost innumerable, Thalberg produced two operas,—*Cristina*, which proved a complete failure, and *Florinda*, which fared but little better at Her Majesty's Theatre in 1851. He played in London for the last time in 1863, and afterwards retired to his estate near Naples. He died at Naples, April 27, 1871.

THALES OF MILETUS (640-546 B.C.), son of Examyus and Cleobuline, is universally recognized as the founder of Greek geometry, astronomy, and philosophy. He is said by Herodotus and others to have been of Phœnician extraction, but the more common account (see Diogenes Laertius) is that he was a native Milesian of noble birth. Zeller thinks that his ancestors belonged to the Cadmean tribe in Bœotia, who were intermingled with the Ionians of Asia Minor, and thus reconciles the conflicting statements. The nationality of Thales is certainly Greek and not Phœnician. The high estimation in which he was held by his contemporaries is shown by the place he occupied as chief of the seven "wise men" of Greece; and in later times amongst the ancients his fame was quite remarkable. It is well known that this name (σοφός) was given on account of practical ability; and in accordance with this we find that Thales had been occupied with civil affairs, and indeed several instances of his political sagacity have been handed down. Of these the most remarkable is the advice, praised by Herodotus, which he gave to his fellow-countrymen "before Ionia was ruined,"—"that the Ionians should constitute one general council in Teos, as the most central of the twelve cities, and that the remaining cities should nevertheless be governed as independent states" (Herod., i. 170). It is probable, however, that in the case of Thales the appellation "wise man," which was given to him and to the other six in the archonship of Damasius (586 B.C.),[1] was conferred on him not only on account of his political sagacity, but also for his scientific eminence (Plut., *Solon*, c. 3). To about the same time must be referred his celebrated prediction of the eclipse of the sun, which took place on May 28, 585 B.C. This event, which was of the highest importance, has given rise to much discussion. The account of it as given by Herodotus (i. 74) contains two statements:—(1) the fact that the eclipse did actually take place during a battle between the Medes and the Lydians, that it was a total eclipse (Herodotus calls it a "night battle"), that it caused a cessation of hostilities and led to a lasting peace between the contending nations; (2) that Thales had foretold the eclipse to the Ionians, and fixed the year in which it actually did take place. Various dates—ranging from 625 B.C. to 583 B.C.—have been assigned by different chronologists to this eclipse; but, since the investigations of Airy,[2] Hind,[3] and Zech,[4] the date determined by them (May 28, 585 B.C.) has been generally accepted. This date agrees nearly with that given by Pliny (*H. N.*, ii. 12). The second part of the statement of Herodotus—the reality of the prediction by Thales—has been frequently called in question, chiefly on the ground that, in order to predict a solar eclipse with any chance of success, one should have the command of certain astronomical facts which were not known until the 3d century B.C., and then merely approximately, and only employed with that object in the following century by Hipparchus. The question, however, is not whether Thales could predict the eclipse of the sun with any chance of success—much less whether he could state beforehand at what places the eclipse would be visible, as some have erroneously supposed, and which of course would have been quite impossible for him to do, but simply whether he foretold that there would be a solar eclipse in that year, as stated by Herodotus. Now as to this there is quite a remarkable unanimity in the testimony of the ancients, and the evidence is of the strongest kind, ascending to Herodotus, and, according to the account of Diogenes Laertius, even to Xenophanes, who was an Ionian, and not much later than Thales. Further, we know that in the 8th century B.C. there were observatories in most of the large cities in the valley of the Euphrates, and that professional astronomers regularly took observations of the heavens, copies of which were sent to the king of Assyria; and from a cuneiform inscription found in the palace of Sennacherib at Nineveh, the text of which is given by George Smith,[1] we learn that at that time the epochs of eclipses of both sun and moon were predicted as possible—probably by means of the cycle of 223 lunations or Chaldæan Saros—and that observations were made accordingly.

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[1] Bretschneider (*Die Geom. vor Euklides*, p. 40), without stating his authority, gives "between 585 and 583 B.C." as the date of the archonship of Damasius. In this he is followed by some other recent writers, who infer thence that the name "wise" was conferred on Thales on account of the success of his prediction. The date 586 B.C., given above, which is taken from Clinton, is adopted by Zeller.

[2] "On the Eclipses of Agathocles, Thales, and Xerxes," *Phil. Trans.*, vol. cxliii. p. 179 *sq.*, 1853.

[3] *Athenæum*, p. 919, 1852.

[4] *Astronomische Untersuchungen der wichtigeren Finsternisse*, &c., p. 57, 1853.

The wonderful fame of Thales amongst the ancients must have been in great part due to this achievement, which seems, moreover, to have been one of the chief causes that excited amongst the Hellenes the love of science which ever afterwards characterized them. Thales seems not to have left any writings behind him, though as to this there appears to be some doubt (see Diog. Laer., i. 23). Many anecdotes, amusing rather than instructive, are related of him, which have been handed down by Diogenes Laertius and other writers. From some of them it would appear that he was engaged in trade, which is indeed expressly stated by Plutarch (*Solon*, c. 2). It is probable that in the pursuit of commerce he was led to visit Egypt. Of the fact that Thales visited Egypt, and there became acquainted with geometry, there is abundant evidence. Hieronymus of Rhodes (ap. Diog. Laer., i. 27) says, "he never had any teacher except during the time when he went to Egypt and associated with the priests."[2]

But the characteristic feature of the work of Thales was that to the knowledge thus acquired he added the capital creation of the geometry of lines, which was essentially abstract in its character. The only geometry known to the Egyptian priests was that of surfaces, together with a sketch of that of solids, a geometry consisting of some simple quadratures and elementary cubatures, which they had obtained empirically. Thales, on the other hand, introduced *abstract* geometry, the object of which is to establish precise relations between the different parts of a figure, so that some of them could be found by means of others in a manner strictly rigorous. This was a phenomenon quite new in the world, and due, in fact, to the abstract spirit of the Greeks.

The following discoveries in geometry are attributed to Thales:—(1) the circle is bisected by its diameter (Procl., *op. cit.*, p. 157); (2) the angles at the base of an isosceles triangle are equal (Id., p. 250), (3) when two straight lines cut each other the vertically opposite angles are equal (Id., p. 299); (4) the angle in a semicircle is a right angle;[3] (5) the theorem Euclid i. 26 is referred to Thales by Eudemus (Procl., *op. cit.*, p. 352). Two applications of geometry to the solution of practical problems are also attributed to him:—(1) the determination of the distance of a ship at sea, for which he made use of the last theorem; (2) the determination of the height of a pyramid by means of the length of its shadow: according to Hieronymus of Rhodes (Diog. Laert., i. 27) and Pliny (*N. H.*, xxxvi. 12), the shadow was measured at the hour of the day when a man's shadow is the same length as himself. Plutarch, however, states the method in a form requiring the knowledge of Euclid vi. 4, but without the restriction as to the hour of the day (*Sept. Sap. Convis.*, 2). Further, we learn from Diogenes Laertius (i. 25) that he perfected the things relating to the scalene triangle and the theory of lines. Proclus, too, in his summary of the history of geometry before Euclid, which he probably derived from Eudemus of Rhodes, says that Thales, having visited Egypt, first brought the knowledge of geometry into Greece, that he discovered many things himself, and communicated the beginnings of many to his successors, some of which he attempted in a more abstract manner (καθολικώτερον) and some in a more intuitional or sensible manner (αἰσθητικώτερον) (*op. cit.*, p. 65).

From these indications it is no doubt difficult to determine what Thales brought from Egypt and what was due to his own invention. This difficulty has, however, been lessened since the translation and publication of the papyrus Rhind by Eisenlohr;[4] and it is now generally admitted that, in the distinction made in the last passage quoted above from Proclus, reference is made to the two forms of his work,—αἰσθητικώτερον pointing to what he derived from Egypt or arrived at in an Egyptian manner, while καθολικώτερον indicates the discoveries which he made in accordance with the Greek spirit. To the former belong the theorems (1), (2), and (3), and to the latter especially the theorem (4), and also, probably, his solution of the two practical problems. We infer, then, [1] that Thales must have known the theorem that the sum of the three angles of a triangle are equal to two right angles. This inference is made from (4) taken along with (2). No doubt we are informed by Proclus, on the authority of Eudemus, that the theorem Euclid i. 32 was first proved in a general way by the Pythagoreans (see PYTHAGORAS, vol. xx. p. 140); but, on the other hand, we learn from Geminus that the ancient geometers observed the equality to two right angles in each kind of triangle—in the equilateral first, then in the isosceles, and lastly in the scalene (Apoll., *Conica*, ed. Halleius, p. 9), and it is plain that the geometers older than the Pythagoreans can be no other than Thales and his school. The theorem, then, seems to have been arrived at by induction, and may have been suggested by the contemplation of floors or walls covered with tiles of the form of equilateral triangles, or squares, or hexagons. [2] We see also in the theorem (4) the first trace of the important conception of geometrical loci, which we, therefore, attribute to Thales. It is worth noticing that it was in this manner that this remarkable property of the circle, with which, in fact, abstract geometry was inaugurated, presented itself to the imagination of Dante:—

> "O se del mezzo cerchio far si puote
> Triangol sì, ch'un retto non avesse."—*Par.*, c. xiii. 101.

[3] Thales discovered the theorem that the sides of equiangular triangles are proportional. The knowledge of this theorem is distinctly attributed to Thales by Plutarch, and it was probably made use of also in his determination of the distance of a ship at sea.

Let us now consider the importance of the work of Thales. I. In a scientific point of view: (*a*) we see, in the first place, that by his two theorems he founded the geometry of lines, which has ever since remained the principal part of geometry; (*b*) he may, in the second place, be fairly considered to have laid the foundation of algebra, for his first theorem establishes an equation in the true sense of the word, while the second institutes a proportion.[5] II. In a philosophic point of view: we see that in these two theorems of Thales the first type of a natural law, *i.e.*, the expression of a fixed dependence between different quantities, or, in another form, the disentanglement of constancy in the midst of variety—has decisively arisen.[6] III. Lastly, in a practical point of view: Thales furnished the first example of an application of theoretical geometry to practice,[7] and laid the foundation of an important branch of the same—the measurement of heights and distances. For the further progress of geometry see PYTHAGORAS.

As to the astronomical knowledge of Thales we have the following notices:—(1) besides the prediction of the solar eclipse, Eudemus attributes to him the discovery that the circuit of the sun between the solstices is not always uniform;[8] (2) he called the last day of the month the thirtieth (Diog. Laert., i. 24); (3) he divided the year into 365 days (Id., i. 27); (4) he determined the diameter of the sun to be the 720th part of the zodiac;[9] (5) he appears to have pointed out the constellation of the Lesser Bear to his countrymen, and instructed them to steer by it [as nearer the pole] instead of the Great Bear (Callimachus ap. Diog. Laert., i. 23; *cf.* Aratus, *Phænomena*, v. 36 *sq.*). Other discoveries in astronomy are attributed to Thales, but on authorities which are not trustworthy. He did not know, for example, that "the earth is spherical," as is erroneously stated by Plutarch (*Placita*, iii. 10); on the contrary, he conceived it to be a flat disk, and in this supposition he was followed by most of his successors in the Ionian schools, including Anaxagoras. The doctrine of the sphericity of the earth, for which the researches of Anaximander had prepared the way,[1] was in fact one of the great discoveries of Pythagoras, was taught by Parmenides, ~~who was~~ connected with the Pythagoreans, and remained for a long time the exclusive property of the Italian schools.[2]

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[1] *Assyrian Discoveries*, p. 409.

[2] *Cf.* Pamphila and the spurious letter from Thales to Pherecydes, ap. Diog. Laer.; Proclus, *In primum Euclidis Elementorum Librum Commentarii*, ed. Friedlein, p. 65; Pliny, *H. N.*, xxxvi. 12; Iamblichus, *In Vit. Pythag.*, 12; Plutarch, *Sept. Sap. Convis.*, 2, *De Iside*, 10, and *Plac.*, i. 3, 1.

[3] This is unquestionably the meaning of the statement of Pamphila (temp. Nero), ap. Diog. Laert., i. 24, that he was the first person to describe a right-angled triangle in a circle.

[4] *Ein mathematisches Handbuch der alten Aegypter*, Leipsic, 1877.

[5] Auguste Comte, *Système de Politique Positive*, iii. pp. 297, 300.

[6] P. Laffitte, *Les Grands Types de l'Humanité*, vol. ii. p. 292.

[7] *Ibid.*, p. 294.

[8] Theonis Smyrnæi Platonici *Liber de Astronomia*, ed. Th. H. Martin, p. 324, Paris, 1849. *Cf.* Diog. Laert., i. 24.

[9] This is the received interpretation of the passage in Diogenes Laertius, i. 24 (see Wolf, *Gesch. der Astron.*, p. 169), where σεληναίου is probably a scribe's error for ζῳδιακοῦ. *Cf.* Apuleius, *Florida*, iv. 18, who attributes to Thales, then old, the discovery: "quotiens sol magnitudine sua circulum quem permeat metiatur."

Whilst in virtue of his political sagacity and intellectual eminence Thales held a place in the traditional list of the wise men, on the strength of the disinterested love of knowledge which appeared in his physical speculations he was accounted a "philosopher" (φιλόσοφος). His "philosophy" is usually summed up in the dogma "water is the principle, or the element, of things"; but, as the technical terms "principle" (ἀρχή) and "element" (στοιχεῖον) had not yet come into use, it may be conjectured that the phrase "all things are water" (πάντα ὕδωρ ἐστί) more exactly represents his teaching. Writings which bore his name were extant in antiquity; but, as Aristotle, when he speaks of Thales's doctrine, always depends upon tradition, there can be little doubt that they were forgeries.

From Aristotle we learn (1) that Thales found in water the origin of things; (2) that he conceived the earth to float upon a sea of the elemental fluid; (3) that he supposed all things to be full of gods; (4) that in virtue of the attraction exercised by the magnet he attributed to it a soul. Here our information ends. Aristotle's suggestion that Thales was led to his fundamental dogma by observation of the part which moisture plays in the production and the maintenance of life, and Simplicius's, that the impressibility and the binding power of water were perhaps also in his thoughts, are by admission purely conjectural. Simplicius's further suggestion that Thales conceived the element to be modified by thinning and thickening is plainly inconsistent with the statement of Theophrastus that the hypothesis in question was peculiar to Anaximenes. The assertion preserved by Stobæus that Thales recognized, together with the material element "water," "mind," which penetrates it and sets it in motion, is refuted by the precise testimony of Aristotle, who declares that the early physicists did not distinguish the moving cause from the material cause, and that before Hermotimus and Anaxagoras no one postulated a creative intelligence.

It would seem, then, that Thales sought amid the variety of things a single material cause; that he found such a cause in one of the forms of matter most familiar to him, namely, water, and accordingly regarded earth and all that it contains as water variously metamorphosed; and that, asking himself no questions about the manner of its transformation, he was content "to see in the forces of nature present deities" (Zeller).

The doctrine of Thales was interpreted and developed in the course of three succeeding generations. First, Anaximander chose for what he called his "principle" (ἀρχή), not water, but a corporeal element intermediate between fire and air on the one hand and water and earth on the other. Next, Anaximenes, preferring air, resolved its transformations into processes of thinning and thickening. Lastly, Heraclitus asserted the claims of fire, which he conceived to modify itself, not occasionally, but perpetually. Thus Thales recognized change, but was not careful to explain it; Anaximander attributed to change two directions; Anaximenes conceived the two sorts of change as rarefaction and condensation; Heraclitus, perceiving that, if, as his predecessors had tacitly assumed, change was occasional, the interference of a moving cause was necessary, made change perpetual. But all four agreed in tracing the variety of things to a single material cause, corporeal, endowed with qualities, and capable of self-transformation. A new departure was taken by the Eleatic Parmenides (see vol. xviii. p. 315), who, expressly noting that, when Thales and his successors attributed to the supposed element changing qualities, they were untrue to the principle of monism, required that the superficial plurality of nature should be strictly distinguished from its fundamental unity. Hence, whereas Thales and his successors had confounded the One, the element, and the Many, its modifications, the One and the Not-One or Many became with Parmenides matters for separate investigation. In this way two lines of inquiry originated. On the one hand Empedocles and Anaxagoras, abandoning the pursuit of the One, gave themselves to the scientific study of the Many; on the other Zeno, abandoning the pursuit of the Many, gave himself to the dialectical study of the One. Both successions were doomed to failure; and the result was a scepticism from which the thought of Greece did not emerge until Plato, returning to Parmenides, declared the study of the One and the Many, jointly regarded, to be the true office of philosophy. Thus, meagre and futile as the doctrine of Thales was, all the Greek schools, with the solitary exception of that of Pythagoras, took their origin from it. Not in name only, but also in fact, Thales, the first of the Ionian physicists, was the founder of the philosophy of Greece.

Bibliography.—(A) Geometrical and Astronomical.—C. A. Bretschneider, *Die Geometrie u. die Geometer vor Euklides*, Leipsic, 1870; H. Hankel, *Zur Geschichte der Mathematik*, Leipsic, 1874; G. J. Allman, "Greek Geometry from Thales to Euclid," *Hermathena*, No. v., Dublin, 1877; M. Cantor, *Vorlesungen über Geschichte der Mathematik*, Leipsic, 1880; P. Tannery, "Thalès de Milet ce qu'il a emprunté à l'Égypte," *Revue Philosophique*, March 1880; "La Tradition touchant Pythagore, Œnopide, et Thalès," *Bull. des Sc. Math.*, May 1886; R. Wolf, *Geschichte der Astronomie*, Munich, 1877. (B) Philosophical.—E. Zeller, *Die Philosophie d. Griechen*, i. 168-183, Leipsic, 1876 (*Presocratic Philosophy*, i. 211-227, Lond., 1881); F. Ueberweg, *Grundriss d. Gesch. d. Philosophie*, § 12, Berlin, 1871 (*Hist. of Philosophy*, Lond., 1880); T. Decker, *De Thalete Milesio*, Halle, 1865; A. B. Krische, *Forschungen*, pp. 34-42, Göttingen, 1840. (G. J. A.—H. JA.)

THALLIUM, one of the rarer elements of chemistry. Its discovery is one of the outcomes of Bunsen and Kirchhof's method of spectrum analysis. When Crookes, in 1861, applied this method to the flue-dust produced in the roasting of a certain kind of pyrites he observed in its spectrum a green line foreign to all then known spectra, and concluded that his substance must contain a new element, to which he gave the name of *thallium*, from θαλλός, a green twig. Crookes presumed that his thallium was something of the order of sulphur, selenium, or tellurium; but Lamy, who anticipated him in isolating the new element, found it to be a metal. Our present knowledge of the chemistry of thallium is based chiefly upon the labours of Crookes.

The chemical character of thallium presents striking peculiarities. Dumas once called it the "*ornithorhynchus paradoxus* of metals." As an elementary substance, it is very similar in its mechanical and physical properties to lead; like lead it forms an almost insoluble chloride and an insoluble iodide. But the hydroxide of thallium, in most of its properties, comes very close to those of the alkali metals; it is strongly basilous, forms an insoluble chloroplatinate, and an alum strikingly similar to the corresponding potassium compounds. Yet, unlike potassium or lead, it forms a feebly basic sesquioxide similar to manganic oxide, Mn_2O_3.

Traces of thallium exist in many kinds of pyrites, as used for vitriol-making. The only known mineral of which it forms an essential component is the "crookesite" of Skrikerum, Småland, Sweden, which, according to Nordenskiöld, contains 33·3 of selenium, 45·8 of copper, 3·7 of silver, and 17·2 of thallium in 100 parts. Crookesite, however, is scarce. The best raw materials for the preparation of thallium are the flue-dusts produced industrially in the roasting of thalliferous pyrites and the "chamber muds" accumulating in vitriol-chambers wrought with such pyrites; in both it is frequently associated with Selenium (*q.v.*). The flue-dust from the pyrites of Theux, near Spa (Belgium), according to Böttcher, contains 0·5 to 0·75 per cent. of thallium; that of the pyrites of Meggen, according to Carstanjen, as much as 3·5 per cent.; while that of the pyrites of Ruhrort yielded 1 per cent. of the pure chloride to Gunning.

For the extraction of the metal from chamber mud, the latter is boiled with water, which extracts the thallium as Tl_2SO_4. From the filtered solution the thallium is precipitated by addition of hydrochloric acid, as TlCl, along, in general, with more or less of chloride of lead. The mixed chlorides are boiled down to dryness with oil of vitriol to convert them into sulphates, which are then separated by boiling water, which dissolves only the thallium salt. From the filtered solution the thallium is recovered, as such, by means of pure metallic zinc, or by electrolysis. The (approximately pure) metallic sponge obtained is washed, made compact by compression, fused in a porcelain crucible in an atmosphere of hydrogen, and cast into sticks. Methods for the final purification of the metal will easily be deduced from what follows.

The *metal* is bluish white; it is extremely soft but almost devoid of tenacity and elasticity. Its specific gravity is 11·86. It fuses at 290° C.; at a white heat it boils and can be distilled in hydrogen gas. When heated in air it is readily oxidized, with formation of a reddish or violet vapour. When exposed to the air it readily draws a film of oxide; the tarnished metal when plunged into water reassumes its metallic lustre, the oxide film being quickly dissolved. When kept in contact with water and air it is gradually converted into hydroxide, Tl_2OH_2O or TlOH.

This *hydrate*, TlOH, most conveniently prepared by decomposing the solution of the sulphate with baryta water, crystallizes from its solution in long yellow needles, $TlOH$ or $TlOH + H_2O$, which dissolve readily in water, forming an intensely alkaline solution, which acts as a caustic, like, for instance, potash-ley, and like it greedily absorbs carbonic acid from the atmosphere. But, unlike the alkalies, it readily loses its water at 100° C. and even at the ordinary temperature, to pass into the state of anhydrous Tl_2O, which is black or black-violet.

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[1] In likening the earth to a cylinder Anaximander recognized its circular figure in one direction.

[2] See G. V. Schiaparelli, *I Precursori di Copernico nell' Antichità*, p. 2. Milan, 1873.

The *chloride*, $TlCl$, is readily obtained from the solution of any thallous salt (*e.g.*, the sulphate), by addition of hydrochloric acid, as a white precipitate similar in appearance to chloride of silver, like which it turns violet in the light and fuses below redness into a (yellow) liquid which freezes into a horn-like flexible mass. The specific gravity of this "horn" thallium, as one might call it, is 7·02. One part of the precipitated chloride dissolves at 0° C. in 500 parts of water, and in 70 parts at 100° C. It is less soluble in dilute hydrochloric acid. Carbonate of soda solution dissolves it pretty freely.

The *iodide*, TlI, is a yellow precipitate, which requires 16,000 parts of cold water and still more of solution of iodide of potassium for its solution.

The *chloroplatinate*, $PtCl_6Tl_2$, readily obtainable from thallous-salt solutions by addition of chloride of platinum ($PtCl_6H_2$), is a yellow precipitate soluble in no less than 15,600 parts of cold water.

The *carbonate*, Tl_2CO_3, comes closer to the lithium compound than to any other ordinary carbonate. It forms resplendent monoclinic prisms, soluble at 18° C. in 19·1 and at 100° in 4·46 parts of water. A stable bicarbonate, $TlHCO_3$, does exist.

The *sulphate*, Tl_2SO_4, forms rhombic prisms isomorphous with K_2SO_4. It dissolves at 18° C. in 20·8 and at 101° in 5·2 parts of water. It unites with vitriol into an acid salt, $TlHSO_4 + 3H_2O$, and with sulphate of alumina into an "alum," $Al_2(SO_4)_3Tl_2SO_4 + 24H_2O$.

Thallic salts are related to thallous pretty much as manganic are to manganous. The chloride, $TlCl_3$, is obtained as a solution by passing chlorine into a suspension of thallous chloride in water. The solution, when evaporated *in vacuo*, deposits colourless crystals, $TlCl_3 + H_2O$. For the oxide, if chlorine be passed into a solution of thallous chloride in carbonate of soda a brown precipitate is produced, which, after drying, has the composition $Tl_2O_3 + H_2O$. When heated with strong hydrochloric acid it evolves chlorine and yields $TlCl$; when heated with oil of vitriol it yields oxygen gas and thallous sulphate. Thallic sulphate, however, does exist,—in crystals, $Tl_2(SO_4)_3 + 7H_2O$, soluble in dilute sulphuric acid, but decomposed by water, with precipitation of hydrated Tl_2O_3.

Analysis.—All thallium compounds volatile or liable to dissociation at the temperature of the flame of a Bunsen lamp impart to such flame an intense green colour. The spectrum consists of only one line, which, of course, has a definite position in the spectrum, and consequently is easily identified,—a most delicate test.

From solutions containing it as thallous salt the metal is easily precipitated as chloride, iodide, or chloroplatinate by the corresponding reagents (see *supra*). Sulphuretted hydrogen, in the presence of free mineral acid, gives no precipitate; sulphide of ammonium, from neutral solutions, precipitates Tl_2S as a dark brown or black precipitate, insoluble in excess of reagent. Thallic salts are easily reduced to thallous by means of solution of sulphurous acid, and thus rendered amenable to the above reactions.

The atomic weight of thallium was determined very carefully by Crookes. He found it $Tl = 204·2$,—O being 16. (W. D.)

THAMES, the most important river in Great Britain, has its source in several streams on the Gloucestershire border, the main one having its rise in the parish of Coates, 3 miles south-west of Cirencester. The upper part of the river, until the junction with the Thame near Dorchester, is generally called the Isis, a usage to which Camden perhaps gave currency, who derives the word Tamesis or Thames from the junction of the names of the two rivers, the Thame and Isis. The total length of the river from Thames Head to London Bridge is 170 miles, and to Sheerness 228 miles. It drains an area of 6100 miles. It becomes navigable 24 miles from its source, near Lechlade, its waters having been greatly augmented by the junction of the Colne, Leach, and Churn; here also is the junction with the Thames and Severn Canal. The height of its source above sea-level is 370 feet, and that of the stream at Lechlade 250 feet, the average fall between Lechlade and London Bridge (146 miles) being 21 inches per mile. The course is remarkably equable throughout. Above Teddington, 19 miles from London Bridge, the tidal wave may be said to cease, and thence up to Lechlade navigation is carried on by the aid of locks. A small steamer plies as high as Oxford. While at Lechlade the daily flow of the ordinary summer level is about 100 million gallons, the flow at Teddington is about 380 million gallons. There are seven hours of ebb tide and five hours of flow tide. From the Nore to London Bridge, a distance of 40 miles, the tidal wave travels in two hours, and in other two hours it reaches Teddington. The width of the river at Teddington is 250 feet, and at London Bridge the width at high tide is 800 feet, the depth being 30 feet, while at low tide the width is 650 feet and the depth 12 feet. Large barges can ascend the river 150 miles above London Bridge, vessels of 200 tons as high as the bridge, and of 400 tons to the Pool, below which, at Irongate and St Katherine's wharf, deep-sea steamer navigation commences, while vessels of any tonnage can come as high as Deptford.

The Thames leaves the Gloucestershire and Wiltshire border near Buscot, after which it separates successively Berks and Oxford, Berks and Bucks, Middlesex and Surrey, and, finally, at its estuary, Essex and Kent. Below Lechlade it has a winding course, passing near Farringdon and Bampton. After receiving the Windrush, it passes near the grounds of Blenheim, whence it receives from the left the Evenlode, and at Oxford it receives from the left the Cherwell. It then flows in a southerly direction to Abingdon, where it receives on the right the Ock from the valley of the White Horse, and has a junction with the Wilts and Berks Canal. Turning in an easterly direction it is joined, about a mile after passing Dorchester, by its principal affluent the Thame. Thence, through an opening of the Chiltern Hills, it passes Bensington, and turns southwards by Wallingford and Reading, where it receives the Kennet from the right. It then bends northward to Henley, eastward to Great Marlow, and southward to Maidenhead, where it receives from the right the Loddon. Winding in a south-easterly direction it passes Eton, Windsor, Datchet, Staines, and Chertsey, receiving at Staines the Colne from the left. Flowing through the grounds of Hampton Court it reaches Kingston and Teddington, where its bulk is increased by the tidal wave. From Richmond, where it receives the Mole, it begins to pass the villas and suburbs of London. At Gravesend, 27 miles below London, it has a width of half a mile, and at the Nore lighthouse, 50 miles below London Bridge, the estuary widens to nearly 10 miles. In the tidal reaches the principal affluents of the Thames are the Mole at Richmond, the Brent at Brentford, the Wandle at Wandsworth, the Lea at Blackwall, the Roding at Barking Creek, the Ingrebourne at Rainham, and the Medway at Sheerness. The land adjoining the river is greatly subject to floods, and from above London there were in ancient times wide stretches of marsh land covered by shallow lagoons. The embankments below London Bridge date possibly from the time of the Romans, but their origin is the subject of much dispute (see LONDON, vol. xiv. p. 840). Between London Bridge and Chelsea the bed of the river has been altered artificially, and flooding is prevented by a marine wall (see LONDON, vol. xiv. p. 823). The Thames occupies the bed of a much larger prehistoric river, the gravels of which adjoin its banks at a considerable distance.

The scenery, though scarcely to be called picturesque, and in a certain sense monotonous, has a peculiar charm from the richness of its sylvan beauty and its pleasant alternation of hill and dale. The number of islands that occur in the course of the river add to its interest, and afford convenient seclusion for the erection of boat-houses and tents. The Thames vies with the Tyne as the principal river for boat-racing in England, and of course greatly surpasses the latter river as regards amateur boat-racing, the principal fixtures in which are the Oxford and Cambridge boat race and the Henley regatta. The river affords about one half of the water supply of London, and is the principal outlet for its sewage. It is under the government of conservators, originally constituted in 1857, but their duties have been extended by several subsequent Acts.

See *The River Thames from Oxford to the Sea*, 1859; Cassell's *Royal River* (richly illustrated), 1885; Huxley's *Physiography*, 1877; and Dickens's *Dictionary of the Thames*.

THÁNA, or TANNAH, a district in Bombay presidency, India, with an area of 4243 square miles, lying between 18° 42′ and 20° 20′ N. lat. and 72° 45′ and 73° 48′ E. long. It extends along the coast for 105 miles, with a breadth of 50 miles, and is confined between the Sahyádri Gháts on the E. and the sea on the W., while on the N. it is bounded by the Portuguese territory of Daman and by Surat district, and on the S. by Kolába and Poona districts. The district is well watered and wooded, and, except in the north-east, is a low-lying rice tract broken by hills. The spurs of the Gháts form health resorts; the two most conspicuous hills are Mátherán and Tungár. Most of the hills were once fortified, but the forts built on them are now dilapidated and useless. The only rivers of any importance are the Vaitarna and the Ulhás, the former being navigable to a distance of about 20 miles from its mouth; the latter is also navigable in parts for small craft. There are no lakes; but the Vehár and the Tulsi, formed artificially, supply Bombay city with water. The forests, lying chiefly in the northern half of the district, occupy 1664 square miles, or about 40 per cent. of the total area. The average annual rainfall exceeds 90 inches.

In 1881 the population of Thána was returned at 908,548 (males 468,236, females 440,312); Hindus numbered 806,805, Mohammedans 42,391, and Christians 39,545. The district has seven towns with populations exceeding 10,000, namely, Bandra (14,987), THANA (see below), Bhiwandi (13,837), Kalyan (12,910), Bassein (10,357), Panvel (10,351), Uran (10,149). The area under cultivation in 1885–86 was 1,002,448 acres, and 768,057 remained uncultivated. The total area of crops was 522,810 acres, including 5885 twice cropped. Rice is by far the most important product, and occupied 324,680 acres; it is also the chief article of export. Sugar-cane and plantains are cultivated largely, as well as mangoes and cocoa-nuts. In 1885–86 the gross revenue of the district was £245,182, the land yielding £130,409. The territory comprised in the district of Thána formed part of the dominions of the peshwá, and was annexed by the British in 1818 on the overthrow of Baji ráo. Since then the operations to put down the Koli robbers, which extended over several years, have been the only cause of serious trouble, and lately, in 1874 and 1877, there were a number of gang robberies which were suppressed, but not without difficulty.

THÁNA, chief town of the above district and a station on the Great Indian Peninsula Railway, lies 20 miles north-east of Bombay city, in 19° 11′ 30″ N. lat. and 73° 1′ 30″ E. long., and in 1881 had a population of 14,456 (males 7856, females 6600). It is a municipal town and a port, and contains a civil hospital and post-office.

THANE, or THEGN. See ENGLAND, vol. viii. p. 274; and NOBILITY, vol. xvii. p. 529.

THAPSACUS. See MESOPOTAMIA, vol. xvi. p. 49.

THAR AND PÁRKAR, or THUR AND PARKER, a district in the east of Sind, Bombay presidency, India, with an area of 12,729 square miles. It lies between 24° 13′ and 26° 15′ N. lat. and between 68° 51′ and 71° 8′ E. long., and is bounded on the N. by Khaipur state, on the E. by the states of Jaisalmir, Malani, and Jodhpur, on the W. by Hyderabad district, and on the S. by the Runn of Cutch. The district is divided into two portions. The western part, called the "Pat," is watered by the Eastern Nara and the Mithrau canals, which constitute the sole water-system of the district, and the presence of water has created a quantity of jungle and marsh; the other part, called the "Thar," is a desert tract of rolling sand-hills, running north-east and south-west, composed of a fine but slightly coherent sand. To the south-east of Thar is Párkar, where there are ranges of rocky hills, rising to 350 feet above the surrounding level, and open plains of stiff clay. The Párkar portion of the district contains the ruins of several old temples; one of these is a Jain temple, which contained an idol of great sanctity and repute, known under the name of Gorcha. The climate is subject to considerable extremes in temperature, being excessively hot in the summer and very cold in winter, the cold increasing as the sand-hills are approached.

The census of 1881 returned the population at 203,344 (males 112,400, females 90,944); Hindus numbered 43,755, Mohammedans 109,924, and Christians only 14. Umarkot, the birthplace of Akbar, is the chief town, with a population of 2828. The chief products of the district are rice, joár, bajri, cotton, and oil seeds. It is estimated that only 45 per cent. of the arable area is under cultivation. The exports are chiefly rice, wheat, oil-seeds, cattle, goats, and sheep; the imports consist of cotton, metals, dried fruits, piece goods, sugar, and tobacco. The manufactures are chiefly blankets, camel saddles, and coarse cotton cloth. The imperial revenue in 1885–86 amounted to £44,313, of which the land supplied £32,927.

Very little is known of the early history of the district. The Soda Rajputs, said to be descendants of Parmar Soda, are supposed to have come into this part of Sind about 1226, when they quickly displaced the rulers of the country, though, according to other authorities, they did not conquer the country from the Sumras, the dominant race, before the beginning of the 16th century. The local dynasty of the Sodas succumbed to the Kalhoras about 1750, since which period the district has been subject more or less to Sind. The Talpur mirs succeeded the Kalhoras, and built a number of forts to overawe the people, who were lawless and addicted to robbery. On the British conquest of Sind in 1843 the greater part of the district was made over to Cutch; and in 1856 it was wholly incorporated in the province of Sind. In 1859 a rebellion broke out, which was quickly suppressed.

THARRAWADDY, a district in the Pegu division of Burmah, with an area of 2014 square miles. It lies between 17° 30′ and 18° 40′ N. lat. and between 95° 20′ and 96° 10′ E. long., and is bounded on the N. by Prome, on the E. by the Pegu Yoma range, on the S. by Hanthawaddy, and on the W. by Henzada. The Pegu Yoma range separates Tharrawaddy from Toungú district, and forms the water-parting between the rivers Irrawaddy and Sittang; there are also many small elevations. The Irrawaddy, which traverses the district for 46 miles, is the principal navigable river. Another important river is the Hlaing, which runs through the district from north to south, receiving from the east, through numerous channels, the drainage of the Pegu Yoma Mountains, which fertilizes the plain on its eastern bank. There are twenty-three teak forests and four fuel reserves in the district, covering an area of 817 square miles. Among the wild animals generally found in the mountains are the elephant, rhinoceros, bison, and various kinds of feathered game.

In 1881 the population was returned at 278,155 (males 143,413, females 134,742), of whom 1985 were Hindus, 1110 were Mohammedans, 270,552 were Buddhists, whilst Christians and aborigines numbered 2368 and 2135 respectively. The area under cultivation in 1885–86 comprised 323,542 acres, and that available for cultivation 186,002 acres; forests occupied 364,524 acres. The chief products of the district are rice, sesamum, tobacco, sugar-cane, cotton, and fruits. The gross revenue of Tharrawaddy in 1885–86 was £85,254, of which the land yielded £51,523. The history of the district is identical with that of HENZADA (*q.v.*). Tharrawaddy was formed in 1878 out of that portion of Henzada lying east of the Irrawaddy. Its headquarters are at Thoon-tahay, on the stream of the same name.

THASOS, an island in the north of the Ægean Sea, off the coast of Thrace, 3½ miles distant from the plain of the river Nestus (now the Kara-Su). The island was colonized at an early date by Phœnicians, attracted probably by its gold mines; they founded a temple of Hercules, which still existed in the time of Herodotus. Thasus, son of Phœnix, is said to have been the leader of the Phœnicians, and to have given his name to the island. In 720 or 708 B.C. Thasos received a Greek colony from Paros. In a war which the Parian colonists waged with the Saians, a Thracian tribe, the poet Archilochus threw away his shield. The Greeks extended their power to the mainland, where they owned gold mines which were even more valuable than those on the island. From these sources the Thasians drew great wealth, their annual revenues amounting to 200 or even 300 talents. Herodotus, who visited Thasos, says that the best mines on the island were those which had been opened by the Phœnicians on the east side of the island, facing Samothrace. After the capture of Miletus (494 B.C.) Histiæus laid siege to Thasos. The attack failed, but, warned by the danger, the Thasians employed their revenues to build war ships and strengthen their fortifications. This excited the suspicions of the Persians, and Darius compelled them to surrender their ships and pull down their walls. After the defeat of Xerxes the Thasians joined the Greek confederacy; but afterwards (in 467, 465, or 464, according to different calculations), on account of a difference about the mines and marts on the mainland, they revolted. The Athenians defeated them by sea, and, after a siege that lasted more than two years, took the capital, Thasos, and compelled the Thasians to destroy their walls, surrender their ships, pay an indemnity and an annual contribution, and resign their possessions on the mainland. In 411 B.C., at the time of the oligarchical revolution at Athens, Thasos again revolted from Athens and received a Lacedæmonian governor; but in 407 the partisans of Lacedæmon were expelled, and the Athenians under Thrasybulus were admitted. After the battle of Ægospotami (405 B.C.), Thasos again fell into the hands of the Lacedæmonians; but the Athenians must have recovered it, for it formed one of the subjects of dispute between them and Philip of Macedonia. In the embroilment between Philip III. of Macedonia and the Romans, Thasos submitted to Philip, but received its freedom at the hands of the Romans after the battle of Cynoscephalæ (197 B.C.), and it was still a "free" state in the time of Pliny. Thasos, the capital, stood on the north side of the island, and had two harbours, one of which was closed. Archilochus described Thasos as "an ass's backbone crowned with wild wood," and the description still suits the mountainous island with its forests of fir. The highest mountain, Ipsario, is 3428 feet high. Besides its gold mines, the wine, nuts, and marble of Thasos were well known in antiquity. The mines and marble quarries are no longer worked; and the chief exports are now fir timber for shipbuilding, olive oil, honey, and wax. The imports consist of manufactured goods, beasts of burden, and corn, for the island is too mountainous to grow enough corn for the inhabitants.

In 1858 the population, distributed in ten villages, was estimated at 10,000. The people are Greek Christians, and do not differ in appearance from the inhabitants of the other Greek islands. The villages are mostly situated at some distance from the sea; for the island suffered from pirates up to a time within living memory. In the early part of this century sentinels stood on duty night and day, and at a signal of alarm the whole population, including the Turkish aga himself, used to hide in the woods. For a description of the island and its remains of antiquity, see A. Conze, *Reise auf den Inseln des thrakischen Meeres*, Hanover, 1860.

THAYETMYO, a district in the Irrawaddy division of Burmah, having an area of 2397 square miles, and lying between 18° 50' and 19° 30' N. lat. and between 94° 30' and 95° 50' E. long. It is bounded on the N. by the newly acquired territory of Burmah, on the E. by Toungú district, on the S. by Prome, and on the W. by Sandoway. On the west is the Arakan Yoma range, and on the east the Pegu Yoma; and the face of the country, where it does not rise into mountains, is everywhere broken by low ranges of hills, many of which are barren and destitute of all vegetation. The greater part of the district is wooded, and the Yomas east and west are covered with forests now mostly preserved. The chief river is the Irrawaddy, which traverses Thayetmyo from north to south. The country is well drained; the drainage finds its way to the Irrawaddy by three main streams (the Pwon, Ma-htún, and Ma-de) on the west, and by two (the Kye-nee and Bhwotlay) on the east. Several salt and hot springs occur in many localities of the district; petroleum is also found, and extensive lime quarries exist a few miles south of Thayetmyo. The principal wild animals are leopards, wild cats, barking deer, elephants, rhinoceroses, tigers, black bears, and wild hogs. Silver pheasants and partridges are found in large numbers, especially in the mountains.

In 1881 the number of inhabitants in the district was 169,560 (males 87,308, females 82,252); Hindus numbered 2620, Mohammedans 1561, Christians 2349, and Buddhists 148,629. The chief town is Thayetmyo, with a population (1881) of 16,097; it is situated in 19° 18' 43" N. lat. and 95° 15' 40" E. long., on the right bank of the Irrawaddy. Of the total area of 1,534,080 acres, only 108,167 were under cultivation in 1885-86; 547,631 were available for cultivation; and forests occupied 256,256 acres. The chief products are rice, cotton, oil seeds, and tobacco; cutch is also very abundant, and the manufacture of the dye-stuff is carried on extensively. Coal has recently been found in the district, and earth oil-wells exist, but neither coal nor oil has yet been extracted in any quantity. The revenue of the district in 1885-86 was returned at £36,702, of which the land contributed £10,482. On the annexation of Pegu by the British in 1852-53, Thayetmyo was formed into a subdivision of Prome district; and in 1870 it was erected into a separate jurisdiction and placed under a deputy-commissioner.

THEATRE (*θέατρον*, "a place for seeing," from *θεάομαι*). The invention of a building specially devised for dramatic representations was due to the Athenians (see DRAMA). At first representations at the Dionysiac festivals were held on temporary wooden platforms; an accident, however, which occurred in 500 B.C. induced the Athenians to begin the construction of a permanent building. This first theatre was not completed till 340 B.C., and during the interval a large number of theatres, designed on the same model, had been erected in many towns of Greece and Asia Minor, though in some cases, as at Sparta, they were used for assemblies of the people and dances rather than for dramatic performances. The great Dionysiac theatre at Athens was placed in the Lenæum, an enclosure sacred to Dionysus, and its auditorium is scooped out of the rock at the base of the Acropolis on its south-east side. A similar position on the slope of a hill was always chosen by the Greeks, and it was not till the 1st century B.C. that theatres were built by the Romans on a level site.

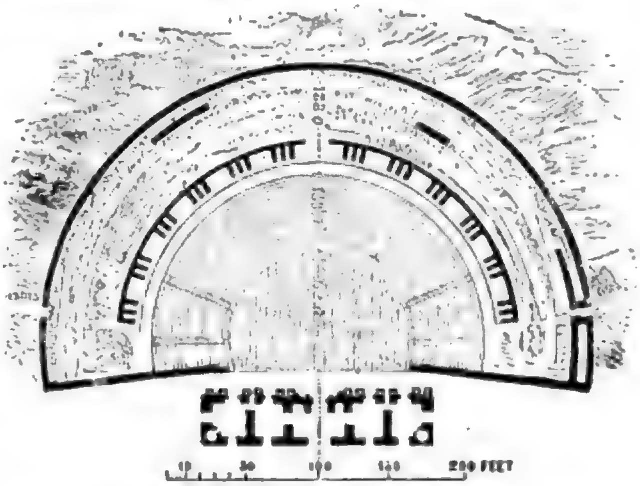

FIG. 1.—Plan of the Theatre at Myra.

Fig. 1 shows the plan of the existing theatre at Myra, in the south-east of Lycia, which, though late in date, is built after the old Greek model.[1] The seats for the audience are arranged in concentric tiers, rising like steps one above the other (see fig. 2); these mainly rest on a cavity excavated in the hill-side, and the whole space occupied by the spectators was called the *κοῖλον* (Lat. *cavea*). About half-way up the slope is an encircling passage (*διάζωμα*, *præcinctio*). Flights of steps divide the seats into wedge-shaped blocks (*κερκίδες*, *cunei*). At the highest level behind the top row of seats ran a colonnade, forming a covered passage with a gallery at the top. Rows of niches were formed in the back wall of this, and also sometimes in the low wall encircling the *διάζωμα*; in these niches a series of large bronze jars (*ἠχεῖα*) were set: they were intended to catch and repeat the reverberation of the voices from the stage. Vitruvius (iii. 5) gives

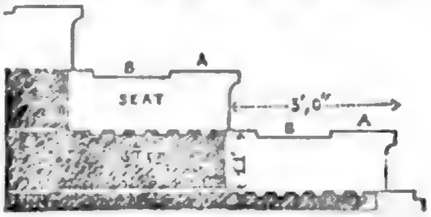

FIG. 2.—Section showing the Seats A,—with B, place for spectators' feet.

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[1] See Texier and Pullan, *Asia Minor*, London, 1865.

elaborate directions for the construction of these vases, which were to be tuned in a chromatic scale;[1] he mentions their use by the Greeks, but says he knows of no Roman theatre which possessed these vases, the real utility of which is very problematical.[2] The segmental floor space in a Greek theatre was called the *ὀρχήστρα (orchestra)*, and was occupied by the chorus; in the centre of this was the *θυμέλη*, a platform slightly raised on steps, in the middle of which was an altar to Dionysus. The stage (*προσκήνιον, proscenium*) was a narrow platform, raised 3 to 5 feet above the orchestra, with which it communicated by stairs, so that the chorus could move from one place to the other; the central part of the stage, where the principal actors usually stood, was the *λογεῖον* (*pulpitum*). The stage was also connected with a chamber under it (*ὑποσκήνιον*) by a flight of stairs called *χαρώνιοι κλίμακες*, by which ghosts ascended. At the back of the stage was a lofty wall, which usually reached to the level of the colonnade behind the highest row of seats; this was the *σκηνή* (*scena*), in which were three doors leading into the stage from the actors' dressing-rooms behind it.[3] This wall was usually decorated with three orders of columns and entablatures, forming an architectural façade, which represented a palace or temple, before which the action of the play was supposed to take place. Other movable wooden scenery was in some cases added in front of the permanent scena; or curtains with woven or embroidered figures were hung against it to form a background to the actors (*παραπέτασμα* or *αὐλαίαι, aulæa* or *siparium*). More elaborate painted scenes were also used, but, according to Aristotle (*Poet.*, iv. 16), not before the time of Sophocles. Various kinds of machinery were used, such as the *μηχανή*, to suspend in the air an actor who was playing the part of a god descending from heaven;[4] and the *βροντεῖον*, an apparatus to imitate thunder by stones rolled in metal jars, probably in the ghost-chamber under the stage. Women were not excluded from the Greek tragic drama, but appear to have sat by themselves in the upper rows of seats (Athenæus, xii. 534).[5] At least in late times the chief priestesses of Athens occupied marble thrones in the *προεδρία* or front row.

The remains of the Dionysiac theatre at Athens, the prototype of all later theatres, were excavated in 1862, when the proscenium, orchestra, and lower rows of seats were found in a fair state of preservation. It must have held 30,000 people: the cavea reaches from the foot of the Acropolis hill to close under the upper circuit wall. The rock-cut cavern, which was faced with the choragic monument to Thrasyllus (320 B.C.), seems to have opened behind the highest row of seats; the face of the rock is here scarped to a curve concentric with the lines of seats. The most interesting discovery was that of a row of 67 marble thrones in the front row, each inscribed with the name of one of the chief Athenian priests or with that of a secular official.[6] The cavea was divided into 13 cunei; a low wall separated the auditorium from the orchestra. The front or "riser" of the stage is decorated with fine reliefs of deities on large marble slabs. These existing features are mostly restorations of the time of Hadrian, but the reliefs themselves are of much earlier date. The floor of the orchestra is very late, formed of roughly laid slabs of stone, with a large central lozenge in marble, which may mark the limits of the thymele, and is apparently part of an earlier pavement.

The position of the Dionysiac theatre, with many of the chief temples of Athens in sight, and with its glorious view of Mount Hymettus, the blue waters of the Ægean Sea, and the islands of Salamis and Ægina, should not be forgotten in reading the dramas of the great tragedians, with their impassioned appeals to the glories of nature and their allusions to the protective presence of the divine patrons of Attica

Outside Athens the largest Greek theatres were those at Megalopolis (Paus., viii. 32), Cnidus, Syracuse, Argos, and Epidaurus. By the end of the 4th century B.C. every important Hellenic city possessed its theatre, and new ones were built or old ones restored throughout the whole period of Roman domination. The most perfect existing example is that at Aspendus in Pamphylia,[7] a building of the 2d century of our era, in which the early Greek model has been closely followed. Aspendus is the only place where the whole scena with its three orders of columns is still standing, and every row of seats exists in almost perfect condition. In this theatre the whole interior appears to have been covered by an awning,[8] supported along the top of the scena by wooden poles set in rows of perforated corbels like those on the Colosseum in Rome. The earlier Greek theatres were probably unsheltered from the sun. Next to Aspendus, the theatre of Tauromenium, in Sicily (see TAORMINA), is the best preserved, at least as far as regards the scena and the upper gallery round the cavea. That at Myra, in Lycia (fig. 1). is also in good preservation.

The Roman Theatre.—In the main the theatres of the Romans were copied closely from those of the Greeks, but in the Greek theatre the orchestra occupied more than a semicircle, while the Romans made it exactly half a circle. The accompanying diagrams (see fig. 3) show the principle on which the plan of each was set out.[9] The Romans also introduced another important change, in many cases constructing theatres on a level site, not scooped out of a hillside as in the case of Hellenic theatres. This necessitated an elaborate arrangement of substructures, with raking vaults to carry the seats of the cavea, and also an additional visible façade with tiers of arches following the semicircle of the auditorium. The design universally adopted for this appears to have been tiers, usually three in number, of open arches, with intermediate

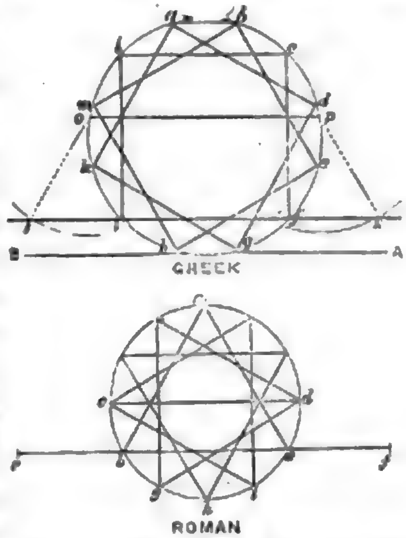

FIG. 3.—Diagram to show the Principle on which the Plans of the Greek and Roman Theatre were set out.

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[1] The well-preserved theatre at Tauromenium, in Sicily, still has these niches, which are contrived in the dwarf wall on which the columns of the upper gallery stood.

[2] Earthenware vases, which are sometimes found under the floors of mediæval church stalls, were probably placed there through a mistaken notion that this was carrying out Vitruvius's recommendation.

[3] The central door, used by the chief actor, was "the royal door."

[4] Hence the Roman proverbial phrase, "deus ex machina."

[5] This is shown by Jacobs, *Verm. Schriften*, iv. p. 272, and Passow in *Zimmermann's Zeitschr. f. d. Alterth.*, 1837, No. 29.

[6] These thrones are of various dates, ranging from the reign of Augustus or even earlier to that of Hadrian; see *Papers of the American School of Classical Studies at Athens*, vol. I. p. 123. Similar Greek theatre seats of earlier date still exist in the choirs of some churches in Rome, where they were once used for the episcopal or celebrant's throne. These were probably brought to Rome during the imperial period for use in the Roman theatres or amphitheatres. The finest example of pure Hellenic work is in S. Pietro in Vincoli; it is decorated with delicate honeysuckle scroll-work in relief.

[7] See Texier and Pullan, *Asia Minor*, London, 1865.

[8] There was also a wooden pent-roof corbelled out over the stage.

[9] See Vitruvius, iii. 8 (Greek theatre) and iii. 2 to 7 (Roman).

engaged columns, each tier being of a different order, as is still to be seen in the remains of the theatre of Marcellus in Rome.[1] The development of the use of the stone arch, and still more the use of concrete for forming vaults, enabled the Romans to erect their theatres on any site. Those in Rome were placed in the level plain of the Campus Martius.

During the Republican period the erection of permanent theatres with seats for the spectators was thought to savour of Greek luxury and to be unworthy of the stern simplicity of the Roman citizens. Thus in 154 B.C. Scipio Nasica induced the senate to demolish the first stone theatre which had been begun by C. Cassius Longinus ("tanquam inutile et nociturum publicis moribus," Liv., *Epit.*, 48). Even in 55 B.C., when Pompey began the theatre of which remains still exist in Rome, he thought it wise to place a shrine to Venus Victrix at the top of the cavea, as a sort of excuse for having stone seats below it—the seats theoretically serving as steps to reach the temple. This theatre, which was completed in 52 B.C., is spoken of by Vitruvius as "the stone theatre" *par excellence*: it is said in the Regionary catalogues to have held 40,000 people. It was also used as an amphitheatre for the bloody shows in which the Romans took greater pleasure than in the purer intellectual enjoyment of the drama. At its inauguration 500 lions and 20 elephants were killed by gladiators. Near it two other theatres were erected, one begun by Julius Cæsar and finished by Augustus in 13 B.C., under the name of his nephew Marcellus,[2] and another built about the same date by Cornelius Balbus (Suet., *Aug.*, 29; Pliny, *H. N.*, xxxvi. 16). Scanty remains exist of this last theatre, but the ruins of the theatre of Marcellus are among the most imposing of the buildings of ancient Rome.

A long account is given by Pliny (*H. N.*, xxxvi. 2 and 24) of a most magnificent temporary theatre built by the ædile M. Æmilius Scaurus in 58 B.C. It is said to have held the incredible number of 80,000 people, and was a work of the most costly splendour. Still less credible is the account which Pliny gives (*H. N.*, xxxvi. 24) of two wooden theatres built by C. Curio in 50 B.C., which were made to revolve on pivots, so that the two together could form an amphitheatre in the afternoon, after having been used as two separate theatres in the morning.

In some cases the Romans built two theatres close together, one for the Greek and the other for the Latin drama, as is the case at Hadrian's magnificent villa near Tivoli. The two theatres at Pompeii are still well preserved, and all Roman provincial towns of any importance seem to have possessed at least one theatre, designed with the semicircular orchestra after the Roman fashion (see fig. 3). The theatres built under the Roman rule in Hellenic cities seem, on the other hand, to have been usually constructed on the old Greek model, probably because they were designed by Greek architects. This is the case at Tauromenium, Aspendus, and Myra see (fig. 1). An important exception to this rule is the still well-preserved theatre of Herodes Atticus, at the south-west angle of the Athenian Acropolis, which has a semicircular orchestra. It was built in the reign of Hadrian by Herodes Atticus,[3] a very wealthy Greek, who spent enormous sums in beautifying the city of Athens; he called it the Regillum, after his wife Regilla. Its cavea, which is excavated in the rock, held about 6000 people: it was connected with the great Dionysiac theatre by a long and lofty porticus or stoa, of which considerable remains still exist, probably a late restoration of the stoa built by Eumenes II. of Pergamum. In the Roman theatre the "orchestra" was occupied, not by the chorus, but by senators and other persons of rank (Vitr., iii. 6).[4] The Romans used scenery and stage effects of more elaboration than was the custom in Greece. Vitruvius (iii. 7) mentions three sorts of movable scenery:—(1) for the tragic drama, façades with columns representing public buildings; (2) for comic plays, private houses with practicable windows and balconies;[5] and (3) for the satyric drama, rustic scenes, with mountains, caverns, and trees.

The Modern Theatre.—During the Middle Ages miracle plays with sacred scenes were the favourite kind of drama; no special buildings were erected for these, as they were represented either in churches or in temporary booths. In the 16th century the revival of the secular drama, which, in the reign of Elizabeth, formed so important a part of the literature of England, was carried on in tents, wooden sheds, or courtyards of inns, mostly by strolling actors of a very low class. It was not till towards the close of the century that a permanent building was constructed and licensed for dramatic representations, under the management of Shakespeare and Burbage.[6] In

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[1] This design was also adopted for their amphitheatres, such as the colossea of Rome and Capua, the plan of which resembles the cavea of two theatres set together so as to enclose an oval space.

[2] According to Livy (xl. 51), the theatre of Marcellus was built on the site of an earlier one erected by Æmilius Lepidus.

[3] This theatre was not begun when Pausanias wrote his book *Attica*, and was complete when he wrote the *Achaica* (see Paus., vii. 20). It is illustrated in *Mon. Inst.*, vi., plate 16.

[4] The pit and stalls in a modern theatre occupy an analogous position.

[5] These are shown on Græco-Roman vases of the latest type, with paintings of burlesque parodies of mythological stories.

[6] The first building specially erected in London for dramatic purposes was built in 1576–77 by the actor James Burbage, who was originally a carpenter by trade. It was constructed of timber, and stood in Holywell Lane, Shoreditch, till 1598, when it was pulled down; it was known as "The Theatre" *par excellence*. Of almost equally early date was the "Curtain" theatre, also in Shoreditch; many explanations of its name have been given, but the real one appears to be that it was so called from the plot of ground, known as "The Curten," on which it stood. It probably continued in use till the general closing of theatres by order of the parliament in 1642.

The "Globe" theatre, famous for its association with Shakespeare, was built by James Burbage, who used the materials of "The Theatre," in the year 1598. Its site was in Southwark, in a district called "The Bankside," near the old "Bear Gardens." It was an octagonal structure of wood, with lath and plaster between the main framework. It was burnt in 1613, rebuilt, and finally pulled down and its site built over in 1644. Its name was derived from its sign of Atlas supporting the globe. Near it were two less important theatres, "The Rose," opened in 1592 by Henslowe, and "The Swan," opened in 1598 and probably owned also by Henslowe; like the Globe, it was an octagonal wood-and-plaster building.

The "Blackfriars" theatre, another of the Burbages' ventures, was built in 1596 (not 1576, as stated by Collier, *Hist. of Dramatic Poetry and Annals of the Stage*, new ed., 1879, vol. i. p. 287), near the old Dominican friary. The "Fortune" theatre was built by Edward Alleyn, the great rival of the Burbages, in 1599–1600, at a total cost, including the site, of £1320. It stood between Whitecross Street and Golding Lane. It existed as late as 1819, when a drawing of it was given by Wilkinson (*Londina illustrata*, 1819). The "Red Bull" theatre was probably originally the galleried court of an inn, which was adapted for dramatic purposes towards the close of Elizabeth's reign. Other early theatres were the "Hope" or "Paris Garden" theatre, the "Whitefriars" and "Salisbury Court" theatres, and the "Newington" theatre. A curious panoramic view of London, engraved by Visscher in 1616, shows the Globe, the Hope, and the Swan theatres.

The plan of the first English theatres appears to have had no connexion with those of classical times, as was the case in Italy: it was evidently produced in an almost accidental way by the early custom of erecting a temporary platform or stage in the middle of the open courtyard of an inn, in which the galleries all round the court formed boxes for the chief spectators, while the poorer part of the audience stood in the court on all sides of the central stage. Something similar to this arrangement, unsuitable though it now seems, was reproduced even in buildings, such as the Globe, the Fortune, and the Swan, which were specially designed for the drama. In these and other early theatres there was a central platform for the stage, surrounded by seats except on one side, where there was a "green-room" or the 16th and 17th centuries a favourite kind of theatrical representation was in the form of "masques," with processions of grotesquely attired actors and temporary scenic effects of great splendour and mechanical ingenuity. In the reigns of James I. and Charles I. Ben Jonson and the architect Inigo Jones worked together in the production of these "masques," Jonson writing the words and Inigo Jones devising the scenic effects, the latter being very costly and complicated, with gorgeous buildings, landscapes, and clouds or mountains, which opened to display mimic deities, thrown into relief by coloured lights. These masques were a form of opera, in which Ben Jonson's words were set to music. Ben Jonson received no more for his libretto than Inigo Jones did for his scenic devices, and was not unnaturally annoyed at the secondary place which he was made to occupy: he therefore revenged himself by writing severe satires on Inigo Jones and the system which placed the literary and mechanical parts of the opera on the same footing. In an autograph MS. which still exists this satirical line occurs—"Painting and carpentry are the soul of masque" (see Cunningham, *Life of Inigo Jones*, London, 1848).

In Italy, during the 16th century, the drama occupied a more important position, and several theatres were erected, professedly on the model of the classic theatre of Vitruvius. One of these, the Teatro Olimpico at Vicenza, still exists; it was designed by Palladio, but was not completed till 1584, four years after his death. It has an architectural scena, with various orders of columns, rows of statues in niches, and the three doors of the classic theatre, but the whole is painted with strong perspective effects which are very unclassical in spirit. Scamozzi, Palladio's pupil, who completed the Teatro Olimpico, built another pseudo-classical theatre in 1588 at Sabbionetta for the duke Vespasiano Gonzaga, but this does not now exist.

In France the miracle play developed into the secular drama rather earlier than in England. In the reign of Louis XI., about 1467, the "Brothers of the Passion" had a theatre which was partly religious and partly satirical. In the 16th century Catherine de' Medici is said to have spent incredible sums on the dresses and scenery for the representation of the Italian ballet; and in the middle of the 17th century the regular opera was introduced at Paris.

At the end of the 18th century the theatres of San Carlo at Naples, La Scala at Milan, and La Fenice at Venice were the finest in Europe; all these have been rebuilt in the present century, but have been eclipsed by the theatres of Paris, St Petersburg, and other capitals, both in size and architectural splendour.

In the modern theatre the auditorium has changed comparatively little, except that the stalls have gradually encroached upon and almost absorbed the pit. The arrangement of the boxes, stalls, balcony, and gallery are too well known to need description. Few people, have, however, any notion of the immense size and extreme complication of the space and machinery behind the proscenium, of which the visible stage occupies but a very small proportion. The stage-floor slopes upwards away from the audience, so that it may appear deeper than it really is by diminishing the foreshortening.[1] Its extent behind the most distant plane of scenery is usually quite as great as that which the audience sees. In addition to this extension of the visible stage there are three other enormous spaces filled with the machinery to work the scenery.

(1) Of these the first consists of the "wings" (Fr. *coulisses*), a series of chambers or platforms on each side of the stage, arranged many stories high, and reaching to more than double the height of the proscenium.

(2) The "dock" or under-space (Fr. *dessous*), extending under the whole area of the stage floor, and about equal in height to the proscenium, is divided into three or four stories by successive floors, and contains long rows of immense windlasses (Fr. *gril*) for raising and lowering scenery, and also an elaborate arrangement of lifts by which actors can suddenly appear or vanish through the stage floor. A very ingenious device called the "star trap," invented by an English mechanician (Fr. *trappe Anglaise*), allows an actor to vanish through the floor without any opening in it being visible. This is done by making the trap door of thin boards (something like a venetian blind) fixed on to flexible bands of steel; the weight of the actor makes these open in the middle and let him through, while the steel springs close the opening as soon as they are released. The whole movement is so rapid that the actor seems to sink through the solid floor.[2] In all mechanical appliances for theatrical purposes England is far ahead of other countries, many of which have adopted English methods.

(3) The third space, and the largest of all, is that above the proscenium—the "flies" (Fr. *dessus* or *cintre*), extending over the whole of the stage, and reaching sometimes to nearly double the height of the proscenium. This also is divided into many floors, and contains rows of great windlasses, by which scenery can be hoisted up out of sight, without folding or bending it. All these three parts of the building are filled with a complicated but most orderly series of ropes, lifts, and machinery of every sort, of which it is impossible here to give a detailed description.

The old method of fixing scenery was to slide it in two halves from the wings in grooves formed in the stage floor: these are no longer used, as much more realistic effects can be gained by supporting scenery from the top, or by building it up with supports of its own, so that, instead of a series of painted planes set parallel to the stage front, castles, cathedrals, or even whole streets are actually built upon the stage, and give striking effects of real perspective.

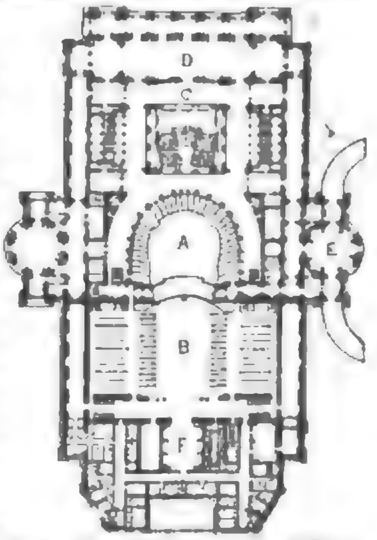

Fig. 4.—Plan of the Grand Opera House in Paris: 200 feet to the inch.
A, Auditory. B, Stage. C, Grand Staircase. D, Great Saloon. E, Royal Entrance. F Green-room.

A rapidly growing tendency now exists to increase the mechanical perfection of the theatre. The extended use of iron instead of wood for the stage floor and the various machines has been a great gain in space and rapidity of working. It is now considered a great object to drop the curtain as seldom as possible, and even the Grand Opera House of Paris is now left far behind in the modern competition for mechanical perfection,[3] though from an architectural point of view it is the most magnificent and costly of all existing buildings of its kind. See fig. 4.

The latest improvement to prevent delay between the scenes has been introduced in the Madison Square theatre in New York city, which has two stages, one above the other. During the performance of a scene the second stage floor is

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"tireynge-howse." The upper galleries or boxes completely surrounded the stage, even the space over the green-room being occupied by boxes. This being the arrangement, it is easy to see why the octagonal plan was selected in most cases, though not in all,—the Fortune theatre, for example, was square. An interesting specification and contract for the building of the Fortune theatre is printed by Halliwell-Phillipps (*op. cit. infra*, p. 164). In all its details the Fortune is specified to be like the Globe, except that it is to be square in plan, and with timbers of heavier scantling. The walls are to be of wood and plaster, the roof tiled, with lead gutters, the stage of oak, with a "shadow" or cover over it, and the "tireynge-howse" to have glazed windows. Two sorts of boxes are mentioned, viz., "gentlemen's roomes" and "twoo-pennie roomes." A woodcut showing this arrangement of the interior is given in a collection of plays edited by Kirkman in 1672.

Much valuable information about the early theatres of London is given by Wilkinson, *Londina Illustrata* (1819), in which are engravings of some of them. See also Collier, *Hist. of Dramatic Poetry*, 1879; Halliwell-Phillipps, *Life of Shakespeare*, 1883; Malone, *History of the Stage*, 1790, republished by Boswell in 1821; the publications of the New Shakspere Society; the Ninth Report of the Historical MSS. Commission; and a series of articles on early London theatres, by T. F. Ordish, in *The Antiquary*, vols. xi., xii., and xiv., 1885-86.

[1] This device was practised by the mediæval architects in most European countries, who frequently made the floor of cathedrals and other large churches to slope upwards from west to east, sometimes as much as from two to three feet.

[2] Other varieties of this, such as the "vampire trap," allow an actor to vanish through an apparently solid wall.

[3] In 1883 M. Reyer's *Sigurd* was refused at the Paris Opera House mainly on account of the absence of the necessary mechanical appliances.

being prepared in the under-space, with all its scenery fixed, and when the curtain falls the first stage rises into the upper regions and the second floor goes up to take its place. These floors are accurately balanced by heavy counterpoise weights, so that the whole of these enormous masses are moved with comparatively little force.

On the whole, for magnificence of effect and mechanical ingenuity the great London pantomimes are unrivalled. Their transformation-scenes are marvels of the mechanist's skill, and are often devised with very high artistic talent. Unhappily much danger and suffering have often to be undergone by the women who act the part of fairies and the like, suspended high in the air by almost invisible supports, and by the young children who have to squeeze themselves into pasteboard shells representing insects or reptiles.

In addition to the above-mentioned parts of the theatre, which are reserved for the mechanical working of the performance, much space is occupied by the "green-room" for the actors, and rows of dressing-rooms. An immense deal of storage room is also required, and some of the Parisian theatres have large magazines for this purpose in the suburbs. In many cases also the atelier for the scene painters is far removed from the theatre, and thus far better space and lighting for the work can be provided. Fig. 5 shows the plan of the Drury Lane theatre, in many respects the best arranged in London.

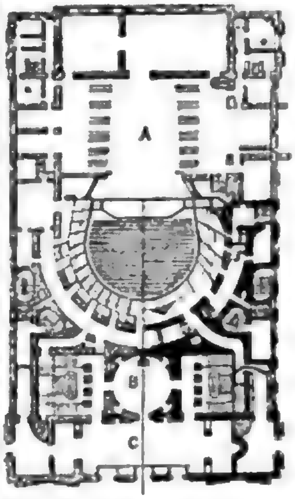

Fig. 5.—Plan of Drury Lane Theatre: 100 feet to the inch.
A. Stage. B, Saloon between the Chief Staircases. C, Entrance Hall.

The painting of theatrical scenery has frequently been the work of artists of very high talent, such as Raphael in Rome, Watteau, Boucher, and Servandoni in France, and Stanfield in England. Paintings of very high artistic merit and wonderfully decorative effect are now produced for theatrical purposes, especially in France, Germany, and England.[1] In England especially great historical and antiquarian knowledge are brought to the aid of this branch of art. The landscapes in particular are sometimes works of great beauty, and very beautiful effects of lake scenery with trees and mountains reflected in the water are got by setting great sheets of plate glass over the stage floor, slightly inclined, so that a real reflexion is thrown by the landscape painted on the scene behind. Another ingenious device, used by Wagner at Baireuth and also in England for magical scenes, was to form a thin and semi-transparent curtain of vapour, which was sent up by a perforated steam-pipe concealed in a groove in the stage.

The various methods of lighting used are an important item in the production of striking effects. The old system of a row of "foot-lights," with their unpleasant upward shadow, is now almost obsolete. Dip candles were used till 1720, when moulded candles were introduced into French theatres. The next improvement was the lamp of M. Argand, with its circular wick. In 1822 gas was first used in a Parisian theatre, next came the oxyhydrogen lime light, used for special effects, and now electric lighting is rapidly superseding all other kinds.

The old way of producing lightning was to blow lycopodium or powdered resin with bellows through a flame, and this is still used in realistic effects of conflagrations. More effective lightning is now made by flashing the electric light behind a scene painted with clouds, in which a zigzag aperture has been cut out and filled with a transparent substance. Thunder is made by shaking large sheets of iron, by rolling cannon balls above the ceiling of the auditorium, and by clapping together a series of planks strung together on two ropes. Wind is imitated by a machine with a cogged cylinder, which revolves against coarse cloth tightly stretched. The sound of rain is produced by shaking parched peas in a metal cylinder.

The orchestra is now usually arranged either below or above the proscenium, so that the musicians are not visible. The prompter is placed at one side, in the wings, so as to avoid the disfigurement of the hood-like box which formerly used to cut the front line of the stage into two halves. This is, however, less convenient for the actors.

Till the middle of the present century little trouble or expense was laid out on dresses and accessories. Certain conventional costumes, made of cheap stuff, were used for each part, with but little regard to historical correctness. Armour and weapons were made of pasteboard covered with metal foil, and stage jewellery was made of small cup-like pieces of tin formed with many facets. Now, however, no trouble or expense is spared to get the costumes and various properties archæologically correct: real jewels and the richest stuffs are often used for the dresses, as well as real furniture of the most costly sort for the furnishing of the scenic rooms. As much as £20,000 is sometimes spent before the play can be presented. All this splendour and realism is very hostile to the true interests of the drama; magnificent scenery and costly accessories are expected by the audience, rather than good acting. In some scenes, such as the ball in the first act of Romeo and Juliet, as recently represented at the Lyceum, the words and acting of the chief performers were almost lost in the general bustle and splendour of the scene. Frequently, too, the noise of setting up some elaborate scene behind almost drowns the voices of the actors in front of the drop scene.

Another serious cause of the present low state of acting in England is the fact that a popular play sometimes runs for several hundred nights without a break, thus reducing the performers to the condition of machines. The modern system of expending large sums on dresses and decoration naturally prevents that frequent change of subject which is so desirable, and which in France is provided for by the rules of the Théâtre Français, where acting of a very high order of merit still survives.

The present system, aided by the enormous size to which London has unhappily grown, has completely changed the character of the audience. Instead of an audience largely composed of *habitués*, who by their constant attendance at the theatre had gained some knowledge of what acting ought to be, and were prepared to show their disgust at clap trap or ranting, we have now practically a fresh and ignorant audience every night, who, by their applause of what is worst and their coldness to real refinement of acting, do much to lower the dramatic standard and demoralize the actors.

For further information the reader is referred to Donnet, *Théâtres de Paris*, 1821; Salomons, *Construction des Théatres*, Paris, 1871; Garnier, *Le Nouvel Opéra de Paris*, 1876-81; Contant, *Principaux Théâtres Modernes*, Paris, 1870; Moynet, *L'Envers du Théâtre*, Paris, 1874; Pougin, *Dictionnaire du Théâtre*, Paris, 1885. (J. H. M.)

LAW RELATING TO THEATRES.

The regulation of the theatre by legislation can be traced back to the time of the lower empire, in which it depended almost wholly upon constitutions of Theodosius and Valentinian, incorporated in the Theodosian Code (tit. xv. 5, 6, 7), and a century later to a large extent adopted by Justinian. In the whole of this law there is an evident attempt at a compromise between the doctrines of Christianity and the old Roman love of public spectacles of all kinds. It deals less with theatrical representations proper than with gladiatorial contests and chariot races.[2] The Theodosian Code provided that the sacraments were not to be administered to actors save where death was imminent, and only on condition that the calling should be renounced in case of recovery. Daughters of actors were not to be forced to go on the stage, provided that they lived an honest life. An actress was to be allowed to quit the stage in order to become a nun. There were also numerous sumptuary regulations as to the dress of actors. None of the law which has been mentioned so far was adopted by Justinian, but what follows was incorporated in *Cod.* xi. 40 ("De Spectaculis et Scenicis"), which consists entirely of extracts from the Theodosian Code of a very miscellaneous nature. Provision was made for the exhibition of public games and theatrical spectacles by magistrates, practically confining them to exhibiting in their own cities. Statues of actors were not to be placed in the public streets, but only in the proscenium of a theatre. A governor of a province was entitled to take the money raised for public games for the purpose of repairing the city walls, provided that he gave security for afterwards celebrating the games as usual. In *Cod.* iii. 12, 11 ("De Feriis") is a constitution of Leo and Anthemius forbidding dramatic representations on Sunday. The *Digest* (iii. 2) classed all who acted for hire ("omnes propter pecuniam in scenam prodeuntes") as infamous persons, and as such debarred them from filling public offices. A mere contract to perform, not fulfilled, did not, however, carry infamy with it. By the 51st of the *Novellæ* actresses could retire from the stage without incurring a penalty, even if they had given sureties or taken an oath.

In England, as in other countries of western Europe, theatrical legislation was of comparatively recent introduction. Such legislation was unnecessary as long as the theatre was under the control of the church and actors under its protection (see DRAMA). The earliest regulations were therefore, as might be expected, made by the church rather than by the state. The ecclesiastical ordinances were directed chiefly against the desecration of churches, though they sometimes extended to forbidding attendance of the faithful as spectators at plays of a harmless kind.[3] Sacraments and Christian burial were denied by the canon law to actors, whose gains, said St Thomas, were acquired *ex turpi causa.*[1] The same law forbade plays to be acted by the clergy, even under the plea of custom, as in Christmas week, and followed the Code of Justinian in enjoining the clergy not to consort with actors or be present at plays (see the *Decretals* of Gregory, iii. 1, 12, and 15, "De Vita et Honestate Clericorum"). As lately as 1603 canon lxxxviii. of the canons of the Church of England enacted that churchwardens were not to suffer plays in churches, chapels, or churchyards.

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[1] Scene paintings are usually executed in distemper, frequently in an atelier formed in the roof of the theatre; the artist partly works with his canvas laid upon the floor, or, where space allows, the painting is hung against a wall and the artist works from a scaffold, with tiers of boarding arranged so that he can reach to any part of the great canvas.

[2] The word *ludi* seems sometimes to include, sometimes to exclude, dramatic performances. Its meaning in a particular instance depends on the context.

[3] A large number of such ordinances will be found cited in Prynne, *Histriomastix*; Bossuet, *Maximes et Reflexions sur la Comédie*; Mariana, *De Spectaculis*; Smith, *Dictionary of Christian Antiquities*, arts. "Actors" and "Theatre."

The Reformation marks the period of transition from the ecclesiastical to the non-ecclesiastical authority over the drama. Precautions began to be taken by the crown and the legislature against the acting of unauthorized plays, by unauthorized persons, and in unauthorized places, and the acting of plays objectionable to the Government on political or other grounds. The protection of the church being withdrawn, persons not enrolled in a fixed company or in possession of a licence from the crown or justices were liable to severe penalties as vagrants. The history of the legislation on this subject is very curious. An Act of the year 1572 (14 Eliz. c. 5) enacted that "all fencers, bearwards, common players of interludes, and minstrels (not belonging to any baron of this realm, or to any other honourable person of greater degree)," wandering abroad without the licence of two justices at the least, were subject "to be grievously whipped and burned through the gristle of the right ear with a hot iron of the compass of an inch about." This statute was superseded by 39 Eliz. c. 4, under which the punishment of the strolling player is less severe, and there is no mention of justices. The jurisdiction of justices over the theatre disappears from legislation from that time until 1788. In 39 Eliz. c. 4 there is a remarkable exception in favour of persons licensed by Dutton of Dutton in Cheshire, in accordance with his claim to liberty and jurisdiction in Cheshire and Chester, established in favour of his ancestor by proceedings in *quo warranto* in 1499. The stricter wording of this Act as to the licence seems to show that the licence had been abused, perhaps that in some cases privileges had been assumed without authority. In 14 Eliz. c. 5 the privileges of a player attached by service of a noble or licence from justices, in the later Act only by service of a noble, and this was to be attested under his hand and arms. The spirit of the Acts of Elizabeth frequently appears in later legislation, and the unauthorized player was a vagabond as lately as the Vagrant Act of 1744, which was law till 1824. He is not named in the Vagrant Act of 1824 The Theatre Act of 1737 narrowed the definition of a player of interludes, for the purposes of punishment as a vagabond, to mean a person acting interludes, &c., in a place where he had no legal settlement.

Before the Restoration there were privileged places as well as privileged persons, *e.g.*, the court, the universities, and the inns of court. With the Restoration privilege became practically confined to the theatres in the possession of those companies (or their representatives) established by the letters patent of Charles II. in 1662 (see Drama). In spite of the patents other and unprivileged theatres gradually arose. In 1735 Sir John Barnard introduced a bill "to restrain the number of playhouses for playing of interludes, and for the better regulation of common players." On Walpole's wishing to add a clause giving parliamentary sanction to the jurisdiction of the lord chamberlain, the mover withdrew the bill. In 1737 Walpole introduced a bill of his own for the same purpose, there being then six theatres in London. The immediate cause of the bill is said to have been the production of a political extravaganza of Fielding's, *The Golden Rump.* The bill passed, and the Act of 10 Geo. II. c. 28 regulated the theatre for more than a century. Its effect was to make it impossible to establish any theatre except in the city of Westminster, and in places where the king should in person reside, and during such residence only. The Act did not confine the prerogative within the city of Westminster, but as a matter of policy it was not exercised in favour of the nonprivileged theatres, except those where the "legitimate drama" was not performed. The legitimate drama was thus confined to Covent Garden, Drury Lane, and the Haymarket from 1737 to 1843. In the provinces patent theatres were established at Bath by 8 Geo. III. c. 10, at Liverpool by 11 Geo. III. c. 16, and at Bristol by 18 Geo. III. c. 8, the Act of 1737 being in each case repealed *pro tanto.* The acting of plays at the universities was forbidden by 10 Geo. II. c. 19. It is not a little remarkable that the universities, once possessing unusual dramatic privileges, should not only have lost those privileges, but have in addition become subject to special disabilities. The restrictions upon the drama were found very inconvenient in the large towns, especially in those which did not possess patent theatres. In one direction the difficulty was met by the lord chamberlain granting annual licences for performances of operas, pantomimes, and other spectacles not regarded as legitimate drama. In another direction relief was given by the Act of 1788 (28 Geo. III. c. 30), under which licences for occasional performances might be granted in general or quarter sessions for a period of not more than sixty days. The rights of patent theatres were preserved by the prohibition to grant such a licence to any theatre within 8 miles of a patent theatre. During this period (1737–1843) there were several decisions of the courts which confirmed the operation of the Act of 1737 as creating a monopoly. The exclusive rights of the patent theatres were also recognized in the Music Hall Act of 1752, and in private Acts dealing with Covent Garden and Drury Lane, and regulating the rights of parties, the application of charitable funds, &c. (see 16 Geo. III. cc. 13, 31; 50 Geo. III. c. ccxiv; 52 Geo. III. c. xix; 1 Geo. IV. c. lx.). The results of theatrical monopoly were beneficial neither to the public nor to the monopolists themselves. In 1832 a select committee of the House of Commons recommended the legal recognition of "stage-right" and the abolition of theatrical monopoly. The recommendations of the report as to stage-right were carried out immediately by Bulwer Lytton's Act, 3 and 4 Will. IV. c. 15 (see Copyright). But it was not till 1843 that the present Theatre Act, 6 and 7 Vict. c. 68, was passed, a previous bill on the same lines having been rejected by the House of Lords. The Act of 1843 inaugurated a more liberal policy, and there is now complete "free trade" in theatres, subject to the conditions imposed by the Act. The growth of theatres since that time has been enormous. In 1885 there were forty-six licensed under the Act in London, Liverpool coming next with ten. Nor does the extension seem to have been attended with the social dangers anticipated by some of the witnesses before the committee of 1832.

The suppression of objectionable plays was the ground of many early statutes and proclamations. While the religious drama was dying out, the theatre was used as a vehicle for enforcing religious and political views not always as orthodox as those of a miracle play. Thus the Act of 34 and 35 Hen. VIII. c. 1 made it criminal to play in an interlude contrary to the orthodox faith declared, or to be declared, by that monarch. Profanity in theatres seems to have been a crying evil of the time. The first business of the Government of Edward VI. was to pass an Act reciting that the most holy and blessed sacrament was named in plays by such vile and unseemly words as Christian ears did abhor to hear rehearsed, and inflicting fine and imprisonment upon any person advisedly contemning, despising, or reviling the said most blessed sacrament (1 Edw. VI. c. 1). A proclamation of the same king in 1549 forbade the acting of interludes in English on account of their dealing with sacred subjects. In 1556 the council called attention to certain lewd persons in the livery of Sir F. Leke representing plays and interludes reflecting upon the queen and her consort and the formalities of the mass. The same queen forbade the recurrence of such a representation as the mask given by Sir Thomas Pope in honour of the princess Elizabeth at Hatfield, for she "misliked these follies." By the Act of Uniformity, 1 Eliz. c. 2, it was made an offence punishable by a fine of a hundred marks to speak anything in the derogation, depraving, or despising of the Book of Common Prayer in any interludes or plays. In 1605 "An Act to restrain the Abuses of Players" made it an offence punishable by a fine of £10 to jestingly or profanely speak or use certain sacred names in any stage play, interlude, show, may-game, or pageant (3 Jac. I. c. 21). In consequence of the appearance of players in the characters of the king of Spain and Gondomar, an ordinance of James I. forbade the representation on the stage of any living Christian king The star chamber in 1614 fined Sir John Yorke for representing a Catholic drama in his house. The first Act of the reign of Charles I. forbade acting on Sunday (see Sunday). Puritan opposition to the theatre culminated in the ordinance of the Long Parliament (see vol. vii. p. 434). After the Restoration there are few royal proclamations or ordinances, the necessary jurisdiction being exercised almost entirely by parliament and the lord chamberlain. One of the few post-Restoration royal proclamations is that of February 25, 1665, restraining any but the company of the Duke of York's theatre from entering at the attiring house of the theatre.

Preventive censorship of the drama by an officer of state dates from the reign of Elizabeth, and is perhaps the only example of censorship of the press still existing in the United Kingdom (see Press Laws). Such a censorship is not unknown in other countries, and it seems to have existed even in republican Rome, if one may judge from Horace's line,—

> "Quæ neque in æde sonent certantia judice Tarpa."

The master of the revels appears to have been the dramatic censor from 1545 to 1624, when he was superseded by the lord chamberlain. In some cases the supervision was put into commission. Thus with Tilney, the master of the revels in 1581, were associated by order of the privy council a divine and a statesman. In other cases it was delegated, as to Daniel the poet by warrant in 1603. The proposal to give statutory authority to the jurisdiction of the lord chamberlain led, as has been already stated, to the withdrawal of Sir John Barnard's bill in 1735, and to considerable debate before the bill of 1737 became law. Lord Chesterfield's objection to the bill in the House of Lords was not unreasonable. "If the players," said he, "are to be punished, let it be by the laws of their country, and not by the will of an irresponsible despot." The discretion reposed by the Acts of 1737 and 1843 in the lord chamberlain has been, according to the report of a select committee of the House of Commons in 1866, on the whole wisely exercised. On the other hand, there have been instances where perhaps both he and his subordinate officer, the examiner of stage plays, have been somewhat nice in their objections. Thus, during the illness of George III., *King Lear* was inhibited. George Colman, when examiner, showed an extraordinary antipathy to such words as "heaven" or "angel." The lord chamberlain's powers are still occasionally exerted in the interests of public decency, less frequently for political reasons. Before 1866 the lord chamberlain appears to have taken into consideration the wants of the neighbourhood before granting a licence, but since that year such a course has been abandoned.

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[1] For this reason it appears to have been the custom in France for actors to be married under the name of musicians. See *Hist. Parlémentaire de la Révolution Française*, vol. vi. p. 301. The difficulties attending the funeral of Molière (*q.v.*) are well known.

The existing law of theatres is mainly statutory. It will be convenient to treat it as it regards the building, the performance, and the licensing of the building and of the performance. A theatre may be defined with sufficient accuracy for the present purpose as a building in which a stage play is performed for hire. It will be seen from the following sketch of the law that there are a considerable number of different persons, corporate and unincorporate, with jurisdiction over theatres. A consolidation of the law seems urgently required, and the placing of jurisdiction in the hands of a central authority for the United Kingdom. The committee of 1866 recommended the transfer to the lord chamberlain of the regulation of all places of amusement, and an appeal from him to the home secretary in certain cases, as also the extension of his authority to preventive censorship in all public entertainments; but no legislation resulted. Several bills for the amendment of the law have been recently introduced, but hitherto without success in the face of more burning political questions.

Building.—A theatre (at any rate to make it such a building as can be licensed) must be a permanent building, not a mere tent or booth, unless when licensed by justices at a lawful fair by § 23 of the Act of 1843. It must, if in the metropolis, conform to the regulations as to structure contained in the Metropolitan Building Acts and the Metropolis Management Acts, especially the Act of 1878 (41 and 42 Vict. c. 32). This Act makes a certificate of structural fitness from the Board of Works necessary as a condition precedent for licence in the case of all theatres of a superficial area of not less than 500 square feet licensed after the passing of the Act, gives power to the board in certain cases to call upon proprietors of existing theatres to remedy structural defects, and enables it to make regulations for protection from fire. Such regulations were issued by the board on May 2, 1879. As to theatres in provincial towns, the Towns Improvement Act, 1847, and the Public Health Act, 1875, confer certain limited powers over the building on municipal corporations and urban sanitary authorities. In many towns, however, the structural qualifications of buildings used as theatres depend upon local Acts and the by-laws made under the powers of such Acts. To a more limited extent the rules made by justices may enforce certain structural requirements.

Performance.—To constitute a building where a performance takes place a theatre, the performance must be (*a*) of a stage play, and (*b*) for hire. (*a*) By § 23 of the Act of 1843 the word "stage-play" includes tragedy, comedy, farce, opera, burletta, interlude, melodrama, pantomime, or other entertainment of the stage, or any part thereof. The two tests of a stage play appear to be the excitement of emotion and the representation of action. The question whether a performance is a stage play or not seems to be one of degree, and one rather of fact than of law. A *ballet d'action* would usually be a stage play, but it would be otherwise with a *ballet divertissement.* § 14 empowers the lord chamberlain to forbid the acting of any stage play in Great Britain whenever he may be of opinion that it is fitting for the preservation of good manners, decorum, or the public peace to do so. § 15 imposes a penalty of £50 on any one acting or presenting a play or part of a play after such inhibition, and avoids the licence of the theatre where it appears. Regulations of police respecting the performance are contained in 2 and 3 Vict. c. 47, and in many local Acts. A performance may also be proceeded against as a nuisance at common law, if, for instance, it be *contra bonos mores* or draw together a great concourse of vehicles, or if so much noise be heard in the neighbourhood as to interfere with the ordinary occupations of life. Very curious instances of proceedings at common law are recorded. In 1700 the grand jury of Middlesex presented the two playhouses and also the bear-garden on Bankside (the "Paris garden" of *Henry VIII.*, act v. sc. 3) as riotous and disorderly nuisances. In 1819 certain players were prosecuted and convicted before the court of great sessions of Wales for acting indecent open-air interludes at Berriew in Montgomeryshire. Performances on Sunday, Good Friday, and Christmas day are illegal (see SUNDAY). Regulations as to the sale of intoxicating liquors during the performance are made by the Licensing Acts and other public general Acts, as well as by local Acts and rules made by justices. It is frequently a condition of the licence granted to provincial theatres that no exciseable liquors shall be sold or consumed on the premises. The Children's Dangerous Performances Act, 1879 (42 and 43 Vict. c. 34), forbids under a penalty of £10 any public exhibition or performance whereby the life or limbs of a child under the age of fourteen shall be endangered. It also makes the employer of any such child indictable for assault where an accident causing actual bodily harm has happened to the child, and enables the court on conviction of the employer to order him to pay the child compensation not exceeding £20. (*b*) The performance must be for hire. § 16 of the Act of 1843 makes a building one in which acting for hire takes place, not only where money is taken directly or indirectly, but also where the purchase of any article is a condition of admission, and where a play is performed in a place in which exciseable liquor is sold. In a recent case of Shelley *v.* Bethell (*Law Reports*, 12 Queen's Bench Division, 11) it was held that the proprietor of a private theatre was liable to penalties under the Act, though he lent the theatre gratuitously, because tickets of admission were sold in aid of a charity.

Licensing of Building.—By § 2 of the Act of 1843 all theatres (other than patent theatres) must be licensed. By § 7 no licence is to be granted except to the actual and responsible manager, who is to be bound by himself and two sureties for due observance of rules and for securing payment of any penalties incurred. The metropolitan theatres other than the patent theatres (as far at least as they are included in the boroughs named in the Act of 1843) are licensed by the lord chamberlain. By § 4 his fee on grant of a license is not to exceed 10s. for each month for which the theatre is licensed. The lord chamberlain appears to have no power to make suitable rules for enforcing order and decency. He can, however, by § 8, suspend a licence or close a patent theatre where any riot or misbehaviour has taken place.

Provincial theatres fall under three different licensing authorities. The lord chamberlain licenses theatres in Windsor and Brighton, and theatres situated in the places where the queen occasionally resides, but only during the time of such occasional residence (§ 3). Theatres at Oxford and Cambridge, or within 14 miles thereof, are licensed by the justices having jurisdiction therein, but before any such licence can come into force the consent of the chancellor or vice-chancellor must be given. The rules made by the justices for the management of the theatre are subject to the approval of the chancellor or vice-chancellor, who may also impose such conditions upon the licence as he thinks fit. In case of any breach of the rules or conditions, he may annul the licence (§ 10). All other provincial theatres are licensed by four or more justices at a special session held within twenty-one days after application for a licence shall have been made to them (§ 5). The fee is not to exceed 5s. for each month for which the theatre is licensed (§ 6). The justices, like the lord chamberlain, appear to have no discretion as to granting a licence. Their act is purely ministerial and confined to ascertaining that the applicant is the actual and responsible manager, and that he and his sureties are of sufficient substance to provide the requisite bonds. § 9 gives the justices authority to make at the special session suitable rules for enforcing order and decency at the theatres licensed by them, and of rescinding or altering such rules at a subsequent special session. It also gives a secretary of state power to rescind or alter such rules, and to make other rules. In case of riot or breach of the rules, the justices may order the theatre to be closed, and it thereupon becomes an unlicensed house. Penalties are imposed by the Act for keeping or acting in an unlicensed theatre, and for producing or acting in an unlicensed play.

Licensing Performance.—A stage play must be duly licensed before performance. § 12 of the Act of 1843 prescribes that a copy of every new play and of every addition to an old play, and of every new prologue or epilogue or addition thereto (such copy to be signed by the master or manager), shall be sent to the lord chamberlain, and, if the lord chamberlain does not forbid it within seven days, it may be represented. § 13 empowers the lord chamberlain to fix a scale of fees for examination; the fee is now two guineas for a play of three or more acts, one guinea for a play of less than three acts. All plays represented previously to the Act are held to be licensed. A play once licensed is licensed once for all, unless the licence be revoked under § 14. The examination is the duty of a special officer of the lord chamberlain's department, the examiner of stage plays.

Music Halls.—Music was at no time the object of restrictions as severe as those imposed upon the drama. The present Music Hall Act (25 Geo. II. c. 36) was passed in 1752, probably in consequence of the publication in 1750 of Fielding's *Inquiry into the Causes of the late Increase of Robbers.* It is remarkable that two works of the same writer should from opposite causes have led to both theatre and music hall legislation of lasting importance. The Act was originally passed for a term of three years, but was made perpetual by 28 Geo. II. c. 19. It applies only to music halls within 20 miles of London and Westminster. Every such music hall must be licensed at the Michaelmas quarter sessions, the licence to be signified under the hands and seals of four or more justices. The licence may be granted for music or dancing or both. Public notice of the licence is to be given by affixing over the door the inscription "Licensed pursuant to Act of Parliament of the twenty-fifth of King George the Second." The penalty for keeping an unlicensed music hall is £100. Music halls beyond the radius of 20 miles from London and Westminster are usually governed by local legislation, which in most cases follows, *mutatis mutandis*, the lines of the Act of 1752. The music hall, like the theatre, must generally fulfil certain structural requirements. In one important respect the law is more lenient to the music hall than to the theatre. A licence is necessary for a single performance of a stage play, but it is only habitual music or dancing that requires a music hall licence.

Scotland.—In Scotland the theatre has always exercised a smaller amount of influence than in England, and there has been little exclusively Scotch legislation on the subject. An Act of 1555, c. 40, discountenanced certain amusements of a semi-theatrical kind by enacting that no one was to be chosen Robert Hude (*sic*), Little John, abbot of Unreason, or queen of May. A proclamation of James VI. in 1574, and an Act of 1579, c. 12, followed the lines of English legislation by making persons using unlawful plays, such as jugglery or fast and loose, punishable as vagabonds. In 1574 the General Assembly claimed to license plays, and forbade representations on Sunday. As in England, the licensing power seems then to have passed from the church to the crown, for in 1599 James VI. licensed a theatre at Edinburgh. The Act 1672, c. 21, exempted comedians while upon the stage from the sumptuary provisions of the Act respecting apparel. The chamberlain of Scotland, while such an office existed, appears to have exercised a certain police jurisdiction over theatres. The Theatre Act of 1843 extends to Scotland, as did also the previous Act of 1737.

Ireland.—Theatrical legislation, as far as it went, was based upon English models. Thus ridicule of the liturgy was forbidden by 2 Eliz. c. 2 (Ir.); common players of interludes and wandering minstrels were deemed vagabonds, 10 and 11 Car. I. c. 4 (Ir.). In 1786 an Act was passed to enable the crown to grant letters patent for one or more theatres in Dublin city and county, 26 Geo. III. c. 57 (Ir.). The preamble alleges that the establishing of a well-regulated theatre at the seat of government will be productive of public advantage and tend to improve the morals of the people. Exceptions from the restrictions of the Act were made in favour of entertainments for the benefit of the Dublin lying-in hospital and exhibitions of horsemanship or puppet-shows.

United States.—Public entertainments, dramatic or otherwise, are usually under the control of the municipal authorities. In some States, such as New York and Massachusetts, there is State legislation, requiring places of public entertainment to be licensed by the proper authority. In many States it is a condition of the licence that intoxicating liquors shall not be sold in such places. Other conditions, more or less usual, are that there shall be no Sunday or dangerous performances, that acrobats shall be properly protected, and that female waiters shall not be employed. Structural qualifications are in some cases made necessary. Thus in 1885 the New York legislature passed an Act containing many minute provisions for ensuring the safety of theatres against fire. A characteristic piece of legislation is the New York Act of 1873, c. 186, enacting that no citizen is to be excluded from a theatre by reason of race, colour, or previous condition of servitude. This Act of course merely carries out the important principle affirmed in art. xiv. of the amendments to the constitution of the United States. See PRIVILEGE.

The most recent if not the only work on the law relating to theatres is Geary's *Law of Theatres and Music Halls*, 1885. (J. W†.)

THEBES. See EGYPT, vol. vii. p. 776 *sq.*

THEBES (anciently Θῆβαι, *Thebæ*, or in poetry sometimes Θήβα, in modern Greek *Phiva*, or, according to the corrected pronunciation, *Thivæ*), one of the most interesting towns in Greece, is situated on low hilly ground of gentle slope a little north of the range of Cithæron, which divides Bœotia from Attica, and on the edge of the Bœotian plain, about 44 miles from Athens, whence it is now reached by two carriage-roads. It has about 3500 inhabitants, and is the seat of a bishop. The present town occupies the site of the ancient citadel, the Cadmea; two fragments of ancient wall are visible on the north, and another, belonging either to the citadel or the outer wall, on the south. Two streams, rising a little south of the town, and separated by an average distance of about half a mile, flow on the two sides, and are lost in the plain. These are the ancient Ismenus on the east and Dirce (Δίρκη) on the west, which gave to the town its name ἐπώνυμος. The Dirce, now Platziótissa, has several springs. From the west side of the Cadmea another copious fountain (Paraporti) falls to the Dirce. In a suburb to the east is another (Fountain of St Theodore), and north-west are two more. The Cadmea itself is supplied with water brought from an unknown source to the south by works supposed of prehistoric antiquity. It now enters the town by an aqueduct of twenty arches of Frankish construction. The "waters" of Thebes are celebrated both by Pindar and by the Athenian poets, and the site is still, as described by Dicæarchus (3d century B.C.), "all springs," κάθυδρος πᾶσα. One, from which a pasha of Negroponte (Eubœa) is said to have supplied his table, is still called "the spring of the cadi." Some of the marble basins, seats, &c., remain, and, with the fragments of wall above mentioned, are the only relics of the classic time. The most curious of later buildings is the church of St Luke, south-east of the Cadmea, believed to contain the tomb of the evangelist. From the abundance of water the place is favourable to gardens, and the neighbouring plain is extremely fertile. But the population is scanty, and the town at present of no importance.

In prehistoric times the Cadmea, with the enlarged city of Thebes into which it developed, was a power of the first rank, as is shown by its unrivalled legends. More particularly the mythical wars with Argos (see below) point to a time when the "Hellenes" of North Greece were still contending unequally against the "Achæans" of the Peloponnesus. In the legend as given by Æschylus these names are accurately preserved. At the beginning of continuous history (6th century B.C.) Thebes had long been possessed by immigrants from Thessaly, who knew the previous inhabitants as Cadmeans (Καδμεῖοι).

The history of the town to the end of the 4th century is part of the general history of the nation (see GREECE). It had an aristocratic constitution, and claimed a contested sovereignty over the other towns of Bœotia. Down to 371 B.C. this status was not essentially changed. The battle of Coronea (394) showed the increasing military strength of the Thebans, and in 371 the genius of Epaminondas raised them by the victory of Leuctra for a brief period to the leading position in Hellas. Philip of Macedon spent part of his youth as a hostage at Thebes, and probably learnt there important lessons in war. By him and his successor the state was destroyed. In 338 the Thebans shared with the Athenians the defeat of Chæronea, and received a Macedonian garrison; the lion-monument erected by them on the field of battle, and still existing there, though in fragments, is a more impressive memorial of their greatness than anything now visible at the town itself. In 335, after the death of Philip, they revolted, and were punished by Alexander with a fearful vengeance. It is said that 6000 Thebans were slain at the capture and 30,000 taken prisoners. The population was dispersed, and the town entirely razed (except, according to tradition, the house of the poet Pindar); and, though it was soon restored by the Macedonian Cassander (315), it never again played a leading part in history. In 86 B.C., having sided against the Romans in the Mithradatic war, it was plundered by Sulla, and fell into such decay that Strabo describes it as little better than a village. In the 2d century the traveller Pausanias, who gives a full account of it (ix. 5 *sq.*), found only the citadel inhabited. In 395 A.D., however, it had some strength, for Alaric, on his way to the capture of Athens, did not think fit to attack it. In the later times of the Eastern empire (10th to 12th century) it again became wealthy and important, being specially celebrated for the manufacture of silk and cloth. In 1143 it was plundered by the Normans of Sicily (who transferred thither the chief artisans of the silk trade), and, after the capture of Constantinople by the crusaders (1204), became with Athens a fief of the feudal empire. In 1311 it was again plundered by the Catalan Grand Company, a body of Spanish mercenaries, and appears to have had no return of prosperity.

Of more lasting effect than the politics of Thebes have been its legends. Bœotia, or rather the Cadmeis (Thucyd., i. 12), was a land of poetry from extremely ancient times, and the stories of Thebes are in Greek literature as important as those of Troy. The legends of the five chief groups will be found under the names indicated in the following division:—(1) the foundation of the Cadmea by Cadmus; (2) the foundation by Amphion,—to this belong originally the "seven-gated" wall, the name of *ἑπτάπυλος Θήβη*, and the legends of Zethus, Antiope, and Dirce; (3) war of the "Seven" (under Adrastus of Argos); war of the Epigoni, or "descendants" of the Seven; the story of Œdipus; (4) legends of Bacchus,—at Thebes as elsewhere this religion was comparatively late, but became characteristic of the town; (5) legends of Heracles (commonly found with those of Bacchus; Thebes was reputed the birthplace of both). From the epic poems, of which little but titles remain, these tales descended to the Attic tragedians; upon them are founded the *Seven against Thebes* of Æschylus, the *Œdipus Tyrannus*, *Œdipus Coloneus*, and *Antigone* of Sophocles, the *Phœnissæ*, *Supplices*, and *Bacchæ* of Euripides, &c., with innumerable plays not extant. Apart from direct imitation of these works, the stories themselves, through Statius, Boccaccio, and others, have exercised a great influence on modern literature. In historical times the Thebans were not conspicuous for intellectual accomplishments, but their reputation is sufficiently sustained by Pindar, perhaps the most distinctively Hellenic of all the national poets.

The most famous monument of ancient Thebes was the outer wall with its seven gates, which even as late as the 6th century B.C. was probably the largest of artificial Greek fortresses. The names of the gates vary, but four are constant,—the Prœtides, Electræ, Neistæ or Neitæ, and Homoloides; Pausanias gives the others as Ogygiæ, Hypsistæ, Crenææ. There is evidence that the gate Electræ was on the south, and near it was the tomb of the Thebans who fell at the capture by Alexander. The gates shown to Pausanias as Neistæ and Prœtides led respectively north-west and north-east. Two of the springs have been identified with some probability,—that of St Theodore with the Œdipodea, in which Œdipus is said to have purged himself from the pollution of homicide, and the Paraporti with the dragon-guarded fountain of Ares (see CADMUS). Dicæarchus, referring to the town of Cassander, gives two measurements for the circuit, equal to about 9 miles and 5½ miles, but even the smaller is impossible for the wall, and they probably refer to the territory proper of the town, or *γῆ Θηβαΐς*. Beyond this the topography is wholly uncertain. From the interest of the site in history and still more in literature, as the scene of so many dramas, the temptation to fix details has been specially strong. Conjectural plans or descriptions, differing widely, are given by Leake, Forchhammer, Ulrichs, Bursian, and others (references below). All are based on the assumption that the description of Pausanias and the allusions of the Attic tragedians may be read together and combined, and that the result will give the plan as it existed in the 5th and 4th centuries B.C. But to this two objections must be taken. (1) The account of Pausanias, even when clear in itself, is very uncertain evidence for anything earlier than the destruction by Alexander. It is said indeed that the restored town occupied the same area, but this is consistent with great disturbance of tradition; and we have further to allow for inaccurate transmission through 450 years of decadence, and finally for the quality of Pausanias's information, given apparently by casual guides to a traveller extremely uncritical. (2) It may be doubted whether the tragedians had accurate knowledge of Theban topography, and they had certainly no reason for introducing it in their plays. Their plots are laid in a remote past; and it is difficult to suppose them on the one hand so careful as to fit their scenes to the actual Thebes, and on the other hand so careless as to presume that it had suffered no great change between the times of Cadmus or of Œdipus and their own days. Indeed they did not make this mistake. The plays which contain most references to topography are the *Seven against Thebes* and the *Phœnissæ*. In the *Seven* the name of "Thebes" does not occur at all (the title is a misnomer, probably not given by the author); the town is called by its ancient name "The Cadmea" (*Καδμεία πόλις*), and the whole play assumes that the "city of Cadmus" was much smaller than the Thebes contemporary with Æschylus can have been. In the *Phœnissæ* the circuit of the walls is said to be so small that a person within must necessarily know all that had taken place in a general attack (v. 1356). None of the conjectural plans would approximately satisfy this, nor can it have been true for the time of Euripides. After this, it is not surprising to find that the attempt to use the plays as evidence is involved in unanswered difficulties, a few of which are given below.

In itself, however, and as relating to the ruins of the restored town merely, the description of Pausanias is curious and interesting. The principal buildings were at that time (2d century) the temple of Apollo Ismenius, which must have stood somewhere about the present church of St Luke, the theatre, near the gate Prœtides, the Heracleum, with a gymnasium and race-course, and the temples of Artemis Eucleia, of Ammon, and of Fortune (*Τύχη*). Besides these Pausanias was shown all the gates, all the legendary sites, the house of Pindar (north-west beyond the Dirce), statues, &c., dedicated by him, several statues of immense antiquity, others attributed to the greatest artists, and in fact much more than it is easy to believe.

1. *Apollo Ismenius* and *Apollo Spodius.*—Sophocles (*Œ. T.*, 21) mentions, as one of the Theban sanctuaries, "the oracular ashes of Ismenus," *Ἰσμηνοῦ μαντεία σποδός*. Pausanias, who calls the river not Ismenus but Ismenius, describes (1) a temple of Ismenius or Apollo Ismenius (ix. 10, 2), and (2) an altar of Apollo Spodius, made of ashes and used in a peculiar manner as an oracle (ix. 11, 7). We should suppose from Sophocles that both observations related to the same sanctuary; and Sophocles clearly identified the two. But in Pausanias they are in different places and have no connexion at all. Either therefore the topography and ritual of the one period differed from those of the other, or, which is equally probable, the poet used Theban names without regard to accuracy.

2. *The Fountain of Ares.*—Euripides, in the *Supplices* (v. 650 *sq.*), describes an army advancing on Thebes from the south as having its right at the Ismenian hill, its left at the fountain of Ares, and "the chariots below the monument of Amphion." Pausanias also places the Ismenian hill on the right of the southern gate. But the fountain of Ares he places on the same side, a description quite inconsistent with this and other allusions. Ulrichs, while insisting on the agreement about the hill, merely observes on this that Pausanias is unintelligible. Of a still greater difficulty he says nothing. The tomb of Amphion is placed by Æschylus north of the town, and there or in that direction was shown to Pausanias. The topographers accordingly suppose that the "chariots" of Euripides were in the plain to the north. But there is no suggestion in the passage that any part of the advancing army was separated from the rest, and the observer expressly says that *he was at the place where the chariots fought and had a particularly good view of this part of the battle* (v. 684). Now he stood on the gate Electræ, *i.e.*, as far as possible from the tomb of Amphion, as placed by Æschylus and Pausanias. It is impossible to make a consistent account of this, and it seems plain that Euripides took up the name "tomb of Amphion" at hazard, and ignored or forgot that the real tomb could not be brought into his picture.

3. *The Altar of* (*Athena*) *Onca.*—This was shown to Pausanias (ix. 12, 1), who was told that it marked the place where the lying down of a cow indicated to Cadmus the site destined for his city (*ἵζει ἐνταῦθα οἰκῆσαι*). "It is said," he continues, "that in the acropolis there was formerly the house of Cadmus (*Κάδμου οἰκία*)." No other indication is given as to the place of the altar, and the natural inference is that it was shown in the Cadmea. But Æschylus (*Septem*, 501) places it outside the walls. Accordingly it is suggested that the oracular sign only indicated the neighbourhood of the destined site, and that the altar shown to Pausanias was near that of Apollo Spodius, which is mentioned last before it, and may have been outside the wall. But this juxtaposition proves nothing about the place of Onca, for Pausanias himself shows that mention of Onca here is suggested by a reference to "oxen" in connexion with the altar of Spodius, which brought to his mind the "cow" of the other legend.

4. *The Tomb of Amphion and Zethus.*—Apart from the confusion of Euripides already noticed, there is a difficulty about the mention of this monument in Pausanias and Æschylus. Pausanias, after describing several buildings near the gate Prœtides, concluding with some in the market-place, mentions next (without further indication of place) the tomb of Amphion and Zethus, and continues thus,—"the way from Thebes to Chalcis (north-east) is by this gate Prœtides, &c." Æschylus places the tomb of Amphion outside the wall opposite the north gate (*Septem*, 527), and the Prœtides elsewhere. Ulrichs concludes that Pausanias "evidently" went out by the north gate to view the monument and then returned to the Prœtides. Of course this is possible, but it is useless to draw exact inferences from documents which require such an hypothesis. It is equally probable that Pausanias identified the tomb with a monument called the Ampheion, which seems (Ulrichs, p. 17) to have been somewhere near the market-place. Indeed, there is no proof that they were not identical, for the only evidence that the tomb was outside the wall (and therefore different from the Ampheion) is that of Æschylus and Euripides, whose imaginary cities were not much larger than the Cadmean hill, and must have excluded the Ampheion itself.

On the history, see references under GREECE; on the topography and legends, Ulrichs, *Reisen und Forschungen in Griechenland*, ii. 1 *sq.*; Leake, *Travels in Northern Greece*, ii. xiv.; Bursian, *Geographie von Griechenland*, i. 226 *sq.*; and the "*Seven against Thebes*," ed. by A. W. Verrall, "Introduction." (A. W. V.)

THECLA, St, virgin, is commemorated by the Latin Church on September 23. The *Breviary* relates that she was born of illustrious parentage at Iconium, and came under the personal teaching of the apostle Paul. In her eighteenth year, having broken her engagement with Thamyris, to whom she had been betrothed, she was accused by her relations of being a Christian, and sentenced to be burned. Armed with the sign of the cross, she threw herself upon the pyre, but, the flames having been extinguished by a sudden rain, she came to Antioch, where she was exposed to the wild beasts, then fastened to bulls that she might be torn asunder, then thrown into a pit full of serpents, but from all these perils she was delivered by the grace of Christ. Her ardent faith and her holy life were the means of converting many. Returning once more to her native place, she withdrew into a mountain solitude, and became distinguished by many virtues and miracles, dying at the age of ninety. She was buried at Seleucia.

The substance of the foregoing narrative, with many other curious incidents, occurs in the very ancient apocryphal book entitled the περίοδοι of Paul and Thecla (*Acta Pauli et Theclæ*). Tertullian tells us that this work was written by a presbyter in Asia, "out of love to Paul," but that his conduct was not approved, and led to his deposition. What caused special offence was its recognition of the right of women to preach and baptize. There is no doubt that the present differs very considerably from the original form of the *Acta*, but even now its Gnostic origin is betrayed in several features which it still retains—for example, the rejection of marriage. For the text, see the *Acta Apost. Apocr.* of Tischendorf, who in the Prolegomena gives a large body of evidence for its great antiquity A translation is given in the *Ante-Nicene Christian Library*.

THEFT is, in modern legal systems, universally treated as a crime, but the conception of theft as a crime is not one belonging to the earliest stage of law. To its latest period Roman law regarded theft (*furtum*) as a delict *prima facie* pursued by a civil remedy,—the *actio furti* for a penalty, the *vindicatio* or *condictio* for the stolen property itself or its value. In later times, no doubt, a criminal remedy to meet the graver crimes gradually grew up by the side of the civil, and in the time of Justinian the criminal remedy, where it existed, took precedence of the civil (*Cod.*, iii. 8, 4). But to the last criminal proceedings could only be taken in serious cases, *e.g.*, against stealers of cattle (*abigei*) or the clothes of bathers (*balnearii*). The punishment was death, banishment, or labour in the mines or on public works. In the main the Roman law of theft coincides with the English law. The definition as given in the *Institutes* (iv. 1, 1) is "furtum est contrectatio rei fraudulosa, vel ipsius rei, vel etiam ejus usus possessionisve," to which the *Digest* (xlvii. 2, 1, 3) adds "lucri faciendi gratia." The earliest English definition, that of Bracton (150*b*), runs thus: "furtum est secundum leges contrectatio rei alienæ fraudulenta cum animo furandi invito illo domino cujus res illa fuerit." Bracton omits the "lucri faciendi gratia" of the Roman definition, because in English law the motive is immaterial,[1] and the "usus ejus possessionisve," because the definition includes an intent to deprive the owner of his property permanently. The "animo furandi" and "invito domino" of Bracton's definition are expansions for the sake of greater clearness. They seem to have been implied in Roman law. *Furtum* is on the whole a more comprehensive term than theft. This difference no doubt arises from the tendency to extend the bounds of a delict and to limit the bounds of a crime. Thus it was *furtum* (but it would not be theft at English common law) to use a deposit of pledge contrary to the wishes of the owner, to retain goods found, or to steal a human being, such as a slave or *filius familias* (a special form of *furtum* called *plagium*). The latter would be in English law an abduction under certain circumstances, but not a theft. On the other hand, one of two married persons could not commit *furtum* as against the other, but theft may be so committed in England since recent legislation. As a *furtum* was merely a delict, the *obligatio ex delicto* could be extinguished by agreement between the parties; it will be seen that this cannot be done in England. In another direction English law is more considerate of the rights of third parties than was Roman. As will appear hereafter, the thief can give a good title to stolen goods; in Roman law he could not do so, except in the single case of a *hereditas* acquired by *usucapio*. The development of the law of *furtum* at Rome is historically interesting, for even in its latest period is found a relic of one of the most primitive theories of law adopted by courts of justice: "They took as their guide the measure of vengeance likely to be exacted by an aggrieved person under the circumstances of the case" (Maine, *Ancient Law*, ch. x.). This explains the reason of the division of *furtum* into *manifestum* and *nec manifestum*. The manifest thief was one taken red-handed,—"taken with the manner," in the language of old English law. The Twelve Tables denounced the punishment of death against the manifest thief, for that would be the penalty demanded by the indignant owner in whose place the judge stood. The severity of this penalty was afterwards mitigated by the prætor, who substituted for it the payment of quadruple the value of the thing stolen. The same penalty was also given by the prætor in case of theft from a fire or a wreck, or of prevention of search. No doubt the object of this large penalty was to induce injured persons to refrain from taking the law into their own hands. The Twelve Tables mulcted the non-manifest thief in double the value of the thing stolen. The actions for penalties were in addition to the action for the stolen goods themselves or their value. The quadruple and double penalties still remain in the legislation of Justinian. The search for stolen goods, as it existed in the time of Gaius, was a survival of a period when the injured person was, as in the case of summons (*in jus vocatio*), his own executive officer. Such a search, by the Twelve Tables, might be conducted in the house of the supposed thief by the owner in person, naked except for a cincture, and carrying a platter in his hand, safeguards apparently against a violation of decency and against any possibility of his making a false charge by depositing some of his own property on his neighbour's premises. This mode of search became obsolete before the time of Justinian. Robbery (*bona vi rapta*) was violence added to *furtum*. By the *actio vi bonorum raptorum* quadruple the value could be recovered if the action were brought within a year, only the value if brought after the expiration of a year. The quadruple value, it is to be noted, included the stolen thing itself, so that the penalty was in effect only a triple one. It was inclusive, and not cumulative, as in *furtum*.

In England theft appears to have been very early regarded by legislators as a matter calling for special attention. The pre-Conquest compilations of laws are full of provisions on the subject. It is noticeable that the earlier ones appear to regard theft as a delict which may be compounded for by payment. Considerable distinctions of person are made, both in regard to the owner and the thief. Thus, by the laws of Ethelbert, if a freeman stole from the king he was to restore ninefold, if from a freeman or from a dwelling threefold. If a theow stole, he had only to make a twofold reparation. In the laws of Alfred ordinary theft was still only civil, but he who stole in a church was punished by the loss of his hand. The laws of Ina named as the penalty death or redemption according to the wer-gild of the thief. By the same laws the thief might be slain if he fled or resisted. Gradually the severity of the punishment increased. By the laws of Athelstan death in a very cruel form was inflicted. At a later date the *Leges Henrici Primi* placed a thief in the king's mercy, and his lands were forfeited. Putting out the eyes and other kinds of mutilation were sometimes the punishment. The principle of severity continued down to the present century, and until 1827 theft of certain kinds remained capital. Both before and after the Conquest local jurisdiction over thieves was a common franchise of lords of manors, attended with some of the advantages of modern summary jurisdiction. It might be exercised either over thieves who committed a theft or were apprehended within the lordship (*infangthef*), or over those inhabitants of the lordship who were apprehended elsewhere (*outfangthef*). Either or both franchises might be enjoyed by grant or prescription. As lately as 1 Ph. and M. c. 15 infangthef and outfangthef were confirmed to the lords marchers of Wales. An analogous franchise was *theam*, or the right of calling upon the holder of stolen goods to vouch to warranty, *i.e.*, to name from whom he received them. In the old law of theft there were to be found two interesting survivals of the primitive legal notions which were found in Roman law. Up to a comparatively recent date a distinction analogous to that between *furtum manifestum* and *nec manifestum* was of importance in English criminal practice. The thief "taken with the manner" was by the Statute of Westminster the First not to be admitted to bail (see *Letters of Junius*, lxviii.). In modern procedure the probable guilt or innocence of the accused is not so much to be considered in a question of bail as the probability of his appearance at the trial. The other matter worthy of notice is the old pursuit (*secta*) by hue and cry. In the pre-Conquest codes the owner was generally allowed to take the law into his own hand, as in early Roman law, and get back his goods by force if he could, no doubt with the assistance of his neighbours where possible. From this arose the later development of the hue and cry, as the recognized means of pursuing a thief. The Statutes of Westminster the First and of *De officio coronatoris* enacted that all men should be ready to pursue and arrest felons, and ten years later the Statute of Winchester (1285) enforced upon all the duty of keeping arms for the purpose of following the hue and cry. It also made the hundred liable for thefts with violence committed in it, an adoption no doubt in feudal law of the old pre-Conquest liability of the frithborg. As justice became more settled, the hue and cry was regulated more and more by law, and lost much of its old natural simplicity. This led to its gradually becoming obsolete, though the Statutes of Westminster the First and *De officio coronatoris* are still nominally law as far as they relate to the hue and cry. The Statute of Winchester as to the liability of the hundred was repealed in 1827.

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[1] Thus destruction of a letter by a servant, with a view of suppressing inquiries into her character, makes the servant guilty of larceny in English law.

The term theft in modern English law is sometimes used as a synonym of larceny, sometimes in a more comprehensive sense. In the latter sense it is used by Mr Justice Stephen, who defines it as "the act of dealing from any motive whatever, unlawfully and without claim of right, with anything capable of being stolen, in any of the ways in which theft can be committed" (for which see § 296–300), "with the intention of permanently converting that thing to the use of any person other than the general or special owner thereof" (*Digest of the Criminal Law*, § 295). In this broader sense the term applies to all cases of depriving another of his property, whether by removing or withholding it. It thus includes larceny, robbery, cheating, embezzlement, and breach of trust. Embezzlement is a statutory crime created as a separate form of offence in the last century (see vol. viii. p. 159). The difference between larceny and embezzlement turns mainly on the fact of the master's being in actual or constructive possession of the stolen property (see POSSESSION). Fraudulent breach of trust was not made a specific offence until 1857 (see TRUST).

Larceny (a corruption of *latrocinium*), or theft proper, was felony at common law. The common law of larceny has been affected by numerous statutes, the main object of legislation being to bring within the law of larceny offences which were not larcenies at common law, either because they were thefts of things of which there could be no larceny at common law, *e.g.*, beasts *feræ naturæ*, title deeds, or choses in action, or because the common law regarded them merely as delicts for which the remedy was by civil action, *e.g.*, fraudulent breaches of trust. The earliest Act in the statutes of the realm dealing with larceny appears to be the *Carta Forestæ* of 1225, by which fine or imprisonment was inflicted for stealing the king's deer. The next Act appears to be the Statute of Westminster the First (1275), dealing again with stealing deer. From this it seems as though the beginning of legislation on the subject was for the purpose of protecting the chases and parks of the king and the nobility. An immense mass of the old Acts will be found named in the repealing Act of 1827, 7 and 8 Geo. IV. c. 27. An Act of the same date, 7 and 8 Geo. IV. c. 29, removed the old distinction between grand and petit larceny.[1] The former was theft of goods above the value of twelve pence, in the house of the owner, not from the person, or by night, and was a capital crime. It was petit larceny where the value was twelve pence or under, the punishment being imprisonment or whipping. The gradual depreciation in the value of money afforded good ground for Sir Henry Spelman's sarcasm that, while everything else became dearer, the life of man became continually cheaper. The distinction between grand and petit larceny first appears in statute law in the Statute of Westminster the First, c. 15, but it was not created for the first time by that statute. It is found in some of the pre-Conquest codes, as that of Athelstan, and it is recognized in the *Leges Henrici Primi*. A distinction between simple and compound larceny is still found in the books. The latter is larceny accompanied by circumstances of aggravation, as that it is in a dwelling-house or from the person. The law of larceny is now contained chiefly in the Larceny Act, 1861, 24 and 25 Vict. c. 96 (which extends to England and Ireland), a comprehensive enactment including larceny, embezzlement, fraud by bailees, agents, bankers, factors, and trustees, sacrilege, burglary, housebreaking, robbery, obtaining money by threats or by false pretences, and receiving stolen goods, and prescribing procedure, both civil and criminal. There are still, however, some earlier Acts in force dealing with special cases of larceny, such as 33 Hen. VIII. c. 12, as to stealing the goods of the king, and the Game, Post-Office, and Merchant Shipping Acts. Later Acts provide for larceny by a partner of partnership property (31 and 32 Vict. c. 116), and by a husband or wife of the property of the other (45 and 46 Vict. c. 75). Proceedings against persons subject to naval or military law depend upon the Naval Discipline Act, 1866, and the Army Act, 1881. There are several Acts, both before and after 1861, directing how the property is to be laid in indictments for stealing the goods of counties, friendly societies, trades unions, &c. The principal conditions which must exist in order to constitute larceny are these:—(1) there must be an actual taking into the possession of the thief, though the smallest removal is sufficient; (2) there must be an intent to deprive the owner of his property for an indefinite period, and to assume the entire dominion over it, an intent often described in Bracton's words as *animus furandi*; (3) this intent must exist at the time of taking; (4) the thing taken must be one capable of larceny either at common law or by statute. One or two cases falling under the law of larceny are of special interest. It was held more than once that a servant taking corn for the purpose of feeding his master's horses, but without any intention of applying it for his own benefit, was guilty of larceny. To remedy this hardship, 26 and 27 Vict. c. 103 was passed to declare such an act not to be felony. The case of appropriation of goods which have been found has led to some difficulty. It now seems to be the law that in order to constitute a larceny of lost goods there must be a felonious intent at the time of finding, that is, an intent to deprive the owner of them, coupled with reasonable means at the same time of knowing the owner. The mere retention of the goods when the owner has become known to the finder does not make the retention criminal. Larceny of money may be committed when the money is paid by mistake, if the prisoner took it *animo furandi*. In two recent cases the question was argued before a very full Court for Crown Cases Reserved, and in each case there was a striking difference of opinion. In Reg. *v.* Middleton, *Law Rep.*, 2 Crown

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[1] This provision was most unnecessarily repeated in the Larceny Act of 1861.

Cases Reserved, 88, the prisoner, a depositor in a post-office savings bank, received by the mistake of the clerk a larger sum than he was entitled to. The jury found that he had the *animus furandi* at the time of taking the money, and that he knew it to be the money of the postmaster-general. The majority of the court held it to be larceny. In a case in 1885 (Reg. *v.* Ashwell, *Law Rep.*, 16 Queen's Bench Division, 190), where the prosecutor gave the prisoner a sovereign believing it to be a shilling, and the prisoner took it under that belief, but afterwards discovered its value and retained it, the court was equally divided as to whether the prisoner was guilty of larceny at common law, but held that he was not guilty of larceny as a bailee. The procedure in prosecutions for larceny has been considerably affected by recent legislation. The inconveniences of the common-law rules of interpretation of indictments led to certain amendments of the law, now contained in the Larceny Act, for the purpose of avoiding the frequent failures of justice owing to the strictness with which indictments were construed. Three larcenies of property of the same person within six months may now be charged in one indictment. On an indictment for larceny the prisoner may be found guilty of embezzlement, and *vice versa*; and if the prisoner be indicted for obtaining goods by false pretences, and the offence turn out to be larceny, he is not entitled to be acquitted of the misdemeanour. A count for receiving may be joined with the count for stealing. In many cases it is unnecessary to allege or prove ownership of the property the subject of the indictment. The Act also contains numerous provisions as to venue and the apprehension of offenders. In another direction the powers of courts of SUMMARY JURISDICTION (*q.v.*) have been extended, in the case of charges of larceny, embezzlement, and receiving stolen goods, against children and young persons and against adults pleading guilty or waiving their right to trial by jury. The maximum punishment for larceny is fourteen years' penal servitude, but this can only be inflicted in certain exceptional cases, such as horse or cattle stealing and larceny by a servant or a person in the service of the crown or the police. The extreme punishment for simple larceny after a previous conviction for felony is ten years' penal servitude. Whipping may be part of the sentence on boys under sixteen.

Robbery is larceny accompanied by violence or threatened violence. Whether obtaining money by threats to accuse of crime was robbery at common law was open to some doubt. It is now a specific offence under the Larceny Act, punishable by penal servitude for life. Whipping may be added as part of the sentence for robbery by 26 and 27 Vict. c. 44.

Cheating is either a common-law or statutory offence. An indictment for cheating at common law is now of comparatively rare occurrence. The statutory crime of obtaining money by false pretences is the form in which the offence generally presents itself. Like embezzlement, this offence dates as a statutory crime from the last century. It now depends upon the Larceny Act. A false pretence is defined by Mr Justice Stephen as "a false representation made either by words, by writing, or by conduct that some fact or facts existed" (*Digest of the Criminal Law*, § 330). The principal points to notice are that the false pretence must be of an existing fact (*e.g.*, it was held not to be a false pretence to promise to pay for goods on delivery), and that property must have been actually obtained by the false pretence. The broad distinction between this offence and larceny is that in the former the owner intends to part with his property, in the latter he does not. By 22 and 23 Vict. c. 17, no indictment for obtaining money by false pretences is to be presented or found by the grand jury unless the defendant has been committed for trial or the indictment is authorized in one of the ways mentioned in the Act. The maximum punishment for the common-law offence is fine or imprisonment at discretion, for the statutory five years' penal servitude.

Stolen Goods.—The owner of the goods stolen has an action against the thief for the goods or their value. How far he is entitled to pursue his civil right to the exclusion of criminal prosecution does not seem very clear upon the authorities. One of the latest statements of the law was that of Mr Justice Watkin Williams:—"It has been said that the true principle of the common law is that there is neither a merger of the civil right, nor is it a strict condition precedent to such right that there shall have been a prosecution of the felon, but that there is a duty imposed upon the injured person not to resort to the prosecution of his private suit to the neglect and exclusion of the vindication of the public law; in my opinion this view is the correct one" (Midland Insurance Company *v.* Smith, *Law Rep.*, 6 Queen's Bench Division, 568). Dealing with stolen goods by persons other than the thief may affect the rights of such persons either criminally or civilly. Two varieties of crime arise from such dealings. (1) Receiving stolen goods knowing them to have been stolen, a misdemeanour at common law, is by the Larceny Act a felony punishable by penal servitude for fourteen years where the theft amounts to felony, a misdemeanour punishable by penal servitude for seven years where the theft is a misdemeanour, as in obtaining goods by false pretences. Recent possession of stolen property may, according to circumstances, support the presumption that the prisoner is a thief or that he is a receiver. The Prevention of Crime Act, 1871, made important changes in the law of evidence in charges of receiving. It allows, under proper safeguards, evidence to be given in the course of the trial of the finding of other stolen property in the possession of the accused, and of a previous conviction for any offence involving fraud and dishonesty. (2) Compounding theft, or theftbote, that is, taking back stolen goods or receiving compensation on condition of not prosecuting, is a misdemeanour at common law. It need not necessarily be committed by the owner of the goods. Under the Larceny Act it is a felony punishable by seven years' penal servitude to corruptly take money or reward for helping to recover stolen goods without using all due diligence to bring the offender to trial. By the same Act, to advertise or print or publish any advertisement offering a reward for the return of stolen goods, and using any words purporting that no questions will be asked, &c., renders the offender liable to a penalty of £50. This penalty must, by 33 and 34 Vict. c. 65, be sued for within six months, and the assent of the attorney-general is necessary. Various Acts provide for the liabilities of pawnbrokers, publicans, marine-store dealers, and others into whose possession stolen goods come. Search for stolen goods can only be undertaken by a police officer under the protection of a search warrant. The law as to stolen goods, as far as it affects the civil rights and liabilities of the owner and third parties, is shortly as follows. As a general rule a purchaser takes goods subject to any infirmities of title. The property in money, bank-notes, and negotiable instruments passes by delivery, and a person taking any of these *bona fide* and for value is entitled to retain it as against a former owner from whom it may have been stolen. In the case of other goods, a *bona fide* purchaser of stolen goods in market overt (see SALE) obtains a good title (except as against the crown), provided that the thief has not been convicted. After conviction of the thief the property revests in the owner, and the court before which the thief was convicted may order restitution, except in the cases specially mentioned in the Larceny Act, *i.e.*, the *bona fide* discharge or transfer of a security for value without notice and the fraudulent dealing by a trustee, banker, &c., with goods and documents of title to goods entrusted to him. After conviction of the thief the goods must be recovered from the person in whose hands they are at the time of the conviction, for any sales and resales, if the first sale was in market overt, are good until conviction of the thief. If the goods were obtained by false pretences and not by larceny, the question then is whether the property in the goods has passed or not, and the answer to this question depends upon the nature of the false pretences employed. If the vendee obtains possession of goods with the intention by the vendor to transfer both the property and the possession, the property vests in the vendee until the vendor has done some act to disaffirm the transaction. But if there was never any such intention,—if, for instance, the vendor delivers the goods to A. B. under the belief that he is C. D.,—the property does not vest in the transferee, and the owner may recover the goods even from a *bona fide* purchaser.[1]

Scotland.—There is a vast quantity of Acts of the Scottish parliament dealing with theft. The general policy of the Acts was to make thefts what were not thefts at common law, *e.g.*, stealing fruit, dogs, hawks, or deer, and to extend the remedies, *e.g.*, by giving the justiciar authority throughout the kingdom, by making the master in the case of theft by the servant liable to give the latter up to justice, or by allowing the use of firearms against thieves. The general result of legislation in England and Scotland has been to assimilate the law of theft in both kingdoms. As a rule, what would be theft in one would be theft in the other. There can be theft of children in Scots as in Roman law, under the name of *plagium*. The crime of stouthrief is robbery accompanied by exceptional violence. The English receiving stolen goods and obtaining money under false pretences are represented by the reset and fraud of Scots law. Theftbote or *redemptio furti* appears in legislation as early as the assizes of King William, c. 2. The offender was there subjected to the ordeal of water if convicted on the oath of three witnesses, to be immediately hanged if the oath of three *seniores* were added. The offence was made punishable by 1436, c. 1, 1515, c. 2, and appears still to be a crime. Blackmailing, under that name, was forbidden by 1567, c. 27. There is no consolidation Act for Scotland like the Larceny Act for England and Ireland, but various Acts are in force dealing with specific offences or with procedure. Thus 7 Anne c. 21, § 7, makes theft by landed men no longer treason, as it had previously been. 4 Geo. II. c. 32 deals with theft of lead, &c., fixed to houses, 21 Geo. II. c. 34 with the admissibility of an accomplice as witness in a charge of cattle stealing, 51 Geo. III. c. 41 with theft of linen, &c. The most important Act relating to procedure is 31 and 32 Vict. c. 95, § 12, by which a previous conviction for theft may be libelled and proved as aggravation of robbery, and a previous conviction for robbery as aggravation of theft. Stolen goods are always taken subject to the inherent *vitium reale* of their acquisition, and the true owner may recover them from any one in whose possession they are. The protection given by market overt is unknown in Scotland. See Macdonald, *Criminal Law*, p. 18.

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[1] For the Roman and English law, see, besides the authorities cited, Hunter, *Roman Law*; Muirhead, *Roman Law*; 4 Stephen, *Commentaries*, pt. vi. chap. v.; 3 Stephen, *Hist. of the Criminal Law*, chap. xxviii.

United States.—The law depends almost entirely upon State legislation, and is in general accordance with that of England. The only Acts of Congress bearing on the subject deal with theft in the army and navy, and with theft and receiving on the high seas or in any place under the exclusive jurisdiction of the United States. The doctrine of market overt is not acknowledged by any State. (J. W†.)

THEISM

Meanings of the word theism. Its generic sense.

THE term theism has three significations. In its widest acceptation its object is the Divine, whether regarded as personal or impersonal, as one being or as a number of beings. In this sense theism is coextensive with religion and worship, includes all forms of polytheism and of pantheism, as well as all varieties of monotheism, and so may be said to denote the genus of which polytheism, pantheism, and monotheism are species. The conception of the Divine, in its utmost abstractness and generality, is, however, so vague that it may reasonably be doubted if the forms of theism, thus understood, can be distributed into strictly logical and natural species, with definitions at once perfectly distinct in themselves and exactly accordant with phenomena. It may seem as if polytheism and monotheism must, by arithmetical necessity, be exclusive of each other and exhaustive of theism; but this is not so. Pantheism may clearly partake of the nature of both, and has been sometimes extravagantly polytheistic, sometimes only doubtfully distinguishable from fully developed monotheism. Probably few, if any, polytheistic religions are purely polytheistic, or, in other words, do not imply in some mode and measure the unity as well as the plurality of the Divine. Christian monotheism answers to a formal definition of monotheism only inasmuch as it holds to the unity of the Godhead, but contravenes it inasmuch as it holds that in the one Godhead there are three Divine persons, each God.

Its negatives.

The complete negation of theism in its generic sense is atheism—the denial of the existence or of the knowability of the Divine. It is only in modern times that the word atheism has acquired this meaning, only in recent times that it has come to be exclusively employed with this meaning. The Greeks meant by it simply disbelief in the Greek gods. The early Christians were called atheists because they refused to acknowledge the pagan deities. Protestants have been charged by Roman Catholics and Roman Catholics by Protestants with atheism. Throughout even the 18th century the word was used in an extremely loose manner, and often affixed to systems by which the existence and agency of God were unequivocally recognized. Atheism, in the sense now generally admitted to be alone appropriate, may be of three species,—namely, denial of the existence of the Divine, denial that the Divine has been shown to exist, and denial that it can be known that the Divine exists. The first species has been called *dogmatic atheism*, the second *critical atheism*; and the third has been designated, and may conveniently be designated, *religious agnosticism*. Agnosticism *per se* should not be identified with atheism or with any of its forms. The term antitheism has been used by some theologians, *e.g.*, Chalmers and Foster, as equivalent to dogmatic atheism; but it may with much more practical advantage be employed to denote all systems of belief opposed to theism, either in the generic sense already indicated, or in the specific sense of monotheism. Understood in this latter mode, it is much more comprehensive than the term atheism. Polytheism and pantheism are alike antitheistic theories, although on different grounds; while only those theories which deny that there is evidence for belief even in the existence of any god, any divine being, are atheistic.

Theism ordinarily equivalent to monotheism.

It is somewhat remarkable that the term theism by itself never occurs in its etymological and generic sense, never means as a separate word what it means in the compounds atheism, polytheism, pantheism, and monotheism. Ordinarily it is identified with monotheism, and consequently opposed to polytheism and to pantheism, as well as to atheism. Whereas polytheism acknowledges a plurality of finite gods, theism as monotheism acknowledges only one absolute infinite God. Whereas pantheism regards all finite things as merely aspects, modifications, or parts of one eternal self-existent being—all material objects and all particular minds as necessarily derived from a single infinite substance,—and thus combines, in its conception of the Divine, monism and determinism, theism as monotheism, while accepting monism, rejects determinism, and attributes to the Divine all that is essentially implied in free personal existence and agency. Pantheism is, however, wonderfully protean, and rarely conforms to its ideal; hence the systems called pantheistic are seldom purely pantheistic, and are often more monotheistic than pantheistic.

Theism and deism.

Sometimes the term theism is employed in a still more special sense, namely, to denote one of two kinds of monotheism, the other kind being *deism*. Although *deus* and *theos* are equivalent, deism has come to be distinguished from theism. The former word first appeared in the 16th century, when it was used to designate antitrinitarian opinions. In the 17th century it came to be applied to the view that the light of nature is the only light in which man can know God, no special revelation having been given to the human race. Dr Samuel Clarke, in the Boyle Lectures preached in 1705, distributed deists into four classes. The first class "pretend to believe the existence of an eternal, infinite, independent, intelligent being, and, to avoid the name of Epicurean atheists, teach also that this supreme being made the world; though at the same time they agree with the Epicureans in this, that they fancy God does not at all concern Himself in the government of the world, nor has any regard to, or care of, what is done therein." The second class acknowledge not only that God made all things, but that He sustains and governs them, yet deny that He has any regard in His government to moral distinctions, these being merely the products of human will and law. The third class believe in the being, natural attributes, providence, and to some extent in the moral attributes and government of God, but deny the immortality of the soul and a future state of rewards and punishments. The fourth class acknowledge the being, natural and moral perfections, and providence of God, as also the immortality of the soul and a future state of rewards and punishments, yet profess to believe only what is discoverable by the light of nature, without believing any divine revelation (Clarke, *On the Attributes*, pp. 140–153, ed. 1823). This division is not an exact classification, nor does it rest on any precise definition of deism, but it, with substantial accuracy, discriminates and grades the varieties of English deism. Clarke did not contrast deism with theism, or even employ the latter word. His contemporary, Lord Shaftesbury, on the other hand, generally used the term theism, yet only as synonymous with deism, and with a protest against either being opposed to revelation (*Characteristics*, vol. ii. p. 209, ed. 1727). Kant, in his *Kritik der reinen Vernunft*, explicitly distinguished and opposed deism and theism, but in a very peculiar manner. "The person who believes in a transcendental theology alone is termed a *deist*; he who acknowledges the possibility of a natural theology also, a *theist*. The former admits that we can cognize by pure reason alone the existence of a supreme being, but at the same time maintains that our conception of this being is purely transcendental, and that all that we can say of it is that it possesses all reality, without being able to define it more closely. The second asserts that reason is capable of presenting us, from the analogy of nature, with a more definite conception of this being, and that its operations, as the cause of all things, are the results of intelligence and free will. The former regards the supreme being as *the cause of the world*—whether by the necessity of his nature, or as a free agent, is left undetermined; the latter considers this being as the *author of the world*" (*Werke*, ii. 491, edited by Rosenkranz, Meiklejohn's tr., 387–8). The account here given of deism seems neither self-consistent nor intelligible, and applies, equally well or equally ill, to every system—atheistic, agnostic, pantheistic, idealistic, or materialistic—which admits the existence but not the intelligence or personality of an *Urwesen*, eternal being, or first cause; and the account of theism excludes all reference to revelation, and applies to every form of what has been regarded as deism. In recent theology deism has generally come to be regarded as, in common with theism, holding in opposition to atheism that there is a God, and in opposition to pantheism that God is distinct from the world, but as differing from theism in maintaining that God is separate from the world, having endowed it with self-sustaining and self-acting powers, and then abandoned it to itself. This distinction is real, and perhaps the best attainable. At the same time many called deists must be admitted not to have taught deism thus understood; for example, most of the "English deists" did not deny that God was present and active in the laws of nature, but merely denied that He worked otherwise than through natural laws. If by deism be meant belief in a personal God who acts only through natural laws, and by theism belief in a personal God who acts both through natural laws and by special interventions, this distinction also is real, and may be useful. The chief objection to it is that deism when so contrasted with theism does not denote, or even include, what theologians have generally agreed to call by the name.

The present article will treat specially of theism in the sense of monotheism, but not to the exclusion of the relations between theism thus understood and theism in other acceptations.

Nature of primeval religion.

Monotheism has been very generally assumed to have been the primitive religion. Lord Herbert, Cudworth, and others have elaborately defended this opinion in the past, and it still finds learned advocates. On the other hand, the vast majority of recent anthropologists hold that religion originated in some rude phase of polytheism, and that monotheism has been everywhere preceded by polytheism. Schelling, Max Müller, and Hartmann have maintained that the starting-point of religion was *henotheism*, an imperfect kind of monotheism, in which God was thought of as one, only because others had not yet presented themselves to the mind,—a monotheism of which polytheism was not the contradiction, but the natural development. Pantheism has also been frequently represented to be the earliest phase of religion. All these representations, however, will be found on examination to be very conjectural. The present state of our knowledge does not warrant our holding any view regarding the nature of primeval religion as established. The data which carry us farthest in our search for the historical origin of religion are undoubtedly the names expressive of the Divine which have been preserved in the most ancient languages. They show us how men conceived of the Divinity long before the erection of the oldest monuments or the inscription of the oldest records. Language is much older than any of the statements in language. But language by no means carries us back to primitive man, or even to the historical origin of the idea of deity. The Egyptian word *nutar* and the names of the Egyptian gods found in the oldest Egyptian inscriptions prove that at a date long before the Egyptians wrote history, or are known to have worshipped animals or ancestors, they conceived of Divinity as power, and their deities as great cosmic forces; but, as that word and these names cannot be shown to have belonged to man's primitive speech, they cannot show what was man's primitive religious belief, and do not disprove that the forefathers of the people who first used them may have had some lower and ruder conception of the Divine than that which they convey. There are, according to Dr Legge, no words in the Chinese language known to be older than *ti*, *t'ien*, *shang-ti*, and these words are good historical evidence that the Chinese conceived of the Divine, thousands of years before the Christian era, as a universal ruling power, comprehending the visible heavens, and an invisible, infinite, omnipresent force, manifested in the azure of the firmament, possessed so far of intellectual and moral qualities, and working towards ethical ends. There is no evidence that when the Chinese first used these words they worshipped fetiches, but neither is there evidence to the contrary, and even if there were it would not disprove that the ancestors of the Chinese had passed through an era of fetichism. All members of the Semitic family of languages have the word *El*, or some modification of it, to denote deity, and hence we may conclude that the Semites had the word in this sense before they separated and became distinct peoples, but not that the idea of God originated when the word was first thus employed. All members of the Teutonic group of languages have the word *God*, or some slightly modified form thereof, and all members of the Slavic group of languages have the word *Bog*, or some modification thereof, to express the same conception: it does not follow that either Teutons or Slavs had no idea of deity until the former so applied the word *God*, and the latter so applied the word *Bog*. Both Teutons and Slavs are Aryans, and there is an older Aryan term for deity than either *God* or *Bog*. The Sanscrit *deva*, the Latin *deus*, and the northern *ti*, *tivar*, are forms of a word which must have been used by the Aryans to express their idea of the Divine when, in a prehistoric age, they lived together in their original home; but we are not entitled to infer that even that prehistoric Aryan term is the oldest word for deity. It may not be older than the primitive Semitic word or the primitive Turanian word, or the *nutar* of the Egyptians, or the *t'ien* of the Chinese, or the earliest designations for the Divine in the earliest African and American languages. And there may have been Divine names older than any of these. The science of language has been able to reconstruct in part a prehistoric Aryan language, and may similarly be able to reconstruct a prehistoric Semitic language, a prehistoric Turanian, and perhaps a prehistoric Hamitic language. Should it proceed thus far it will probably perceive that all these prehistoric languages arose out of a still earlier prehistoric language in which also were words expressing ideas of the Divine. There may be many strata of language buried too deep for human excavation in the abysses of unrecorded time. By no pos-

Evidence of language inadequate.

sibility, therefore, can the analysis of existing languages disclose to us the oldest name for deity or the historical origin of the idea of deity. Geology shows the vast antiquity of man, and nothing proves that he may not have been awed or comforted by thoughts of the Divine ages before the invention of the oldest Aryan or Semitic words. It is merest conjecture to assign the formation of the conception of deity to the dawn of historic time. Between primitive speech, primitive religion, the primitive condition of man, and the little streak of light called human history there stretches an immeasurable expanse of darkness.

Evidence of book of Genesis.

The belief in primitive monotheism is generally rested on the authority of the opening chapters of Genesis. It is, however, doubtful if the appeal to them be legitimate, because doubtful if their strict historicity can be proved to those who insist on judging them merely by critical and historical criteria, or even if it can be fairly inferred from the view that they form part of a revelation. Then, although these chapters plainly teach monotheism, and represent the God whose words and acts are recorded in the Bible as no mere national God but the only true God, they do not teach, what is alone in question, that there was a primitive monotheism,—a monotheism revealed and known from the beginning. They give no warrant to the common assumption that God revealed monotheism to Adam, Noah, and others before the flood, and that the traces of monotheistic beliefs and tendencies in heathendom are derivable from the tradition of this primitive and antediluvian monotheism. The one true God is represented in Genesis as making himself known by particular words and in particular ways to Adam, but is nowhere said to have taught him that He only was God. Adam knew, of course, only one God, as there was only one God to know; but that he knew there was only one God we are not told, nor are any grounds given us even for conjecturing that he knew it. We are told that God created the heavens and earth, but not that Adam was told it, and we know too little about Adam to be able to conceive how he could have understood the statement. We are informed that he knew God—the God who manifested himself to him in particular acts, but not what general idea he formed of God—whether henotheistic, pantheistic, or monotheistic, whether definitely exclusive of polytheism or not, or in what measure anthropomorphic. It is not otherwise as regards what is reported of Noah. In fact, primitive monotheism is read into the records in Genesis only because they are read in an inaccurate and uncritical manner. If read aright, it would be seen that, while they speak much of how God acted towards man, they speak so extremely little as to what early man knew of God that the appeal to them on behalf of the hypothesis of primitive monotheism must be futile, even on the traditional view of their authorship and historicity.[1]

Evidence of history. Early religions not monotheistic.

Egyptian religion.

Chinese religion.

It is impossible to prove historically that monotheism was the primitive religion. Were, then, the oldest known historical forms of religion monotheistic? Many maintain they were, but adequate evidence has never been adduced for the opinion. The oldest known religion is probably the Egyptian, and for at least three thousand years its history can be traced by the aid of authentic records contemporary with the facts to which they relate. Its origin, however, is not disclosed by Egyptian history, and was unknown to the Egyptians themselves. When it first appears in the light of history it has already a definite form, a character not rude and simple, but of considerable elevation and subtility, and is complex in contents, having certain great gods, but not so many as in later times, ancestor-worship, but not so developed as in later times, and animal worship, but very little of it as compared with later times. For the opinion that its lower elements were older than the higher there is not a particle of properly historical evidence,—not a trace in the inscriptions of mere propitiation of ancestors, or of belief in the absolute divinity of kings or animals; on the contrary, ancestors are always found propitiated through prayer to some of the great gods, kings worshipped as emanations and images of the sun-god, and the divine animals adored as divine symbols and incarnations. The greater gods mentioned on the oldest tombs and in the oldest writings are comparatively few, and their mere names—Osiris, Horus, Thoth, Seb, Nut, Anubis, Apheru, Ra, Isis, Neith, Apis—conclusively prove that they were not ancient kings or deceased ancestors, but chiefly powers of nature, and especially, although not exclusively, of the heavens; yet from the earliest historical time they were regarded as not merely elemental, but as also ethical powers, working indeed visibly and physically in the aspects and agents of nature, yet in conformity to law and with intelligence and moral purpose. Wherever the powers of nature are thus worshipped as gods, the feeling that the separate powers are not all power, that the particular deities are not the whole of divinity, must be entertained and will find expression. The Egyptians had undoubtedly such a sense of the unity of the Divine from the dawn of their history, and they expressed it so strongly in various ways from a very early period that they have been pronounced monotheists not merely by theologians attached to a traditional dogma but by most eminent Egyptologists—De Rougé, Mariette, Brugsch, and Renouf. As these scholars, however, truthfully present the facts, they satisfactorily refute themselves. A religion with about a dozen great gods—distinct as regards their names, characteristics, histories, relationships, symbols, and worship—is not monotheism in the ordinary or proper sense of the term. A religion in which the Divine is viewed as merely immanent in nature, and the deities deemed physical as well as moral, elemental as well as ethical powers, is rather pantheistic than monotheistic. Further, all assertions to the effect that the unity of the Divine is most emphatically expressed in the earliest historical stages of the religion are contrary to the evidence adduced even by those who make them. To quote Patah-Hotep as a proof of the monotheism of the Egyptian religion in its oldest historical phase is as uncritical as it would be to draw Homeric theology from the dialogues of Plato. The Egyptian religion was a polytheism which implied monism; it was not monotheism, which is exclusive of polytheism. Hence, notwithstanding frequent approximations to monotheism, the general result of the development of its monistic principles was pantheism, not monotheism. As to the ancient Chinese religion, Dr Legge easily shows that Prof. Tiele's description of it as "a purified and organized worship of spirits, with a predominant fetichist tendency," has no historical warrant, but he fails completely to substantiate his own view, namely, that it was a strict and proper monotheism. The names T'ien and Ti afford no evidence that the early Chinese fathers regarded deity as truly and properly spiritual and personal. It is not in the most ancient Chinese writings that spirituality and personality are ascribed to T'ien, and such ascriptions are exceptional in Chinese writings of any date. The great development of ancestor worship in China has been largely due to the impersonal character of T'ien.

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[1] Among works in which the hypothesis of primitive monotheism is supported, the following may be mentioned:—Steuco, *De Perenni Philosophia*, 1540; Herbert, *De Religione Gentilium*, 1645; Gale, *Court of the Gentiles*, 1669–78; Cudworth, *True Intellectual System*, 1678; Bryant, *Ancient Mythology*, 1774–76; Creuzer, *Symbolik u. Mythologie*, 1819–21; De Bonald, *Législation Primitive*, 1819; Lüken, *Traditionen des Menschengeschlechts*, 1856; Gladstone, *Homer and the Homeric Age*, 1860; Ebrard, *Apologetik*, pt. ii., 1876; Zöckler, *Lehre vom Urstand des Menschen*, 1880; Cook, *Origins of Religion and Language*, 1884; Rawlinson, *Early Prevalence of Monotheistic Beliefs* (No. 11 of Present Day Tracts).

Semitic religions.

The arguments which have been adduced in support of the hypothesis of a primitive Semitic monotheism are also insufficient. M. Renan's belief in a monotheistic instinct peculiar to the Semitic race has been so often and so convincingly shown to be contradicted both by history and psychology that another refutation of it might well be regarded as a mere slaying of the slain. Divine names like El, Baal, Adon, and Melech, being the oldest terms in the Semitic languages expressive of the Divinity, and having been retained through all the changes and perversions of Semitic religion, have often been maintained to imply that primitive Semitic belief was monotheistic. But in reality Baal, Melech, and Adon were not names originally, or indeed at any time, given to the one Supreme God, or exclusively to any particular god; on the contrary, they were titles applicable to many different gods.

Aryan religions.

The oldest historical form of Aryan religion—the form in which the Vedas present it—is designated by Max Müller henotheism, in opposition to the organized anthropomorphic polytheism to which he restricts the term polytheism, but henotheism thus understood includes polytheism in its wider and more ordinary acceptation, while it excludes monotheism properly so called. The oldest known form of Aryan religion was indubitably polytheistic in the sense of being the worship of various nature-deities; and everything approximating to monotheism in India, Persia, Greece, and other Aryan-peopled lands was the product of later and more advanced thought. The assertion that history everywhere or even anywhere shows religious belief to have commenced with monotheism is not only unsupported by evidence, but contrary to evidence.[1]

Early religions not mere polytheisms.

While the oldest known religions of the world were thus not forms of monotheism, neither were they mere polytheisms, wholly devoid of monistic and monotheistic germs and tendencies. The Chinese religion, indeed, can hardly be said to have been at any period a polytheism, the Chinese people no more regarding spirits and deceased ancestors as gods than Roman Catholics so regard angels and saints. They have throughout their whole known history explicitly and clearly acknowledged the unity of the Divine—the uniqueness of T'ien (Ti, Shang-Ti). Had they in like manner acknowledged the spirituality, personality, transcendence of the Divine, their monotheism would have been indubitable. Then, even in those ancient religions, where a plurality of deities is apparent, a sense of the unity of the Divine is notwithstanding implied, and in the course of their development comes to expression in various ways. It could not be otherwise, for in these religions the divine powers (deities) are also powers of nature, and hence sprung from and participant in a mysterious common nature, an ultimate and universal agency which is at once the source of physical and divine existences and forces. Neither nature-deities nor powers of nature are ever conceived of, or indeed can be conceived of, as entirely distinct and independent. The lowest forms of polytheism, such as fetichism and animism, have no more marked characteristic than the indefiniteness of their idea of the Divine and the imperfect individualization of their deities. In the highest forms of nature-worship, *e.g.*, the Vedic, Egyptian, and Babylonian-Assyrian, the same trait is perceptible. This implicit monism of nature-worship may, through the action of various causes, come to explicit utterance in diverse modes, and has in fact done so, with the result that even in the oldest known polytheisms are to be found remarkable approximations to monotheism. One form of approximation was henotheism. When worship is ardent and earnest the particular god worshipped is apt to have ascribed to him the attributes, as it were, of all the gods—an almost absolute and exclusive godhead. Max Müller has shown how prominent a phenomenon henotheism is in the Vedas. Page Renouf has shown that it is very conspicuous also in the ancient inscriptions and hymns of Egypt. Horus, Ra, Osiris, Amun, Knum, were severally spoken of as if each were absolute God, invested not only with distinctive divine attributes but with all divine attributes. In the religious records of Babylon and Assyria monotheistic approximations of the same kind are likewise common. Now, in themselves such monotheistic modes of expression may truly be held to be the products of passing moods of mind, not reflexions of permanent conviction. But every mood of mind tends to perpetuate itself, and the enthusiasm of piety which utters itself in henotheistic praises and prayers may take abiding possession of the soul of a powerful ruler or even of the hearts of a whole class of society or of a whole people, and may seem to them to find the strongest possible confirmation in experience. We may illustrate from Assyrian religious history. Tiglath-Pileser showed a marked preference for the worship of Asshur, to him "king of all the gods," "he who rules supreme over the gods." Nebuchadnezzar, again, showed a great partiality for the god Merodach, and applied exclusively to him such magnificent titles as "the lord of all beings," "the lord of the house of the gods," "the lord of lords," "the lord of the gods," "the king of heaven and earth." Nabonidus, on the other hand, specially revered Sin, the moon-god, and represented him as "the great divinity," "the king of gods upon gods," "the chief and king of the gods of heaven and earth." A preference of this kind might arise from some merely accidental or personal cause, and be confirmed by experiences mainly individual, and yet have a vast historical influence. The devotional choice of a people must tend, however, still more than that of any monarch to the elevation of one god towards absolute godhead. It was accordingly what raised Asshur, the special national god of the Assyrians, to the head of the Babylonian-Assyrian pantheon during the Assyrian period. In a struggle of deities for supremacy the national god has an immense advantage in that he has both the piety and the patriotism of the people on his side. His rule is identified with providence; he is credited with all the victories and successes of the nation; and his power and godhead seem certified by fact and experience. The logic of events in every advancing nation combines with the essential tendencies of piety and with the growth of conscience and reason to promote belief in the unity and perfection of the Divine. The general course of providence is no more polytheistic than it is atheistic. The best exemplification of the operation of the piety of an influential class in transcending polytheism is Brahmanism. But for the impulse given by Brahmanical piety Brahmanical speculation would never have reduced the Vedic gods to manifestations of Brahma. Henotheistic forms of approximation to monotheism are not, however, the only ones. Particular gods—all of them—may be dropped out of view, and the generic thought of God alone retained. The mind and heart of the devout may be directed exclusively to the power of the powers, the God in the gods, God simply, the Divinity. The formation of names expressing Divinity in the abstract is an evidence of the existence of such a process, and names of the kind are to be found even among very rude peoples. But there are more obvious and conclusive indications. In one of the most ancient of books, for example, and probably the oldest manuscript in the world, the maxims of Patah-Hotep, a wise Egyptian prince of the fifth dynasty, God simply (*nutar*) is often spoken of without a name or any mythological characteristic, and in a way which is in itself quite monotheistic. "If any one beareth himself proudly he will be humbled by God, who maketh his strength." "If thou art a wise man, bring up thy son in the love of God." "God loveth the obedient, and hateth the disobedient." Sentences like these standing alone would be pronounced by every one monotheistic; and even when standing alongside of references to "gods" and "powers" they show that said gods and powers were not deemed by the Egyptian sage inconsistent with oneness of power and godhead or exhaustive of their fulness. In Babylonian-Assyrian religious history there are also distinct traces of the rise of the spirits of worshippers above particular deities, simply to deity. Sometimes they appear with special clearness in connexions which tell of awakened and afflicted conscience, of the pressure of a sense of sin and guilt forcing on the heart, as it were, a conviction of One with whom it has to deal, of its need of the forgiveness and favour, not of this god or of that, but of God. The following passage may be cited as an instance. "O my Lord, my sins are many, my trespasses are great, and the wrath of the gods has plagued me with disease, and with sickness and sorrow. I fainted, but no one stretched forth his hand! I groaned, but no one heard! O Lord, do not abandon Thy servant; in the waters of the great stream do Thou take his hand; the sins which he has committed do Thou turn to righteousness." Many parallel passages might be drawn from Hindu, Greek, and other sources. Clearness of moral perception is decidedly favourable to monotheistic belief. The practical reason contributes as well as the speculative reason, and precisely in the measure of its healthiness and vigour, to the formation of a true idea of the Divine. It was due more to their moral earnestness and insight than to their intellectual superiority that the Persians came nearer to monotheism than any other people of heathen antiquity. Ahriman was entirely evil, and therefore only to be hated and combated; while Ahuramazd was absolutely divine, perfectly good, and therefore to be supremely worshipped and obeyed. This moral dualism approached more closely to true monotheism than the later speculative monism, which placed above both Ahuramazd and Ahriman Zervanakarene, boundless time, indeterminate being, an ethically indifferent destiny. Finally, reason in striving to understand and explain the world tends towards monotheism. The mind cannot be expected to recognize the unity of God until it recognizes the unity of nature; when it sees nature to be a whole, a universe or cosmos, it cannot but form a conception of it which will be pantheistic, if the unity of substance, law, and evolution be alone acknowledged, and monotheistic if a unity of causality, rational plan, and ethical purpose be also apprehended. In the measure in which reason advances either on the path of scientific investigation or of philosophical speculation, polytheism must retreat and disappear; in the measure in which it discerns unity, order, system, moral government, indications of spiritual character and design in the world, monotheism must rise and spread. Now, in the chief progressive heathen nations reason, it can be proved, has gradually gained on imagination. Hence the polytheisms which they built up in their youth have been undermined and broken down by them in their maturity.[1]

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[1] The view opposed in the above paragraph is that maintained in the following works (as well as those mentioned in the previous note),—De Rougé, *Études sur le Rituel Funéraire*, 1860; Renouf, *Hibbert Lectures*, 1879; Brugsch, *Religion u. Mythologie d. alten Aegypter*, 1884; Legge, *Religion of the Chinese*, 1880; Renan, *Hist. des Langues Sémitiques*, also *Considérations sur le Caractère Gen. des Peuples Semitiques*, and *Nouvelles Considerations*; Pesch, *Der Gottesbegriff in den heidnischen Religionen des Alterthums*, 1886. Among the many replies to Renan, Max Müller's ("Semitic Monotheism," in *Chips*, vol. i.) and Steinthal's (in *Z. V. S. W.*, i.) specially merit to be mentioned.

Mono-theistic moveme in Gree

A monotheistic movement can be clearly traced in ancient Greece. The popular religion of Greece, as it appeared in the Homeric poems, was as distinctly polytheistic and as little monotheistic as any known religion. Its gods were all finite, begotten, and thoroughly individualized beings. The need of unity was responded to only by the supremacy of Zeus, and Zeus was subject to destiny, surrounded by an aristocracy far from orderly or obedient, and participant in weakness, folly, and vice. To its eternal honour the Greek spirit, however, was not content with so inadequate a conception of the Divine, but laboured to amend, enlarge, and elevate it. The poets and dramatists of Greece purified and ennobled the popular myths, and, in particular, so idealized the character and agency of Zeus as to render them accordant with a true conception of the Godhead. The Zeus of Æschylus and of Sophocles was not only not the Zeus of Homer, but was a god belief in whom was inconsistent with belief in any of the Homeric gods. The dramatists of Greece did not assail the popular conception of Divinity, but they substituted for it one which implied that it was without warrant or excuse. They developed the germs of monotheism in the Greek religion, while leaving untouched its polytheistic assumptions and affirmations. These, however, were not only persistently undermined, but often directly attacked by the philosophers, some of whom eventually reached a reasoned knowledge of the one absolute Mind. Xenophanes, Empedocles, and Anaxagoras were among the pre-Socratic philosophers who, on grounds of reason, rejected the polytheism and anthropomorphism of the current mythology, and advocated belief in one all-perfect divine nature. Socrates, although avoiding all attacks on the popular religion calculated to weaken the popular reverence for divine things, had real faith only in the one supreme Reason, the source and end of all things; and the best representatives of later Greek philosophy were in this respect his followers. Plato attained by his dialectic a conception of God which will always deeply interest thoughtful men. God he deemed the highest object of knowledge and love, the source of all being, cognoscibility, truth, excellence, and beauty,—the One, the Good. The controversy as to whether his conception may be more correctly designated theistic or pantheistic will, perhaps, never be brought to a decisive conclusion, but in its general truth and grandeur it must be admitted far to transcend either the monotheism of the vulgar or any popular form of pantheism. Aristotle's characteristic cautiousness of judgment showed itself in the very meagreness of his theology. The representation which he gives of God hardly meets at all the demands of affection and of practical life, yet so far as it goes will be generally regarded as thoroughly reasonable. It is more unequivocally theistic than that of Plato. It sets forth God as without plurality and without parts; free from matter, contingency, change, and development; the eternal unmoved mover, whose essence is pure energy; absolute spirit, self-thinking reason, the *νοήσις νοήσεως*; the one perfect being, whose life is completely blessed, and whose likeness is the goal towards which the whole universe tends. Stoicism was originally and predominantly a materialistic or hylozoic form of pantheism; but some of its greatest representatives conceived of God in a decidedly theistic manner as the supreme moral reason. The beautiful hymn of Cleanthes to Zeus is full of the purest devotional feeling, springing from a clear sense of personal relationship to the one all-ruling personal Spirit. Greek philosophy proceeded throughout its whole course in entire independence of the popular polytheism, and was a continuous demonstration of its futility; and it largely contributed to that reasoned natural knowledge of God which must underlie all rational belief in revelation. It discerned in some measure all the chief arguments which have since been employed as theistic proofs. It failed, however, to conceive of God as truly creative, or of the universe as in its very substance the result of divine action; it failed also to make evident, even to cultured minds, the superiority of monotheism to pantheism and scepticism; and it failed especially to convert the common people to faith in one sole Deity.[1]

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[1] The best literature relating to the subject of the preceding paragraph is indicated in the lists of books given in connexion with the relevant sections in Tiele's *Outlines of the History of Religion*, and particularly in the French translation by M. Vernes. Hegel's *Philosophy of Religion*, Bunsen's *God in History*, Freeman Clarke's *Ten Great Religions*, the St Giles *Lectures on the Faiths of the World*, still more the series of *Sacred Books of the East*, and of ancient texts published under the title of *Records of the Past*, and the volumes of the *Rev. de l'Hist. des Religions*, will be found useful to those wishing to make a survey of heathen thought regarding God so far as it approximated to the theistic idea. For the conceptions of the Divine entertained by non-civilized peoples, see especially Waitz's *Anthropologie*, and Réville's *Religions des Non-Civilisés*, who both give extensive lists of literature.

Israel presents us with the first example of a monotheistic nation. The controversies as to how Israel acquired this pre-eminence can only be decided by critical and historical investigations into which we cannot here enter (see ISRAEL).

The science of Old Testament theology, giving due heed to the results of critical, historical, and exegetical research regarding the documents with which it deals, has to trace by what means and through what stages Hebrew monotheism was developed and established; and to the treatises on this science our readers must be referred. The monotheistic movement in Israel was one of continuous progress through incessant conflict until a result was reached of incalculable value to humanity. That result was a faith in God singularly comprehensive, sublime, and practical,—a faith which rested, not on speculation and reasoning, but on a conviction of God having directly revealed Himself to the spirits of men, and which, while ignoring metaphysical theorizing, ascribed to God all metaphysical as well as moral perfections; a faith which, in spite of its simplicity, so apprehended the relationship of God to nature as neither to confound them like pantheism nor to separate them like deism, but to assert both the immanence and the transcendence of the divine; a faith in a living and personal God, the almighty and sole creator, preserver, and ruler of the world; a faith, especially, in a God holy in all His ways and righteous in all His works, who was directing and guiding human affairs to a destination worthy of His own character; and, therefore, an essentially ethical, elevating, and hopeful faith. The existence of utterances in the Hebrew Scriptures which show that Hebrew faith was not always thus enlightened, and sometimes conceived of God as partial and cruel, is no reason for not acknowledging the general justice and grandeur of its representation of the Supreme.[2]

The God of the Old Testament is also the God of the New. Christ and the apostles accepted what Moses and the prophets had taught concerning God; they assigned to Him no other attributes than had already been assigned to Him. Like Moses and the prophets also they made no attempt formally to prove the existence or logically to define the nature of God, but spoke of Him either as from vision or inspiration. And yet their doctrine of God has original and peculiar features. Thus, first, the fatherhood of God was taught with incomparable distinctness and fulness by Jesus Christ,—a fatherhood not merely of natural creation or national election, but of spiritual relationship of love, sympathy, mercy, and grace for individual souls. Such fatherhood, if acknowledged at all, was only very rarely and vaguely acknowledged in heathendom, and, although not wholly absent from the Old Testament, is far from clearly and prominently there, and, indeed, is present chiefly by implication in passages which refer directly only to God's connexion with the people of Israel, as an elect and covenant people; it is conspicuous and central, however, in the conception of God introduced by Christianity. Secondly, Divine fatherhood had its correlate in Divine sonship. God is represented in the New Testament as revealing His fatherhood through His Son, Jesus Christ. In Old Testament representations of Israel, the Messiah, and Wisdom, and in the Logos doctrine of Judæo-Alexandrian philosophy, some approximations to this conception of the Divine may be traced, but they fell far short of it. According to the New Testament, God is not merely infinitely exalted above the world and definitely distinguished therefrom, nor merely immanent and everywhere operative in nature, but also incarnate in Christ; and Christ is not merely "the Son of man," essentially sharing in humanity and truly representing it before God, but also "the Son of God," essentially sharing in Divinity, and giving the fullest disclosure of it to man. The foundation of the Christian faith as laid down in the New Testament is that Christ through His unique relation as Son to the Father perfectly declared and expressed the nature and will of God in relation to human salvation. Thirdly, God is exhibited in the New Testament as the Spirit, the Holy Ghost, who dwells in the spirits of men, to work in them the will of the Father, and to conform them to the image of the Son. Only when thus exhibited can the revelation of the Divine name be regarded from the New Testament point of view as other than manifestly incomplete. Even the manifestation of God in Christ, being objective and single, must be supplemented by a manifestation which is subjective and multiple, before the one God, the one Christ, can find a place in the manifoldness of souls, the multitude of separate hearts and lives. The manifestation of the Spirit is such a manifestation, and completes in principle the revelation of the Christian idea of God, the revelation of His threefold nature and name. This revelation completed God can be thought of as absolute spirit, absolute love, absolute good, and was, to some extent explicitly, and throughout implicitly, so represented in the New Testament. It is precisely in virtue of the threefold representation of God characteristic of the New Testament that Christianity is still held by so many of the world's profoundest thinkers as the absolute and perfect religion, the crown and consummation of religion,—speculatively considered, an absolute revelation of God, and practically considered, a perfect salvation,—within which there may be infinite evolution and progress, but beyond which there can be no true light or real growth.[3]

Doctrine of the Trinity.

The threefold representation of God in the New Testament was an entirely religious and practical representation, inseparably connected with the historical facts of

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[1] See Zeller, *Die Entwickelung des Monotheismus bei den Griechen* (in *Vorträge*, vol. i.); and Cocker, *Christianity and Greek Philosophy*, 1875; also, Meiners, *Historia Doctrinæ de Vero Deo*, 1780.

[2] See the *O. T. Theologies* of Oehler, Schultz, Kayser, Piepenbring, &c.; Ewald, *Lehre der Bibel von Gott*; Baudissen, *Stud. z. Semit. Religionsgeschichte*; Kuenen, *Hibbert Lecture*; Duhm, *Theologie d. Propheten*; W. Robertson Smith, *Prophets of Israel*, &c.. As to the name "Jahveh," an instructive summary and examination of views is given by Prof. Driver in his article "Recent Theories on the Origin and Nature of the Tetragrammaton," in *Studia Biblica*, Oxford, 1885.

[3] The New Testament representation of God is treated of in the *New Testament Theologies* of Schmid, Reuss, Oosterzee, and Weiss; also in Wittichen, *Die Idee Gottes*, 1865.

Christ's life and the spiritual experiences of the early Christians. It was not an ontological or even theological doctrine, and will be identified by no competent exegete with the dogma of the Divine Trinity set forth in the œcumenical creeds. The propositions constitutive of the dogma of the Trinity—the propositions in the symbols of Nice, Constantinople, and Toledo relative to the immanent distinctions and relations in the Godhead—were not drawn directly from the New Testament, and could not be expressed in New Testament terms. They were the products of reason speculating on a revelation to faith—the New Testament representation of God as a father, a redeemer, and a sanctifier—with a view to conserve and vindicate, explain and comprehend it. They were only formed through centuries of effort, only elaborated by the aid of the conceptions and formulated in the terms of Greek and Roman metaphysics. The evolution of the doctrine of the Trinity was far the most important fact in the doctrinal history of the church during the first five centuries of its post-apostolic existence. To trace and describe it fully would be almost to exhibit the history of Christian thought during these centuries. It had necessarily an immense influence on the development of theism. The acceptance of the catholic doctrine of the Trinity implied the rejection of pantheism, of abstract monotheism, of all forms of monarchianism or unitarianism. It decided that theistic development was not to be on these lines or in these directions. At the same time the dogma itself was a seed for new growths of theistic thought, and demanded a development consistent with its own nature. It is a doctrine, not as to the manifestations and revelations of Godhead, but as to their ground and explanation, the constitution of Godhead, a doctrine as to a trinity of essence, which accounts for the Trinity of the gospel dispensation. It affirms the unity of God, but requires us to conceive of His unity, not as an abstract or indeterminate self-identity, not as "sterile, monotonous simplicity," but as a unity rich in distinctions and perfections,—the unity of an infinite fulness of life and love, the unity of a Godhead in which there are Father, Son, and Holy Spirit, a trinity of persons, a diversity of properties, a variety of offices, a multiplicity of operations, yet sameness of nature, equality of power and glory, oneness in purpose and affection, harmony of will and work. It finds its dogmatic expression as to what is ultimate in it in the formula—One substance in three persons, of which the first eternally generates the second, and the third eternally proceeds from the first and second. Now, manifestly, however much such a doctrine as this may have satisfied thought on a revelation as to the Godhead, it cannot have exhausted or completed it. If it answered certain questions it raised others, and these more speculative and profound than those which had been answered. What is meant by affirming God to be "substance" or "in three persons"? What is meant by divine "generation" or "procession"? How are the substance and persons related? How are the persons distinguished and interrelated? These and many kindred and connected questions reason became bound to discuss by its adoption of the doctrine of the Trinity. This obligation could only be temporarily and partially evaded or concealed by representing the doctrine as "a mystery" to be accepted simply on authority or with blind faith. Data of the doctrine may have been given to faith, but the doctrine itself was the work of reason, and on no ground not plainly absurd could that work be held to have terminated in 589 A.D. As soon as an inspired record is left at all, as soon as any speculation is allowed on its contents, as soon as the process of forming doctrine is permitted to begin, all conceivable right to stop the movement anywhere is lost. By the blending, however, of trinitarianism with theism the whole character of the latter was, of necessity, profoundly changed. A trinitarian theism must be vastly different from a unitarian as regards practice. It must be equally so as regards theory. It must be far more speculative. By its very nature it is bound to undertake speculative labours in which a simply unitarian theism will feel no call to engage.[1]

Theism in patristic writers.

It was the general conviction of the early Christian writers that formal proofs of the Divine existence were neither necessary nor useful. In their view the idea of God was native to the soul, the knowledge of God intuitive, the mind of man a mirror in which, if not rusted by sin, God could not fail to be reflected. The design argument, however, came early into use and was frequently employed. More speculative modes of reasoning were resorted to by Dionysius of Tarsus, Augustine, and Boetius. The unity of God had to be incessantly affirmed against polytheists, Gnostics, and Manichæans. The incomprehensibility of God and His cognoscibility were both maintained, although each was sometimes so emphasized as to seem to obscure the other. That the knowledge of God may be reached by the three ways of *causality*, *negation*, and *eminence* was implied by the pseudo-Dionysius, although only explicitly announced by Scotus. Neither any systematic treatment of the Divine attributes nor any elaborate discussion of single attributes was attempted. The hypothesis of eternal creation found a vigorous defender in Origen, but met with the same fate as the dualist hypothesis of uncreated matter and the pantheistic hypothesis of emanation. Of all the patristic theologians Augustine was undoubtedly the most philosophical apologist and exponent of theism. He alone attempted to refute agnosticism, and to find a basis for the knowledge of God in a doctrine of cognition in general. On the large, difficult, and as yet far from adequately investigated subject, the influence of Platonic and Aristotelian, Stoic and Academic, Neopythagorean and Neoplatonic speculation on the formation of the Christian *doctrina de Deo*, it is, of course, impossible here to enter.[2]

Mohammedanism.

Mohammed (570–632) founded a monotheistic religion which spread with amazing rapidity through Arabia, Syria, Persia, North Africa, and Spain, and gave, almost wherever it spread, a mighty impulse to the minds and wills of men. It was received as the gift of special inspiration and revelation, although its creed contained little of moment on which reason would seem to be incompetent to decide. It had obvious merits, and must be admitted to have rendered real and important services to culture, religion, and humanity, but had also conspicuous faults, which have done much injury to individual, domestic, and national life. If the latest were always the best, it would be the most perfect of the three great theistic religions of the world; but it is, in fact, the least developed and most defective. Instead of evolving and extending, it marred and mutilated the theistic idea which it borrowed. Instead of representing God as possessed of all spiritual fulness and perfections, it exhibited Him as devoid of the divinest spiritual attributes. It recognized His transcendent exaltation above His creatures, but not His sympathetic presence with His creatures; apprehended vividly His almighty power, His eternity, His omnipresence and omniscience, but only vaguely and dimly His moral glory, His love and goodness, His righteousness and holiness. The Allah of Mohammed was essentially despotic will, and so fell far below the Jahveh of Moses, essentially righteousness, and the Heavenly Father of Christ, essentially holy love. Mohammedanism is almost as contrary to Christianity as one form of theism can be to another. It is as unitarian as Christianity is trinitarian. Its cardinal tenet is as distinctly anti-trinitarian as anti-polytheistic. It has often been represented as having had the providential task assigned it of preparing the way for Christianity by destroying polytheism; in reality, it has hitherto offered a far more stubborn resistance to Christianity than any polytheistic religion has done.[1]

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[1] Baur, *Ch. Lehre v. d. Dreieinigkeit*, &c., 1841–43; Meier, *Lehre v. d. Trinität in hist. Entwickl.*, 1844.

[2] Roesler, *Philosophia Veteris Eccl. de Deo*, 1782; and the histories of Christian doctrine by Hagenbach, Neander, Shedd, Bonifas, Sheldon, Harnack, &c.; Gangauf, *Des h. Augustinus speculative Lehre von Gott*, 1884.

Mediæval theology.

The mediæval world was so complex, so full of contrasts and contradictions, that it cannot be "summed up in a formula." Most general statements current regarding it will be found on examination only partially true. It is often described as the age in which external religious authority ruled, and all religious thought ran in narrow, strictly prescribed paths, whereas, in fact, the mediæval theologians were far freer to speculate on almost all points of religious doctrine than Protestant divines have been. Because traditionalism abounded, it is forgotten that rationalism also abounded; because scholasticism flourished, that mysticism was prevalent; because theism was common, that pantheism, speculative and practical, was not uncommon. The Middle Age was, however, *par excellence*, the age of theology. Theology never before or since so interested and dominated the human intellect. Nearly every eminent mediæval thinker was a theologian. The chief streams of theistic belief and speculation which traversed the Middle Age were three,—the Christian, Jewish, and Mohammedan. The first was much the broadest and fullest. Few points of theistic doctrine were left unhandled by the Christian divines of the Middle Age. The conclusions came to on the chief points were various and divergent. As to the manner in which God is known, for instance, some laid stress on faith or authoritative revelation; others on immediate consciousness, the direct vision of the pure in heart, the illumination of the Spirit of God in the minds and hearts of the true children of God; others on reason and proof; and some attempted mediation and synthesis. Anselm gave logical form to an *a priori* argument for the Divine existence based on the idea of God as a being than whom a greater cannot be conceived. His most ingenious attempt to demonstrate the absurdity of supposing the perfect, the infinite, to be a mere subjective fiction prepared the way for the multitude of attempts, identical or similar in aim, which have since been made. Thomas Aquinas was the best representative of those who held that the invisible God was only to be known through His visible works. He argued from motion to a mover, from effect to cause, from the contingent to the necessary, from lower kinds of good to a supreme good, and from order and purpose in the world to a governing intelligence. Raymond of Sebonde added to the ontological and physico-teleological arguments a moral argument. William of Occam criticized keenly and unfavourably both the *a priori* and *a posteriori* proofs, and held that the existence of God was not a known truth but merely an article of faith. There was not less diversity of view as to how far God may be known. Erigena held that even God Himself could not comprehend His own nature, and Eckhart that the nature of God is necessarily unknowable, as being a nature without nature, without predicates, without opposites, pure oneness. That man cannot know God's real nature, cannot know Him *per essentiam*, cannot have a *quidditiva cognitio Dei*, and that the so-called attributes of God are only descriptive of the effects of His operations as they appear to the human mind, or even are merely symbols or metaphors, was maintained by many of the scholastic doctors. Aquinas, for example, with all his confidence as a dogmatic system-builder, so denied the cognoscibility of God. That the human mind may have a true, although it cannot have a perfect knowledge of God,—an apprehensive but not a comprehensive knowledge of Him,—was, however, in the Middle Age, as it has been ever since, the position most commonly taken up. The scholastic divines discussed a multitude of foolish questions regarding God, but that was not due to extravagant faith in the power of the human mind to know or comprehend God. Prof. Sheldon very justly says, "on the whole, the scholastic theology, notwithstanding some strong negative statements, assumes in reality a minimum of acquaintanceship with the essential nature of God." The negative statements are, for the most part, those of the mystics with respect to the beatific vision. Mediæval discussions as to the nature of God turned chiefly on two points,—the relation of the Divine essence to the Divine attributes and of the one Divine substance to the three Divine persons. The conclusion come to by the vast majority of scholastic theologians on the first point was that the attributes were not really or objectively in God, but merely human representations reflected, as it were, on the idea of God, because the mental constitution of man is what it is, and because God wished to be thought of in certain divers manners. To hold them objectively real in God, and therefore intrinsically distinct either from the essence of God or from one another, was considered to be incompatible both with the incomprehensibility and with the absolute simplicity of the Divine nature. Duns Scotus, in maintaining that the attributes were *formalitates realiter distinctæ*, took up an exceptional position. On the other point the conclusion as generally reached was one seemingly quite inconsistent with the foregoing, namely, that the persons were objectively and eternally real and distinct. The discrepancy is especially apparent in those theologians (*e.g.*, Anselm, Abelard, Hugo and Richard of St Victor, Alexander of Hales, and Aquinas) who represented the persons of the Trinity as corresponding to distinctions among the very attributes which they in another reference denied to be distinct. The mediæval schoolmen, with very few and doubtful exceptions, conjoined with their theism the doctrine of the Trinity as defined by the ancient church. Roscelin of Compiègne and Gilbert de la Porrée laid themselves open to the charge of tritheism; and obviously nominalism, by allowing nothing but a nominal existence to the essence or general nature of which the individual is a specimen, tended towards tritheism,—towards resolving the Trinity into a triad of Divine individuals or self-subsistent beings, connected only by a common specific character. While the schoolmen accepted the doctrine of the Trinity on authority, they did not conceive themselves precluded from endeavouring to illustrate it and to make it appear as consonant to reason as possible. They sought to show its consistency with the unity of God, and its general reasonableness by various speculative considerations, but especially by the aid of analogies drawn from the constitution of the mind and even from particular physical phenomena. They did not suppose that they were thereby demonstrating the doctrine of the Trinity: they fully recognized that doctrine to be the indication of a mystery, "dark with excess of light," and the truth of which could only be directly apprehended in the beatific vision conferred by the highest and most special grace; but they proceeded on the belief that, inasmuch as it was a central truth of revelation, the whole creation, and above all, the nature and essence of man's spirit, must bear witness to it. At least one good result followed. Those who exercised their minds on the doctrine of the Trinity were necessarily led in some measure to form another idea of God than that of either an indeterminate unity or a confused synthesis of attributes,—to think of Him, with some clearness and steadiness, in an organic and harmonious manner, as absolute being, absolute life, absolute spirit, absolute intelligence, absolute love. Such thought as this distinctly appeared in Anselm, the St Victors, Aquinas, Bonaventura, Dante, &c. The omnipresence, omnipotence, and omniscience of God, and, generally, what are called His metaphysical and intellectual attributes, were discussed with excessive elaborateness and subtlety, while His moral attributes were left in the background, or considered without sufficient earnestness or insight. The problems regarding the relationship of the Divine attributes to human agency, and, in particular, as to the compatibility of Divine prescience and predestination with human freedom and responsibility, were even too laboriously and minutely debated between the mediæval Augustinians and their opponents. What the disputants on both sides lacked was intellectual humility. They strode along "dim and perilous ways" as if they were in plain and safe paths, or as if their own faculties were superhuman. As to the general relation of God to the universe, few, if any, of the schoolmen can be charged with deism. While assigning to God a being and life transcending the universe, they also affirmed that He was everywhere in the universe, everywhere wholly present, everywhere essentially and actively present. Pantheism was prevalent all through the Middle Ages, but only two of its representatives, perhaps—Erigena and Eckhart,—showed much speculative capacity.[1]

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[1] See MOHAMMEDANISM, and authorities there mentioned; also Kuenen, *Hibbert Lectures*, lect. 1, with authors and works there indicated.

Mohammedan theism.

Mohammedan theism drew chiefly from faith and fanaticism the force which carried it onwards with such rapidity in its early career of conquest. At the same time it powerfully stimulated reason, as soon appeared in remarkable intellectual achievements. Of course, reason could not fail to reflect on the contents of the faith by which it had been awakened. The result was the formation of many schools of religious opinion. So far as our subject is concerned, however, all mediæval Mohammedan thinkers may be ranked as philosophers, theologians, or mystics. The philosophers derived little of their doctrine from Mohammed. Even in what they taught regarding God they followed mainly Aristotle, and in some measure the Neoplatonists. They maintained the unity of God, but conceived of it in a way unknown to Mohammed, namely, as a unity allowing of the reality of no distinctions, qualities, or attributes in God. Then, although they affirmed the unity of God in the strictest abstract manner, they were not monists but dualists, inasmuch as they denied creation *ex nihilo*, and asserted the eternity of matter. The mode in which they supposed the multiplicity of finite things to have been produced from God was by a series of emanations originating in Divine intelligence, not in Divine will. Their proofs of the Divine existence were, for the most part, founded on the principle of causality. The philosophers did not openly oppose the theism of the Koran, but they ignored it or set it aside, and represented it as only a useful popular faith, not a response to the demands of cultured reason. The "theologians," on the other hand, took their stand upon the Koran, sought to defend and develop into doctrine its representations of God, and to show the inconclusiveness and inconsistencies of the teaching of the philosophers regarding God. Even those of them, however, who exalted faith and revelation most—the orthodox Motakallemin or Asharites—by no means dispensed with philosophy and reason. It was chiefly on the metaphysical hypothesis of the atomic constitution of matter that they rested their proofs of the Divine existence. It was by subtle reasonings that they sought to establish the non-eternity of matter and the unity and immateriality of God. It was on speculative grounds that they contended God had eternally possessed all the attributes ascribed to Him in the Koran. Their predestinationism was as logically elaborated as that of the Augustinian scholastics. There flourished for a short period a school of liberal Mohammedan theologians, the Motazilites, who, while accepting the two fundamental doctrines of Islam—the unity of God and the divine mission of Mohammed,—refused to regard the Koran as an absolute religious authority, and sought to transform Mohammedanism into a reasonable and ethical monotheism. They insisted on the rightful conformity of faith to reason, on human freedom, and on the righteousness as well as the unity of God. They endeavoured, in fact, to substitute for a God whose essence was absolute or arbitrary will a God whose essence was justice. This meant, however, not to develop or even reform, but to subvert and displace the Mohammedan idea of God, and the wonder is, not that they failed in so arduous a task, but that they had the courage to undertake it. Mohammedan mysticism (Sufism) was a reaction, chiefly of the Persian mind, against the narrowness and harshness of the monotheism of the Arabian prophet. Unlike philosophy, it was not a mere exotic, but an indigenous growth within the Mohammedan area, and hence orthodoxy has never been able to eradicate it. It has been the chief support of spiritual feeling and the chief source of poetry in Mohammedan lands. It still flourishes, has branches innumerable, and through its poets has shed seed widely even over Christendom. The mystics refuse to think of God as an arbitrary unlimited Will, separate and apart from everything; as one who reveals Himself clearly only through the words of a prophet; as a being before whom man is mere dust and ashes, and who demands no higher service than fear, unquestioning faith, and outward obedience. In their view God is immanent in all things, expresses Himself through all things, and is the essence of every human soul. There is not only no God but God, but no being, life, or spirit except the being, life, and spirit of God; and every man may be God's prophet, and more even than His prophet. For a man to know God is to see that God is immanent in himself, and that he is one with God, the universal life which breathes through all things. Such knowledge or vision must glorify all nature, and must dilate and rejoice the heart of him who possesses it. Joy and ecstacy must characterize the worship of the Sufi. A religious scepticism based on philosophical scepticism—disbelief in the existence of God grounded on disbelief in any truth not guaranteed by sense or mathematical demonstration—was not unknown among the Saracens, although no work in defence of it has come down to us, and perhaps none may have been written.

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[1] For the history of mediæval theism may be consulted the histories of philosophy by Tennemann, Ritter, Erdmann, &c.; the special histories of mediæval philosophy by Stockl and Haureau, and of later scholasticism by K. Werner; the histories of the Trinity and of Christian doctrine already mentioned; and a multitude of monographs, *e.g.*, those of Christlieb, Huber, and Stockl on Erigena; of Hasse, Remusat, Bouchitté on Anselm or his ontological argument; Delitzsch's *Kritische Darstellung der Gotteslehre des Thomas Aquinas*; Ritschl's "Gesch. Studien z. ch. Lehre von Gott," in *Jahresb. f. deutsche Theol.*, x., referring chiefly to Aquinas and Scotus, &c. Mediæval mysticism has found in Schmidt, Lasson, Preger, Jundt, admirable historians. On Eckhart there are good works by Martensen, Lasson, and others; see also a paper by Prof. Pearson in *Mind*, No. xli. On mediæval predestinarianism consult chapter in Mozley's *Treatise on the Augustinian Doctrine of Predestination*. The keenest hostile criticism of mediæval theism is that of Pasquale D'Ercole, *Il Teismo Filosofico Christiano*, 1884.

In Algazel philosophical scepticism was combined with religious dogmatism and mysticism. He subjected the doctrines of the philosophers to a keen and hostile criticism, and maintained that reason was incompetent to reach the knowledge of God, yet cherished an ardent and exalted faith in God, based partly on the Koran and partly on mystic contemplation and devout experience.[1]

Theism of later Judaism.

Jewish and Mohammedan religious thought were intimately connected in the Middle Age, and ran a nearly parallel course. The Rabbanites and the Karaites of Judaism corresponded to the orthodox and the Motazilites of Mohammedanism. In their theism there was no new feature or peculiar significance. Jewish theosophic mysticism found expression in the Kabbalah. The idea of God there presented was at once excessively abstract and excessively fanciful. It must be studied, however, in the original source or in special works. The Jewish philosophers differed little from the Arabian philosophers in their teaching regarding the evidences of the Divine existence, the nature and consequences of the Divine unity, and the meaning of the Divine attributes. At the same time, they, with a few exceptions, affirmed the non-eternity of matter, and did not, like the Arabian Aristotelians, represent providence as merely general. They maintained strongly the transcendence of God and the impossibility of the human mind forming any positive conception of His essential being. They held that He was known as necessarily existent, but also as in Himself necessarily unknowable. Their view of the unity of God led them to an idea of God which may not unjustly be designated agnostic, and which prevented their regarding either nature or Scripture as a revelation of what God really is. Almost alone among eminent Jewish writers of the Middle Age, Jehuda Halevi contended that the representation of God given in the revelation to Israel was self-evidencing, independent of the support of philosophy, and unattainable in any speculative way. The function of reason was, in his view, not to sit in judgment on what had been delivered regarding God to the Jews, but to repel the objections which philosophy had brought against it, and to show the inadequacy of the results reached by unaided human intelligence. Maimonides undertook to establish that reason and faith, science and revelation, were at one in what they affirmed regarding God, but in order to make out his thesis he sacrificed the literal sense of Scripture whenever it did not accord with the tenets of his philosophy, and substituted for the representation of God given through Moses and the prophets one very different in character. His idea of God is highly abstract and metaphysical,—the idea of a being so unlike every other being that no name or predicate whatever when applied to Him can bear its ordinary, or indeed any intelligible meaning. Existence, eternity, unity, power, wisdom, justice, and other attributes, are not in Him what they are in any other being or even analogous in Him to what they are in any other being.[2]

Renaissance period.

In Christian Europe the human mind took a fresh start at the epoch of the Renaissance. It revolted against the authorities to which it had long been submissive, and exercised private judgment with a confidence uncorrected and unmoderated by experience. It turned with ardour to the free discussion of the greatest theme of thought, and probably at no period of history has there been more individual diversity of opinion on that theme. God and His relation to the universe were treated of from a multitude of points of view. Scepticism, naturalism, and pantheism appeared in various forms; all ancient systems of thought as to the Supreme Being found advocates; all modern theories as to the nature of the Divine were in some measure anticipated. Did our limits permit it would not be uninteresting to expound the speculations concerning Deity of several of the writers of the Renaissance,—and especially, perhaps, of these three—Nicolaus of Cusa, Giordano Bruno, and Thomas Campanella. The theosophic mysticism of the period was a preparation for the Reformation.[3]

The fusion of theology and philosophy was the distinctive feature of mediæval Christendom; their separation has been a marked characteristic of modern Christendom. Even when both have been occupied with religious inquiries and thoughts of God they have kept apart; they have often co-operated, but seldom commingled. Theology has been on the whole cleric, and comparatively conservative; philosophy has been on the whole laic, and comparatively progressive. But for theology holding fast to what had been handed down as truth regarding God there must have been little continuity or consistency in the development of religious convictions; but for philosophy restlessly seeking ever more light there would have been little growth or increase of knowledge of the Divine.

The Reformation.

The Reformers held that there was a knowledge of God naturally planted in the human mind, and also derivable from observation of the constitution and government of the world, but that this knowledge was so marred and corrupted by ignorance and sin as to require to be confirmed and supplemented by the far clearer and fuller light of the special revelation in the Scriptures. They were deeply sensible of the evils which had arisen from the over-speculation of the scholastic divines on the nature of God, and were under the impression that it would have been well if men had been content to accept the statements of Scripture on the subject with simple and unhesitating faith. Luther wished theology to begin at once with Jesus Christ. Melanchthon said, "There is no reason why we should devote ourselves much to these most lofty subjects, the doctrine of God, of the unity of God, of the Trinity of God"; and in the early editions of his *Loci Communes* he entered into no discussion of these themes. Zwingli in his *De Vera et Falsa Religione* and even Calvin in his *Institutio Religionis Christianæ* delineated the *doctrina de Deo* only in outline and general features. In the confessions of the churches of the Reformation nothing which the ancient church had œcumenically determined as regards that doctrine was rejected, and nothing new was added thereto. It soon became apparent, however, that the mind would by no means confine its thoughts of God within the limits which the Reformers believed to be alone legitimate and safe. The idea of God is so central in religion that it must affect and be affected by every change of thought on any religious theme. The many and violent controversies within Protestantism all reacted on the doctrine relative to Deity, causing it to be studied with intense energy, but in a manner and spirit very unfavourable, on the whole, to truth and piety. Every new dispute elicited more abstruse conclusions and more subtle definitions. In the disputations of orthodox divines of the 17th and 18th centuries as to the nature, the attributes, the decrees, and the operations of God, we see scholasticism with all its peculiarities reintroduced and often exaggerated. Yet Protestant theism was in various respects an advance on that of the doctors of mediæval scholasticism. The protest of the Reformers against the faults of the scholastic treatment regarding God did not lose its pertinency or value because their own followers fell into these very faults. If the subsequent history plainly showed that the doctrine could not have been so fixedly and exhaustively determined by the ancient church as the Reformers supposed, it also showed that the scholastic treatment of the doctrine had been justly condemned by them, and that speculation regarding God when not rooted in spiritual experience must necessarily be unfruitful. The scholasticism of Protestantism was in essential contradiction to the genius and aim of Protestantism. Then, in the Protestant doctrine of God more prominence was given than had previously been done to His manifestation in redemption, to the relation of His character towards sin, and, in particular, to the attribute of justice. The strong emphasis laid on the righteousness of God marked a distinct ethical advance. At the same time the idea of God in the older Protestant theology was far from ethically complete. His fatherhood was strangely ignored or most defectively apprehended. Absolute sovereignty had assigned to it the place which should have been given to holy love, and was often conceived of in an unethical manner. Further, whereas among mediæval theologians it was the rule and not the exception, among Protestant divines it was the rare exception and not the rule, to affirm God to be unknowable. They asserted merely His incomprehensibility and man's limited knowledge of His perfections. They did not in general, however, abandon, at least explicitly, the premiss from which mediæval theologians inferred the Divine incognoscibility, namely, that the absolute simplicity of the Divine essence was incompatible with the existence of distinctions therein.[1]

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[1] Schahrastani's *Geschichte der religiösen u. philosophischen Secten bei den Arabern*, Germ. trans. by Haarbrucker, 1850-51; Wüstenfeld, *Die Akademie der Araber u. ihre Lehrer*, 1837; Schmölders, *Essai sur les Écoles Philosophiques chez les Arabes*, 1842; Munk, *Mélanges de Philosophie Juive et Arabe*, 1859; Steiner, *Die Mutaziliten oder Freidenker im Islam*, 1865; Renan, *Averroès et L'Averroïsme*, 1852, &c. On Eastern mysticism, see Tholuck, *Ssufismus s. Theosophia Persarum Pantheistica*, 1821, and *Blüthensammlung aus der morgenländischen Mystik*, 1825; Cowell, "Persian Literature," in *Oxford Essays* for 1855; Palmer, *Oriental Mysticism*, 1867; Redhouse, *The Mesnevi of Jelalu-d-Din*, 1881 *sq.*; Vaughan, in *Hours with the Mystics*, treats of the Oriental as well as Christian mystics. For Persian mysticism in its latest forms, see De Gobineau, *Religions et Philosophie dans l'Asie Centrale*, 1866. On Algazel, see Gosche, "Ueber Ghazzâlis Leben u. Werke," in *Abhand. (philol. u. hist.) d. k. Akad. d. Wiss. z. Berlin*, 1858.

[2] Munk, *Esquisse Historique de la Philosophie chez les Juifs*, 1849; Eisler, *Vorlesungen über die jüdischen Philosophen des Mittelalters*, 1870, 1876; Joel, *Beiträge z. Gesch. d. Philosophie*, 1876. On the Kabbalah, see Franck and Ginsburg. Kaufmann, *Geschichte der Attributenlehre in der jüdischen Religionsphilosophie des Mittelalters*, 1877; Friedlander, *Guide of the Perplexed of Maimonides*, 3 vols., 1885.

[3] M. Carrière's *Philosophische Weltanschauung der Reformationszeit*, 1887; Punjer's *Religionsphilosophie*, i. 51-59, 69-75, 76-80; Bobbe's *Conoscenza di Dio*, iii. 1-90.

Anti-trinitarianism.

Difference of opinion as to the relation of reason to Scripture was in the Protestant world one of the chief causes of difference of belief as to God. Assaults on trinitarianism were contemporary with the Reformation, and they proceeded more on the conviction that the doctrine of the Trinity was unreasonable than that it was unscriptural. The founder of Socinianism, indeed, not only fully accepted the authority of Scripture, but went so far as to represent it as the source of all religious truth, even of the primary truths of natural religion; yet, while he thus apparently and in theory attributed the knowledge of God more to Scripture and less to reason than did Luther or Calvin, really and in practice he did just the reverse, because he conceived quite otherwise of the connexion between Scripture and reason. While he held Scripture to be the source of religious truth, he also held reason to be so the organ of religious truth that nothing contrary to reason could be accepted on the authority of Scripture, and that only those declarations of Scripture could be deemed to be interpreted aright which were interpreted in accordance with the axioms of reason. Luther, on the other hand, proclaimed aloud, Strangle reason like a dangerous beast if it dare to question Scripture; and Calvin, although he did not speak so harshly, demanded the unqualified submission of reason to the authority of Scripture. Antitrinitarianism has maintained its ground throughout the Protestant area, has assumed a variety of forms, and has exerted a powerful influence. It has been unable, it is often said, to do more than revive the doctrines which distracted the ancient church and were condemned by it as heresies. And this must be so far admitted. The doctrine of the Trinity comprehends only a few propositions, and every departure from it must involve a rejection of one or more of these, and must, consequently, belong to some one of a very few possible types or classes of belief. But essentially the statement is superficial and unjust. For the ways in which, and the grounds on which, both the affirmations of which the doctrine consists and the negations of these have been maintained have not been the same. Alike the defences and the attacks have in the later era implied a deeper consciousness of the nature of the problems in dispute than those of earlier times. As of history in general, so of the history of the doctrine of God, it holds good that no present has been the mere reproduction of any past. Deism. The rationalistic process was carried farther in English deism and its Continental developments. Deism sought to found religion on reason alone. It represents "nature" as the sole and sufficient revelation of God. There is no warrant for the view that the deists held nature to be independent of God, self-conservative and self-operative,—or, in other words, God to be withdrawn from nature, merely looking on and "seeing it go." They believed that God acted through natural laws, and that it was doubtful if He ever acted otherwise than through these. Whatever was taught about God in Christianity and other positive religions beyond what reason could infer from nature ought, in their opinion, to be rejected as fiction and superstition. All their zeal was negative,—against "superstition." What was positive in their own doctrine had but a feeble hold on them. God was little more to them than a logical inference from the general constitution of the world. They lacked perception of the presence of God, not only in the Bible, but in all human life and history.[2]

Modern philosophy.

Modern philosophy, from its rise to the close of the 18th century, showed a double development, the one ideal and the other empirical, the Cartesian and the Baconian. The former was the more essentially religious. Descartes endeavoured to found philosophy on an indubitable refutation of absolute scepticism. Such a refutation he believed himself to have effected when he had argued that thought, even in the form of doubt, necessarily implies the existence of him who thinks; that the implication yields a universal criterion of certainty; and that the presence of the idea of God in a man's mind, the consciousness of the mind's imperfection, and especially the character of the mind's concept of God as that of the most real being containing every perfection, demonstratively establish that God is and is what He is thought to be. God is and is true; therefore man has not been made to err, and whatever he clearly and distinctly sees as true must be true. In the opinion of Descartes, the idea of God is inherent in reason, is the seal of all certainty, and the corner-stone of all true philosophy. To the whole Cartesian school theology was the foundation of all science. To Spinoza, who most fully developed some of the distinctive principles of Descartes, it was identical with all science, for to him God was the only substance, and all things else were only His attributes or modes. Besides the pantheism of Spinoza, the occasionalism of Guelinx, Malebranche's vision of things in God, Leibnitz's pre-established harmony and optimism, and Wolf's rationalism were natural, if not necessary, outgrowths from the same root,—Cartesian theism. Perhaps, of all the many services to the cause of theism with which Cartesianism must be credited the greatest was that it constantly gave prominence to the absolute perfection of God.[1] Baconian or empirical philosophy was content if, by the ways of causality and design, it could rise to an apprehension of a First Cause and Supreme Intelligence. It tended of itself to a phenomenalism, sensationism, associationism, unfavourable to theism. It was, however, counteracted, restrained, and modified by Cartesianism and Platonism, and it naturally allied itself with positive science. The massive defence of theism erected by the Cambridge school of philosophy against atheism, fatalism, and the denial of moral distinctions was avowedly built on a Platonic foundation. The popularity during the 18th century of the design argument, and what was called physico-theology, was largely due to the impression made on the general mind by the brilliant discoveries of the founders of modern astronomy, chemistry, and other physical sciences. Bishop Berkeley showed how an empirical philosophy might be logically evolved into a theistic immaterialism, Hume how it might be logically dissolved into an agnostic nihilism.

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[1] Gass, *Gesch. d. prot. Dogm.*, i.; Heppe, *Dogm. d. deutsch. Protestantismus im 16ten Jahrh.*, i.; Frank, *Gesch. d. prot. Theol.*, i.; Dorner, *Hist. of Prot. Th.*, ii.; and Muller, *De Godsleer van Calvijn*, 1883.

[2] Besides the works of Gass, Frank, and Dorner already mentioned, see the histories of deism by Leland, Lechler, and Sayous; of rationalism by Stäudlin, Tholuck, Hagenbach, and Hurst; Noack's *Freidenker*, 3 vols., 1853-55; Farrar's *Crit. Hist. of Free Thought*, 1863; Hunt's *Rel. Thought in England*, 3 vols., 1870-73; Leslie Stephen's *Engl. Thought in the Eighteenth Cent.*, 2 vols., 1883; Cairns's *Unbelief in the Eighteenth Cent.*, 1881; Beard's *Hib. Lect.*, 1883; and the 2d vol. of Gillett's *God in Human Thought*, 1874.

In the 16th, 17th, and 18th centuries mysticism had many representatives, several of whom, as, *e.g.*, Weigel, Ottingen, Swedenborg, and especially Jacob Boehme, are entitled to a considerable place in any detailed history of theism. To the eyes of Boehme God revealed Himself from without and within in the most real and intimate manner. In the powers, antagonisms, and conjunctions of creation he saw the energies, struggles, and victories of the creative Spirit itself; in the constitution and operations of physical and human nature, the essential constitution and necessary processes of the Divine nature. His thoughts of God were in striking contrast to those of the deists and natural theologians of the 17th and 18th centuries, and strikingly anticipated those of a Schelling, Hegel, and Baader in the 19th century. Could Swedenborg's doctrine of correspondences be verified, our means of insight into the character of God would be largely extended.

The 19th century is sufficiently far advanced to allow us to see that a new epoch even in the history of theism began near its commencement. The revolution in philosophy initiated by Kant has profoundly affected theistic thought. It has introduced that type of agnosticism which is what is most original and distinctive in the antitheism of the present age, and at the same time stimulated reason to undertake bolder inquiries as to the Divine than those which Kant prohibited. The enlarged and deepened views of the universe attained through the discoveries of recent physical science have rendered incredible the idea of a God remote from the world, irresistible the conviction that the eternal source of things must be immanent in their constitution, changes, and laws. The rapid growth of biology and the spread of the doctrine of evolution have not only tended in the same direction, but given a new and nobler conception of the teleology of the universe, and, consequently, of God as the supreme intelligence. History—which the natural theologians of the 18th century so strangely ignored, which the solitary Italian thinker Vico alone recognized with clearness and comprehensiveness of vision to be necessarily the chief scene of the self-revelation of God—began with Lessing and Herder to be generally seen in its true religious light. The comparative or historical method of study has created two disciplines or sciences, comparative theology and Biblical theology,—which are both largely occupied with tracing the development of the idea of God. The ethical spirit of the age has so told on its religious teaching that to no generation save that to which the gospel was originally given has the Divine fatherhood been so distinctly set forth as to the present. Dogmatic theology, especially in Germany, has been earnestly active; and its chief representatives have laboured so to amend and advance the doctrine concerning God that it may satisfy the new requirements which have arisen.

Present state of thought.

It is now necessary briefly to indicate the present state of thought on the chief points and problems of theism.

Origin of idea of God.

As to the origin, then, of our actual idea of God, that, it is seen, can only be the whole religious history of man which precedes it, and the whole religious nature of man which underlies that history. It is absurd to refer exclusively to any faculty, intuition, or feeling, any revelation or instruction, any person or event, what can be traced in growth and formation through thousands of years, and can be shown by facts and documents to have been influenced by all the chief causes which have made history what it is. The history of the idea of God is the centre of all history, both explained by and explaining it; and our nineteenth-century idea of God is the result of the entire historico-psychological process which has produced the culture and religion of the 19th century. The idea of God is what it now is because God's whole guidance of man and man's whole search for God, the whole economy and evolution of things and the whole constitution and development of thought and feeling, have been what they have been from the beginning of history to the present time. Anthropology, comparative psychology, the science of language, comparative theology, Biblical theology, the history of philosophy, and the history of Christian doctrine, have all been engaged in attempting to discover the factors and stages of the vast and complex process which has resulted in the accepted idea of God; and, by their separate and conjunct endeavours, they have succeeded in casting great light on all parts of the process.

As to the absolute historical origin of theism—as to where, when, and how the theistic conception of the Divine first obtained recognition among men—a definitive answer has not yet been reached. But the labour expended on the problem has not been wasted. It has made clearer the nature of the inquiry, rendered apparent the unsatisfactoriness of previous solutions, opened up glimpses of divers ways by which men have been led to belief in the unity of God, and accumulated means and materials for future and probably more successful work.

The question as to the psychological origin of theism cannot be wholly separated from that as to its historical origin. Unless theism can be shown to be the primitive form of religion, it cannot be held to have had an entirely peculiar and distinct psychological origin, but must be viewed as simply a phase or development of religion. It cannot be said that there is as yet agreement as to the psychological origin, or as to the psychological constitution even, of religion. The hypothesis of a simple impartation of the knowledge of God and spiritual things through primitive revelation, or through instruction and tradition which go back to the first appearance of man on earth, still retains a hold on certain conservative minds, but has received no confirmation from modern science and discovery, and is plainly of its very nature inadequate. A revelation relative to God in words or signs could have no meaning to a mind devoid of thoughts of God; spiritual instruction is only possible where there are spiritual powers to understand and profit by it; tradition will carry nothing far to which intelligence is indifferent. There have been many attempts made during the present century to refer the origin of belief in God to some emotional source, some element or state of sensitivity. Thus Strauss has reaffirmed the hypothesis of Epicurus, Lucretius, and Hume, that fear made the gods; Feuerbach has resolved religion into desire,

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[1] Saisset, in the first part of his *Modern Pantheism* has somewhat elaborate studies on (1) the theism of Descartes, (2) God in the system of Malebranche, (3) the pantheism of Spinoza, and (4) the theism of Leibnitz. Huber (1854) and Elvenich (1865) have written special treatises on the Cartesian proofs of the Divine existence. Among the most thorough studies of Spinoza are those of Camerer, Pollock, and Martineau. Herder, Voigtländer, and others have maintained that he was a theist, not a pantheist. On the *Théodicée* of Leibnitz there are three excellent papers by Prof. Torrey in the *Andover Rev.* for October, November, and December 1885. The best general history of philosophy is Kuno Fischer's; the best history of Cartesianism F. Bouillier's.

God being conceived to be what man would wish himself to be; Schleiermacher has argued that a feeling of absolute dependence, of pure and complete passiveness, is our evidence for the presence of an infinite energy, an infinite being; Mansel has represented the feeling of dependence and the conviction of moral obligation as the sources of the religious consciousness; Pfleiderer represents religion as a response to the sense of conflict and contradiction between man's feelings of dependence and of freedom; Rauwenhoff traces its origin to respect (*Achtung*), the root also of moral conduct and of family life; others have referred it to specific ethical feelings; and many have represented it to be essentially love. The number of these attempts and the diversity of those results are explained by the complexity of religious feeling. In religion all the feelings which raise man above the merely animal condition are involved. Man is not religious by any one feeling or by a few feelings, but by the whole constitution of his emotional nature. His heart, with all its wealth of feelings, has been made for God. Hence all the theories referred to have easily been shown to be one-sided, and to have exaggerated the significance and influence in religion of particular emotional elements, but hence also they all contain more or less important portions of the truth, and have all contributed towards a knowledge of the full truth. Man is not only, however, disposed by all his chief sentiments for religion, but all these sentiments, when normally and healthfully developed, tend towards theism. It is only in a theistic form of religion that they can find true rest and satisfaction. One God can alone be the object of the highest devotional fear, can alone be regarded as ideally perfect, or as a being on whom the worshipper is absolutely dependent, can alone be loved with the whole heart and esteemed with undivided reverence, can alone be recognized as the sole author of the moral law, the alone good. The theories which trace the origin of religion to feeling have the merit of recognizing that religion is not an affair of mere intellect; that the Divine could not even be known by men if they had not feelings and affections as well as intellectual powers; that, if God be love, for example, He can only be known by love; that, if He have moral attributes, we must have moral feelings in order to be able to recognize them. On the other hand, in so far as those theories represent religion as reducible to mere feeling or as independent of intellect, they have the fault of overlooking that all the feelings included in religion presuppose apprehensions and judgments, and are valid only in so far as they have the warrant of intelligence. It is as much an error, however, to account for religion by any one intellectual principle as by any one emotional element. Religion has no one special seat, such as "the central point of unity behind consciousness," imagined by Schleiermacher; no "special organ," such as "conscience" was supposed to be by Schenkel; and no one special principle of cognition, such as the law of causality has been represented to be by several philosophers and theologians. All the ultimate principles of cognition are involved in religion, and all lead, if consistently followed far enough, to theism. The whole head as well as the whole heart has been made for religion, and for the perfect form of religion. Max Muller, in his *Hibbert Lectures*, traces the idea of God to a special faculty of religion—"a subjective faculty for the apprehension of the infinite," "a mental faculty, which, independent of, nay, in spite of, sense and reason, enables man to apprehend the infinite under different names and under varying disguises." This view will not bear, perhaps, a close scrutiny. The infinite, as an *implicit condition* of thought, is not more involved in religious than in other thought. We cannot think anything as finite without implying the infinite. Space cannot be thought of except as *extensively*, nor time except as *protensively*, infinite. As a condition of thought, the infinite is involved in religious knowledge only so far as it is involved in all knowledge. On the other hand, as an *explicit object* of thought, it is not present in the lower forms of religion at all, which exist only because the thought of infinity is not associated in the religious consciousness with that of Deity, except where reflexion is somewhat highly developed; and, even in the highest stages of religion, it is only apprehended as one aspect of Deity. Infinity is not God, but merely an attribute of the attributes of God, and not even an exclusively Divine attribute. The hypothesis that the idea of God is gained by intuition or vision is proved to be erroneous by the fact that the idea of God, and the process by which it is reached, are capable of being analysed, and therefore not simple, and likewise by the variety and discordance of the ideas of God which have been actually formed. The apprehension of God seems to be only possible through a process which involves all that is essential in the human constitution—will, affection, intelligence, conscience, reason,—and the ideas which they supply—cause, design, goodness, infinity, &c. These are so connected that they may all be embraced in a single act and coalesce in one grand issue. During the last thirty years there has been more psychological investigation as to the origin and nature of religion than during all previous history, and the whole tendency of it has been to set aside all solutions which represent man as religious only in virtue of particular sentiments or principles, and to make manifest that the psychology of religion is that of the entire human nature in a special relationship. The best of the later investigations are much more thorough and comprehensive than any of earlier date.[1]

Kantian agnosticism.

The agnosticism originated by Kant has been one of the distinctive and prominent phenomena in the history of religion and theism during the 19th century. It sprang out of an earlier agnosticism. Hume and his predecessors admitted that the conditions of thought—otherwise, the categories of experience or ideas of reason—were in appearance necessary and objectively valid, but in reality only arbitrary and subjective, their seeming necessity and objectivity being illusory, and consequent on mere repetitions and accidental associations of sensations and feelings. Kant showed that they were not only seemingly but really necessary to thought, and irresolvable into the particular in experience. He denied, however, that we are entitled to consider them as of more than subjective applicability,—that what we necessarily think must necessarily be, or be as we think it. He affirmed all knowledge to be confined to experience, the phenomenal, the conditioned. It was quite in accordance with this view of the limits of knowledge that he should have denied that we can know God, even while he affirmed that we cannot but think of God. It was by no means in obvious harmony with it that he should have affirmed that we must, on moral grounds, retain a certain belief in God. Sir W. Hamilton and Dean Mansel followed Kant in holding that we can have no knowledge of God in Himself, as knowledge is only of the relative and phenomenal. They strove to show that the notions of the unconditioned, the infinite, the absolute, are mere negations of thought, which destroy themselves by their mutual contradictions and by the absurdities which they involve. Yet both of these philosophers held that there is a revelation of God in Scripture and conscience, and that we are bound to believe it, not indeed as teaching us what God really is, but what He wishes us to believe concerning Him. Herbert Spencer, adopting Kant's theory of the limits of knowledge, and regarding as decisive Hamilton and Mansel's polemic against the philosophies of the Absolute, has concluded that the only truth underlying professed revelations, positive religions, and so-called theological sciences is the existence of an unknowable and unthinkable cause of all things. In the view of the Positivist the unknowable itself is a metaphysical fiction. The Kantian doctrine has had a still more extensive influence in Germany than in Britain, and German philosophers and theologians have displayed great ingenuity in their endeavours to combine with it some sort of recognition of God and of religion. Fries, De Wette, and others have relegated religion to the sphere of faith, Schleiermacher and his followers to that of feeling, Ritschl and his school to that of ethical wants, F. A. Lange to that of imagination, &c. Their common aim has been to find for piety towards God a special place which they can fence off from the rest of human nature, so as to be able to claim for religion independence of reason, speculation, and science, a right to existence even although necessarily ignorant of the object of its faith, feeling, moral sense, or phantasy.[2]

The movement indicated has led to no direct conclusion which has obtained, or is likely to obtain, general assent. It has had, however, a very important indirect result. It has shown how interested in, and dependent on, a true criticism or science of cognition are theism and theology. It has made increasingly manifest the immense significance to religion of the problem as to the powers and limits of thought which Kant stated and discussed with so much vigour and originality. Hence research into what the Germans call "die erkenntnisstheoretischen Grundsätze"—the philosophical bases—of theism has been greatly stimulated and advanced by the movement. This is an enormous gain, which more than compensates for sundry incidental losses. Kant's solution of the problem which he placed in the foreground of philosophy has not been found to be one in which the mind can rest. From his agnosticism down to the very empiricism which it was his aim to refute descent is logically inevitable. The agnosticism of piety has in no form been able to discover a halting place,—a spot on which to raise theism or any solid religious construction. In no form has it been able to prove its legitimacy, to maintain its self-consistency, or to defend itself successfully against the agnosticism of unbelief. It is, therefore, not surprising that it should have been very generally regarded as dangerous to theism in reality, even when friendly to it in intention. Yet there is much in the theory of cognition on which it proceeds which the theist can utilize. Indeed, no theory of cognition can afford a satisfactory basis to theism which does not largely adopt and assimilate that of Kant. He has conclusively shown that all our knowledge is a synthesis of contingent impressions and necessary conditions; that without the latter there can be neither sense, understanding, nor reason; that they constitute intelligence, and are the light of mind; that they also pervade the whole world of experience and illuminate it; that there is neither thing nor thought in the universe which does not exhibit them in some of their aspects; that apart from them there can be no reality, no truth, no science. The agnostic corollaries appended to this theory by Kant and others, instead of being necessary consequences from it, are inconsistent with it. Kant and the agnostics say that we know only the conditioned; but what they prove is that we know also the conditions of thought, and that these conditions are themselves unconditioned, otherwise they would not be necessary. They affirm that we can know only the phenomenal and relative, but what they establish is that it is as impossible to know only the relative and phenomenal as to know only the absolute and noumenal, and that in so far as we know at all we know through ideas which are absolute and noumenal in the only intelligible, and in a very real and important, sense. They maintain, what is very true, if not a truism, that the categories are only valid for experience, and they imply that this is because experience limits and defines the categories, whereas, according to their own theory, it is the categories which condition experience and enter as constituents into all experience, so that to say that the categories are only valid for experience means very little, experience merely existing so far as the categories enable us to have it, and being valid so far as the categories are legitimately applied, although not farther, which leaves no more presumption against religious experience than against sensible experience. They have denied the objective validity of the categories or necessary conditions of thought. This denial is the distinctive feature of all modern agnosticism; and the theist who would vindicate the reality of his knowledge of God, the legitimacy of his belief in God, the worth of his religious experience, must refute the reasonings by which it has been supported; show that consciousness testifies against it, the subjectivity of any true category being unthinkable and inconceivable; and indicate how its admission must subvert not only the foundation of theology but of all other sciences, and resolve them all into castles in the air, or into such stuff as dreams are made of. In the accomplishment of this task as much guidance and aid may be found, perhaps, in the theories of cognition of Ferrier and Rosmini as from those of any of the Germans; but Hegel and his followers, not a few of the Herbartists, Ulrici, Harms, and many other German thinkers, have contributed to show the falsity of the critical theory at this point. Amended here, it is a theory admirably fitted to be the corner-stone of a philosophical theism.

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[1] Among recent disquisitions as to the psychological origin of the religious consciousness and the conception of God may be specified—Pfleiderer's in last ed. of his *Religionsphilosophie*; Biedermann's in last ed. of his *Dogmatik*; W. Hermann's in his *Die Religion im Verhältniss zum Welterkennen und zur Sittlichkeit*, 1879; Kaftan's in his *Das Wesen der chr. Religion*, 1881; Lipsius's in his *Philosophie und Religion*, 1885; and Rauwenhoff's in his "Ontstaan van den Godsdienst," *Theol. Tijdschr.*, May 1885.

[2] Among works in which it is denied that the real nature of God can be known are—Kant's *Kr. d. r. V.*; Fichte's *Kr. aller Offenbarung*; Schleiermacher's *Reden*, *Dialektik*, and *Glaubenslehre*; Trendelenburg's *Log. Untersuchungen*, ii. §§ xx.–xxiv.; Hamilton's *Lect. on Met.*, and *Discussions*; Mansel's *Bampton Lect.*, and *Philosophy of the Conditioned*; H. Spencer's *First Principles*; and the writings of Lange, Ritschl, and other Neo-Kantists. Among works in which the real cognoscibility of God is affirmed are—Calderwood's *Ph. of the Infinite*; C. Hodge's *Sys. Th.*, i.; M'Cosh's *Int. of the Mind*, *Phil. Series*, &c.; H. B. Smith's *Intr. to Ch. Th.*, and *Faith and Philosophy*; Maurice's *What is Revelation?*; Young's *Province of Reason*; and Harris's *Phil. Bases of Theism*. See also L. Robert, *De la Certitude*, &c., 1880; Ollé-Laprune, *De la Certitude Morale*, 1880; G. Derepas, *Les Théories de l'Inconnaissable*, 1883; G. Matheson, in *Can the Old Faith Live with the New?*, 1885; R. T. Smith, *Man's Knowledge of Man and of God*, 1886; Schramm, *Die Erkennbarkeit Gottes*, 1876; and Bertling, *Die Erkennbarkeit Gottes*, 1886.

More may be attempted to be done in the region of the necessary and unconditioned. The conditions of thought, the categories of experience, the ideas of reason are all linked together, so that each has its own place and is part of a whole. And of what whole? The idea of God. All the metaphysical categories are included therein, for God is the Absolute Being; all the physical categories, for He is Absolute Force and Life; all the mental categories, for He is Absolute Spirit; all the moral categories, for He is the Absolutely Good. The idea of God is the richest, the most inclusive, the most comprehensive, of all ideas. It is the idea of ideas, for it takes up all other ideas into itself and gives them unity, so that they constitute a system. The whole system issues into, and is rendered organic by, the idea of God, which, indeed, contains within itself all the ideas which are the conditions of human reason and the grounds of known existence. All sciences, and even all phases and varieties of human experience, are only developments of some of the ideas included in this supreme and all-comprehensive idea, and the developments have in no instance exhausted the ideas. Hence in the idea of God must be the whole truth of the universe as well as of the mind. These sentences are an attempt to express in the briefest intelligible form what it was the aim of the so-called philosophy of the Absolute to prove to be not only true, but *the truth*. Hegel and Schelling, Krause and Baader, and their associates, all felt themselves to have the one mission in life of making manifest that God was thus the truth, the light of all knowledge, self-revealing in all science, the sole object of all philosophy. The Absolute with which they occupied themselves so earnestly was no abstraction, no fiction, such as Hamilton and Mansel supposed it to be,—not the wholly indeterminate, not that which is out of all relation to everything or to anything, not the Unknowable,—but the ground of all relationship, the foundation alike of existence and of thought, that which it is not only not impossible to know, but which it is impossible not to know, the knowledge of it being implied in all knowledge. Hegel expressed not only his own conviction, but the central and vital thought of the whole anti-agnostic movement which culminated in him when he wrote, "The object of religion is, like that of philosophy, the eternal truth itself in its objective existence: it is God, and nothing but God, and the explanation of God. Philosophy is not a wisdom of the world, but a knowledge of the unworldly; not a knowledge of outward matter, of empirical being and life, but knowledge of that which is eternal, of that which is God and which flows from His nature, as that must manifest and develop itself. Hence philosophy in explaining religion explains itself, and in explaining itself explains religion. Philosophy and religion thus coincide in that they have one and the same object." The adherents of the philosophy of the Absolute must be admitted to have fallen, in their revulsion from agnosticism, into many extravagances of gnosticism; but a theist who does not sympathize with their main aim, and even accepts most of the results as to which they are agreed, cannot be credited with having much philosophical insight into what a thorough and consistent theism implies. A God who is not the Absolute as they understood the term, not the Unconditioned revealed in all that is conditioned, and the essential content of all knowledge at its highest, cannot be the God either of a profound philosophy or a fully-developed religion. The philosophy of the Absolute was, on the whole, a great advance towards a philosophical theism.[1]

And yet it was largely pantheistic, and tended strongly towards pantheism. This was not surprising. Any philosophy which is in thorough earnest to show that God is the ground of all existence and the condition of all knowledge must find it difficult to retain a firm grasp of the personality and transcendence of the Divine and to set them forth with due prominence. Certainly some of the most influential representatives of the philosophy of the Absolute ignored or misrepresented them. The consequence was, however, that a band of thinkers soon appeared who were animated with the most zealous desire to do justice to these aspects of the Absolute, and to make evident the one-sidedness and inadequacy of every pantheistic conception of the Divine. This was the common aim of those who gathered around the younger Fichte, and whose literary organ was the *Zeitschrift für Philosophie*. Chalybaus, K. Ph. Fischer, Sengler, Weisse, Wirth, and Ulrici may be named as among the ablest and most active. The Roman Catholic Günther and his followers worked in much the same spirit. Lotze has effectively co-operated by his ingenious defence of the thesis that "perfect personality is to be found only in God, while in all finite spirits there exists only a weak imitation of personality; the finiteness of the finite is not a productive condition of personality, but rather a limiting barrier to its perfect development." This movement also, then, has tended to develop and contributed to enrich the theory of theism. Its special mission has been to prove that theism is wider than pantheism, and can include all the truth in pantheism, while pantheism must necessarily exclude truth in theism essential to the vitality and vigour both of religion and of morality.[2]

The philosophy of the Absolute, judged of from a distinctly theistic point of view, was defective on another side. It regarded too exclusively the necessary and formal in thought, trusted almost entirely to its insight into the significance of the categories and its powers of rational deduction. Hence the idea of the Divine which it attained, if vast and comprehensive, was also vague and abstract, shadowy and unimpressive. Correction was needed on this side also, and it came through Schleiermacher and that large company of theologians, among whom Lipsius and Ritschl are at present the most prominent, who have dwelt on the importance of proceeding from immediate personal experience, from the direct testimony of pious feeling, from the practical needs of the moral life, &c. From these theologians may be learned that God is to be known, not through mere intellectual cognition, but through spiritual experience, and that no dicta as to the Divine not verifiable in experience, not efficacious to sustain piety and to promote virtue, to elevate and purify the heart, to invigorate the will, to ennoble the character, to sanctify both individuals and communities, are likely to be true. Experience of the Divine can be the richest and surest experience only if it not merely implies all that is absolute and necessary in consciousness and existence, but is also confirmed and guaranteed by all that is relative and contingent therein.

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[1] On the doctrine of God propounded by the philosophers of the Absolute may be consulted the histories of philosophy by Chalybäus, Michelet, Erdmann, Ueberweg, K. Fischer, Harms, Zeller, &c., also Pünjer, ii. bks. 3 and 5; the chapters in Pfleiderer on Schelling, Hegel, Neo-Schellingianism, and Neo-Hegelianism; Dorner's *Hist. of Prot. Th.*, ii. 257, 395; Lichtemberger's *Hist. des Idées Religieuses en Allemagne*, &c., *passim*; Ehrenhaus's *Hegel's Gottesbegriff*, &c.; Franz on Schelling's *Positive Philosophie*; Opzoomer's *Leer van God, bij Krause*; K. Ph. Fischer's *Characteristik der Theosophie Baaders*; &c.

[2] See art. "Theismus," by Ulrici, in Herzog's *Real-Encyklopädie*, xv. As representing this phase of theism the following works may be named:—C. H. Weisse's *Idee der Gottheit*, 1844, and *Philosophische Dogmatik*, 1855; Wirth's *Speculative Idee Gottes*, 1845; Sengler's *Idee Gottes*, 1845–47; J. H. Fichte's *Speculative Theologie*, 1846–47; Hanne's *Idee der absoluten Persönlichkeit*, 1867; Ulrici's *Gott u. die Natur*, 1875; and Lotze's *Microcosmos*, ii. ix. 4–5 (Eng. tr.). The school is well represented in America by Prof. Bowne. See his *Studies in Theism*, especially ch. 7–9. See also art. of Prof. J. S. Candlish on "The Personality of God," in *Princeton Rev.*, Sept. 1884, and of Gardiner on "Lotze's Theistic Philosophy," in *Presby. Rev.*, Oct. 1885.

Theistic "proofs."

What are known as "the proofs" for the Divine existence have from the time of Kant to the present been often represented as sophistical or useless. This view is, however, less prevalent than it was. During the last twenty years the proofs have been in much greater repute, and have had far more labour expended on them, than during the previous part of the century. They have, of course, been considerably modified, in conformity with the general growth of thought and knowledge. For instance, they are no longer presented elaborately analysed into series or groups of syllogisms. It is recognized that the fetters which would assuredly arrest the progress of physical and mental science cannot be favourable to that of theology. It is recognized that the validity of the proofs must be entirely dependent on the truthfulness with which they indicate the modes in which God reveals Himself, the facts through which man apprehends the presence and attributes of God, and that, therefore, the more simply they are stated the better. Man knows God somewhat as he knows the minds of his fellow-men—namely, inferentially,—yet through an experience at once so simple and so manifold that all attempts at a syllogistic representation of the process must necessarily do it injustice. The closeness and character of the connexion of the proofs have also come to be more clearly seen. They are perceived to constitute an organic whole of argument, each of which establishes its separate element, and thus contributes to the general result—confirmatory evidence *that* God is, and complementary evidence as to *what* God is. The explanation of this doubtless is that the apprehension of God is itself an organic whole, a complex and harmonious process, involving all that is essential in the human mind, yet all the constituents of which are so connected that they may be embraced in a single act and coalesce into one grand issue.

The cosmological argument.

The cosmological argument concludes from the existence of the world as temporal and contingent, conditioned and phenomenal, to the existence of God as its one eternal, unconditioned, self-existent cause. It is an argument which has been in no respect discredited by recent research and discussion, which is in substance accepted not only by theists but by pantheists, and which forms the basis even of the philosophy of Herbert Spencer. The principle on which it proceeds—the principle of causality—has only come to be more clearly seen to be ultimate, universal, and necessary. The hypothesis of an infinite series of causes and effects has not had its burden of irrationality in the least diminished. The progress of science has not tended to show that the world itself may be reasonably regarded as eternal and self-existent; in the view of theists it has only tended to render more probable the doctrine that all physical things must have their origin in a single non-physical cause. The necessity of determining aright the bearings of the new views reached or suggested by science as to the ultimate constitution of matter, the conservation of energy, cosmic evolution, the age and duration of the present physical system, &c., has been the chief factor in the latest developments of the argument *a contingentia mundi*. The teleological argument, which concludes from the regularities and adjustments, preconformities and harmonies, in nature that its first cause must be an intelligence, has been both corrected and extended owing to recent advances of science and especially of biological science. The theory of evolution has not shaken the principle or lessened the force of the argument, while it has widened its scope and opened up vistas of grander design, but it has so changed its mode of presentation that already the *Bridgewater Treatises* and similar works are to some extent antiquated. Perhaps the most promising of the later applications of the argument is that which rests on the results obtained by a philosophical study of history, and which seeks to show that the goal of the evolution of life, so far as it has yet proceeded, is the perfecting of human nature, and the eternal source of things a power which makes for truth and righteousness. The ethical argument—the proof from conscience and the moral order—held a very subordinate place in the estimation of writers on natural theology until Kant rested on it almost the whole weight of theism. It has ever since been prominent, and has been the argument most relied on to produce practical conviction. Much importance is now rarely attached to those forms of the metaphysical argument which are deductions from a particular conception, as, *e.g.*, of a perfect being. Ignorance alone, however, can account for the assertion often met with that the argument is generally abandoned. It has only been transformed. It has passed from a stage in which it was presented in particular ontological forms into one in which it is set forth in a general epistemological form. As at present maintained it is to the effect that God is the idea of ideas, the ultimate in human thought, without whom all thought is confusion and self-contradiction. In this form, by what theologians and religious philosophers possessed of much speculative insight is it not held?[1]

The changes adopted in the methods of theistic proof have all tended in one direction, namely, to remove or correct extreme and exaggerated conceptions of the Divine transcendence and to produce a true appreciation of the Divine immanence,—to set aside deism and to enrich theism with what is good in pantheism. The general movement of religious speculation within the theistic area has been towards mediation between the extremes of pantheism and of deism, towards harmonious combination of the personal self-equality and the universal agency of the Divine. Positive science has powerfully co-operated with speculation in giving support and impulse to this movement. While the modern scientific view of the world does not result in pantheism, it affords it a partial and relative justification, and requires a theism which, while maintaining the personality of God, recognizes God to be in all things and all things to be of God, through God, and to God. It may be said that theism has always thus recognized the Divine immanence. The vague recognition of it, however, which precedes scientific insight and the conquest and absorption of pantheism is not to be identified with the realizing comprehension of it which is their result.[2]

The idea of God in contemporary theology

As to the further treatment of the idea of God in recent or contemporary theology, the following may be mentioned as, perhaps, the chief distinctive features:—first, the general endeavour to present the idea as a harmonious reflex of the Divine nature and life, instead of as a mere aggregate of attributes; secondly, and consequently, the greater care shown in the classification and correlation of the attributes, so as to refer them to their appropriate places in the one great organic thought; and, thirdly, the more truly ethical and spiritual representation given of the Divine character. To realize the nature and import of the first of these features it is only necessary to compare the expositions given of the idea of God in the works of such theologians as Nitzsch, Thomasius, Dorner, Philippi, Kahnis, and even more in those of the representatives of German speculative theism, with such as are to be found in the treatises of Hill, Watson, Wardlaw, and Hodge, which, although published in the present century, express only the views of an earlier age. As to the second point, there has of late been a vast amount of thought expended in endeavouring so to classify and co-ordinate the attributes, and so to refer them to the various moments of the Divine existence and life, as that God may be able to be apprehended both in His unity and completeness, self-identity and spiritual richness, as one whole harmonious and perfect personality. Of the work attempted in this direction our limits will not allow us to treat. In regard to the third feature, any one who will peruse an essay like Weber's *Vom Zorne Gottes*, or Ritschl's *De Ira Dei*, and compares the way in which the Biblical conception of the wrath of God is there presented with the mode of exhibiting it prevalent for so many ages, is likely to be convinced that considerable progress has been made even in recent times in the study of the moral aspects of God's character. That the Divine glory must centre in moral perfection, in holy love, is a thought which is undoubtedly being realized by all theists with ever-increasing clearness and fulness.[3]

Advance of trinitarianism.

It follows from the above that theistic thought has been moving in a direction which could not fail to suggest to those influenced by it that a rigidly unitarian conception of God must be inadequate, and that the trinitarian conception might be the only one in which reason can rest as self-consistent. So long as the simplicity of the Divine nature was conceived of as an abstract self-identity, intelligence could not venture to attempt to pass from the unity to the trinity of the Godhead, or hope for any glimpse of the possibility of harmoniously combining them. But, this view of the simplicity of the Divine nature having been abandoned, and an idea of God attained which assigns to Him all the distinctions compatible with, and demanded by, completeness and perfection of personality, the doctrine of the Trinity necessarily entered on a new stage of its history. The free movement of thought in this century, far from expelling it from its place in the mind of Christendom, has caused it to strike deeper root and grow with fresh vigour. Never since the Nicene age has theological speculation been so actively occupied with the constitution of the Godhead, and with the trinitarian representation thereof, as from the commencement of the present century. It is, of course, impossible here to describe any of the attempts which, during this period, have been made to show that the absolute Divine self-consciousness implies a trinitarian form of existence, and that intelligently to think the essential Trinity is to think those moments in the Divine existence without which personality and self-consciousness are unthinkable; or that a worthy conception of Divine love demands a trinitarian mode of life; or that a world distinct from God presupposes that God as triune is in and for Himself a perfect and infinite world, so that

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[1] See the present writer's *Theism*, and the indications of the literature given in the notes.

[2] See the extremely interesting papers by Peabody, Montgomery, Howison, and Harris in the *Journal of Speculative Philosophy* for Oct. 1885, on the question, "Is Pantheism the Legitimate Outcome of Modern Science?" Also F. E. Abbot's *Scientific Theism*, 1885; and J. Fiske's *Idea of God as affected by Modern Knowledge*, 1885.

[3] Bruch, *Lehre von den Göttl. Eigenschaften*, 1842; Moll, *De Justo Attributorum Dei Discrimine*, 1855. Both are, however, already inadequate.

His attributes and activities already fully realized in the trinitarian life can proceed outwards, not of necessity but of absolute freedom; or that the whole universe is a manifestation of His triune nature, and all finite spiritual life a reflexion of the archetypal life, self-sustained and self-fulfilled therein. All the more thoughtful trinitarian divines of the present endeavour to make it apparent that the doctrine of the Trinity is not one which has been merely imposed upon faith by external authority, but one which satisfies reason, gives expression to the self-evidencing substance of revelation, and explains and supports religious experience. If it be thought that their success has not been great, it has to be remembered that they have been labouring near the commencement of a movement, and so at a stage when all individual efforts can have only a very limited worth. To one general conclusion they all seem to have come, namely, that the idea of God as substance is not the only idea with which we can connect, or in which we may find implied, tri-personality. The category of substance is, in some respects, one very inapplicable to God, as the philosophy of Spinoza has indirectly shown. If the theologians referred to be correct, the doctrine of the Trinity is not specially dependent upon it. In their view God cannot be thought of consistently as, *e.g.*, Absolute Life, Absolute Intelligence, or Absolute Love, unless He be thought of in a trinitarian manner.

Position of unitarian theism.

While trinitarian theism has thus during the present century shown abundant vitality and vigour, it cannot be said to have gained any decided victory over unitarian theism. The latter has also within the same period spread more widely and shown more practical activity, more spiritual life, than in any former age. The unitarianism represented by a Martineau is a manifest advance on that which was represented by a Priestley. Theism in its unitarian form is the creed of very many of the most cultured and most religious minds of our time, alike in Europe and America. In this form it has also signally shown its power in contemporary India. Brahmoism is, perhaps, the most remarkable example of a unitarian theism which exhibits all the characteristics of a positive faith and a churchly organization. The unitarian theism of the present age is distinguished by the great variety of its kinds or types. None of these, it must be added, are very definite or stable. Hence unitarian theism is often seen to approximate to, or become absorbed into, agnosticism or pantheism, cosmism or humanitarianism. This may be due, however, less to its own character than to the character of the age.[1]

Man's interest in the idea of God.

The mind of man has clearly not yet ceased to be intensely interested in thoughts of God. There are no grounds apparent for supposing that it will ever cease to seek after Him or to strive to enlarge its knowledge of His ways. And, if the idea of God be what has been suggested in the foregoing pages, the search for God cannot fail to meet with an ever-growing response. If the idea of God be the most comprehensive of ideas, inclusive of all the categories of thought and implicative of their harmonious synthesis and perfect realization, all thought and experience must of its very nature tend to lead onwards to a fuller knowledge of God. For the knowledge of God, on this view, consists in no mere inference reached through a process of theological argumentation, but in an ever-growing apprehension of an ever-advancing self-revelation of God; and all philosophy, science, experience, and history must necessarily work together to promote it.

Growth of the idea in speculative thought.

All speculative thought, whether professedly metaphysical or professedly theological, is conversant with ideas included in the idea of God. It deals with what is necessary in and to thought; and within that sphere, notwithstanding many aberrations, it has made slow but sure progress. The history of philosophical speculation is not only, like the whole history of man, essentially rational, but it is, in substance, the history of reason itself in its purest form,—not the record of an accidental succession of opinions, but of the progressive apprehension by reason of God's revelation of Himself in its own constitution. "There is much in the history of speculative thought, just as in the outward life of man, that belongs to the accidental and irrational—errors, vagaries, paradoxes, whimsicalities, assuming in all ages the name and the guise of philosophy. But, just as the student of the constitutional history of England can trace, amidst all the complexity and contingency of outward and passing events, through successive times and dynasties, underneath the waywardness of individual passion and the struggle for ascendency of classes and orders, the silent, steady development of that system of ordered freedom which we name the constitution of England, so, looking back on the course which human thought has travelled, we shall be at no loss to discern beneath the surface change of opinions, unaffected by the abnormal displays of individual folly and unreason, the traces of a continuous onward movement of mind."[2] And this continuous onward movement is towards the clearer and wider apprehension of the whole system of ultimate truths which is comprehended in the idea of the Absolute Truth. The thoughts of men as to God are necessarily enlarged by increase of insight into the conditions of their own thinking. The disquisitions of merely professional theologians on the nature and attributes of God have done far less to elucidate the idea of God than the philosophical views of great speculative thinkers, and would have done less than they have actually accomplished were it not for the guidance and suggestion found in these views.

Contributions of science;

The sciences co-operate with speculative philosophy and with one another in aiding thought to grow in the knowledge of God. The greatness, the power, the wisdom, the goodness, of the God of creation and providence must be increasingly apprehended in the measure that nature and its course, humanity and its history, are apprehended; and that measure is given us in the stage of development attained by the sciences. "God's glory in the heavens," for example, is in some degree visible to the naked eye and uninstructed intellect, but it becomes more perceptible and more impressive with every discovery of astronomy. Not otherwise is it as regards all the sciences. Each of them has its distinctive and appropriate contribution to bring towards the completion of the revelation of God, and cannot withhold it.

of moral experience;

But the idea of God is not one which can be rightly apprehended merely through intellect speculatively exercised or operating on the findings of science. It requires to be also apprehended through moral experience and the discipline of life. Neither individuals nor communities can know more of God as a moral being than their moral condition and character permit them to know. The apprehension of God and the sense of moral distinctions and moral obligations condition each other and correspond to each other. History shows us that sincere and pious men may receive as a supernaturally revealed truth the declaration that God is love, and yet hold that His love is very limited, being real only to a favoured class, and that He has foreordained, for His mere good pleasure, millions of the human race to eternal misery. How was such inconsistency possible? Largely because these men, notwithstanding their sincerity and piety, were lacking in that love to man through experience of which alone God's love can be truly apprehended. In like manner, it is not only the science of law which cannot advance more rapidly than the sense of justice, but also theology so far as it treats of the righteousness of God. Thus the knowledge of God is conditioned and influenced by the course of man's moral experience.

of religious experience.

The same may be said of the distinctively religious experience. In it also there has been a continuous discovery and a continuous disclosure of God. It is not long since the ethnic religions were very generally regarded as merely stages of human folly, so many monuments of aversion to God and of departure from the truth as to God. It was supposed that they were adequately described when they were called "idolatries" and "superstitions." This view rested on a strangely unworthy conception both of human nature and of Divine providence, and is fast passing away. In its place has come the conviction that the history of religion has been essentially a process of search for God on the part of man, and a process of self-revelation on the part of God to man, resulting in a continuous widening and deepening of human apprehension of the Divine. All, indeed, has not been progress in the history of religion either in the ethnic or Christian period; much has been the reverse; but all stages of religion testify that man has been seeking and finding God, and God making Himself known unto man.

Coming struggles with agnosticism.

But, while knowledge of God may reasonably be expected unceasingly to grow, in all the ways which have been indicated, from more to more, it is not to be supposed that doubt or denial of God's existence must, therefore, speedily disappear. Religious agnosticism cannot fail to remain long prevalent. The very wealth of contents in the idea of God inevitably exposes the idea to the assaults of agnosticism. All kinds of agnosticism merge into agnosticism as to God, from the very fact that all knowledge implies and may contribute to the knowledge of God. The more comprehensive an idea is from the more points can it be assailed, and the idea of God, being comprehensive of all ultimate ideas, may be assailed through them all, as, for example, through the idea of being, or of infinity, or of causality, or of personality, or of rectitude. Then, in another way, the unique fulness of the idea of God explains the prevalence of agnosticism in regard to it. The ideas are not precisely in God what they are in man or nature. God is being as man or nature is not; for He is independent and necessary being, and in that sense the one true Being. God is not limited by time and space as creatures are; for, whereas duration and extension merely are predicates of creatures, the corresponding attributes of God are eternity and immensity. God as first cause is a cause in a higher and more real sense than any second cause. So as to personality, intelligence, holiness, love. Just because the idea of God is thus elevated in all respects, there are many minds which fail or refuse to rise up to it, and which because of its very truth reject it as not true at all. They will not hear of that Absolute Truth which is simply the idea of God; but that they reject it is their misfortune, not any argument against the truth itself. (R. F.)

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[1] Goblet d'Alviella, *Contemporary Evolution of Religious Thought in England, America, and India*, 1885.

[2] Principal Caird, *Progressiveness of the Sciences*, pp. 27, 28, Glasgow, 1875.

THEMIS, the Greek mythological personification of custom. In Homer the word occurs both in the singular and in the plural (themistes), with the sense of "custom," "unwritten law." But even in Homer Themis is also spoken of as a goddess who, at the command of Zeus, calls the gods to an assembly and summons or disperses the assemblies of men. But after all she is a thin abstraction, a faint shadow, by the side of the full-blooded gods of Olympus. Hesiod furnished her with a pedigree (making her the daughter of Sky and Earth), and married her to Zeus, by whom she became the mother of a brood of well-bred abstractions,—Legality, Justice, Peace, the Hours, and the Fates. Pindar, no doubt with a full sense of her abstract nature, speaks of her as the assessor of Zeus. In one passage (*Prom.*, 209) Æschylus seems to regard her as identical with Earth, and "Earth-Themis" had a worship and priestess at Athens, where Athene also appears with the surname Themis. There was a tradition that the oracle at Delphi had first been in the hands of Earth, who transferred it afterwards to Themis, who in turn gave it up to Apollo. Themis had temples at Athens, Thebes, Tanagra, and Epidaurus. At Olympia she had an altar, and at Trœzen there was an altar of the Themides (plural of Themis). In modern writers Themis sometimes stands as a personification of law and justice,—an idea much more abstract and advanced than the original sense of "traditional custom."

THEMISTIUS, named *εὐφραδής*, or "the well-languaged," was a rhetorician and philosopher of the latter half of the 4th century. Of Paphlagonian descent, he settled and taught at Constantinople. Thence he was called to Rome, but, after a short stay in the West, returned to the Eastern capital, where he resided during the rest of his life. Though a pagan, he was admitted to the senate by Constantius in 355. He was prefect of Constantinople in 384 on the nomination of Theodosius. Themistius's paraphrases of Aristotle's *Posterior Analytics*, *Physics*, and *De Anima* are deservedly esteemed; but weariness and disgust are the sentiments stirred by the servile orations in which he panegyrizes successive emperors, comparing first one and then another to Plato's "true philosopher," and, when all other compliments have been exhausted, to the "idea" itself. (See Reiske, quoted with approval by Dindorf in the preface to his edition: "Fuit aulicus adulator et versipellis, vanus jactator philosophiæ suæ, specie magis quam re cultæ, ineptus et ridiculus vexator et applicator Homeri et veteris historiæ, tautologus et sophista; in omnibus orationibus pæne eadem, et ubique argutiæ longe petitæ.") Themistius's paraphrases of the *De Cælo* and of book Λ of the *Metaphysics* have reached us only through Hebrew versions.

The first edition of Themistius's works (Venice, 1534) included the paraphrases and eight of the orations. Nineteen orations were known to Petavius, whose editions appeared in 1613 and 1618. Harduin (Paris, 1684) gives thirty-three. Another oration was discovered by Angelo Mai, and published at Milan in 1816. The most recent editions are W. Dindorf's of the orations (Leipsic, 1832) and L. Spengel's of the paraphrases (Leipsic, 1866). The Latin translations of the Hebrew versions of the paraphrases of the *De Cælo* and book Λ of the *Metaphysics* were published at Venice in 1574 and 1558 respectively. See Fabricius, *Bibliotheca Græca*, vi. 799 *sq.*

THEMISTOCLES was born in the latter part of the 6th century B.C., some time during the rule of the Pisistratidæ at Athens, the son of an Athenian father, Neocles, by a foreign woman from Thrace or Caria. A wayward, ambitious, aspiring boy, out of sympathy alike with ordinary boyish amusements and with the learning and culture of the age, he was told, it is said, by his schoolmaster "that he would certainly be something great, whether good or bad." The victory of Marathon in 490 stirred the young man's soul, and he seems to have foreseen that it was but the beginning of a yet greater conflict. He resolved from that time to make his country great, that he might be great and famous himself. As he was rising to political distinction, he had for his rival the Greek "Cato," the incorruptible Aristides, a purer patriot, a better citizen, but a less sagacious and far-seeing statesman. The two men were in sharp antagonism as to what their country's policy should be, and it ended in a vote of ostracism which sent Aristides into temporary banishment in 483. The main question between them probably was whether Athens should seek greatness by sea or by land (see vol. xi. p. 99), and the victory of the policy of Themistocles led on to the most brilliant era in Greek history, the maritime supremacy of Athens. Persia, he felt sure, was meditating a great revenge, and Athens must make herself a naval power to avert the blow. Already a small war with the Æginetan islanders, close to her own shores, had roused her energies, and at the prompting of Themistocles she had built 200 ships and trained a number of seamen. In 480 the storm which Themistocles had clearly foreseen burst; the great king, as he was called, was covering the land with his troops and the sea with his ships. Greece was divided and panic-stricken; Thessaly and all to the north of Bœotia had joined the enemy, and the despair of the remainder of the Greek world was echoed by the oracle of Delphi. There was, however, a word of hope in the memorable phrase of the "wooden wall,"[1] which, it was generally felt, must point to the fleet, more, however, with a view to flight than to resistance. Salamis, too, was named in the oracle, coupled with the epithet "divine," which Themistocles cleverly argued portended disaster to the enemies of the Greeks rather than to the Greeks themselves. It was a great achievement when he finally prevailed on his fellow-citizens to quit their city and their homes—it seemed for ever—and to trust themselves to their ships. There had been some sea-fights off the northern shores of Eubœa; the Spartans had fallen at Thermopylæ, and Xerxes and his host were now laying waste Attica, not, however, before its inhabitants had conveyed their families to the adjacent island of Salamis, where also the Greek fleet had taken up its station, the Persian armada of 1200 vessels being in harbour at Phalerum. The Athenians from their ships saw the flames in which their city, its acropolis and its temples, were perishing, but their spirits rose with calamity, and with one heart, at the bidding of Themistocles, they called back all of their brethren who were in temporary banishment, Aristides among them. Nearly two-thirds of the entire fleet was theirs, but for the sake of unity among the allies, who would follow only the lead of Sparta, they acquiesced in its being under the command of a Spartan admiral. It was clear, however, that the fate of Greece now depended on the action of the Athenians and on the prudence and ability of Themistocles, by whom they were guided. The Greeks of the Peloponnese, more particularly the Corinthians, were for moving the fleet from Salamis to the isthmus, as the enemy's land forces were already in possession of the neighbouring shores of Attica. Seeing the danger of yet further disunion, with the probable result of the breaking up and dispersion of the fleet, and having in vain protested against quitting their present station, Themistocles went straight to the Spartan admiral, Eurybiades, and induced him to call another council. There was much angry debating, till at last the Spartan felt he must yield to the threat of Themistocles that the Athenians would either fight at Salamis or sail away as they were to Italy. But the Peloponnesian Greeks were still dissatisfied, and insisted that they ought to be at the isthmus for the defence of what yet remained of Greece; a third council was held, and Themistocles felt that its decision would be against him, when, by a sudden happy thought, he contrived to have a secret message conveyed to the commanders of the Persian fleet through his slave, an Ionian Greek from Asia, a man of intelligence and education, and well acquainted with the Persian language. The communication came in the name of Themistocles, who professed that he wished well to the king, and that now was a good opportunity for attacking and crushing the Greeks, as they were divided among themselves and were bent on flight. The stratagem was successful, and the enemy's great armada advanced along the coast of Attica that same night, and took up a position which effectually confined the Greek fleet within the narrow[1] strait between Salamis and the southern shore of Attica. The Greek captains, not knowing the state of the case, were still wrangling through the night, when just before daybreak the banished Aristides came from Ægina with the news that the Persian fleet was close at hand and that retreat was impossible. "Let us still be rivals," he said to Themistocles, "but let our strife be which can best save our country."

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[1] "The wooden wall shall alone remain unconquered to defend you and your children."

The great victory of Salamis (see vol. xi. p. 100) left Greece mistress of the sea, and was followed by the retreat of Xerxes. Themistocles, it is said, frightened the king back to Asia by another secret message, to the effect that the victorious Greeks were bent on following him up to the Hellespont and burning his bridge of boats, but that he was doing his best to check their ardour, though in reality he had himself advised immediate pursuit of the enemy. We cannot but admire the man's sagacity and far-sightedness in thus laying the king under an obligation which he might some day turn to his own profit, though we cannot but feel that he had some of the worst as well as some of the most splendid characteristics of the Greek. After the victory Themistocles sailed with the Athenian squadron through the Ægean, and from some of the islanders who had sided with the enemy he exacted heavy fines, out of which, it appears, he filled his own purse. When the Greeks met at the isthmus to decide according to custom the prizes of merit for the glorious day of Salamis, he received only the second prize, the first being awarded to the Spartan admiral, but by way of compensation he was soon afterwards heartily welcomed at Sparta, and loaded with honours so extraordinary as to imply that even the Spartans themselves recognized him as the first man in Greece. It was not long, however, before he gave them deadly offence. After the victories of Platæa and Mycale in 479 the Athenians went back to their desolate city and began to rebuild and fortify it. Jealous fears of the growing power of Athens were awakened, and the Spartans, as representatives of the Greeks generally, formally protested against the fortification of a Greek city outside the Peloponnese, on the ground that some future Persian invader might make it a base of operations. Themistocles saw the dangers of Spartan opposition, and got the Athenians to commission him to arrange matters along with two other envoys, who, however, were purposely not allowed to arrive at Sparta at the same time as himself. He told the Spartan magistrates that before he could transact business with them he must wait for his colleagues; meanwhile Athens was being fortified, every man, woman, and child putting a hand to the work, and as soon as Themistocles understood that it was sufficiently advanced he declared openly that Athens would brook no sort of interference. The Spartans felt they had been tricked, but they could do nothing. And now Themistocles proceeded to fortify Piræus, and to enlarge the harbour, thus providing Athens with an excellent naval dockyard, and holding out an inducement to foreigners to settle in the city for the purposes of trade. Twenty war ships, too, were at his suggestion to be built every year, and nothing left undone to make Athens prosperous and powerful.

A few years afterwards (in 471 probably) we find his political career terminated by a vote of ostracism, due perhaps in part to Spartan influence at Athens, and also to an offensive boastfulness and ostentation which disgusted the sensitive Athenian democracy. He was even charged with corrupt practices and with receiving bribes from Persia. From Argos, whither he had retired as an exile, he was forced to flee by a threat of the Spartans, who alleged that they had proofs of his treasonable complicity in the schemes of their countryman Pausanias, and to take refuge in the island of Corcyra; but here again he was pursued by Spartan and Athenian commissioners, and driven to seek the protection of Admetus, king of the Molossians, the chief people of Epirus. In the court of this half-Greek half-barbarian prince he found a hospitable reception, and he was furnished with the means of crossing the Ægean to Ephesus. Shortly after his arrival in Asia, the son of Xerxes, Artaxerxes, succeeded to the throne of Persia, and to him Themistocles contrived to make himself known as a fugitive from ungrateful Greece, which he had saved, and now ready and willing to advise and assist the king in avenging his father's defeat. He was treated, it is said, with marked respect, and was liberally pensioned with the revenues of three wealthy towns—Magnesia, Myus, and Lampsacus. It was at the first of these, which was near the coast, and whence he might be supposed to have opportunities for watching the affairs of Greece, that he passed the last year of his life, dying a natural death at the age of 65. The year of his death is not accurately ascertainable; opinions vary between 460 and 447.

Herodotus, Thucydides, and Plutarch are our chief original sources for the life of Themistocles. The subject is fully treated in the histories of Grote and Thirlwall. (W. J. B.)

THÉNARD, Louis Jacques (1777–1857), was born on the 4th of May 1777, at Louptière, near Nogent-sur-Seine, in Champagne. His father, though a poor man, sent him to the academy of Sens, where he received a liberal education. At the age of sixteen he went to Paris to study pharmacy. He attended the lectures of Fourcroy and Vauquelin, and saw that the only way to learn chemistry was to work at it. Vauquelin, himself a poor man, admitted a few students to his laboratory on payment of a fee of 20 francs a month. But this fee was prohibitory to the peasant's son; the utmost that his father could send him just kept him alive in Paris. Thénard went to Vauquelin and asked to be allowed to do any menial work for him, if only he would let him assist in his laboratory. One of Vauquelin's sisters had slipped into the room and heard part of the conversation; she said to her brother, "He is a good lad; you should keep him; he will help you in the laboratory, and look after our *pot au feu*; your dandy assistants always let it boil." Thénard was engaged on these terms. Long afterwards he said that he looked upon the chemistry of the *pot au feu* and the process of simmering as of very great importance: they had been the turning-point of his life. Thénard assisted Vauquelin in the laboratory and at his lectures, and, when by starving for a day or two he accumulated sous enough to pay for a seat in the gallery, used to go to the theatre to improve his pronunciation and rub off his rustic accent.

By and by Vauquelin gave him an opportunity of testing his powers as a lecturer. Having to go for some days to the country, he asked Thénard to take his place. For the first two or three lectures his attention was fixed on his work, and his eyes did not wander from the lecture table. On the fifth day he ventured to look round the room, when to his consternation he saw Fourcroy and

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[1] Not more than a quarter of a mile wide in its narrowest part.

Vauquelin among the audience. They were so satisfied with what they had heard that they obtained for Thénard in 1797 an appointment as teacher of chemistry in a school, and in 1798 the post of repétiteur at the École Polytechnique.

In 1804 Vauquelin resigned the professorship of chemistry at the Collége de France, and successfully used his influence to have Thénard appointed. In 1810 he succeeded Fourcroy both as professor of chemistry at the École Polytechnique and as member of the Academy. He was also appointed professor of chemistry in the faculty of the sciences. He was made a chevalier of the Legion of Honour in 1814, commander in 1837, and grand officer in 1842. In 1825 Charles X. gave him the title of baron; from 1827 to 1830 he represented the department of Yonne in the chamber of deputies. In 1832 Louis Philippe made him a peer of France. As vice-president of the conseil supérieure de l'instruction publique, he exercised a great influence on scientific education in France. He died 21st June 1857, and was buried at La Ferte, near Châlon-sur-Saône. In 1861 a statue was erected to him at Sens, and in 1865 the name of his native village was changed to La Louptière-Thénard. Thénard was tall and strongly built, his hair was thick and black, his eyes bright, and his manner active and prompt. He married, in 1810, Mlle. Humblot, granddaughter of Conté. His wife and several of his children predeceased him. He was survived by his son Paul, who had assisted him in some of his later researches.

Thénard was above all things a teacher: as he himself said, the professor, the assistants, the laboratory, everything, must be sacrificed to the students. The history of his discovery of the peroxide of hydrogen well illustrates the predominance of the teacher in his character. He was lecturing on the formation of salts, and had told his students that a metal must be oxidized to a certain extent in order that it may combine with an acid to form a salt; if the metal be combined with more than the proper quantity of oxygen, the excess of oxygen will be given off when the oxide is treated with an acid, and, as an illustration, he mentioned the action of acids on peroxide of barium. As he spoke his conscience smote him, for the experiment had not been made. Immediately after lecture he mixed peroxide of barium and nitric acid, keeping the temperature low by means of ice. He was surprised to see the peroxide dissolve without any evolution of gas. He left the mixture standing, and next day, before lecture, noticed small bubbles of gas rising from it. Pouring some of the liquid into a test-tube and warming it, he saw a large amount of gas escape, which he easily recognized as pure oxygen. At first he thought the acid had been oxidized, but he soon saw the true explanation of the phenomena, and discovered the peroxide of hydrogen. His lecture experiments were few, well-chosen, and accurately performed. If any failure occurred he would roundly scold his assistant, often apologizing for his vehemence when the short fit of anger was over. His lecture room, seated for 1000, was almost always crowded by eager and attentive students and visitors.

Like most great teachers, Thénard published a text-book, and perhaps we may say that by his *Traité de Chimie Élémentaire, Théorique et Pratique* (4 vols., Paris, 1813–16; 6th ed., 5 vols., 1833–36) he did even more to further the progress of the science than by his numerous and important original discoveries. His first original paper (1799) was on the compounds of arsenic and antimony with oxygen and sulphur. Careful analyses led him to conclusions as to the composition of the metallic oxides contradictory of some of Berthollet's theoretical views; he also showed (1802) that Berthollet's "zoonic acid" was impure acetic acid. Berthollet, far from resenting these corrections from a younger man, took this opportunity of introducing himself, and invited Thénard to become a member of the "Société d'Arcueil," to the proceedings of which Thénard contributed important papers. Soon after his appointment as repétiteur at the École Polytechnique Thénard made the acquaintance of Gay-Lussac, and formed with him a lifelong friendship. Their joint work, and its relation to the discoveries of Davy, have been fully recorded in the article GAY-LUSSAC. Of his separate investigations perhaps the most important is that on the compound ethers, begun in 1807. He showed that each acid gives its own ether, and that the acid and alcohol can be recovered by decomposing the ether by means of caustic alkali. His discovery of peroxide of hydrogen (1818) has already been described. His researches on sebacic acid (1802) and on bile (1807) also deserve special notice. The blue substance known as Thénard's blue (essentially aluminate of cobalt) was prepared by him in response to a demand by Chaptal for a cheap blue, as bright as ultramarine, and capable of standing the temperature of the porcelain furnace

Thénard's researches were chiefly published in the *Annales de Chimie et de Physique*, in the *Memoires de la Société d'Arcueil*, and in the *Comptes Rendus* and the *Memoires* of the Academy of Sciences. (A. C. B.)

THEOBALD, LEWIS (1688–1744), will survive as the prime butt of the original *Dunciad* when as a playwright, a littérateur, a translator, and even as a Shakespearean commentator, he will be entirely forgotten. The son of an attorney, Theobald was born at Sittingbourne, in Kent, in 1688, and, after a moderate education at Isleworth, studied for the profession of law,—a profession, however, which he never practised. He was a man with literary impulses, but without genius, even of a superficial kind; as a student, as a commentator, he might have led a happy and enviable life, had not the vanity of the literary idea led him into a false position. His *Persian Princess* (1711) and his *Electra* (1714) gained no distinction. In 1726 *The Double Falsehood* had a certain vogue, partly from Theobald's pretence that the greater part of the play was by Shakespeare. In 1717 he commenced a series of papers (not to "The Censor," as has sometimes been stated, but under that title) which appeared in Mist's *Weekly Journal*; these do not seem to have been highly thought of by his contemporaries, but they were successful in gaining for Theobald not a few enemies, among whom Dennis may be named. Seven or eight years later Theobald's censorious tendencies had intensified rather than moderated, and in 1726 he ventured to attack the most eminent literary man of the day in his *Shakespear Restored, or a Specimen of the many Errors as well committed as unamended by Mr Pope in his edition of this Poet*. Two years later the censor was himself castigated severely, and, as the dedicatee of *The Dunciad*, he had long an unenviable notoriety; as readers of the famous satire will remember, he occupied the place of chief victim until replaced by Colley Cibber in 1743. In the matter of Shakespeare editing, however, he had the advantage of his powerful rival. When in 1733 Theobald published his edition of Shakespeare in seven volumes, that of Pope had to go to the wall. Lewis Theobald wrote other dramas besides those already mentioned, and translated plays from Sophocles and Aristophanes, besides a rendering of Plato's *Phædo* and a part translation of the *Odyssey*; but for none of these things is he now remembered. The student of English history might find it worth while to glance through Theobald's *Life of Raleigh* (1719). He died in 1744.

For plays, &c., see the *Biographia Dramatica*, vol. i.

THEOCRITUS, of Syracuse, the foremost Greek pastoral poet, lived a life of which nothing is known except from allusions in his own works. The epigram appended to his poems makes him say, "I am a Syracusan, a man of the people, a son of Praxagoras and Philinna." He must have been born early in the 3d century, among a Dorian people, whose Dorian speech survives in his rural idyls. These "little pictures" chiefly represent the life of shepherds, neat-herds, and fishermen in the woods and on the shores of Sicily. They are doubtless inspired by the popular poetry of his time, and have much in common with the Romaic chants of the modern Greek shepherds. The first idyl is a song on Daphnis, the ideal herdsman, sung by the shepherd Thyrsis to a goatherd. The second is the magical chant which Simætha pours forth to the magic moon, in the hope of recovering her lover. In the third a goatherd sings to his love, Amaryllis. The fourth is an interchange of rude banter between two country fellows; and the fifth is of the same kind. The scenes are in southern Italy. The sixth is a Sicilian singing match between two ideal herdsmen,—not contemporary rustics, but poets of nobler themes. The scene of the seventh is in Cos, where the poet introduces himself at a singing match. He may have been attached to the Asclepian medical school in Cos; his friend Nicias was a physician. Sicily and rival minstrels occupy the ninth idyl. The tenth contains probably some real popular ditties, chanted by the reapers. The eleventh, addressed to Nicias, is a piece of artificial mythological *genre*, "The Cyclops in Love." The twelfth is a lyric, almost of passionate affection. The thirteenth is another idyl on a mythical topic, the adventures of Hercules and Hylas. The fourteenth and fifteenth are sketches of military and urban life, the mercenary soldier in love, and the gathering at the Adonis feast in Alexandria. Theocritus had wandered to the court of Ptolemy, and joined the literary society of his court. The sixteenth is a patriotic piece: the poet urges Hiero to assail the Carthaginians in Sicily. The seventeenth is a conventional hymn to Ptolemy Philadelphus on his marriage with his sister. The eighteenth is an epithalamium; the nineteenth a tiny picture of Eros stung by a bee; the twentieth is the complaint of a herdsman rejected by a girl of the town; the twenty-first an idyl of fisher life: two poor old fishermen recount their dreams. The twenty-second idyl is a piece of heroic myth, the adventures of Castor and Polydeuces; and the twenty-fourth is a tiny epic on the infancy of Hercules. The twenty-third is an amorous complaint. The twenty-fifth describes the slaughter by Hercules of the Nemean lion. The twenty-sixth justifies, in the interests of the ritual of Dionysus, the murder of the curious Pentheus. The twenty-seventh is the "Wooing of Daphnis," or "Oaristys," an amorous discourse between a girl and a swain. The twenty-eighth is a graceful piece of *vers de société*, sent to a lady with the gift of an ivory distaff. The twenty-ninth is amorous; and there remain an imperfect and a spurious piece, and a set of twenty-three epigrams.

On a general view, Theocritus's surviving poems turn out to be—(1) rural idyls, the patterns of Virgil's eclogues, and of all later pastoral poetry; (2) minute epics, or cabinet pictures from mythology; (3) sketches of contemporary life in verse; (4) courtly compositions; and (5) expressions of personal kindliness and attachment. The first category and the third are those on which the fame of Theocritus depends. His verse has a wonderful Doric melody; his shepherds are natural Southern people: it is not his fault that what he wrote truly of them has become a false commonplace in the pastoral poetry of the North.

Of Theocritus's own life we only know what has been recorded, that he lived in Syracuse, Cos, and Alexandria, and that he was acquainted with Nicias, with Aratus, the astronomical writer, and with Philinus, head of a school or sect of physicians. The rest is silence or conjecture. Suidas says that, in addition to the surviving poems, the *Prœtidæ*, the *Hopes*, *Hymns*, the *Heroines*, *Dirges*, *Elegies*, and *Iambics* were attributed to him.

The charm of Theocritus can only be tasted in his original Doric, but the best English version is by Mr C. S. Calverley. M. Couat's book on the Alexandrine school of poetry may be recommended. J. Hauler, *De Theoc. Vita et Carminibus* (Freiburg, 1856), Hempel, *Quæst. Theoc.* (Kiel, 1881), and Rannow, *Studia Theocritea* (Berlin, 1886), may also be found useful. The best English edition of the poems is that of Bishop Wordsworth. (A. L.)

THEODOLITE. See Surveying.

THEODORA, the wife of the emperor Justinian (*q.v.*), was born probably in Constantinople, though according to some in Cyprus, in the early years of the 6th century, and died in 547. We shall first give the usually received account of her life and character, and then proceed to inquire how far this account deserves to be accepted. According to Procopius, our chief, but by no means a trustworthy authority for her life, she was the daughter of Acacius, a bear-feeder of the amphitheatre at Constantinople to the Green Faction, and while still a child was sent on to the stage to earn her living in the performances called mimes. She had no gift for either music or dancing, but made herself notorious by the spirit and impudence of her acting in the rough farces, as one may call them, which delighted the crowd of the capital. Becoming a noted courtesan, she accompanied a certain Hecebolus to Pentapolis (in North Africa), of which he had been appointed governor, and, having quarrelled with him, betook herself first to Alexandria, and then back to Constantinople through the cities of Asia Minor. In Constantinople (where, according to a late but apparently not quite groundless story, she now endeavoured to support herself by spinning, and may therefore have been trying to reform her life) she attracted the notice of Justinian, then patrician, and, as the all-powerful nephew of the emperor Justin, practically ruler of the empire. He desired to marry her, but could not overcome the opposition of his aunt, the empress Euphemia. After her death (usually assigned to the year 523) the emperor yielded, and, as a law, dating from the time of Constantine, forbade the marriage of women who had followed the stage with senators, this law was repealed. Thereupon Justinian married Theodora, whom he had already caused to be raised to the patriciate. They were some time after (527) admitted by Justin to a share in the sovereignty; and, on his death four months later, Justinian and Theodora became sole rulers of the Roman world. He was then about forty-four years of age, and she some twenty years younger. Procopius relates in his unpublished history (Ἀνέκδοτα) many repulsive tales regarding Theodora's earlier life, but his evident hatred of her, though she had been more than ten years dead when the *Anecdota* were written, and the extravagances which the book contains, oblige us to regard him as a very doubtful witness. Some confirmation of the reported opposition of the imperial family to the marriage has been found in the story regarding the conduct of Justinian's own mother Vigilantia, which Nicholas Alemanni, the first editor of the *Anecdota*, in his notes to that book, quotes from a certain "Life of Justinian," by Theophilus, to which he frequently refers, without saying where he found it. Since the article Justinian (*q.v.*) was published, the present writer has discovered in Rome what is believed to be the only MS. of this so-called life of Justinian; and his examination of its contents, which he has lately published, makes him think it worthless as an authority. See article Theophilus.

Theodora speedily acquired unbounded influence over her husband. He consulted her in everything, and allowed her to interfere directly, as and when she pleased, in the government of the empire. She had a right to interfere, for she was not merely his consort, but empress regnant, and as such entitled equally with himself to the exercise of all prerogatives. In the most terrible crisis of Justinian's reign, the great Nika insurrection of 532, her courage and firmness in refusing to fly when the rebels were attacking the palace saved her husband's crown, and no doubt strengthened her command over his mind. Officials took an oath of allegiance to her as well as to the emperor (*Nov.* viii.). She even corresponded with foreign ambassador and instructed Belisarius how to deal with the popes.

copius describes her as acting with harshness, seizing on trivial pretexts persons who had offended her, stripping some of their property, throwing others into dungeons, where they were cruelly tortured or kept for years without the knowledge of their friends. The city was full of her spies, who reported to her everything said against herself or the administration. She surrounded herself with ceremonious pomp, and required all who approached to abase themselves in a manner new even to that half-Oriental court. She was an incessant and tyrannical match-maker, forcing men to accept wives and women to accept husbands at her caprice. She constituted herself the protectress of faithless wives against outraged husbands, yet professed great zeal for the moral reformation of the city, enforcing severely the laws against vice, and immuring in a "house of repentance" on the Asiatic side of the Bosphorus five hundred courtesans whom she had swept out of the streets of the capital. How much of all this is true we have no means of determining, for it rests on the sole word of Procopius. But there are slight indications in other writers that she had a reputation for severity.

In the religious strife which distracted the empire Theodora took part with the Monophysites, and her coterie usually contained several leading prelates and monks of that party. As Justinian was a warm upholder of the decrees of Chalcedon, this difference of the royal pair excited much remark and indeed much suspicion. Many saw in it a design to penetrate the secrets of both ecclesiastical factions, and so to rule more securely. In other matters also the wife spoke and acted very differently from the husband; but their differences do not seem to have disturbed either his affection or his confidence. The maxim in Constantinople was that the empress was a stronger and a safer friend than the emperor; for, while he abandoned his favourites to her wrath, she stood by her protégés, and never failed to punish any one whose heedless tongue had assailed her character.

Theodora bore to Justinian no son, but one daughter,—at least it would seem that her grandson, who is twice mentioned, was the offspring of a legitimate daughter, whose name, however, is not given. According to Procopius, she had before her marriage become the mother of a son, who when grown up returned from Arabia, revealed himself to her, and forthwith disappeared for ever; but this is a story to be received with distrust. That her behaviour as a wife was irreproachable may be gathered from the fact that Procopius mentions only one scandal affecting it, the case of Areobindus. Even he does not seem to believe this case, for, while referring to it as a mere rumour, the only proof he gives is that, suspecting Areobindus of some offence, she had torture applied to this supposed paramour. Her health was delicate, and, though she took all possible care of it, frequently quitting the capital for the seclusion of her villas on the Asiatic shore, she died comparatively young. Theodora was small in stature and rather pale, but with a graceful figure, beautiful features, and a piercing glance. There remains in the apse of the famous church of St Vitale at Ravenna a contemporaneous mosaic portrait of her, to which the artist, notwithstanding the stiffness of the material, has succeeded in giving some character.

The above account is in substance that which historians of the last two centuries and a half have accepted and repeated regarding this famous empress. But it must be admitted to be open to serious doubts. Everything relating to the early career of Theodora, the faults of her girlhood, the charges of cruelty and insolence in her government of the empire, rest on the sole authority of the *Anecdota* of Procopius,—a book whose credit is shaken by its bitterness and extravagance. If we reject it, little is left against her, except of course that action in ecclesiastical affairs which excited the wrath of Baronius, who had denounced her before the *Anecdota* were published.

In favour of the picture which Procopius gives of the empress it may be argued (1) that she certainly did interfere constantly and arbitrarily in the administration of public affairs, and showed herself therein the kind of person who would be cruel and unscrupulous in her choice of means, and (2) that we gather from other writers an impression that she was harsh and tyrannical, as, for instance, from the references to her in the lives of the popes in the *Liber Pontificalis* (which used to pass under the name of Anastasius, the papal librarian). Her threat to the person whom she commanded to bring Vigilius to her was "nisi hoc feceris, per Viventem in sæcula excoriari te faciam." Much of what we find in these lives is legendary, but they are some evidence of Theodora's reputation. Again (3) the statute (*Cod.*, v. 4, 23) which repeals the older law so far as relates to *scenicas mulieres* is now generally attributed to Justin, and agrees with the statement of Procopius that an alteration of the law was made to legalize her marriage. There is therefore reason for holding that she was an actress, and, considering what the Byzantine stage was (as appears even by the statute in question), her life cannot have been irreproachable.

Against the evidence of Procopius, with such confirmations as have been indicated, there is to be set the silence of other writers, contemporaries like Agathias and Evagrius, as well as such later historians as Theophanes, none of whom repeat the charges as to Theodora's life before her marriage. To this consideration no great weight need be attached. It is difficult to establish any view of the controversy without a long and minute examination of the authorities, and in particular of the *Anecdota*. But the most probable conclusions seem to be—(1) that the odious details which Procopius gives, and which Gibbon did not blush to copy, deserve no more weight than would be given nowadays to the malignant scandal of disappointed courtiers under a despotic government, where scandal is all the blacker because it is propagated in secret (see PROCOPIUS); (2) that apparently she was an actress and a courtesan, and not improbably conspicuous in both those characters; and (3) that it is impossible to determine how far the specific charges of cruelty and oppression brought against her by Procopius deserve credence. We are not bound to accept them, for they are uncorroborated; yet the accounts of Justinian's government given in the *Anecdota* agree in too many respects with what we know *aliunde* to enable us to reject them altogether; and it must be admitted that there is a certain internal consistency in the whole picture which the *Anecdota* present of the empress. About the beauty, the intellectual gifts, and the imperious will of Theodora there can be no doubt, for as to these all our authorities agree. She was evidently an extraordinary person, born to shine in any station of life.

Her fortunes have employed many pens. Among the latest serious works dealing with them may be mentioned M. Antonin Débidour's *L'Impératrice Theodora: Étude Critique*, Paris, 1885, which endeavours to vindicate her from the aspersions of Procopius; and among more imaginative writings are Sir Henry Pottinger's interesting romance *Blue and Green* (London, Hurst and Blackett, 1879), M. Rhangabé's tragedy Θεοδώρα (Leipsic, 1884), and M. Sardou's play *Theodora*, produced in Paris in 1884. See also Dr F. Dahn's *Prokopios von Cäsarea*, 1865. (J. BR.)

THEODORE OF MOPSUESTIA, the most eminent representative of the so-called school of Antioch, the beginnings of which date from about the middle of the 3d century (see LUCIAN and PAUL OF SAMOSATA). He was born at Antioch about the middle of the 4th century, and was a friend of Chrysostom; in rhetoric the celebrated Libanius was his teacher. Soon, however, he attached himself to the school of the great exegete and ascetic, Diodorus, a presbyter in Antioch, and, with only a transitory period of vacillation, he ever afterwards remained faithful to the theology and ascetic discipline of this master. Under Diodorus he became a skilful exegete, and ultimately the pupil outstripped the master in Biblical learning. About 383 Theodore became a presbyter in Antioch, and began to write against Eunomius the Arian and against the christology of Apollinaris. Soon after 392 he became bishop of Mopsuestia in Cilicia (the modern Missis near Adana). As such he was held in great respect, and took part in several synods, with a reputation for orthodoxy that was never questioned. It was greatly to his advantage that in the Eastern Church the period between the years 390 and 428 was one of comparative repose. He was on friendly terms even with Cyril of Alexandria. He died in 428 or 429, towards the beginning of the Nestorian controversy.

Theodore was a very prolific writer, but, before all, an exegete. He wrote commentaries on almost every book of the Old and New Testaments, of which, however, only a small proportion is now extant, as at a later period he lost credit in the church. We still possess in Greek his commentary on the Minor Prophets, and in Latin translations commentaries on the minor Pauline epistles, besides very many fragments, especially of that on the epistle to the Romans. Theodore's importance as an exegete lies in two characteristics:—(1) in opposition to the allegorical method he insists on getting at the literal meaning, and adheres to it when found; (2) in his interpretation of the Scriptures he takes into account the historical circumstances in which they were produced, and substitutes the historical-typological for the pneumatico-christological interpretation of prophecy; in other words, he interprets all Old Testament passages historically in the first instance, and sees the fulfilment of Old Testament prophecy in the history of Christ and His church only in so far as the entire Old Testament is a "shadow of things to come." Following his master Diodorus, who had already written a treatise *Τίς διαφορὰ θεωρίας καὶ ἀλληγορίας*, Theodore also was the author of a special dissertation against the allegorists, *i.e.*, against Origen and his followers, which, however, has unfortunately perished. The comparative freedom of Theodore's view of inspiration is also noteworthy. He discriminates between historical, prophetical, and didactic writings, and in accordance with this distinction assumes varying degrees of inspiration. Finally, he entertained very bold opinions about the canon and several of the books included in it. He esteemed very lightly the Solomonic writings and the book of Job; Canticles he explained as a nuptial poem of Solomon's; the book of Job appeared to him in many places hardly worthy of its subject, and he censures the writer sharply; Chronicles, Ezra, and Nehemiah he entirely rejected; he denied the accuracy of the titles of the Psalms, and referred the so-called Messianic element almost invariably to the kings of Israel; he even criticized the catholic epistles and rejected the epistle of James. His commentaries contain a great deal of learned matter, and his grammatico-historical observations are still to some extent useful. But, on the other hand, his learning must not be overestimated. It falls behind that of Origen, Eusebius, and Jerome, notwithstanding the superiority of his method. It is specially noticeable that Theodore troubled himself little about textual criticism. He simply accepts the text of the LXX. as that of revelation, and never manifests the slightest effort to control it by the original or by the Syriac.

But in addition to his commentaries Theodore also wrote extensive dogmatico-polemical works, which were destined to operate long after his death disastrously for his fame. As a disciple of Diodorus, Theodore accepted the Nicene teaching on the doctrine of the Trinity, but at the same time in christology took up a position very closely approaching that of Paul of Samosata. The violence of his opposition to his fellow countryman, Apollinaris of Laodicea, perhaps the most acute and far-seeing theologian of the century, made it necessary for Theodore to formulate his christology with precision (in fifteen books on the Incarnation—all lost except a few fragments—and in special treatises against Apollinaris). He held the Logos to have assumed a complete manhood, which had to pass through the stages of ethical development just as in the case of any other human being. In this the Logos only supported the man Christ Jesus, but was not essentially connected with him; the Logos dwelt in him (*ἐνοικεῖν*), but any such thing as *ἕνωσις φυσική* did not and could not exist, because the finite is not "capax infiniti," and because any *ἕνωσις* would have destroyed the reality of the human nature. The same sober and thoughtful way of looking at things, and the same tendency to give prominence to the moral element, which characterize the commentaries of Theodore appear also in his dogmatic. When, accordingly, the Nestorian controversy broke out, his works also were dragged into the discussion. At Ephesus, indeed, the memory of Theodore does not appear to have been attacked,[1] but soon afterwards the assault began. Marius Mercator, Rabulas of Edessa, Cyril, and other monophysites brought the charge of heresy against his writings, and sought to counteract their influence. But it was not until more than a century afterwards that his fanatical adversaries succeeded—in spite of the strong opposition of the best theologians of the West—in obtaining from Justinian the condemnation of his works in the controversy of the Tria Capitula, as it is called; this act of the emperor was confirmed by the fifth œcumenical council, and Theodore's name was accordingly deleted from the list of orthodox writers. From that day Theodore's works ceased to be read within the Byzantine Church, and hence have been lost. The Syrians, on the other hand, have always held in high esteem the memory of the great teacher, and have even carried back their liturgy to his name. The Nestorians possess, or possessed, a very large number of writings by him in Syriac translations.[2]

Theodore took part also in the Pelagian controversy at the time when it raged in Palestine. In the treatise, only partially preserved,[3] *Πρὸς τοὺς λέγοντας φύσει καὶ οὐ γνώμῃ πταίειν τοὺς ἀνθρώπους*, he sharply controverts the doctrine of original sin and Jerome its advocate. In his view the theory of Augustine is "a new heresy," "a malady"; he regarded it as a doctrine which necessarily led to dualism and Manichæism. The attitude thus taken by Theodore is not surprising; he more nearly takes up the ground of the old church doctrine as set forth in the apologists and in the great Greek fathers of the 3d and 4th centuries. The Pelagians driven from the East were received by him in Cilicia.

A brother of Theodore, Polychronius by name, bishop of Apamea, also achieved fame as an exegete, and expounded the theology of the school of Antioch.[4]

Literature.—Migne, *Patrol.*, ser. Gr., lxvi. The Greek fragments of Theodore's New Testament commentaries have been collected by Fritzsche (*Theod. Mops. in N. T. Comm.*, Turin, 1847). The commentaries on the Pauline epistles (Pitra, *Spic. Solesm.*, i. 49 *sq.*) have been recognized by Jacobi (*Ztschr. f. christl. Wissensch.*, 1854) and Hort (*Journ. Class. and Sacr. Philol.*, iv., 1859, p. 302 *sq.*), and edited by Jacobi (Halle University *Programmes*, 1855–60). They have also been edited very admirably by Swete (*Theod. Mops. in Epp. B. Pauli Comm.*, i., ii., Cambridge, 1880–82), along with the Greek fragments and the fragments of the dogmatical writings, on this edition, see Schürer, *Theol. Lit. Ztg.*, 1880–82. The commentary on the Minor Prophets will be found in Mai's *Nov. Patr. Biblioth.*, vii. 1854 (Wegnern, Berlin, 1834; Mai, *Script. Vet. Nov. Coll.*, vi., 1832). See also Sachau, *Theod. Mops. Fragm. Syriaca*, Leipsic, 1869, and Bäthgen, "Der Psalmencommentar des Theod. v. Mops. in Syr. Bearbeitung," in *Ztschr. f. ATliche Wissensch.*, v. 53 *sq.* Extracts from the writings of Theodore occur in the *Catenæ* of Marius Mercator, in the *Acts* of the third and fifth œcumenical councils, in Facundus, Liberatus, and Theodore's chief adversary, Leontius Byzantinus.

The principal monograph on Theodore, apart from the excellent prolegomena of Swete, is that of Kihn (*Th. v. Mops. u. Junilius Afric. als Exegeten*, Freiburg, 1880). On his importance for the history of dogma, see the great works of Baur and Dorner. Upon the Antioch school in general, compare Münscher, *Comment. de Schola Antioch.*, Copenhagen, 1811; Hergenröther, *Die antioch. Schule*, 1866; and Kihn, *Die Bedeutung der antioch. Schule*, Eichstädt, 1866. Literary and biographical details will be found in Dupin, Tillemont, Cave, Fabricius, Noris, Garnier, Schröckh, Alzog; see also Fritzsche, *De Theod. Mops. Vita et Scriptis*, 1836; Sieffert, *Theod. Mops. Vet. Test. Sobrie Interpr. Vind.*, Ratisbon, 1827; Klener, *Symbol. Lit. ad Theod. M. pertin.*, Göttingen, 1836; Specht, *Theod. v. Mops. u. Theodoret*, Munich, 1871; Kihn in the *Tüb. Quartalschr.*, 1879; Nestle in *Theol. Stud. aus Wurtemb.*, ii. 210 *sq.*; and Batiffol, "Sur une Traduction Latine de Th. de Mops.," in *Ann. de Philos. Chrét.*, 1885. (A. HA.)

THEODORE, the name of two popes. Theodore I., pope from November 642 till May 649, succeeded John IV. He was the son of a bishop, and was born in Jerusalem. A zealous opponent of monothelitism, in the course of the protracted controversy he in a Roman synod excommunicated Pyrrhus, patriarch of Constantinople, and signed the document with ink mingled with consecrated wine. Theodore II. had a pontificate of only twenty days (Nov.–Dec. 897).

THEODORET, bishop of Cyrus, and an important writer in the domains of exegesis, dogmatic theology, church history, and ascetic theology, was born in Antioch, Syria, about 390. At an early age he entered the cloister; and in 423 he became bishop of Cyrus, or Cyrrhus, a small city between Antioch and the Euphrates, where, except for a short period of exile, he spent all the rest of his life. The date of his death is uncertain, but it must have been at least six or seven years later than the council of Chalcedon (451). Although thoroughly devoted to the ideals of monasticism, he discharged his episcopal duties with remarkable zeal and fidelity. He was diligent in the cure of souls, labouring hard and successfully for the conversion of the numerous Gnostic communities and other heretical sects which still maintained a footing within the diocese. He himself claims to have brought more than a thousand Marcionites within the pale of the church, and to have destroyed many copies of the *Diatessaron* of Tatian, which were still in ecclesiastical use; and he also exerted himself to improve the diocese, which was at once large and poor, by building bridges and aqueducts, beautifying the town, and similar works.

As an exegete Theodoret belongs to the Antiochene school, of which Diodorus of Tarsus and Theodore of Mopsuestia were the heads. He was not actually the personal disciple of either, but he adopted their methods, though without the consistency and boldness of the first-named. His extant commentaries (those on Canticles, on the Prophets, on the book of Psalms, and on the Pauline epistles—the last the most valuable) are among the best performances of the fathers of the church. They are brief, yet not wanting in that element of practical edification on which Chrysostom lays special weight as characteristic of the Antiochenes. In addition to these complete commentaries, we have fragments of some others (of that on Isaiah, for example), principally met with in catenæ. There are also special elucidations of some difficult Scripture texts.

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[1] A confession, however, drawn up by him was spoken of; see Hahn, *Biblioth. der Symbole*, 2d ed., p. 229 *sq.*

[2] See the catalogue in Assemani, *Bibl. Or.*, iii. 1, p. 3 *sq.*

[3] See Photius, *Biblioth.*, c. 177; Mercator, p. 339 *sq.*, ed. Baluz.

[4] See Bardenhewer, *Polychronius*, Freiburg, 1879.

Theodoret's chief importance is as a dogmatic theologian, it having fallen to his lot to take part in the great monophysite-Nestorian controversy and to be the most considerable opponent of the views of Cyril and Dioscurus of Alexandria. For more than twenty years he maintained the struggle against the Alexandrian dogmatic and its formulæ (*θεοτόκος, ἕνωσις καθ' ὑπόστασιν, μία ὑπόστασις, ἕνωσις φυσική*, and the like), and taught that in the person of Christ we must strictly distinguish two natures (*hypostases*), which are united indeed in one person (*prosopon*), but are not amalgamated in essence. For these years his history coincides with that of the Eastern Church from 430 to 451, and for this very reason it is impossible to sketch it even briefly here (see Hefele, *Conc.-gesch.*, vol. ii.). The issue was not unfavourable to Theodoret's cause, but melancholy enough for Theodoret himself: the council of Chalcedon condemned monophysitism indeed, but he unhappily yielded to pressure so far as also to take part in pronouncing "anathema upon Nestorius, and upon all who call not the Holy Virgin Mother of God, and who divide the one Son into two." As Theodoret had previously been a constant defender of Nestorius, it was impossible for him to concur in this sentence upon his unfortunate friend with a clear conscience, and in point of fact he did not change his own dogmatic position. It is distressing, therefore, to find him in his subsequent *Epitome* classing Nestorius as a heretic, and speaking of him with the utmost hostility. Some of Theodoret's dogmatic works are no longer extant: of his five books Περὶ ἐνανθρωπήσεως, for example, directed against Cyril after the council of Ephesus, we now possess fragments merely. A good deal of what passes under his name has been wrongly attributed to him. Certainly genuine are the refutation (Ἀνατροπή) of Cyril's twelve *ἀναθεματισμοί* of Nestorius, and the Ἐρανιστής, or Πολύμορφος (written about 446), consisting of three dialogues, entitled respectively Ἄτρεπτος, Ἀσύγχυτος, and Ἀπαθής, in which the monophysitism of Cyril is opposed, and its Apollinarian character insisted on. Among the apologetico-dogmatic works of Theodoret must be reckoned his ten discourses Περὶ προνοίας.

Theodoret gives a valuable exposition of his own dogmatic in the fifth book of his Αἱρετικῆς κακομυθίας ἐπιτομή, already referred to.[1] This, the latest of his works in the domain of church history (it was written after 451), is a source of great though not of primary importance for the history of the old heresies. In spite of the investigations of Volkmar and Hilgenfeld, we are still somewhat in the dark as to the authorities he used. The chief uncertainty is as to whether he knew Justin's *Syntagma*, and also as to whether he had access to the *Philosophumena* of Hippolytus in their complete form. Besides this work Theodoret has also left us a church history in five books, from 324 to 429, which was published shortly before the council of Chalcedon. The style is better than that of Socrates and Sozomen, as Photius has remarked, but as a contribution to history the work is inferior in importance. It is probable that its author was acquainted with the labours of Socrates; he appears also to have used those of Philostorgius the Arian, but not those of Sozomen. Something indeed still remains to be cleared up as to the sources he employed; apart, however, from some documents he has preserved, relating to the Arian controversy, he does not contribute much that is not to be met with in Socrates. He made a thorough study of the writings of Athanasius for the work. As regards chronology he is not very trustworthy; on the other hand, his moderation towards opponents, not excepting Cyril, deserves recognition. The Ἑλληνικῶν θεραπευτικὴ παθημάτων (*De Curandis Græcorum Affectionibus*)—written before 438—is of an historical and apologetic character, very largely indebted to Clement of Alexandria and Eusebius; it aims at showing the advantages of Christianity as compared with Hellenism, and deals with the assaults of pagan adversaries. The superiority of the Christian faith both philosophically and ethically is set forth, the chief stress being laid on monachism, with which heathen philosophy has nothing to compare. Much prominence is also given to the cult of saints and martyrs.

On this side of his character, however, Theodoret can best be studied in the thirty ascetic biographies of his Φιλόθεος ἱστορία. This collection, which has been widely read, is a pendant to the *Historia Lausiaca* of Palladius and the monkish tales of Sozomen. For the East it has had the same importance as the similar writings of Jerome, Sulpicius, Severus, and Cassianus for the West. It shows that the "sobriety" of the Antiochene scholars can be predicated only of their exegesis; their style of piety was as exaggerated in its devotion to the ideals of monasticism as was that of their monophysite opponents. Indeed, one of the oldest leaders of the school, Diodorus of Tarsus, was himself among the strictest ascetics.

Nearly 200 letters of Theodoret have come down to us, partly in a separate collection, partly in the *Acta* of the councils, and partly in the Latin of Marius Mercator; they are of great value not only for the biography of the writer but also for the history of his diocese and of the church in general.

The edition of Sirmond (Paris, 1642) was afterwards completed by Garnier (1684), who has also written dissertations on the author's works. Schulze and Nösselt published a new edition (5 vols., Halle, 1769-74) based on that of their predecessors; a glossary was afterwards added by Bauer. The reprint will be found in vols. lxxx.-lxxxiv. of Migne, and considerable portions occur in Mansi.

Besides the earlier labours of Tillemont, Ceillier, Oudin, Du Pin, and Fabricius and Harless, see Schröckh, *Kirchengesch.*, vol. xviii.; Hefele, *Conc.-gesch.*, vol. ii.; Richter, *De Theodoreto Epp. Paul. Interprete*, Leipsic, 1822; Binder, *Études sur Théodoret*, Geneva, 1844; Stäudlin, *Gesch. u. Lit. der Kirchengesch.*, Hanover, 1827; Kihn, *Die Bedeutung der antioch. Schule*, 1866; Diestel, *Das A. T. in der christl. Kirche*, Jena, 1869; Specht, *Theodor v. Mopsuestia u. Theodoret v. Cyrus*, Munich, 1871; Roos, *De Theodoreto Clementis et Eusebii Compilatore*, Halle, 1883; Jeep, *Quellenuntersuch. z. d. griech. Kirchenhistorikern*, Leipsic, 1884; and Möller, art. "Theodoret," in Herzog-Plitt's *Realencykl.*, vol. xv. (A. HA.)

THEODORIC, king of the Ostrogoths (*c.* 454–526). Referring to the article GOTHS for a general statement of the position of this, the greatest ruler that the Gothic nation produced, we add here some details of a more personal kind. Theodoric was born about the year 454, and was the son of Theudemir, one of three brothers who reigned over the East Goths, at that time settled in Pannonia. The day of his birth coincided with the arrival of the news of a victory of his uncle Walamir over the sons of Attila. The name of Theodoric's mother was Erelieva, and she is called the concubine of Theudemir. The Byzantine historians generally call him son of Walamir, apparently because the latter was the best known member of the royal fraternity. At the age of seven he was sent as a hostage to the court of Constantinople, and there spent ten years of his life, which doubtless exercised a most important influence on his after career. Shortly after his return to his father (about 471) he secretly, with a *comitatus* of 10,000 men, attacked the king of the Sarmatians, and wrested from him the important city of Singidunum (Belgrade). In 473 Theudemir, now chief king of the Ostrogoths, invaded Mœsia and Macedonia, and obtained a permanent settlement for his people near Thessalonica. Theodoric took the chief part in this expedition, the result of which was to remove the Ostrogoths from the now barbarous Pannonia, and to settle them as "fœderati" in the heart of the empire. About 474 Theudemir died, and for the fourteen following years Theodoric was chiefly engaged in a series of profitless wars, or rather plundering expeditions, partly against the emperor Zeno, but partly against a rival Gothic chieftain, another Theodoric, son of Triarius.[2] In 488 he set out at the head of his people to win Italy from Odoacer. There is no doubt that he had for this enterprise the sanction of the emperor, only too anxious to be rid of so troublesome a guest. But the precise nature of the relation which was to unite the two powers in the event of Theodoric's success was, perhaps purposely, left vague. Theodoric's complete practical independence, combined with a great show of deference for the empire, reminds us somewhat of the relation of the old East India Company to the Mogul dynasty at Delhi, but the Ostrogoth was sometimes actually at war with his imperial friend. The invasion and conquest of Italy occupied more than four years (488–493). Theodoric, who marched round the head of the Venetian Gulf, had to fight a fierce battle with the Gepidæ, probably in the valley of the Save. At the Sontius (Isonzo) he found his passage barred by Odoacer, over whom he gained a complete victory (28th August 489). A yet more decisive victory followed on the 30th September at Verona. Odoacer fled to Ravenna, and it seemed as if the conquest of Italy was complete. It was delayed, however, for three years by the treachery of Tufa, an officer who had deserted from the service of Odoacer, and of Frederic the Rugian, one of the companions of Theodoric, as well as by the intervention of the Burgundians on behalf of Odoacer. A sally was made from Ravenna by the besieged king, who was defeated in a bloody battle in the Pine Wood. At length (26th February 493) the long and severe blockade of Ravenna was ended by a capitulation, the terms of which Theodoric disgracefully violated by slaying Odoacer with his own hand (15th March 493). See ODOACER.

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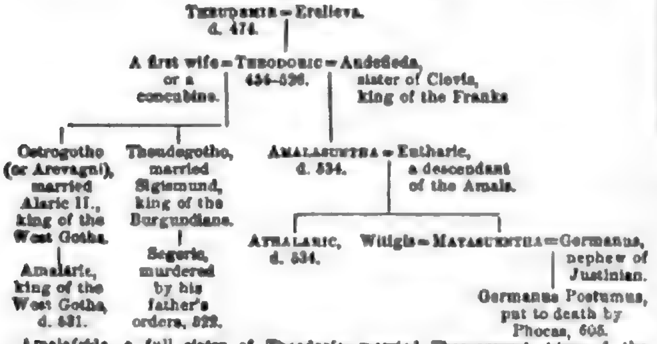
[1] Roman Catholic writers vary greatly in their estimate of Theodoret's christology and of his general orthodoxy. On the latest essay on this subject, by Bertram (*Theodoreti, Episcopi Cyrensis, Doctrina Christologica*, Hildesheim, 1883), see *Theol. Lit.-Ztung.*, 1883, 563 *sq.*

[2] In one of the intervals of friendship with the emperor in 483 Theodoric was made master of the household troops and in 484 consul.

The thirty-three years' reign of Theodoric was a time of unexampled happiness for Italy. Unbroken peace reigned within her borders (with the exception of a trifling raid made by Byzantine corsairs on the coast of Apulia in 508). The venality of the Roman officials and the turbulence of the Gothic nobles were sternly repressed. Marshes were drained, harbours formed, the burden of the taxes lightened, and the state of agriculture so much improved that Italy, from a corn-importing, became a corn-exporting country. Moreover Theodoric, though adhering to the Arian creed of his forefathers, was during the greater part of his reign so conspicuously impartial in religious matters that a legend which afterwards became current represented him as actually putting to death a catholic deacon who had turned Arian in order to win his favour. At the time of the contested papal election between Symmachus and Laurentius (496–502), Theodoric's mediation was welcomed by both contending parties. Unfortunately, at the very close of his reign (524), the emperor Justin's persecution of the Arians led him into a policy of reprisals. He forced Pope John to undertake a mission to Constantinople to plead for toleration, and on his return threw him into prison, where he died. Above all, he sullied his fame by the execution of Boetius and Symmachus (see BOETIUS). It should be observed, however, that the motive for these acts of violence was probably political rather than religious,—jealousy of intrigues with the imperial court rather than zeal on behalf of the Arian confession. Theodoric's death, which is said to have been hastened by remorse for the execution of Symmachus, occurred on 30th August 526. He was buried in the mausoleum which is still one of the marvels of RAVENNA (*q.v.*), and his grandson Athalaric, a boy of ten years, succeeded him, under the regency of his mother Amalasuntha.

Genealogy of Theodoric.


THEUDEMIR = Erelieva.
d. 474.
A first wife = THEODORIC = Audefleda,
or a concubine.
454–526.
sister of Clovis, king of the Franks
Ostrogotho (or Arevagni), married Alaric II., king of the West Goths.
Theudegotho, married Sigismund, king of the Burgundians.
AMALASUNTHA = Eutharic,
d. 534.
a descendant of the Amals.
Amalaric, king of the West Goths, d. 531.
Segeric, murdered by his father's orders, 522.
ATHALARIC, d. 534.
Witigis = MATASUNTHA = Germanus,
nephew of Justinian.
Germanus Postumus, put to death by Phocas, 605.

Amalafrida, a full sister of Theodoric, married Thrasamund, king of the Vandals, and was mother, by an earlier marriage, of Theodahad (d. 536).

Authorities.—The authorities for the life of Theodoric are very imperfect. Jordanes, Procopius, and the curious fragment known as Anonymus Valesii (printed at the end of Ammianus Marcellinus) are the chief direct sources of narrative, but far the most important indirect source is the *Variæ* (state-papers) of Cassiodorus, chief minister of Theodoric. Malchus furnishes some interesting particulars as to his early life, and it is possible to extract a little information from the turgid panegyric of Ennodius. Among German scholars Dahn (*Könige der Germanen*, ii., iii., and iv.), Manso (*Geschichte des Ostgothischen Reichs in Italien*), and Sartorius (*Versuch über die Regierung der Ostgothen*, &c.) have done most to illustrate Theodoric's principles of government. The English reader may consult Gibbon's *Decline and Fall*, chap. xxxix., and Hodgkin's *Italy and her Invaders*, vol. iii., and *Letters of Cassiodorus*. (T. H.)

THEODOSIA, or KAFFA, a seaport and district town of Russia, situated on the east coast of Crimea, 69 miles to the east-north-east of Simpheropol. Its roadstead, which has a width of 18 miles and is never frozen, is well protected from east and west winds, and partly also from the south, but its depth is small, ranging from 11 to 14 feet and reaching 35 feet only in the middle. The want of railway communication with the interior prevents it from gaining the commercial importance it might otherwise have possessed, so that its population was only 10,800 in 1881,—a low figure when compared with the 20,000 it had in 1672 and still more with the figure returned in last century. Many remains of its former importance exist in the city and neighbourhood, the chief being a beautiful mosque—formerly a Genoese cathedral—synagogues several centuries old, old towers with inscriptions, baths, and a palace of Shah-Ghirei in the suburbs. Gardening is one of the leading industries; fishing, a few manufactures, agriculture, and trade are also carried on. The foreign trade, which in 1830–40 reached an average of £90,000 for exports and £66,500 for imports, afterwards fell off, but it has experienced a revival in the course of the last 15 years, the exports of corn, linseed, and wool having reached £167,853 in 1884. The imports are insignificant.

Theodosia, a Milesian colony, was in Strabo's day a flourishing seat of trade (especially in grain), with a harbour capable of accommodating a hundred ships; but before Arrian's time (*c.* 125 A.D.) it appears to have been destroyed. More than a thousand years later (1263 to 1267) the Genoese established here their colony Kafa or Kefa, which grew rapidly up notwithstanding the rivalry of the Venetians. It was fortified, and became the see of a bishop, as well as the chief centre for the Genoese colonies on the Black-Sea coasts. It remained nearly independent until 1475, when it was taken by the Turks, but it continued to prosper under their rule, under the name of Kutchuk-Stambul, or Kryon-Stambul (Stambul of Crimea). The Russians took it in 1771, and annexed it in 1774. From that date it began to decay, and had only 3200 inhabitants in 1829, the emigration of the Crimean Tartars and the competition of Odessa being obstacles to its further growth.

THEODOSIUS I., emperor of Rome, surnamed the Great, was the son of Theodosius, Valentinian's great general, who in 368–69 drove back the Picts and Scots from the Roman territories in Britain, and, after other successes on the Continent, was at last despatched to suppress the revolt of Firmus in Mauretania (372). Shortly after (376), the elder Theodosius, despite his great services, was put to death by order of Valens, probably through fear lest he should be the Theodosius or Theodore whom the prophetic tripod indicated as the future emperor.

The younger Theodosius was born about the year 346. He was a native of Spain, but the exact place of his birth is uncertain (Cauca in Galicia according to Idatius and Zosimus, Italica according to Marcellinus). Pacatus and Claudian seem to claim for him at least a relationship to Trajan, of which, however, there is no satisfactory proof. He accompanied his father into Britain (368), and a little later distinguished himself by defeating the Sarmatians who had invaded Mœsia (374). On his father's death he retired to his native place, where he lived quietly till after the great battle of Adrianople (August 9, 378), when Gratian summoned him to share the empire. Theodosius was made Augustus at Sirmium, January 19, 379, and was assigned all the Eastern provinces, including Illyricum. It was a time of great peril for the Roman state. The Huns had just made their appearance on the western shores of the Black Sea, and, after overthrowing the great nation of the Ostrogoths, had driven the more southern Visigoths to take shelter within the empire. Valens had consented to receive them (376) on condition that they should deliver up their arms and surrender their children as hostages to be distributed throughout the cities of the East. The latter half of the compact was enforced, but not the former; and the barbarians, left without any sustenance, began to plunder the open country. After their great victory at Adrianople they reached the walls of Constantinople, whence they were driven back by the valour of a band of Saracens. Meanwhile the Ostrogoths, the Taifali, the Huns, and the Alans had all crossed the Danube to share the spoils of the empire; and it was against this motley host that Theodosius had to contend. He appears to have gained some successes even before his elevation to the empire (Theodoret, v. 5, 6), and shortly after this retired to Thessalonica to organize his forces. He breathed courage into what remained of the Roman army, and summoned the very miners to his standard. But his chief reliance was placed in certain bodies of the Goths whom he had enrolled in his service. These, under their royal leader Modares, gained at least one decisive victory, probably in the course of 379. From the unchronological account of a later writer, Zosimus, to whom we owe almost all the details of Theodosius's early campaigns, we may infer that in the course of this year or the next Fritigern and his Visigoths were gradually driven across the Danube, where they seem to have met with the Ostrogoths who had shared their fate. For a time the united nations turned their energy against the Western empire, till they forced Gratian to grant them leave to settle in Pannonia and Mœsia. Before setting out on their new journey they perhaps combined their forces to attack Athanaric, who had retreated with his section of the Visigoths into the wilds beyond the Danube at the time of the Hunnish invasion. Unable to withstand their onset, Athanaric offered his services to Theodosius, and was received into Constantinople with every mark of favour, 11th January 381. Fifteen days later he died, and was honoured by the emperor with a splendid funeral, while his followers faithfully discharged the duty of guarding the Danube.

In the two preceding years Thessaly and Macedonia had been swept by the barbarians. On one occasion the emperor himself barely escaped from their hands in a midnight attack which they had been induced to make by the sight of his blazing watchfires; on another the united forces of the Ostrogoths and Visigoths crossed the Danube with the design of pillaging Greece. In his efforts against the invaders Theodosius was ably seconded by his colleague Gratian, who despatched his Frankish officers Bauto and Arbogastes to drive the enemy out of Macedonia and Thessaly (380), and, while Theodosius lay sick at Thessalonica, made such terms with them as the latter emperor was glad to accept on his recovery. A little later, presumably towards the middle of 381, Promotus, Theodosius's lieutenant, inflicted a terrible defeat on a motley host that was attempting to cross the Danube. This was perhaps the decisive battle in the war; and we read that on October 3, 382, all the remaining Goths in the empire submitted to Theodosius. Many of them appear to have entered the Roman army as "fœderati"; and indeed, from the very commencement of his reign, Theodosius seems to have pursued a consistent policy of enrolling the Gothic warriors. At times they accepted his gifts while meditating treachery in their hearts; and Eunapius has preserved the story of how Fravitta, the leader of the faithful party, slew with his own hands his dishonest colleague Eriulf at a banquet in the emperor's own tent. Zosimus has charged Theodosius with burdening the provinces with excessive duties for the purpose of maintaining a host of useless barbarian officers, while the common soldiers were left unpaid. These barbarian troops, according to the same writer, often treated the Roman citizens with the utmost indignity, and on more than one occasion provoked a retaliation for which the emperor refused to see any excuse. They were not, however, all quartered in one place, but received into the legions; while others were sent to Egypt. On the whole, it may be said that his policy of attaching the invaders to himself was the salvation of the empire; it was they who bore the brunt of the battle of the Frigidus; and the knowledge of the emperor's good faith towards the Teutonic auxiliaries in his service must have contributed largely to the defection of Eugenius's army on the same occasion.

In 383 Theodosius created his eldest son Arcadius Augustus. The same year saw the revolt of Maximus in Britain and the murder of Gratian (August 25, 383). For five years Theodosius consented to accept the usurper as his colleague; but, when Maximus, flushed with success, attempted a few years later to make himself master of Italy, which, since the sudden death of Valentinian I. (17th November 375), had been governed under the name of his young son Valentinian II., Theodosius advanced against the invader and overthrew him near Aquileia (28th July 388). This victory was followed by the murder of Maximus and his son Victor, after whose death Theodosius conferred upon Valentinian II. all that part of the empire which his father had held. Theodosius is said to have been induced to take this campaign by his love for Valentinian's sister Galla, whom he now married. Meanwhile there had been fresh dangers from the Goths. In 386 another band of the Grœthingi or Ostrogoths, attempting to cross the Danube, was cut off by Promotus. The same general, in the course of the next two years, punished the barbarians who had deserted Theodosius at the beginning of the campaign against Maximus. Such signal services as these, though coupled with the fact that he had saved the emperor's life, did not prevent Promotus from falling a victim to the intrigues of the favourite Rufinus, who is charged by Zosimus with compassing the death of other noble men. If we may trust the evidence of the last-mentioned historian, from the end of the year 388 Theodosius resigned himself to gluttony and voluptuous living, from which he was only roused by the news that, in the Western empire, Arbogastes the Frank had slain the young emperor Valentinian and set up the grammarian Eugenius in his stead (15th May 392).

Into the curious history of the short-lived pagan revival in the Western empire there is no need to enter here. Zosimus assures us that the tears of Galla threw the whole court into confusion; but there can be little doubt that to a religious, if not superstitious, mind like that of Theodosius it might well have seemed that he was fighting the battles of God, as he led his army of the cross against an enemy on whose standard shone the image of Hercules (Theodoret, v. 24). His host consisted partly of Romans and partly of barbarians. Timasius was leader of the former, but under him was ranged the more renowned Stilicho; the latter were led by Gainas the Goth and Saul the Alan. The engagement was fought near the river Frigidus, some thirty-six miles distant from Aquileia. On the first day Theodosius's barbarians, engaging with those of the hostile army, were almost destroyed, and the victory seemed to be with Eugenius. After a night of prayer, towards cock-crow the emperor was cheered by a vision of St Philip and St John, who, mounted on white steeds, promised him success. With the morning he received and accepted the offer of service on behalf of the enemy's ambush, and once more advanced to the conflict. But even so, the issue of the day was doubtful till, if we may trust the concurrent testimony of all the great contemporary church historians, a sudden gust of wind blew back the enemy's arrows on themselves. This was the turning-point of the battle: Eugenius was slain by the soldiers; and two days later Arbogastes committed suicide (September 5–9, 394). From the north-eastern parts of Italy Theodosius passed to Rome, where he had his son Honorius proclaimed emperor under the guardianship of Stilicho. Thence he retired to Milan, where he died of dropsy (17th

January 395), leaving the empire to be divided between his two sons Honorius and Arcadius,—Honorius becoming emperor of Rome and the West, Arcadius of Constantinople and the East.

Important, however, as the reign of Theodosius was from the political point of view, it is perhaps still more important from the theological. According to Sozomen, his parents were both orthodox Christians, according to the creed sanctioned by the council of Nicæa. It was not, however, till his illness at Thessalonica that the emperor received baptism at the hands of Bishop Ascholius, whereupon, says the same historian, he issued a decree (February 380) in favour of the faith of St Peter and Pope Damasus of Rome. This was to be the true catholic faith; the adherents of other creeds were to be reckoned as heretics and punished. The great council of Constantinople, consisting of 150 orthodox and 36 Macedonian bishops, met in the following year, confirmed the Nicene faith, ordered the affairs of the various sees, and declared the bishop of Constantinople to rank next to the bishop of Rome. The emperor cannot be acquitted of the intolerance which marks edicts such as that depriving apostatizing Christians of the right of bequest. It was not till 389 or 390 that he issued orders for the destruction of the great idol of Serapis at Alexandria. Other edicts of an earlier or later date forbade the unorthodox to hold assemblies in the towns, enjoined the surrender of all churches to the catholic bishops, and overthrew the heathen temples "throughout the whole world." During the reign of Theodosius Gregory of Nazianzus was made bishop of Constantinople—an appointment which he did not long retain. In 383 Theodosius called a new council for the discussion of the true faith. The orthodox, the Arians, the Eunomians, and the Macedonians all sent champions to maintain their special tenets before the emperor, who finally decided in favour of the orthodox party. He seems to have suffered the Novatians to hold assemblies in the city. Perhaps the most remarkable incident in the life of Theodosius from a personal point of view is the incident of his submission to the reprimands of Ambrose, who dared to rebuke him and refuse to admit him to the Lord's Supper till he had done public penance for suffering his Gothic auxiliaries to murder the townsmen of Thessalonica (390). Equally praiseworthy is the generous pardon that the emperor, after much intercession, granted to the seditious people of Antioch, who, out of anger at the growing imposts, had beaten down the imperial statues of their city (387). When the Christians in the eastern part of the empire destroyed a Jewish synagogue and a church belonging to the Valentinians, Theodosius gave orders for the offenders to make reparation. Such impartial conduct drew forth a remonstrance from Ambrose, who, where the interests of his creed was concerned, could forget the common principles of justice. In a sermon preached before Theodosius he introduced the Deity Himself holding an argument against Theodosius on the subject of his remissness, and the imperial penitent yielded to the eloquent bishop. So pliant a disposition rendered him very dear to the saint, who availed himself of his influence to counteract the efforts of Symmachus and the Roman senate for the restoration of the pagan rites at the altar of victory. "I loved the man," says St Ambrose, "who, putting off his kingly robes, mourned publicly in the church a sin to which the guile of others had exposed him,—an emperor who thought it no shame to do an act of public penance that even private people would have blushed to perform." The inspired vision of the saint saw the deceased emperor received into heaven by his old colleague Gratian; while Maximus and Eugenius down in hell were already experiencing how grievous a sin it is to take up arms against lawful princes (Ambrose, *De Obitu Theod.*).

Theodosius was twice married—(1) to *Ælia Flacilla*, the mother of Arcadius (377–408) and Honorius (384–423); (2) to Galla (d. 394), the daughter of Valentinian I.

The chief authorities for the age of Theodosius are Ammianus Marcellinus, Zosimus, Eunapius, and the ecclesiastical historians (Socrates, Sozomen, Theodoret). Much information may also be gleaned from the writings of St Ambrose, St Gregory of Nazianzus, Isidore of Seville, and the orators Pacatus, Libanius, Themistius. Of modern authorities Tillemont supplies an unrivalled collection of facts drily collected from all contemporary or nearly contemporary sources; he is specially useful for his synopsis of the Theodosian laws. Clinton's *Fasti* are the best guide for the chronology of the period. It is hardly necessary to mention the brilliant account given by Gibbon, or, in later years, from the standpoint of Italian history by Mr Hodgkin. (T. A. A.)

THEODOSIUS II. (401–450) succeeded his father Arcadius as emperor of the East in 408. During his minority the empire was ruled by the prætorian prefect Anthemius and Pulcheria, who became her brother's guardian in 414. Under his sister's care the young emperor was brought up rather as a virtuoso than a prince. The chief events of Theodosius's reign are the wars with Persia in 421 and 441, the council of Ephesus (434), and the invasion of the Huns under Attila (441–448). In 450 Theodosius was thrown from his horse while hunting, and received injuries from which he died. He married Athenais, who on being baptized took the name of Eudocia. It was during his reign that the *Codex Theodosianus*, or collection of the constitutions of the Roman emperors, was formed. The idea took birth as early as 425, but was only put into execution between 435 and 438; in the latter year the Code was published.

THEODOSIUS III. was the last of three emperors whose short reigns filled the interval between the death of Justinian II. and the accession of Leo the Isaurian. The emperor Anastasius had sent a fleet to frustrate the intended expedition of the Saracens from Alexandria against Constantinople. On reaching Rhodes the troops rose against their leader, John the Deacon, slew him, and, starting for Constantinople, landed at Adramyttium, where they made a collector of the taxes emperor by the title of Theodosius III. The new emperor besieged Constantinople for six months before he took it; Anastasius resigned, and retired to a monastery, leaving his place to be filled by Theodosius III., who likewise resigned next year (717) in favour of Leo III. The closing years of Theodosius's life were spent in a monastery.

THEODOSIUS, of Tripolis, a Greek geometer and astronomer, three of whose works were contained in the collection of lesser writings named Ὁ *μικρὸς ἀστρονομούμενος* (sc. *τόπος*), or Ὁ *μικρὸς ἀστρονόμος*.[1] Pappus of Alexandria, at the commencement of the sixth book of his *Συναγωγή*, speaks of this collection, the study of which is indispensable to any one who would master the science of astronomy (*τὸν ἀστρονομούμενον τόπον*). These writings, which were highly esteemed in the school of Alexandria, were intermediate between the *Elements* of Euclid and the *Almagest* of Ptolemy, for the understanding of which, indeed, they formed an indispensable introduction. Of the life of Theodosius nothing is known. As to the time when he lived different opinions have been held, he being placed by some in the first century before and by others in the second century after the Christian era. The latter opinion is founded on an error of Suidas (*s.v.*), who on the one hand identifies the author of the three works referred to above with a sceptical philosopher of the same name who lived at the time of Trajan or later, and on the other hand distinguishes him from a native of Tripolis who wrote a poem on spring. It is now generally admitted that the subject of this article is the same as Theodosius the mathematician, who is mentioned by Strabo amongst the natives of Bithynia distinguished for their learning, and whose sons were also mathematicians, the same, too, as the inventor of a universal sun-dial (*horologium πρὸς πᾶν κλίμα*) of that name who is praised by Vitruvius (*De Architectura*, ix. 9). His date, therefore, could not have been later than the 1st century B.C.; he may, however, have lived in the preceding century, inasmuch as the names mentioned by Strabo in the passage referred to above are, as far as we know, arranged chronologically, and Theodosius immediately follows Hipparchus, who made astronomical observations between 161 and 126 B.C., and precedes Asclepiades the physician, who lived at Rome at the beginning of the 1st century B.C.

The statement that he was "of Tripolis" is made, not on the authority of Suidas, as has been erroneously said, but because he is so described in the title of his principal work. It is probable, therefore, that he was a native of

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[1] This collection contained the following books:—"Theodosii Tripolitæ *Sphæricorum* libri iii.; Euclidis *Data*, *Optica*, *Catoptrica*, ac *Phænomena*; Theodosii Tripolitæ *De Habitationibus* et *Noctibus* ac *Diebus* libri ii.; Autolyci Pitanæi *De Sphæra Mota*, et libri ii. *De Ortu atque Occasu Stellarum Inerrantium*; Aristarchi Samii *De Magnitudinibus ac Distantiis Solis ac Lunæ*; Hypsiclis Alexandrini Ἀναφορικὸς sive *De Ascensionibus*; Menelai *Sphæricorum* libri iii."—Fabricius, *Bibliotheca Græca*, ed. Harles, iv. p. 16.

Bithynia, and resided at Tripolis, where he wrote his work. Tripolis is generally taken to be the city of that name on the Phœnician coast, but it may have been a town of the same name in Lydia, on the Meander.

His chief work—*Σφαιρικά*, in three books—treats of the properties of the sphere and its sections, with the object of establishing the geometrical principles of spherical astronomy. This work, which is classical, is distinguished for the order and clearness of the exposition as well as for the rigour of its proofs, and has ever since formed the basis on which the subject of spherical geometry has been treated. It does not contain any trace of spherical trigonometry, which, on the other hand, was the special subject of the work having the same title, and included in the same collection, of Menelaus of Alexandria, who lived at the end of the 1st century.

Montucla suspected that a great part of the three books of Theodosius must have been known before his time, and that he merely did with respect to this branch of geometry what Euclid had done with the elements, namely, he collected and incorporated in his work the different propositions found before his time by astronomers and geometers. This conjecture of Montucla has been confirmed by A. Nokk (*Ueber die Sphärik des Theodosius*, Karlsruhe, 1847), by Heiberg (*Litterargeschichtliche Studien über Euklid*, pp. 43 *sq.*, Leipsic, 1882), and by Hultsch, from whose researches, and especially owing to the publication by the last of the *editio princeps* of Autolycus, it is now quite certain that as early as the middle of the 4th century B.C. there existed a Greek text-book on *Spherics* which, in its essential contents, scarcely deviated from the three books of Theodosius. He must therefore be regarded as merely the editor, or at most the elaborator and expounder, of a doctrine which existed some centuries before him.

The *Spherics* of Theodosius was translated into Arabic at the beginning of the 10th century, and from the Arabic into Latin in the 12th century by Plato of Tivoli (Tiburtinus). This translation was published in 1518 at Venice, but was found so faulty by J. Voegelinus that he published a new Latin version, together with additions from the Arabian commentators, Vienna, 1529, 4to; other Latin translations were published by F. Maurolycus, Messina, 1558, fol.; by C. Clavius, Rome, 1586, 4to; and by Barrow under the title, Theodosii *Sphærica, Methodo Nova Illustrata et Succincte Demonstrata*, London, 1675, 4to. The Greek text was first published, and with it a Latin translation, by J. Pena, Paris, 1558, 4to; it has been edited since by Joseph Hunt, Oxford, 1707, and by E. Nizze, Berlin, 1852, but these two editions are founded on that of Pena. There is also a German translation by Nizze, Stralsund, 1826. His two editions are accompanied with valuable notes and an appendix containing additions from Voegelinus and others.

The two other works of Theodosius which have come down to us have not as yet been published in the original. The propositions, without demonstrations, in the work *περὶ ἡμερῶν καὶ νυκτῶν* (*On Days and Nights*), in two books, were given by Dasypodius, in Greek and Latin, in his *Sphæricæ Doctrinæ Propositiones*, Strasburg, 1572, 8vo. A Latin version of the complete work, with ancient *scholia* and figures, was given by Joseph Auria, Rome, 1591, 4to. Pappus has given a pretty full commentary on the first book of this work of Theodosius. His work *περὶ οἰκήσεων* (*On Habitations*) also was published by Auria, Rome, 1588. It gives an account of how, for every inhabitant of the earth from the equator to the pole, the starry firmament presents itself in the course of a year. The propositions in it were also given by Dasypodius in his work mentioned above.

THEOGNIS OF MEGARA was one of the early Greek elegiac poets; he probably flourished about the middle of the 6th century B.C. We derive our knowledge of his life from the poems that bear his name. After the fall of Theagenes, who had made himself tyrant of Megara about 625, the usual struggles between oligarchy and democracy ensued. Theognis was a violent partisan of the oligarchical faction in his native town, and wrote elegies in which he gave expression to the emotions roused in him by the varying phases of the struggle. He appears on one occasion to have lost his property (verse 345) and been driven into exile: perhaps it was then that he visited Sicily, Eubœa, and Sparta (783 *sq.*). In the end—if we may trust 1123 *sq.*—he returned to Megara, and lived, at least for a time, in something like prosperity. The date of his death is unknown. The verses handed down to us under the name of Theognis amount in all to 1389. Not a few of them are ascribed on the evidence of the ancients to Tyrtæus, Mimnermus, and Solon; modern criticism has made it probable that two of the longer elegies are from the hand of Evenus (467-496 and 667-686); other fragments are demonstrably later than Theognis. It is now generally admitted that the *Theognidea* were put together long after Theognis—possibly even as late as the 4th century B.C.—by some compiler who wished to provide a good collection of moral maxims for educational purposes. To separate the genuine fragments of Theognis from those which were ascribed to him by the reverence of a later age is a hopeless task.

The collection is divided into two books. The first, which is addressed to a youth called Cyrnus, or Polypædes, opens with a spirited invocation of Apollo and Artemis, along with the Muses and the Graces (vv. 1-18); then follows a passage which has been much discussed in connexion with the early history of writing, recommending Cyrnus to set a seal upon the author's verses, to prevent forgers from passing off spurious lines under his name (see Jevons, *Hist. of Greek Lit.*, p. 46). With verse 27 begins a series of counsels to Cyrnus. On the whole they are remarkable neither for loftiness of tone nor for poetic elevation. Cyrnus is counselled to avoid "the bad" and frequent the society of "the good" men—the terms "good" and "bad" being used to denote aristocrats and democrats, just as *καλὸς κἀγαθός* meant an oligarch in the later days of the Peloponnesian War. Sometimes the violence of party feeling leads Theognis beyond all bounds, as when he prays that he may "drink the black blood" of his opponents (349; *cf.* 337-339 and 361). One striking feature in these elegies is the continual refrain about the evils of poverty. "To avoid poverty one should even throw oneself into the vasty deep, or from the beetling rocks" (175-176; *cf.* 266 *sq.*, 351 *sq.*, and 649 *sq.*). Elsewhere the poet reproaches Zeus with allowing evil men to prosper, and afflicting the good (373 *sq.*); he also complains that the punishment due to wicked men often falls upon their sons (731 *sq.*). A pleasing feature is the high value which is placed upon friendship: one is not to part with a friend lightly, or upon some slight occasion of displeasure (323 *sq.*). At the same time no one knows better than Theognis how quickly friends fail one in adversity (299-300). Life has on the whole few charms for our poet: "the best thing for man is not to be born or look upon the rays of the swift sun; once born it is best for him to pass as soon as possible the gates of death, and lie with a great barrow of earth above him" (425-429). The prevailingly sad tone of the elegies is occasionally broken by a convivial note. "It is shameful," says the poet, "to be drunk when others are sober, or sober when others are drunk" (626-627); "among the uproarious I am very uproarious, but among the proper I am the properest of men" (313-314). The only elegy which possesses any considerable poetic merit in the first book is that in which Theognis predicts immortality for his young friend through the fame awaiting his own poems. The second book (1231-1389) consists of a number of amatory elegies addressed to some young friend of the author's. In vigour and harmony of versification they are on the whole superior to the first book; but most if not all of them are probably spurious.

Bergk, *Poetæ Lyrici Græci*, ii. 117-236, Leipsic, 1882

THEOLOGY

The word theology in the classics;

THE word theology comes from a heathen source—from the Greek classics. In the *Republic* of Plato and the *Metaphysics* of Aristotle it occurs, and in its etymological meaning of "discourse or doctrine concerning Deity and Divine things"—λόγος περὶ τοῦ θεοῦ καὶ περὶ τῶν θείων. Men who wrote about the gods and their doings, or who speculated about the Divine in the origination and operations of nature—men like Homer, Hesiod, Pherecydes, and Thales,—were called θεολόγοι. But there could, of course, be no theological science based on the popular religion of Greece. Theology was only to be found among the Greeks in the form of philosophical speculation. Through St Augustine we know that Varro, "the most learned of the Romans," distinguished three kinds of theology,—the first mythical or fabulous, the second physical or natural, and the third civil or popular. The mythical theology he censured as containing many things contrary to the dignity and nature of immortal beings; the natural theology he described as that which is true but beyond the capacity of the vulgar; the civil theology he considered to be that which it was good for the citizens to believe—the received religion of Rome. The general attitude of the Greek and Roman mind to religion was unfavourable to the cultivation of theology. Religion being dissociated in thought from truth could not give rise to science

In the fathers;

In the Middle Ages;

at and after the Reformation.

The words theology and theologian do not occur in Scripture, but it was inevitable that they should be transplanted into Christian soil. Θεόλογος is found, as a V.R. in the inscription of the Apocalypse—the Revelation of John "the Divine," "the theologian,"—and almost certainly refers to his maintaining the Divinity of the Logos—*τὴν τοῦ λόγου θεότητα*,—that the *λόγος* is *θεός*. In the 3d and 4th centuries a theologian usually meant one who distinguished himself in defending the personality and Divinity of the Logos. It was on this ground that Athanasius and Gregory Nazianzen were honoured with the distinctive appellation of "theologians." The term theology has not yet lost its early signification of "doctrine concerning God," although a much wider meaning is more common. Theology in its ordinary general acceptation includes, as one of its divisions, theology understood as the treatment of the problems which directly refer to the being, attributes, and works of God. The *Introductio ad Theologiam*, and a later form of it, the *Theologia Christiana*, composed by Abelard in the 12th century, first gave currency to an acceptation of the word inclusive of all religious truth or belief. Among later scholastics the common designation for a general compendium of religious doctrine was *Summa Theologiæ*. Of such *Summæ* among the most celebrated and characteristic are those of Alexander Hales, Albertus Magnus, and Thomas Aquinas. The mediæval mystics deemed the essence of theology to be the immediate intuition of God, who, being once in contact with the soul, reveals to it the truth of all the principles of faith, and gives it at the same time spiritual peace and happiness. This view led to a use of the word which was prevalent among the Reformers and their immediate successors,—a subjective application which identified it with what was characteristic of the mind of a true theologian, an enlightened and experienced *homo renatus*. In this sense it was a living practical acquaintance with the revelation of grace and truth made by God to man, a "habitus practicus," a "sapientia eminens practica," as it was called. With it, however, these earlier Protestant divines generally conjoined that objective application of the term which was current in later scholasticism, and this at length wholly displaced the subjective acceptation; in other words, theology came to signify, not knowledge of a certain kind as inherent in the mind and operative in the life of the individual, but knowledge in itself, a body of systematized truth, a science. Theology, thus understood, may be viewed, discussed, and applied in a variety of ways, so as to give rise to certain kinds or species of theology. In the 17th century the necessity for specialization of this sort began, from the operation of several causes, to be widely and strongly felt, and it became usual for divines to indicate by the titles of their theological systems the point of view and mode of treatment adopted. An adjective added to the term "theologia" served their purpose. Of adjectives thus employed in the 17th and early part of the 18th century, the following may be mentioned as either frequently used or of some intrinsic interest:—theoretica, practica, didactica, elenctica, polemica, irenica, pacifica, positiva, comparativa, dogmatica, theoretico-practica, didactico-elenctica, &c.

Natural theology.

Comparative theology

The extension given to the signification of the term theology was for a very lengthened period almost universally restricted to the knowledge derivable from the Scriptures, the systematic exhibition of revealed truth, the science of Christian faith and life. It is still thus, perhaps, that the word is most commonly understood. Two things, however, have naturally suggested the employment of it in a wider manner. First, there was the rise and development of a theology not based on revelation,—the rise and development of what is called natural theology. The Greeks and Romans could not distinguish between nature and revelation, reason and faith, because ignorant of revelation and faith in their distinctive Christian sense. In the patristic and scholastic ages of the church, and for some time after the Reformation, men were not in general prepared to admit that there was a knowledge of God and of His attributes and of His relations to the world which might be the object of a science distinct from and independent of revelation. Yet the most learned and thoughtful even of the scholastic divines recognized in some measure that such was the case, and could hardly, indeed, do otherwise after they had become acquainted with the contributions which Greek, Jewish, and Arabian philosophers had made to the defence and elaboration of the doctrine concerning God. The separation of natural and revealed theology was virtually the work of the scholastics. The *Theologia Naturalis sive Liber Creaturarum* of the Spanish physician, Raymond de Sebonde, who taught theology in the university of Toulouse during the earlier part of the 15th century, was, perhaps, the first work which, proceeding on the principle that God has given us two books, the book of nature and the book of Scripture, confined itself to the interpretation of the former, merely indicating the mutual relations of natural and revealed religion. A conviction of the truth of the distinction which he so clearly apprehended gradually spread; more and more importance came to be attached to it. The deists proceeded on it, and tried to exalt natural theology at the expense of all theology professedly based on revelation, by representing the former as the truth of which the latter was the perversion. The wisest of their opponents, and thoughtful Christian writers in general—the adherents of the moderate and rational theology of the 17th and 18th centuries—strove, on the other hand, to show that natural theology was presupposed by revelation and should carry the mind onwards to the acceptance of revelation. Thus natural theology came into reputation, notwithstanding the opposition of those who have denied its existence and contended that the reason of itself can teach us absolutely nothing about God or our duties towards Him. The recognition of natural theology contributed to awaken an interest in the various religions of the world, and thus led to the second circumstance referred to, namely, the rise of what may be called comparative theology, although it has hitherto been more generally designated the science of religions. It can be shown to have originated in the attempts made to prove that the principles of natural theology were to be found in all religions. In Bishop Steuco of Kisami's *De Perenni Philosophia*, published in 1540, and in Lord Herbert of Cherbury's *De Religione Gentilium*, published in 1663, we have two of the earliest and most characteristic attempts of the kind. From that time to the present the study of religions has proceeded at varying rates of progress, but without interruption. Important results have been obtained, and especially this result, the ascertainment, to the satisfaction of all competent judges, of a right method of investigation,—the establishment, as the true mode of study, of the comparative method. As we have a right to speak of comparative anatomy and comparative philology, so have we a right to speak of comparative theology. The inference from the preceding remarks is obvious. If there be a natural theology and a comparative theology, it is a mistake to identify theology *per se* with Christian theology. The word Christian is, in this case, a real and great restriction of the signification of the word theology, and Christian theology is not the only kind of theology. The proper procedure is to give to theology a general and comprehensive meaning, which can be limited and specialized, when requisite, by adjectives like "natural" or "Christian."

Is theology the science of religion or the doctrine of God?

What, then, is the general signification which we should give to the term? There is room for difference of opinion, and especially as to whether God or religion should be regarded as the object of the science. Is theology the science which treats of God? or is it the science which treats of religion? The latter view is now, perhaps, the more current. In addition to intrinsic reasons, the critical and sceptical spirit of the time is in its favour. Many speak of theology as a science of religion because they disbelieve that there is any knowledge of God to be attained. Dr Martineau, in his lecture on *Ideal Substitutes for God*, protests against this tendency, and contends that the older view of theology, as the doctrine or rational apprehension of *God*, ought not to be abandoned, seeing that the new "science of religions," *i.e.*, "the systematic knowledge of what *men have believed and felt* on things sacred to them," can be no proper substitute for the old "theology." We may admit, however, that the protest is essentially true,—that a knowledge of man's religious opinions, emotions, and actions can never supply the place of a knowledge of God, that, when from religion its objective basis, the reality and apprehensibility of God, is taken away, the study of it can have merely the psychological interest which belongs to mental disease and illusions,—and yet prefer the definition of theology as "the science of religion" to its definition as "the doctrine of God." The latter seems much too narrow. Even Christian dogmatics is about as much occupied with man as with God. The doctrines of sin and of the church, for example, are not doctrines regarding God. Then, although the new "science of religions" is not a substitute for the old "theology," it is still a science, or at least a very interesting and important branch of knowledge, which yet cannot be brought under the definition of theology approved by Dr Martineau,—the definition immediately yielded by the etymology of the term. The science of religion is a very different thing from the "science of religions." It is far more comprehensive. The "science of religions" is but one of the latest offshoots of the science of religion; the old theology is its main trunk or stem. Theology, when viewed as the science of religion, has not to do merely with the religious consciousness and its states. It must aim at the complete comprehension of religion, and, unless religion be a delusion and disease, this can never be attained by treating religion merely as a subjective or psychological process to which there are no corresponding objective realities manifested either through nature or revelation. We have no right to assume that it is thus without a real and rational foundation in fact; on the contrary, we are bound to inquire whether it has external grounds and real objects or not, and, if it have them, what they are. We must endeavour to ascertain and expound its objective grounds as well as its subjective contents. Thus the definition of theology as the science of religion in no way excludes what is implied in the definition of it as the science conversant about God and Divine things. It includes more than the latter definition, but does not exclude anything contained therein.

Objections to the former definition met.

The definition of theology as the science of religion has been objected to by Dr Charles Hodge on two grounds:[1]—first, that the word religion is ambiguous, having both an objective sense and a subjective sense, and that its etymology is doubtful; and, second, that to define theology as the science of religion "makes theology entirely independent of the Bible. For, as moral philosophy is the analysis of our moral nature and the conclusions to which that analysis leads, so theology becomes the analysis of our religious consciousness together with the truths which that analysis evolves." As to the first objection, the word religion has, it is true, more significations than one, and consequently may be ambiguously used, but in point of fact it is not so used in the definition in question, in which religion is understood in its generic meaning, and as inclusive both of subjective and of objective religion. Theology has to treat of both, and if it treat of them aright it will not confound them. "The etymology of the word religion is doubtful." Very true. But is no word to be employed in a definition if its etymology be doubtful? That would be an extremely hard law. In definition we have only to do with the actual meaning of terms; we have nothing to do with their origin or history. As to the second objection, it has to be remarked that the definition does not make theology entirely independent of the Bible. It does not make Biblical theology in any degree independent of the Bible. It does not imply that the Bible is not the sole perfect standard by which truth and error, health and disease, are to be separated in the religious consciousness of individuals and the religious history of the race. It only implies that all religious phenomena whatever are to be studied by the theologian, just as moral philosophy cannot leave any moral phenomena unstudied. Moral philosophy, in treating of vice as well as of virtue, does not thereby equalize vice and virtue; and no more does comparative theology, when it treats both of Christianity and heathendom, assume that the former has no superiority over the latter. It is merely a part of the task of moral philosophy to analyse the moral consciousness; it is an equally essential part thereof to inquire into the foundation of rectitude, and to determine objective moral distinctions and relations. In like manner theology has much more to do than merely to analyse the religious consciousness; it has also to treat of the grounds and objects of religion. If some reduce it to a mere analysis of the religious consciousness, and overlook or deny that there is an objective religious revelation in nature and Scripture as well as a religious susceptibility in the mind of man, this is no logical consequence of the statement that theology is the science of religion. There needs, perhaps, no other proof that the definition to which Dr Hodge objects is of some use than to consider for a moment his own definition. "Theology is the science concerned with the facts and the principles of the Bible." Is theology, then, not concerned with the facts and principles of the physical world, the human mind, and history, so far as these are disclosures of God's nature and ways? How can theology start from the Bible when it needs to be proved that there is a revelation from God in the Bible? And how can this be proved unless it is known from other sources than the Bible that there is a God? If there be such sources, theology must have to do with them; it can have no right to neglect anything by which God may be known or by which light may be thrown on the relations between God and man. It is a service to theology so to define it as to leave no room for asserting that it is only conversant with the Bible.

Relation of theology to religion.

Theology, then, is the science of religion. What does this definition imply as to the relation of theology to religion? It implies, first, that theology presupposes and is preceded by religion. This is but an instance of the general truth that experience must precede science, and that science must be founded on experience. The implicit use of principles is always prior to their explicit development. Speech is a great deal older than grammar; men reasoned long before Aristotle taught them how they reasoned; and just as there must be speech before grammar, and reasoning before logic, so must there be religion before theology. Secondly, that theology is the science of religion implies that theology must not only succeed religion, but must evolve out of it a system of truths entitled to be called a science. Science is knowledge in its completest, highest, and purest form. Theology, therefore, by claiming to be the science of religion, professes to be the exhibition of religious facts and principles in their most general and precise shape, in their internal relationship to one another, in their organic unity and systematic independence. The principles of causality and of unity in the human mind impel it to seek law and order, explanation and connexion, as regards the phenomena of religion no less than any other species of phenomena; they impel it, in other words, to perfect its knowledge of these phenomena, and can allow it no rest until it has attained to the system and science of them. Theology is the scientific system of them, and as such is a necessity to the thoughtful religious mind. It is no accident that in every age and nation thoughtful men have reflected on their religious convictions, and sought to trace them to their grounds, and to harmonize and systematize them, or that the Christian church has anxiously studied and debated for centuries problems concerning God, Christ, sin, salvation, &c.,—no accident, but the necessary consequence of those fixed laws of human nature by which man ever seeks, once that his intellect has been truly awakened, to define and complete his knowledge. Conscious that his religious experience, however vivid, involves much which requires to be cleared up; perceiving that the religious history of his race presents many apparently contradictory facts, many perplexing problems; aware that the Bible is no more a system of theology than nature is a system of mechanics or chemistry,—man cannot, as a rational being, do otherwise than endeavour by the investigation of the whole phenomena of the case to verify, analyse, combine, and co-ordinate his notions as to spiritual things, so as to work them up into a comprehensive, consistent, firmly established, adequately certified, naturally organized whole, a scientific system.

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[1] *Systematic Theology*, vol. i. pp. 20-21.

But how may man hope to succeed in his efforts to arrive at a scientific understanding of his religious beliefs, feelings, and practices? How may he educe and elaborate from the phenomena of religion a system of theology entitled to be called science? Only, it is obvious, by following a truly scientific method. What then is a truly scientific method in theology? And what is implied in following it? To these questions a comprehensive, although necessarily brief, answer must now be given.

ientific [illegible] theo- gy.

A right method in theology, as in all other sciences, is such a use of reason on appropriate facts as will best attain truth. It implies, therefore, as an essential condition, a right relation of reason to religious truth or fact, and to the evidence for it. What the right relation is may, perhaps, be defined with substantial accuracy in the following propositions.

[illegible]

(1) Religious truth, like all other truth, is "above reason" in the sense of being not created by but manifested to reason, but is not "above reason" in any special sense which withdraws it from the cognizance of reason. The truths of all science are the discoveries but not the creations of science, and they have been discovered because they existed, because they are the equivalents of a reality which is independent of science. In regard alike to mathematical, physical, mental, and religious truth, reason has only power to seek it, and to find or to miss it; it has no power to make it or right over it, but must accept it as something presented or given to it, and to which it is bound to do homage and yield submission. In this sense all truth is above reason and revealed to reason. In this sense reason stands to religious truth in the same relation as to physical truth, and to Christian truth in the same relation as to the truth in natural religion. Reason is simply the instrument or faculty of apprehending the truth manifested or revealed to it, and it can in no case apprehend truth without the aid of the appropriate manifestation or revelation. Unless Christ had lived and taught, reason could never have known His character and doctrine; but no more could it have known Dante and his *Divina Commedia*, Shakespeare and his creations, Napoleon and his achievements, unless these men had appeared in the world and accomplished in it their work. Without Christ the truth in Christ could not be known, but, Christ being given, that truth comes under the cognizance of reason, ceases to be in any special sense above reason, and affords to reason material for science. By truths above reason are sometimes meant truths which cannot be fully apprehended by reason. Such truths are, however, in no way peculiar to religion. In all regions and directions reason finds that its range of vision is limited, and that its knowledge and science are bounded by nescience and mystery. Truths of special revelation are sometimes represented as above reason in the sense that reason can have no other evidence for them than that of testimony and external authority. But what truths of Scripture have thus been revealed to reveal nothing, and are thus devoid of intrinsic light, of natural affinity to reason, of self-evidencing power? If there be any such, it must be admitted that they cannot in themselves fall within the province of science, although the testimony and assent to them may. Where reason stops science must end.

Reason must be free.

(2) Reason in its investigation of religion must be completely free, *i.e.*, subject to no other laws than those which are inherent in its own constitution. In regard to most sciences there is no need to insist that the method of science is one in which reason is free, because all who occupy themselves with these sciences acknowledge it. But in regard to theology it is otherwise. All who call themselves theologians are by no means disposed to admit that reason, in its search for religious truth and in its efforts to construct theological science, must be absolutely free; on the contrary, many of them hold that the church or the Bible, tradition or the common sense of humanity, must be allowed to have a co-ordinate or even superior jurisdiction. The proposition laid down implies that, if any view of this kind be true, theology is essentially different from science, and it is vain to speak of scientific method in theology. It implies that all claims to religious authority must be based on and conformed to reason, and that all the deliverances of every professedly religious authority must be submitted without reserve or restriction to the reason of the theologian before he can make a scientific use of them. This leads us to another proposition.

Reason limited by its own laws

(3) The only ascertainable limits of reason in the investigation of religious truth, as of other truth, are those which are inherent in its own constitution; and in the search of religious truth, as of all other truth, reason ought to go as far as it can go without violation of the laws of its own constitution. Reason has its limits in its own laws. It is the business of psychology and logic to discover what these laws are. When they are known the powers of reason are known, because reason can never claim to be irrational. It is useless, however, to attempt to mark off the external or objective boundaries of rational research. Human inquiry has, no doubt, external boundaries beyond which it will never pass, but all apparent boundaries of this kind recede as they are approached. There is even absurdity, self-contradiction, in the very attempt to draw any line separating the knowable from the unknowable. To know it one must have already done what we affirm to be impossible,—known the unknowable. We cannot draw a boundary unless we see over it. Reason cannot investigate too deeply any matter whatever, cannot possibly go too far, so long as it remains reason. Its own laws, the laws of evidence

and of inference, are the only discoverable expression of its lawgiver's "thus far." When it violates any of these laws it has gone too far, but only then, and then simply because it has ceased to be rational. As long as it conforms to them the farther it goes the better. All this holds good not less in regard to religion than to any other object of investigation, and is an essential condition of the possibility of religious science. (4) In the study of religion, as in every other department of study, reason should admit nothing as true without sufficient evidence, while rejecting nothing sufficiently proved by evidence of any kind although it cannot be proved by evidence of another kind, or although it may be imperfectly understood or have unsolved difficulties connected with it. Theology is sometimes said to be a doctrine or science of belief or faith (a "Glaubenslehre"). Not a few, however, of those who say so regard belief or faith as essentially inclusive of reason, in the form of an immediate apprehension of primary truth or self-evident fact; in which case theology is only a Glaubenslehre in common with other sciences, and belief or faith is in no special mode or measure its foundation. But, whenever by belief or faith is meant mere belief or faith, a belief or faith independent of and unconformed to reason, the apprehension and appreciation of truth,—to affirm that theology is based on such belief or faith is to represent it as so unlike every other science that it clearly cannot be a science at all. For all belief or faith we are bound to have real evidence, and enough of it. But we have no right to reject any real evidence because there is not more or because there is not evidence of some other kind,—no right to neglect to follow any light there is because it may be dim, and much around it may be dark,—no more right to refuse to accept any well-established conclusion as to God and religion because there is great uncertainty as to the essence of religion, and because God in His absoluteness and infinity immeasurably transcends our highest thoughts, than we have to ignore or contest the conclusions of physical science because we cannot tell what matter is, and because we find that every hypothesis as to its nature brings with it many doubts and difficulties.

Reason deals with evidence.

Sources of religious truth.

The foregoing conditions are perhaps the most general and fundamental of those to which reason must conform if it would originate and follow a scientific method in theology. The next question which demands an answer is, Whence are the data to be derived on which reason must operate in religious apprehension and theological investigation? What are the sources of religious truth? Reason has not the truth in itself, but in order to possess it must find it. As the eye has not physical light within itself, but merely so corresponds to it as to apprehend it, not otherwise is it with reason and intellectual light. By sources of religious truth can only be meant the media through which God manifests Himself,—the ways by which He makes himself known; and the physical world, finite minds, human history, Scripture, and the *testimonium Spiritus Sancti* may all be maintained to be such sources. The atheist and the agnostic will not allow that there are any sources of religious truth; the deist and the rationalist will only admit the claims of general revelation, the exclusive Biblicist only of Scripture; and the mystic will trust chiefly to special spiritual illumination; while the theologian of broader view will hold that all the ways indicated are sources, seeing that in and through them all knowledge and experience as to God and religion may be acquired, and must contend that in the study of theology none of them is to be ignored or excluded, underestimated or overestimated, but all are to be duly considered, and the information supplied by each to be taken in connexion with that supplied by the rest. The sources are distinct, but not isolated. The light from each combines and harmonizes with the light from all the others. The revelation of God in nature is presupposed by that in Scripture, and Scripture contributes to unveil the spiritual significance of nature. Without the light which the human mind supplies there can be no illumination from any other source, and yet all the light of the human mind is gained in connexion with the light from external sources. History gradually evolves the significance of nature, mind, and Scripture, yet cannot be understood if dissevered from the creation in which it is placed, from the mind of man in the principles and faculties of which it is rooted, or from Scripture as the record of the development of a plan of redemption which gives unity and meaning to the whole historical movement. However deep and full a source of religious truth the Bible may be, it is neither independent of other sources nor a substitute for them; on the contrary, while casting light on them all it likewise receives light from them all. The living apprehension of spiritual realities presupposes a discernment which the Divine Spirit alone can give; yet that Spirit, according to the testimony of Scripture, speaks not of Himself, but only in conformity with what has already been uttered by the Father and the Son. It would obviously neither be consistent with the scope nor possible within the limits of an article like the present to determine the distinctive features, natural spheres, and various relationships of the media of revelation or sources of religious truth, but a sufficiently thorough investigation having this aim may safely be pronounced to be one of the chief desiderata of theological science.

Process of theological method.

The process of theological method itself has next to be considered. Its first step is the ascertainment of the relevant facts. But these are all the facts of nature and history, all the truths of Scripture, and all the phases of religion. The various departments of theology are based on and inclusive of various orders of these facts, and each order of facts must be ascertained and dealt with in appropriate special ways. Thus the relevant data of natural theology are all the works of God in nature and providence, all the phenomena and laws of matter, mind, and history,—and these can only be thoroughly ascertained by the special sciences. The surest and most adequate knowledge of them is knowledge in the form called scientific, and therefore in this form the theologian must seek to know them. The sciences which deal with nature, mind, and history hold the same position towards natural theology which the disciplines that treat of the composition, genuineness, authenticity, text, development, &c., of the Scriptures do towards Biblical theology. They inform us, as it were, what is the true text and literal interpretation of the book of creation. Their conclusions are the premisses, or at least the data, of the scientific natural theologian. All reasonings of his which disregard these data are *ipso facto* condemned. A conflict between the results of these sciences and the findings of natural theology is inconceivable. It would be a conflict between the data and conclusions of natural theology, and so equivalent for natural theology to self-contradiction. Then, the data of Biblical theology are all the words contained in the Bible, viewed in their appropriate positions and historical connexions, and what these are and signify can only be ascertained by the processes of historical criticism and of hermeneutics. Biblical theology is the delineation of a section of the history of religious ideas,—that section of which the traces and records remain in the Bible. But the Bible comprehends many strata of writing, deposited at different times, and collocated and connected in various ways, and the history of its composition, the age and succession of its parts, must be ascertained before we can exhibit the history of its contents, the course of the evolu-

The facts of natural theology;

of Biblical theology;

tion of its ideas. If the theories of recent critics as to the formation and relationship of the component portions of the Old Testament be true, the view taken of the development of Old Testament theology must be very different from that formed on the supposition that the traditional theory is correct. And which theory is correct is a question of fact which can only be decided by dispassionate and thorough critico-historical investigation. So false readings must be distinguished from true, erroneous translations from correct, and appropriate from inappropriate interpretations, which presupposes an adequate measure of linguistic, grammatical, and exegetical knowledge and skill. The religion of the Bible, however, is but one of a multitude of religions which have left traces of themselves in documents, monuments, rites, creeds, customs, institutions, individual lives, social changes, &c.; and there is a theological discipline—comparative theology—which undertakes to disclose the spirit, delineate the character, trace the development, and exhibit the relations of all religions with the utmost attainable exactitude. Obviously the mass of data which this science has to collect, sift, and interpret is enormous. They can only be brought to light and set in their natural relationships by the labours of hosts of specialists of all kinds. That hypotheses in this domain will for long arise and vanish with disappointing rapidity is only what is to be expected from its vast extent, the amount of its buried wealth, the gradual and fragmentary way in which its contents must be disinterred, the losses and changes which have occurred in the course of time, and the constant suggestion of fresh interpretations of ancient texts and new solutions of old problems which must come from unceasing discovery. Some theological disciplines, it must also be observed, presuppose others, and have consequently among their data the conclusions of those other disciplines. All doctrine, for example, founded on special revelation presupposes doctrine founded on general revelation; all Christian theology must imply and incorporate natural theology. Christian dogmatics has to make use of the results of natural theology, Biblical theology, and comparative theology, and to raise them to a higher stage by a comprehensive synthesis which connects them with the person and work of Christ, as of Him in whom all spiritual truth is comprehended and all spiritual wants supplied. The conception of it prevalent until lately, as a system formed of generalizations and inferences from texts of Scripture, answers properly to no theological science, but much more nearly to Biblical theology than to Christian dogmatics.

of comparative theology

Appropriate methods of dealing with these data.

When religious data have been ascertained, the materials of theological science have been obtained, but the scientific edifice itself has still to be constructed. The general truths involved in particular disclosures have to be evolved; the laws of the development of phenomena have to be discovered; elements have to be reached by analysis and comprehensive views by synthesis; laws and facts, fundamental and derivative principles, have to be exhibited in their natural organic connexion. This can only be done aright by right methods, and only by a variety of methods. No one-sided process can be appropriate or sufficient. The method must conform to the nature of the matter dealt with and to the end that has to be attained. Theology includes a variety of sciences or disciplines, and these differ so greatly in character that they plainly cannot be studied aright if studied precisely in the same way. Some of them are more allied to criticism, others to history, and others again to philosophy. In some deduction can manifestly have little place, while in others there is no obvious reason why it should not be largely used. There is no kind of science which, with its special processes, may not be called on to contribute to some department of theology. There must be, therefore, in theology need and scope for a great variety of applications of method.

Practical investigation essential.

It is easy, however, to exaggerate the importance of acquaintance with the formal rules of method laid down by logicians. The theory of method must be preceded by practice—true theory by successful practice; and the ablest practitioners are always only to a small extent guided in their practice by conscious reference to the rules of method prescribed by logicians. In theology, as in all other departments of science, a man can only become an investigator by investigating. And whether he will become, through the practice of investigation, a successful investigator or not will depend far more on his general intellectual character, his ingenuity, originality, tact, and sensibility, his familiarity with the relevant facts and with the researches which are really bringing new truths in his department to light, his perseverance and diligence, than on his knowledge of what the theorists on method have taught as to its nature and requirements. Yet, of course, such instruction as logical theory can give is not to be despised, but to be received and acted on with all due appreciation.

Method must be largely inductive.

When the data of the theologian are before him as particular facts, it is obvious that he must so enumerate and classify, so analyse and generalize, so correlate and combine them, as to elicit from them the principles which they imply, before either his procedure or results can be properly characterized as scientific. In other words, a method which starts from particulars must, in order to be scientific, be largely inductive. But in theology, as in all other departments of knowledge, the only induction which is of any value is more than any mere summation or combination of facts. This is not the place for a discussion of the nature of a true induction; but on any view it must hold good that to understand aright what induction in theology is we must know what is implied in all that is comprehended in it,—the ascertainment and collocation of facts, the discrimination of their characteristics, the classification of them, the analysis of what is complex, the synthesis of what is partial, the tracing of uniform relations, the inferential act, &c. Much which would not be without interest or use, or even some degree of novelty, might be said on all these points. Numerous as have been treatises on theology, there has not as yet appeared a single earnest attempt to expound the nature of method in theology; even the many works professedly dealing not only with the encyclopædia but with the methodology have, in reality, quite ignored theological method proper. The present writer can only here note the desideratum; to supply it would require a special and lengthened discussion. The so-called methods of induction—the methods of agreement, of difference, and of concomitant variations—are as applicable in theology as in physical or mental science. They are not, properly speaking, processes of induction; they are merely rules for testing inductions. Their value, of course, is not thereby lessened.

Number of data required varies with nature of the questions considered.

The theologian, not less than the physicist, must be on his guard against fancying that the validity or certainty of his inductions is to be estimated by the number of his instances. Many who have undertaken to prove the Divine existence by the cosmological and teleological arguments have made the fatal mistake of supposing that all that was needed was an accumulation of what they deemed examples or illustrations of Divine wisdom. They have overlooked that what is, above all, necessary is to show the truth of the principles of causality and finality, and the legitimacy of those applications of them, which are involved in the cosmological and teleological arguments. They have spent their strength on what is easy, superficial, and indecisive, and had none left to deal with what is difficult, deep, and of vital moment. They have failed to apprehend that the essential question at issue is not, What or how many appearances of order and of adaptation may be traced in the various provinces of nature? but, Do such appearances *in any case* warrant an inference to a supernatural intelligence and purpose? In like manner many dogmatic theologians have seemed to think that in order to establish a doctrine it was enough to cite a number of texts in its favour. Often their doctrines would be more easily believed if their texts were fewer. Often in the Westminster Confession, for example, where the doctrine causes no difficulty, the texts cited in connexion therewith are quite inadmissible as proofs. Induction requires the strictest regard to relevancy. Whether the data for the proof of general truths in theology must be many or may be few will largely depend, as in physical and mental science, on the nature of the truths. When Newton had made out that the law of gravitation explained a single fact, applied to the moon, no person who fully comprehended his demonstration could seriously doubt either of the certainty or of the universality of the law. It was a case of a vast intellectual conquest achieved by one decisive victory. What remained was merely to take possession of what had been won, and to explain certain apparent anomalies. On the other hand, when Mr Darwin published his *Origin of Species*, he had already accumulated, with amazing industry and ingenuity, and through the uninterrupted investigations of many years, a multitude of observations and considerations in support of the general propositions therein enunciated as laws of biological evolution. Of similar observations and considerations there has since been an enormous increase. Yet the so-called Darwinian laws are still under discussion. Why has their proof or disproof been so different a process from that of the establishment of the law of gravitation? Largely because they are in themselves so different in nature. Laws of evolution can only be reached through the minute investigation of a far greater number of changes and appearances than laws of persistence. The discovery of truths of becoming may not be a more difficult but it is certainly a more delicate and complex process than the discovery of truths of being. Now this distinction not only emerges in theology but pervades it. In some departments of theology the laws to be discovered are laws of evolution, while in others they are laws of existence. Hence the method to be followed in the former must be predominantly chronological and genetic, in the latter predominantly analytic and synthetic. For example, in Biblical theology and comparative theology the inductive process must be of the kind appropriate in historical investigation, whereas in natural theology and Christian dogmatics it must be of the kind appropriate in systematic investigations into which considerations of time, place, and circumstance do not enter. The faculties of mind and processes of method implied in the complete comprehension of religion as a concrete manifestation of spirit are those which are of prime moment in the historical disciplines of theology; the faculties of mind and processes of method involved in the clear apprehension of the truths and laws of religion in its abstract or essential nature are those chiefly requisite in the theoretical disciplines of theology; and, speaking generally, complete comprehension of the concrete presupposes a more minute and exhaustive acquaintance with particulars than does a clear apprehension of the abstract. To determine with scientific precision and thoroughness, for example, what were the stages of the development of doctrine in the Bible, or even to trace with such accuracy and completeness as the data supplied by the Bible and auxiliary sources permit the growth of single important ideas, as, *e.g.*, election, holiness, atonement, and kingdom of God, demands laborious critical investigation and comprehensive and minute historical knowledge. Given, on the other hand, the Christian ideas of God and of man, and the fundamental relation between God and man cannot be otherwise conceived by enlightened reason and conscience than as one of salvation through faith and not by works. True, as all physical nature obeys the law of gravitation, so all Scripture and spiritual experience testify to the power of the principle of faith; but then, also, as the decisive proof of the former lies in the thorough elucidation of any phenomenon which exemplifies it, not in the collection of numerous illustrative phenomena, so the decisive proof of the latter lies in an adequate analysis of any portion or form of the life of genuine faith, not in the accumulation of examples of faith drawn from the Scriptures or other records.

Historical and thetical inductions

The two methods of induction to which reference has just been made—the historical and the thetical—are to be carefully distinguished but not absolutely separated, and still less exhibited as antagonistic. Both have specific and appropriate functions; neither is exclusively legitimate or can alone accomplish the work of science. The historical method by itself can only yield history. It has done all that can in any circumstances be reasonably expected from it, when it has enabled us accurately to realize the course of the history studied, or, in other words, when it has given us a correct reflexion of the history. If, not content therewith, we would further ascertain the nature and laws of the factors which formed the history we must supplement the historical with the thetical method. The historical method leads only to history, and in no form or province is history science. Science even of history, or of any department of history, cannot be reached simply by the historical method, but further requires recourse to the processes of positive science. Comparative theology, Biblical theology, and the history of Christian doctrines are most valuable theological disciplines, but, inasmuch as their methods are purely historical, their results are also purely historical, and they are not, rigidly speaking, sciences, but only sections of the history of religion. The tendency to substitute history for science, and the historical method for the scientific method, is prevalent in the present day in theology, as well as in ethics and jurisprudence, social philosophy and political economy. Obviously, however, it rests on exaggeration and illusion, and confounds things which ought to be distinguished. Neither history of the objects of a science, nor history of the ideas or doctrines of a science, is science, and the historical method of itself can only give us in connexion with science either or both of these forms of history. It is, therefore, inherently absurd to suppose that the historical method can be sufficient in such theological disciplines as natural theology and Christian dogmatics. In reality, it is not directly or immediately available in the study of these disciplines at all, and that just because it does not directly or immediately yield theory, doctrine, science. Only he who knows both the history of the objects and the history of the ideas of a science, and especially of a psychological, social, or religious science, can be expected to advance the science. In the sphere of religion, as in every other sphere, to confound history with science is to eliminate and destroy science; but in no sphere is knowledge of history more a condition of the attainment of science, and historical research, properly conducted, more serviceable to scientific investigation, than in that of religion. To the historical method we owe, not only the historical disciplines of theology, but also in a considerable measure the recent progress of its positive or theoretical disciplines. It can never, however, be, as some fanatical disciples of the historical school would have us to suppose, the method of these last.

Complex problems demand comprehensive inductions.

The inductions of theology, even in its systematic or non-historical departments, often require to be very careful and comprehensive in order to be conclusive. Theories or doctrines like the Christian dogmas of the Trinity, incarnation, and atonement were only arrived at through the labours and controversies of many generations of theologians. It could not be otherwise. These dogmas, simple as they may seem to a superficial glance and untrained eye, are in reality very complex organisms of thought, only capable of being formed by a long process of evolution. They are theories inclusive of many theorems. They comprehend a number of directly constitutive propositions and a still greater number of propositions subordinate and subsidiary to these. Every proposition which they involve should be the expression of real and relevant facts. As wholes they ought to combine a multitude of particulars of different kinds, and even of kinds the harmony of which is far from obvious and needs confirmation. Whoever intelligently accepts any one of these dogmas must, by necessary implication, reject a host of hypotheses regarding its subject, as either inadequate or positively erroneous. Inasmuch as they are not consistent with or are contrary to the dogma, he is logically bound to repudiate them, and yet he is only logically entitled to do so if his proof of the dogma have been so comprehensive and complete as to include their separate and collective refutation. The establishment of the whole truth is only possible through the disproof of all the opposing errors. How the inductive method is applied in theology, however, will be better understood by the examination of a particular exemplification of it than by a general description; and, perhaps, as regards at least form, a more careful or elaborate exemplification could hardly be pointed out than that exhibited in Dr Crawford's treatise on the atonement. An examination of it will show how very complex in reality may be a doctrine which is very simple in appearance, and how comprehensive, therefore, must be the inductive procedure necessary to establish it and to warrant the rejection of the hypotheses which must seem to one who accepts it to err by excess or defect or to be absolutely false.

The deductive element indispensable.

The inductions of theology, like those of other sciences, are seldom or never mere or pure inductions. They would be useless if they were. The examples of pure induction given in treatises on logic may serve their purpose, the illustration of the nature of ratiocination, but they are not reasonings of a kind which can increase positive knowledge. The abstraction of induction from deduction may be needed to exhibit its distinctive formal character, but it is fatal to its practical efficiency. In all reasoning meant to increase our knowledge of objects, induction must receive from deduction some measure of assistance and guidance. This certainly holds true in theology. In regard to the doctrine of the Trinity, for example, the most difficult questions involved turn largely on the signification and application of the terms employed in its expression. These terms must be somehow defined, and definitions once introduced cannot fail to be used to some extent as principles of deduction. They are often largely so used by those who are quite unconscious of making any use of them, and who have no suspicion that the course and character of their reasonings are modified by them. Definitions often secretly introduce a great amount of hypothesis and deduction into reasonings imagined to be exclusively inductive. Further, principles of deduction are directly and explicitly introduced. The truth of the catholic doctrine, or indeed of any doctrine, of the atonement, for example, cannot be proved purely by induction. It is necessary to start with some assumption as to the authority of the Scriptures, or at least as to the authority of those whose teaching is contained in the Scriptures. That assumption itself should, it is true, be proved by a process of apologetical and critical reasoning which is in the main inductive. It cannot, however, any more than the doctrine of atonement, be proved by a purely or exclusively inductive process, *i.e.*, without some co-operation or participation of deduction; and, once proved, it becomes a principle of which a deductive use is made. Every particular statement of Scripture is read and interpreted in the light of it. So far as this is the case, deduction underlies all the inductions of doctrine based on the statements of Scripture. Of course, the dogmatic theologian, in so far as he founds on Scripture, is bound not to presuppose more than he is prepared to prove as a Christian apologist or Biblical critic and interpreter. The assumptions made in systematic theology ought to be the firmly ascertained results of its subsidiary sciences. And the less assumed the better, as the relevancy of the reasoning employed will be so much the more widely acknowledged. Every additional assumption diminishes the number of persons who will grant the principles on which the argumentation proceeds. When, for instance, a doctrine like plenary inspiration is assumed as the basis of an argument for the atonement, the number of persons who can be benefited by the argument must be few. Those who will grant plenary inspiration are not likely to require to be convinced of the truth of the ordinary doctrine of the atonement; they are almost certain to be already convinced. On the other hand, a man may have loose or vague views of inspiration, and yet it may be possible to satisfy him that the doctrine of the atonement is well founded. The proof of the doctrine of the atonement may receive support and confirmation from the proof of the doctrine of plenary inspiration, but ought not to be made dependent on it.

Systematization.

Scientific method has not only to ascertain the facts and data of science, and to discover its laws, but also to distribute and co-ordinate its contents. And this last is likewise an important function. Science is system. To exclude system from science is to suppress and destroy science. The spirit of system is in itself nothing more than the spirit of order and unity. Without unity and order—that is, without system—there is no science; instead of it there can be only confused ideas, isolated opinions. It is absurd to condemn either system or the spirit of system in theology or any other science. To systematize is an intellectual necessity; to systematize aright is a happy achievement and an immense boon; it is merely systematizing erroneously which is evil. Theology, by professing to be a science, pledges itself to systematize in a scientific manner. By claiming to be the science of religion it undertakes to exhibit the truths of religion in their proper relationship to one another, in their organic unity and essential interdependence. Thus to proceed is necessary to it, not only as a consequence, but also as a means of the development of its constituent dogmas, for no doctrine can be truly and fully evolved in isolation, but only in connexion with kindred doctrines and through the general growth of the science or system to which it belongs. Increase of insight into any one truth brings with it clearer views of all contiguous and related truths, and the collective light thus gained illumines each particular to which it extends. To apprehend more distinctly the relations between either facts or theories is to understand better the facts or theories themselves. To comprehend any single doctrine aright we must study, not merely its special data, but those of allied doctrines, trace its connexions with those doctrines, and view both it and them as parts of an organic and harmonious whole. Hence the endeavour to systematize the contents of science should not merely follow the formation of its separate doctrines, but likewise accompany and participate in the process of their formation. Wisely conducted systematization is entitled to be deemed an aid to discovery. It reveals where exploration is needed, and indicates the directions in which research will be successful. It is the highest form and effort of synthetic thought, and synthesis is a not less necessary and fruitful operation in scientific method than analysis.

Abuse of system.

Unfortunately it cannot be denied that there has been a vast amount of erroneous systematizing in theology, and that it has done a vast amount of harm. Doubtless much of the aversion felt and expressed to system in theology is to be traced to the imperfect, artificial, false character of many theological systems. Instead of exhibiting religious truths in their real significance and interdependence, theological systems have often disguised and disfigured, cramped and contorted these truths, or even ignored and rejected them. How, then, is a true and appropriate system to be distinguished from one which is false and imperfect? In various respects, which can here be merely mentioned.

Requisites of a true theological system.

Thus, first, a true system is natural and not artificial. In equivalent terms, it is directly derived from the character of the matter of which it treats, and not arbitrarily imposed on that matter from without. Every system of thought, whether true or false, must, of course, be the product of intellect, but no true system is a mere invention of intellect, a mere subjective creation interposed between the mind and things; it is, on the contrary, a representation of the real natures and relations of things. The human intellect can only construct a true system by finding in and among facts the connexions and harmonies which are actually there. But to do this may require more labour than is agreeable, or may contravene some cherished prejudice, or may not be recognized to be the sole legitimate procedure, and so it may devise, instead, a formula or scheme of thought suggested by some idea drawn from an extraneous source, force that scheme or formula upon things to which it is inappropriate, and so construct a system which is artificial and erroneous. Most sciences have suffered from artificial systematization of this kind, but probably none nearly so much as theology. Metaphysical philosophy has always sought to shape and modify religious and even distinctively Scriptural truths according to its own ideas, methods, and dogmas. Paul and John have often been merely the masks through which Plato and Aristotle have taught. Hegelian divines have passed all religious beliefs, all Scriptural doctrines, through the dialectic devised by their master, and, whatever those beliefs and doctrines may have been before subjection to the operation of that wonder-working machine, they have always come out ground into Hegelian notions. Jurisprudence exerted a similar influence, owing to its having been the only science which was studied with zeal and success in the Latin world when theology began to be independently cultivated by the Latin Church. The Latin mind was so possessed by juristic or forensic ideas that the Latin fathers could not avoid looking at the gospel through them. This way of viewing it is still familiar. The so-called federal school of theology, long and widely influential, exhibited the whole system of religious truth according to the analogy of a covenant,—a succession of covenants between God and man,—in other words, according to a conception which is essentially juristic and political, not intrinsically and properly religious. The making of a metaphor in this manner the basis of an entire system of theology is far from uncommon. Thus, because sin may be likened to disease or to darkness or to death, and holiness to health or light or life, not a few would conceive of all religious truth according to these similitudes, and do violence to the reality when it does not easily adapt itself to the moulds which they have chosen for it. Dr Chalmers, for instance, distributed all systematic theology into a study of the disease and a study of the remedy, and treated the doctrine of the Trinity merely as an appendix. At present, owing to the dominancy of physical science, there is a strong temptation to work upon spiritual facts with physical categories, and even to identify, *i.e.*, to confound, the spiritual with the physical. Hence we hear of natural law, in the sense of mechanical or biological law, in the spiritual world.

Secondly, in a true system of theology the material and formal constituents of knowledge will be duly combined, but not in a false system. No true system of theology can be constructed simply by logical deduction from abstract conceptions, from *a priori* assumptions, from self-evident axioms. Mere reasoning from data so insufficient as these may be made plausible and imposing by being thrown into syllogistic, dialectic, or mathematical shapes, but it cannot be made truly profitable and productive. When the Wolfians had presented theology in the semblance of geometry, they had merely succeeded in dressing it in masquerade and binding it with fetters. Reason can only work effectively in theology when it is in possession of a large and close acquaintance with Divine things and acts harmoniously with the whole spiritual nature. On the other hand, without the application of logical reflexion to the truth implicitly contained in the sources of religious knowledge, without the help of definition, induction, deduction, and all the processes involved in analysis, generalization, judgment, and reasoning, we never could reach a scientific system at all. Such a system is not simply an aggregation or accumulation of the data and constituents of religion, but the product of all the activities and forms of thought which give to the contents of religious experience the order and organization which theology, as science, demands.

Thirdly, a true system is one in which unity is the result of the conciliation of all relevant principles, even although they may be apparently antagonistic, while a false system is one which bases itself on some particular principle or idea to the exclusion of others, also legitimate. In a true system unity is produced by harmonizing differences; in a false system it is produced by ignoring differences. A true system of theology is one which grows out of the struggle of opposing elements and recognizes the validity and significance of all religious truth. It is not, for example, so based on Divine sovereignty that injustice is done to human liberty, or so based on free will that God's agency is largely ignored, but it assigns to both Divine efficiency and human action their proper place, and does so, not merely by maintaining the truth of both, but also by exhibiting their relationship and harmony.

Fourthly, in a true system all the members are not merely included, connected, and classified,—they are also unified through reference to a centre. A true system must be a unity of members pervaded by a common life. In its remotest members must be traceable the pulsations of its heart. Only of late have theologians begun clearly to recognize that this characteristic of a true organic system must be taken into account in the formation of their science. Long after they were fully alive to the importance of treating of each head of doctrine or article of faith, each separate theological locus, they felt hardly any interest as to how the various doctrines, articles, or loci were to be connected. They were often content to take the order of arrangement from some external source, some creed, confession, or catechism. It was a step in advance when, although still arranging the dogmas merely in a series, they endeavoured to give each dogma its place, on the ground of its natural and intrinsic relationship to other dogmas. Theologians have, indeed, differed much as to what is the proper *seriatim* order. One, for example has begun with the nature and state of man, a second with the being and character of God, a third with the Divine authority of the Scriptures, and a fourth has followed the order of the Divine dispensations. Yet there need be no doubt that there is such an order, one in which every dogma is exactly where it ought to be. This order, it may also be safely affirmed, can only be one of advance from the simpler to the more complex. An order in which each dogma has before it only its natural antecedents, and after it only its natural consequents, must be one of continuously increasing complexity. The spirit of order and of system cannot rest, however, in the series. It must classify as well as connect the doctrines. This also may be accomplished in various ways, and even when there is general agreement as to what are the natural groups, there may be considerable difference of opinion as to their delimitation. But the most perfect distribution by classification, if unsupplemented, must be unsatisfactory. A still higher kind of unity has to be attained. It is that of the only unity which is truly organic. It is that of co-ordination and correlation through a single central principle. An intellectual system, a system of science or doctrine, can only have this unity, and be in consequence a true system, when all its particular truths and various departments or divisions of truth are connected with one another and combined into a whole by reference to a common and central truth. The necessity of conforming to this condition of systematizing has now begun to be felt among theologians, and hence in several modern systems of Christian dogmatics the doctrines are not merely distributed into groups, but an attempt is also made to find a centre for the whole system in a single pervasive idea. Such a centre Rothe, for example, finds in the religious consciousness, a consciousness of sin and of grace; Kahnis in the doctrine of the Trinity; and Thomasius and H. B. Smith in Christ Himself, His person and work. So far as Christian theology is concerned, the last of these views is doubtless correct. Christian theology, like Christianity itself, must be Christocentric. All its doctrines either directly and immediately relate to Christ's manifestation of God and redemption of man, or are the antecedents and consequents of those which do. To Christ the entire system owes its distinctive character. For general theology, on the other hand, the central and vital idea can be no other than that of religion itself. It must obviously be one derived from the domain of the science itself, and indeed from the essential nature of the object of the science. As it would be an error to seek the principles of biology elsewhere than in "life," or of psychology elsewhere than in "mind," so must it be to seek the principles of theology elsewhere than in "religion." Theology is the science of religion, and in the true idea of religion should be found the central and constitutive principle of the general system of theology. That it can be found therein will appear as we proceed.

Must the work of method in theology end, however, even with the formation of a system which answers to the requirements just indicated? Is there no still higher procedure or application of theological method legitimate? This is to ask if there be any place for a speculative method in theology, and if speculative theology rest on any solid basis.

The history of theology might, perhaps, suffice of itself to show, on the one hand, that speculation has a large and legitimate place in the sphere of theology, and, on the other hand, that its place is one the limits of which are difficult to fix or keep within. Christian theology was initiated by Gnostic speculation, grandly reasonable in aiming at the exhibition of Christianity as the absolute truth and absolute religion, but otherwise wildly extravagant. An Origen and an Augustine owed largely to speculativeness both their successes and their failures. The defects of scholasticism were due more to misdirection of the reflective understanding than of the speculative reason, and it was especially the speculative and the mystic divines of the Middle Age who opened up the way to modern thought and modern theology. Men like Nicholas of Cusa, Bruno, Telesio, and Campanella, looking from the heights of speculation, saw some aspects of religious truth which the Reformers, standing on lower if safer and less cloudy ground, overlooked. A Descartes and a Spinoza, into whatever errors they may have fallen, certainly did much, and in a directly speculative manner, to enlarge and advance the philosophy of religion. Kant supposed that, by his critical researches into the nature and limits of knowledge, he had made an end of speculative theology and done what would effectually deter reason from speculative adventures. It soon became apparent that his expectations had been doomed to disappointment, that in reality he had excited speculative reason to extraordinary activity and even audacity, and inaugurated an era of theology far more speculative than any which had preceded it. The great speculative movement in philosophy headed by Fichte, Schelling, Hegel, Baader, Krause, and others passed on immediately into the sphere of theology, its leaders themselves proceeding to apply their principles and methods to the explanation of the doctrines and phases of religion. Theologians by profession soon followed in their footsteps. Daub and Marheinecke constructed systems of Protestant dogmatics by means of Hegel's dialectic. Strauss, Baur, and their followers reached by the same method negative and antichristian results, bringing out the contradictions between the doctrines of the church and the speculative truths to which it was held that they should give place. Many theological systems of an almost exclusively speculative character have since appeared in Germany. Weisse's *Philosophische Dogmatik* and Rothe's *Theologische Ethik* are good typical instances. And, while not so predominant, the speculative use of reason is yet conspicuous in the treatises on Christian dogmatics of Dorner, Martensen, Schöberlein, Hofmann, Liebner, Biedermann, and others. In the department of philosophy of religion a speculative procedure is not less frequently followed, either as alone appropriate or as a necessary supplement to the genetic and historic method. Rosmini, Gioberti, and Mamiani inaugurated in Italy a speculative theology second only to that of Germany. Contemporary French theological literature can boast of at least one work displaying real speculative power,—the *Philosophie de la Liberté* of M. Secrétan. In America Hickok, Bushnell, and Mulford may be named as having shown confidence in the competency of speculative reason in the spiritual sphere. In Britain Principal Caird has argued in favour of a speculative procedure in theology with rare skill in his *Introduction to the Philosophy of Religion*. On the whole, however, both in America and Britain, the speculative method has received little recognition from theologians. But this, of course, may be held to be partly cause and partly effect of the want of life and originality, of thoroughness and truthfulness, of ordinary American and British systematic theology.

Is there, then, room and need in theology for the speculative method? The answer must depend on what is meant by speculative method. There are kinds of so-called speculation which are plainly illegitimate and inapplicable. Thus, some have represented speculative theology as part of a philosophy of which the whole system is deduced in a purely and strictly logical manner from an *a priori* principle, idea, or datum. On this view the speculative thinker somehow apprehends an absolute first of thought or being, or both, and then from this primary and necessary datum evolves syllogistically or dialectically a whole philosophy, which includes a whole theology. Such speculation may be safely pronounced futile and delusive. It can never reasonably vindicate its choice of a starting-point, for the absolute first of existence and thought can only be that to which the worlds of fact and experience, of matter and of mind, refer us as their ultimate explanation. It ascribes an extravagant power to mere formal thinking. It is only consistent with exclusive idealism and exclusive rationalism, both justly discredited species of philosophy. It makes theology wholly dependent on a philosophy which must be false, since pure reason cannot, as it assumes, spin out of its own essence or out of any single datum the whole system of truth.

The *Theological Ethics* of Rothe.

There is, however, a theology which claims to be at once speculative and independent of philosophy. Such was the theology which Rothe sought to elaborate in his *Theological Ethics*. In the "Introduction" to that work he has fully explained his method. It is, as there represented, the very same method with that of speculative philosophy, but it starts from a different point,—not from pure self-consciousness, but from the religious self-consciousness or God-consciousness. Its primary datum is, according to Rothe, as immediately certain as that of speculative philosophy, the pious man being just as directly sure of God as the natural man is of his own self. Out of this datum it must evolve all its conclusions by an inward logical necessity, and construct an entire theological system of such a nature that every single thought implicitly supposes the whole. Speculative theology thus conceived of needs but a single fact, the datum from which it starts, and that fact must be a self-evident one, given immediately in and by consciousness; all the rest is a succession of inferences deductively obtained. The facts of religion presented in nature, history, and Scripture not only need not but ought not to be taken into account by it, although at the close of its labours its success must be tested by the conformity or nonconformity of its results with those facts.

> "This system of *a priori* thought," says Rothe, "to be successful as a speculation, must be an absolutely corresponding and constant image of the reality; but the speculative process itself takes no thought whether there be such a reality existing, or how the ideas which it constructs are related to it; but, without looking either to the right hand or to the left, it follows only the course of logical necessity, until it has accomplished the whole circle of its ideas, and constructs a complete system. Then first the speculative thinker looks out of himself, in order to compare the system of thought which he has independently constructed with the objective reality, and to assure himself of his correctness by such a comparison; but in so doing he is slipping out of the region of speculative into that of reflective thinking. The necessity of such a verification, indeed, he acknowledges unconditionally, but he distinguishes clearly between the speculation itself and that reflective critical process by which alone such a verification can be realized. With reference to the empirical reality around him, he acknowledges that his speculation is incorrect if his system of thought is not *there* reproduced, but he still persists that he has to complete his speculative labour without any direct reference to it. He concludes rather, from a clear want of correspondency, that he has speculated incorrectly, and can look for his error in nothing else than in his departure from a strict adherence to the laws of logic. Forthwith, then, he destroys his laboriously constructed system; but if he again proceed to construct another, he must proceed in the very same manner as before, *i.e.*, by looking solely into his own thoughts, as though there were no world around him."

Rothe, it will be observed, cannot be charged with having made theology dependent on philosophy. He represented theological speculation and philosophical speculation as starting from different data, as running parallel to each other, and so as throughout distinct. But this was to avoid one extreme by falling into another. It was virtually to deny the unity of thought, and to assume an incredible dualism in the universe of speculation. A theology absolutely separated from philosophy must be even more unsatisfactory than one wholly dependent on it. Then, the method itself proceeds on assumptions unsupported by evidence, yet far from self-evident. It assumes, for instance, that a system of ideas generated *a priori* will be a counterpart of reality, although it is neither inconceivable nor improbable that the characteristics of real existence may be incapable of being determined by the mere logic of necessary thought. Reason should not thus be credited with the extraordinary power of comprehending reality without requiring to apprehend and study it. Another assumption is, that a complete and self-consistent system can only be reached by an exclusively *a priori* procedure, whereas it is far more likely that such a system will only be attained by a combination of different processes. Again, the primary datum of theological speculation as understood by Rothe—the idea of God—is assumed to be immediately given and immediately certain. But the idea of God is not immediately given or immediately certain. The piety which chooses to affirm so is a piety capricious in its affirmations; the speculation which starts from such a foundation starts from an assumption easily shown by psychology and history to be erroneous. Rothe went even farther astray. He represented not only the bare consciousness of God but the Christian, yea, the evangelical God-consciousness, as a simple and primary datum of consciousness. This was utterly arbitrary. It was to treat as an original apprehension what is indubitably an acquired experience. No *a priori* system—no properly deductive system—can be reasonably imagined to have such a starting-point. For these and other reasons, theological speculation of the kind advocated by Rothe may be rejected.

The *Schriftbeweis* of Hofmann.

Still another species of theological speculation, however, has been attempted and commended,—one which seems more modest, and claims to be more distinctively Christian. It is the method advocated and exemplified in the *Schriftbeweis* of Von Hofmann. He, instead of starting like Rothe with the religious consciousness, chose to start from a real concrete fact, what he calls the Christianity of the Christian,—a Christianity which he supposes to have acquired in the Christian a separate standing of its own, in virtue of which, and independently even of Scripture, it is self-evident certain truth sustained and authenticated by the Spirit of God. From this fact or experience, expressed in its simplest and most general form, as a personal relationship or fellowship between God and man through Jesus Christ, Hofmann would deduce the whole theological system by a process of "thinking within" the central fact, so as logically to evolve from it its manifold wealth of contents, and would refrain on principle from looking outwards, and taking into account the religious facts presented by history, experience, or Scripture. Now, in this system also, speculation is in excess. Such a speculative deduction of facts from facts as is contended for is impossible. Facts are not so involved in one another that they can be evolved from one another by mere thinking, and still less so that from one fact a whole system of facts can be thus evolved. From a single bone, indeed, of an animal which he has never seen or heard of a naturalist may in thought correctly construct the whole skeleton, but not by thinking within or from the one fact before him, but by making use of all the knowledge he has acquired of the structure of animals, of the relations of bones to bones. Dr Hofmann himself was quite unable to carry out the method he contended for. His so-called speculative arguments are mere semblances of what they profess to be. Instead of the contents of his system being really "derived" from the simplest expression of the fact of Christianity, new propositions are constantly borrowed from the known contents of Christianity, and added from without or the simplest expression, in order to help out the unfolding of the system. Further, in Hofmann's system of speculation, as in that of Rothe, we are asked to start from an assumption which is not, and cannot be, justified—the assumption that Christianity in the Christian is independent of its objective grounds. Surely every experience may reasonably be called upon to produce evidence of its legitimacy and validity; and, if so called upon, how can it avoid referring to its grounds? It is only by an examination of the grounds of an experience that we can know whether it is an experience of reality or a form or effect of illusion. The fact from which we are told by Hofmann that we must deduce all other facts is only itself intelligible in the light of many of these facts, and even of the Christian system as a whole; it is a fact which has many conditions, and the right understanding of it requires its being viewed under its various conditions, not as abstracted from and independent of them.

Speculation necessary to true systematization;

In the forms indicated, then, speculation has failed to make good its claim to participate in the formation and development of theology. Does it follow that its claim is wholly unfounded? By no means. Speculation in the forms described pretends to an independence of reality and a creative power for which there is no warrant in reason or confirmation in fact. Hence the futility of such speculation is no disproof of the utility of a speculation which will fully recognize reality and directly endeavour to elucidate it. Speculation of this latter kind seems to be a necessary condition of true systematization and a necessary supplement to induction and to all the special methods of particular sciences. In a true philosophy, for instance, science and speculation must necessarily be combined. So far from claiming independence of the sciences, a true philosophy will base itself upon them, and seek to rise above them by means of them. It is only thus that it can hope to reach the ultimate universal and real principle of knowledge and being, without which there can be no rest for reason or unity in the universe. But, having ascended by an analytic and inductive course to the unity of an all-comprehensive ultimate principle, philosophy must endeavour to descend from it in a synthetic and deductive manner, so as to exhibit the whole organism of existence, or to determine how the many laws of science and the many facts of experience are connected with the absolute in being and causation, and through it with one another. It is conceivable that the descent should be accomplished in various ways, and Plato and Plotinus, Descartes and Spinoza, Fichte, Schelling, Hegel, Krause, Gioberti, and others have attempted it each in a way of his own; but two things are obvious, namely, that philosophy cannot consistently decline the task, and that any method it may adopt in trying to perform it must be one essentially speculative. An inductive and analytic method is clearly inapplicable, for the highest and last results of induction and analysis are just what are to be elucidated through being viewed in relation to the one supreme truth or fact. And among the data with which philosophy must thus synthetically or speculatively deal are those of religion. It requires to show how what theology teaches as to God's nature and operations comports with what itself affirms as to the absolute source and ground of existence, and this necessarily commits it to have recourse to a theologico-speculative use of reason. And to a very large use of it if, for example, theism be true; since, in this case, the absolute principle of philosophy can be no other than God Himself, and its highest task no other than to show Him to be the essence of all existence, the light of all knowledge. In this case philosophy must inevitably become in the highest stage of its development a speculative theology.

and as a supplement to induction.

Nor can positive theology dispense with speculation. It cannot, indeed, begin with it or confine itself to it,—cannot start with some single immediately certain religious fact, and then by mere force of logic evolve therefrom a whole theological system. Its data are all real facts of religion, and these it must deal with, in the first place, mainly by observation and induction. But observation and induction will not always alone lead to a satisfactory result. Observation is confined to experience, which gives only the particular. Induction, in so far as it effects a transition from the particular to the general, already involves the activity of speculative reason; it makes discoveries only when guided by theory; it can never of itself reach ultimate truth; and it is manifestly not its function to raise coherent comprehensive systems on their proper constructive principles. Then, the theologian who renounces speculation must deal most inefficiently with the chief ideas and doctrines of his science. Consider the greatest idea of all—the idea of God. Mere observation and induction do not yield the idea. Exclusively applied, they cannot take us beyond the contingent and conditioned, cannot take us beyond atheism and secularism. Waive, however, this objection, and grant that the idea of God may be given, say, through revelation. What sort of idea must it be in the mind of the theologian who refuses to speculate? Merely that of a complex of the attributes predicated of God in the Bible. Surely that is unworthy to be accounted an idea of God at all. The theologian who is in earnest with the idea of God, who would find order and light in the idea, who would think of Him as He is, Absolute Being, Harmonious Life, Infinite Personality, Perfect Spirit, Ultimate and only Complete Explanation of the Universe, must assuredly speculate, and speculate freely and largely, although he ought also to do so humbly and reverently. Even if he would maintain that we cannot have a knowledge of God as He is—that we must renounce the hope of a speculative knowledge of Him, and be content with a merely regulative knowledge,—he will find that he needs, as Kant, Hamilton, Mansel, and Spencer have practically so fully acknowledged, speculation, and much speculation, to support his thesis. The mind is not necessarily relieved from the duty of exercising speculative thought on the nature of God by receiving a special revelation regarding God. Christianity is a proof that such revelation may only increase obligation in this respect. It brought with it a wondrous idea of God, one of marvellous practical efficacy, but one also which forced Christian reason into paths of speculation, which could only be formulated after lengthened and severe speculative labour, and which no intellectually or spiritually quickened soul can accept otherwise than with speculative exertion. And this may show that speculation is as legitimate and applicable within the sphere of Christianity as within that of general theology. The comprehension of Christianity requires that we penetrate to its distinctive and central principle, and view all its contents in the light of that principle. It is only so that we can hope to accomplish either a true systematization or a true elucidation of its contents. The procedure by which this is effected cannot be one of mere formal logic, of pure deduction, or strict demonstration; it must be one which implies a constant reference to facts and inductive results; but still it must be one which is essentially synthetic and speculative.

Relation of the theological sciences.

Theology is a unity, a whole, but a very complex unity, a whole of many dissimilar parts. It may be spoken of in a broad and general way as a science, but not less correctly as a department of sciences. It includes many studies or disciplines which may be cultivated in a scientific spirit and according to scientific methods, and these studies or disciplines, while closely connected, are also clearly distinct. They are by no means mere divisions of a special science. Natural theology and Christian dogmatics are as distinct from each other as physics is from chemistry or anatomy from physiology. Comparative theology and Biblical theology are as distinct from each other as the study of the general history of mankind is from the study of the history of England.

Encyclopædia of theology.

Hence arise a number of problems. How are the theological sciences related to the non-theological sciences and to one another? How are they located in the vast organism of science as a whole? and how are they connected with one another so as to form a smaller organic whole in themselves? What principles have they in common, and what tasks are proper to each? Wherein do they agree and wherein do they differ in their methods of research? These are very important questions. There cannot be an earnest and scientific study of theology where they are overlooked. It is the special task of the theological discipline called "encyclopædia of theology" to discuss and answer them,—or, in other words, to determine the boundaries of theology, to exhibit and explain its inner organization, to indicate its component parts, and to trace their relations both to one another and to the theological system as a whole. This discipline is, therefore, the appropriate scientific approach and introduction to theology and to the various theological sciences.

It is of comparatively little importance whether or not it be itself called a theological science. Strictly speaking, perhaps, it is rather a section or prolongation of that division of general philosophy which treats of the relations of the sciences. One of the tasks of philosophy is to define and distribute, classify and co-ordinate, the sciences, so as to exhibit them as parts of an harmonious *cosmos* or members of a well-proportioned *corpus*. But philosophy, when in the pursuit of its merely general ends, cannot be expected to go into details and to concern itself with all the subdivisions and ramifications of science. It will be content to trace main lines, to appreciate leading principles, processes, and results, and, in a word, to exhibit the organic unity and variety of science as a whole. It will leave the exact and exhaustive distribution and survey of any particular kind or group of sciences to those who are extensively and minutely acquainted with that kind or group of sciences. The comprehensive philosophic survey of any order or department of studies is the encyclopædia thereof. Hence there is encyclopædia of mathematics, of physics, of philology, and of jurisprudence, as well as of theology. Encyclopædia of philosophy, however, comprehends all the departmental encyclopædias of science. And this for the simple reason that philosophy is inclusive and unitive of all science. As *scientia scientiarum* philosophy is, as Hegel has aptly said, "wesentlich Encyclopadie." Hence theological encyclopædia—the encyclopædia of the sciences conversant with religion—may reasonably be held to be essentially a prolongation, a direct continuation, of philosophy.

Theological encyclopædia has had its course determined by the general movement of theology. The various theological disciplines required to be evolved before they could be co-ordinated. The designation "theological encyclopædia" first occurs in its current technical sense in Mursinna's *Primæ Lineæ Encyclopædiæ Theologicæ* (1764). It was only with the publication of Schleiermacher's *Kurze Darstellung des theologischen Studiums* in 1811 that the full scientific importance of the discipline was made evident. It has since been diligently cultivated in Germany, and is at length finding recognition in other countries.

There are, however, serious defects even in the latest and best expositions of it. Two of these may be noted as being so serious that, owing to their prevalence, theological encyclopædia can hardly be said to have even yet entered a truly scientific stage. One is the virtual or express identification of theology with Christian theology. All the chief theological encyclopædists of Germany—Hagenbach, Lange, Räbiger, Rothe, Von Hofmann—follow Schleiermacher in this amazingly absurd procedure. Logically the Brahmanist, Buddhist, and Mohammedan might with equal justice identify all theology with their own. The superiority of Christianity to other religions, the uniqueness of Christianity among religions, does not alter the nature or lessen the magnitude of the error. Every encyclopædia of theology which confounds the general with the special so completely as to identify theology with Christian theology forfeits its title to recognition as scientific; and almost all, even of the latest and best theological encyclopædias, do so. The other fault referred to is that, even in the latest and best of theological encyclopædias, the constituent sciences of theology are not so coordinated with reference to a centre as to render apparent their organic connexions. The German encyclopædists since Schleiermacher claim, indeed, that they so distribute the various disciplines of theology as to exhibit its natural organization. But the claim is not well founded. In reality, their schemes of distribution have no real unity. They are simply arrangements of the various theological disciplines in a fourfold, threefold, or twofold manner, *i.e.*, for example, as exegetical, historical, systematic, and practical, or as historical, systematic, and practical, or as didactic and practical. But this is merely external classification. It may be faultless of its kind, but it cannot of itself yield more than a superficial and mechanical arrangement of the theological sciences. Theology, to be scientifically surveyed and distributed, must be viewed as a unity, and all its parts must be shown to be included in it, and to have a definite place in it from its very nature and definition, as the science or philosophy of religion. Their relationship to one another must be determined by their relationship to the whole of which they are parts, to that science or rather philosophy which treats of religion as a whole. They can only be unified and coordinated in a truly organic manner by their due reference to religion, and consequently proper inclusion and location in the philosophy of religion. This necessity has as yet been only verbally acknowledged by theological encyclopædists.[1]

Philosophy of religion.

There is an all-comprehensive science of religion,—one which treats of religion in its unity and entirety. It alone completely answers to the idea and definition of theology. It is the one general theological science, comprehends and dominates the special theological sciences, so as to be the science of these sciences, and hence, in accordance with the true distinction between philosophy and science, is properly called philosophy rather than science—the philosophy of religion. All philosophy is science, but all science is not philosophy. Philosophy, as distinguished from science, is general or universal as distinguished from particular or special science. This distinction is, of course, not an absolute one, but of degree—of more or less; every other distinction between them, however, is positively erroneous. The one general theological science is appropriately, therefore, termed philosophy. It is the philosophy of religion as there is a philosophy of nature and a philosophy of mind, each inclusive of various sciences. It is of the very nature of philosophy to be both before and after the sciences to which it relates,—to be at once their root and result, and at the same time their bond of union and source of life. And the general theology which may justly be identified with philosophy of religion has undoubtedly held this relation to the special theological sciences. It preceded them, being the germ from which they evolved, the root from which they have sprung; it has grown up along with them, permeating them as their common life; and it also succeeds and transcends them, basing itself on them and perfecting itself by means of them. It is the one generic science of the object with which it deals, and vast enough to comprehend a whole group of sciences, because its object—religion—is so rich, complex, and varied.

The primary task of a philosophy of religion is to ascertain and exhibit the nature of religion. Now, a general theory of religion is the natural introduction to all special religious studies and theological sciences, and yet can itself only be brought to perfection through the advancement of these studies and sciences. For example, we can only adequately understand the nature of religion through study of the history of religion, and yet we cannot trace the history of religion at all unless we know generally what religion is. Again, in such works on Christian dogmatics as those of Schenkel, Kahnis, Biedermann, and Lipsius, we find a considerable place assigned to an investigation into the general nature of religion. The investigation is manifestly not there strictly appropriate; its true position can only be in another and wider science. At the same time, it is undoubtedly a necessary antecedent to the investigations of Christian dogmatics, from the very fact that Christianity is a religion. On the other hand, Christianity is not only a religion, but a religion which claims to be the perfect or absolute religion; and, clearly, if the claim be well founded, the complete nature of religion can only be understood through that full knowledge of Christianity which Christian science may be expected to give.

From the very nature of religion the science or philosophy which treats of it as a whole must obviously be most comprehensive. Religion is a relation between a worshipping subject and a worshipped object. It implies both distinction and unity. Were there no distinction between the subject and the object there would be no religion, whether the self-identical unity were named God or man. Were there only distinction between them—were God and man absolutely separate from and indifferent to each other,—religion must be in this case also impossible. Religion thus supposes two factors, which are different yet related, so far distinct and so far akin; and our views of religion must depend on our views of these two factors. It involves still more. God does not act on man by the direct manifestation of His absolute essence, nor does man know God by immediate vision. Take away the physical and moral worlds and the written word and the Incarnate Word of God—suppose, that is to say, both general and special revelation removed—and an impassable chasm will separate man from God and all religion be destroyed. The revelation in nature and the revelation through particular inspiration and intervention, however, bridge over this chasm, and consequently religion is everywhere found existing in some form. But even revelation would be useless if man had not faculties to apprehend it and to avail himself of it. The communion of man with God supposes powers of communion in man as well as in God. It can only be realized through religious faculties and processes which can be analysed and which have laws of exercise and evolution that can be traced. Further, religion has a history which shows how man has interpreted or misinterpreted the revelations made to him, what forms religion has assumed in various lands and ages, and how these forms—the religions of the world—have arisen and spread, developed and decayed, influenced one another and affected morality, civilization, and general history. Thus religion, from its very nature or idea, requires us to treat—(1) of the object of religion (God), (2) of the subject in religion (man), and (3) of the media and process of religion, —or, in other words, (*a*) of the modes of Divine manifestation, (*b*) of the powers of human apprehension of the Divine, and (*c*) of religion itself as a kind of psychical life. All the special theological sciences deal with some of these themes, or some portion or portions of some of these themes, in certain aspects, but the philosophy or general science of religion deals with them all in their entirety and organic connectedness, the form appropriate to philosophy—to science which comprehends and thereby transcends special sciences.

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[1] The best account of the history of theological encyclopædia is that given by Räbiger in his *Theologik oder Encyclopädie der Theologie* (1880), of which there is an English translation, with notes which considerably increase the value of the work, by the Rev. J. Macpherson (2 vols., 1884). The account in Zöckler's *Handbuch der theol. Wissenschaften*, i. 87-111 (1883), is also good. The fullest account of the history of attempts to classify the sciences is that of the present writer in *Presby. Rev.* for July 1885 and July 1886. The following may be specified as among the most useful of theological encyclopædias:—Schleiermacher's *Kurze Darstellung des theol. Studiums*, 1st ed., 1810, 2d ed., 1830; Staudenmaier's *Encyclopädie der theol. Wissenschaften, &c.*, 1834; Hagenbach's *Encyclopädie u. Methodologie der theol. Wissenschaften*, 10th ed., 1880; Crooks and Hurst's *Encyclopædia and Methodology, on the Basis of Hagenbach*, New York, 1884; Doede's *Encyclopädie der Christlichen Theologie*, 2d ed., 1883; Lange's *Grundriss der theol. Encyclopädie*, 1877; Von Hofmann's *Encyclopädie der Theologie*, 1879; Rothe's *Theologische Encyclopädie*, 1880; Drummond's *Introduction to the Study of Theology*; and Cave's *Introduction to Theology*, 1886. See also the article of Willibald Grimm, "Zur theol. Encyclopädie," in *Ztschr. f. wissensch. Theol.*, 1882, 1; and Gretillat's *Exposé de Théologie Systématique*, vol. i. "Propédeutique," 1885.

For the philosophy of religion, as the highest discipline of theology, the most natural order to be followed in the treatment of its themes is probably that which has been indicated. It is the order which has been most commonly adopted in treatises that aimed at systematic completeness. God, man, God's manifestation of Himself to man, man's experience of God, and the development of religions, —these are the topics, and such is, in the main, the order of their discussion, usually found in philosophies of religion properly so called. This is, however, because the philosophy of religion as a distinct discipline presupposes the results of the several special theological sciences. Theology ends as it begins, in unity; but the unity in which it ends is very different from that in which it begins. It begins with the confused unity of common knowledge, the complex and undifferentiated germ of the theological sciences; it ends with the unity of the clearest and deepest insight, in which all distinctions are at once recognized and reconciled. This last is the unity of that ultimate stage of theological knowledge which can alone claim to be philosophical as distinguished from scientific; and it can only be reached by those who have attained to an adequate mastery of all the sciences conversant with religion. The philosophical student of the whole must have studied scientifically its parts, know what is to be known about them, and make use of his knowledge in his own proper labours. The student of the parts needs to know only in a general way what religion is, and must follow in his studies an order of procedure determined by his lack or limitation of knowledge. The course by which the mind traverses the partial and special sciences of religion and rises to a philosophy of religion cannot be the same as that through which it unfolds a philosophy of religion itself, exhibits and confirms a religious theory of the universe, and harmonizes and elucidates all results of theological research and all varieties of religious phenomena.

The philosophy of religion is itself, of course, special in relation to philosophy, of which it is only a department. And there may even be a special kind or form of the philosophy of religion, if that kind or form be general enough to include a natural group of theological sciences and to have regard to their collective effects. A special religion may be so significant, so important, and the subject of so many theological disciplines as to render indispensable the division alike of the philosophy and of the sciences of religion into general and special. Christianity, as the most perfect form of religion, the fullest revelation of spiritual truth, the source and theme of a large group of sciences, is such a religion. Hence there may be, and should be, not only a philosophy of religion but a philosophy of Christianity,—not only a generically religious but a specifically Christian theory of the universe. If the claims of Christianity be warranted, if in it religion and revelation were consummated, the philosophy of religion can only reach a satisfactory conclusion when it has passed into a philosophy of Christianity, or, in other words, attained such a comprehension of existence and life in relation to the person and work of Christ as is possible to the human spirit. The philosophy of Christianity must obviously be connected with all Christian disciplines in the same manner as the philosophy of religion is with all other theological disciplines.

History of philosophy of religion. The history of the philosophy of religion has, of course, been closely conjoined with the histories both of theology and of philosophy, and influenced by all the causes which have affected them. In the wide sense of religious reflexion it is as old as either philosophy or theology. As a distinct department of philosophy, and the highest and most comprehensive theological science, it is of comparatively recent origin, and, indeed, younger than many a living individual; but even in this latter sense the whole histories both of philosophy and of theology have been needed as the preparation and foundation for it. It could only appear in its alone adequate form when both philosophy and theology were highly developed, when both had freed themselves from the yoke of all authority save that of truth and reason, when both had discovered their appropriate methods, when they could so combine as to do no violence to the proper nature of either—a kind of combination most difficult to accomplish. But this, as might easily be shown, was not before philosophy and theology became at once critical and speculative, or, in other words, before that great revolution of thought with which the names of Kant, Hegel, and Schleiermacher are so gloriously associated. Only in the present century have philosophy and theology reached the stage in which they can unite and produce a philosophy of religion. And within the century many philosophies of religion have made their appearance, especially in Germany. Indeed, all the more eminent philosophers of Germany have fully recognized that a philosophy of religion is a most essential department of philosophy. That not a few of the so-called philosophies of religion produced have been very defective and erroneous is only what was to be expected. The worth of a man's philosophy of religion cannot be greater than the worth of his philosophy and theology in general. It is impossible that the philosophy of religion of an Hegelian and a Neokantist can accord, very possible that both may be far remote from the truth. If empiricism, positivism, or materialism be true philosophy, or if authority be the foundation of religion and the standard of theology, a philosophy of religion must be illegitimate and superfluous. When religion is assumed to consist merely of beliefs, emotions, and actions which have no objective grounds, no real and rational basis, its development can only be an object of history and of psychological analysis, and there can be no philosophy of religion, but simply a science of religions, which, seeing that it deals entirely with certain forms of mental disease and delusion, must be deemed merely a department of mental pathology. A philosophy essentially religious must combine with a theology essentially rational in order to yield what deserves to be called a philosophy of religion. If religion be the living apprehension and enjoyment of the truth which philosophy has for its mission to seek to comprehend, then, but only then, must a philosophy of religion be necessary alike to philosophy and religion.[1]

Special theological sciences:— We now pass to special theological disciplines which can at the utmost merely become sciences as distinguished from philosophy. They all deal with religion, each of them treating of some particular portion or aspect of it; and the order and mode in which they do so determines their relations to one another and the order of their succession. If we would rise, for example, through study of the parts or phases of religion in a sure and natural manner to a knowledge of it as a whole, we must necessarily begin with what of it is nearest and most accessible to us. But what is so is its history.

Historical; In its historical manifestation it is a phenomenon which no one can refuse to acknowledge. The history itself, however, is not only a most extensive but a very complex phenomenon. It is external and internal, corporeal and spiritual, a history of outward events and actions, institutions and rites, and also of ideas, convictions, and affections. What is external is nearer and more accessible to us than what is internal, and it is through the former that we must penetrate into the latter. They cannot be quite separated, for the external is only intelligible through the internal, and the internal only attainable and verifiable through the external; but they can be so far differentiated, and there is a history mainly of what is external in religion and another mainly of what is internal. The ordinary history of religion is mainly concerned with tracing the growth of religion in its most apparent form and institutional character. It may be divided into three great sections—the ethnic, Biblical, and ecclesiastical,—the history of the heathen religions, the history of the Jewish religion and of the rise of Christianity, and the history of the Christian church.

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[1] There is a laborious and impartial history of the philosophy of religion by Bernhard Pünjer, *Geschichte der christlichen Religionsphilosophie*, 2 vols., 1880-83. Of this valuable work an English translation is soon to appear. Some chapters of the history have been ably written by O. Pfleiderer in his *Religionsphilosophie auf geschichtlicher Grundlage*, 1884, a first volume of a translation of which has been published. For a list of works on the philosophy of religion the last edition of Hagenbach may be consulted. Here the following only can be mentioned:—Hegel, *Philosophie der Religion*, 2 vols., 1832; Krause, *Die absolute Religionsphilosophie*, 2 vols., 1835; Ohlert, *Religionsphilosophie in ihrer Uebereinstimmung mit Vernunft, Geschichte, und Offenbarung*, 1835; Billroth, *Vorlesungen über Religionsphilosophie*, 1837; Steffens, *Christliche Religionsphilosophie*, 2 vols., 1839; Taute, *Religionsphilosophie, vom Standpunkte der Philosophie Herbarts*, 2 parts, 1840-52; Rothe, *Theologische Ethik*, 3 vols., 1845; Weisse, *Philosophische Dogmatik oder Philosophie des Christenthums*, 3 vols., 1855-62; Apelt, *Religionsphilosophie*, 1860; Stöckl, *Lehrbuch der Religionsphilosophie*, 2d ed., 1878; Lotze, *Grundzüge der Religionsphilosophie*, 1882; Von Hartmann, *Religion des Geistes*, 1882; Teichmüller, *Religionsphilosophie*, 1886; Morell, *Philosophy of Religion*, 1849; Caird, *Introduction to the Philosophy of Religion*, 1880; Morris, *Philosophy and Christianity*, 1883.

Whether history in this form, even when studied in the most accurate and thorough manner, should be called science may be doubted, as it is simply occupied with the discovery and description of the particular and concrete. It is not usual so to designate it in any of its sections. The history of religious beliefs and ideas may be as purely and properly history as that of external institutions and transactions. It deals, however, not only with what is internal and spiritual but also with what is abstract and general, and hence it is at least more akin to science than is common history, and its sections are often called sciences. These sections are three in number, and correspond to the sections of the ordinary history. They are known as comparative theology, Biblical theology, and the history of Christian doctrine. To the last of these, symbolics may fairly claim to be a necessary supplement. They are quite distinct from a conceivably attainable knowledge of the laws of religious history, such as might be with strict propriety designated science of religious history, a department of science of history. Of historical science in this last sense there is as yet extremely little.

Psychological; Religion is a spiritual process, and its history continuously implies the affections and operations of mind. The historical treatment of religion, therefore, necessarily leads to its psychological treatment. The history alike of religious events and actions and of religious ideas and beliefs can only be explained through a knowledge of the religious powers and processes, *i.e.*, of the psychological factors and states which condition and determine its development. The psychological study of religion, although it has been greatly neglected, should reach over a very large department of theology. The department may be distributed into three disciplines—the general, comparative, and special psychology of religion. The first should treat of the general religious nature of man; the second should discover and compare the psychical peculiarities to be found in the various religions; and the third should exhibit elaborately the psychology of a particular religion, as, *e.g.*, Biblical and Christian psychology.

Apologetic; The historical and psychological sciences of religion deal with religion merely as an historical and psychological phenomenon. They do not imply its truth, and can be cultivated by those who regard it as a delusion equally with those who acknowledge it to be a certainty. It is the office of apologetics to determine whether or not it is true and how far it is true. If it end not in a negative result, in agnosticism or atheism, it must prove that God reveals himself to man, and that man apprehends God. In other words, apologetics treats of the media of revelation—alike the objective and subjective, Divine and human media—and so is the science, on the one hand, of revelation, and, on the other hand, of religious certitude. It is divisible into general and special, or, in equivalent terms, into theological and Christian apologetics,—the former being the scientific exhibition of the grounds of natural religion, and the latter of the grounds of the Christian religion. They are sometimes combined, inasmuch as both are needed in order to establish the truth of Christianity. In Germany it has become not uncommon to fuse them into one under the name of fundamental theology, described as the science which treats of the foundation of Christianity. And, undoubtedly, it is not only expedient but even necessary to treat of both as introductory and preparatory to the construction of Christian science. But the distinction between them must not, therefore, be forgotten or ignored. Theological apologetics might be irresistible although Christian apologetics were futile. Theological apologetics derives its validity from its relation to natural theology, which has an absolute value of its own, wholly independent of any other science, of Christianity, or of anything else. The alliance of theological and of Christian apologetics is perfectly legitimate; the attempt to combine them into a single science, into a single homogeneous discipline, is decidedly the reverse.

Systematic. The highest stage of theological science is the methodical education and exhibition of the truth involved in religion, either as contents of faith or elements of life. When conversant with the faith it is dogmatics, when with the life ethics; but, of course, here again distinction is not to be confounded with separation. True faith is living faith, and true life is the life of faith. Dogmatics and ethics are so intimately related that it is not surprising that they should have been long left undifferentiated, or that a few eminent theologians should still deny that they can be properly treated apart. Theology at this stage is commonly designated systematic, although the term is not a good one, and others, little if any better perhaps, as didactic, theoretical, positive, thetic, &c., have been suggested as substitutes. Systematic theology, like historical, psychological, and apologetic theology, is divisible into general and special, the former including natural theology and theological ethics, and the latter Christian dogmatics and Christian ethics. The identification, so common in Britain, of systematic theology with Christian dogmatics is, of course, solely due to the survival among us of prescientific thought and language in theology.

The historical and psychological sciences of religion may be conjoined under the designation of empirical, or phenomenological, or historical (in the widest sense); the apologetic and systematic sciences under that of didactic, thetic, speculative, or systematic (in a loose sense). This twofold division of them is the one generally adopted. And as it rests on an obvious and important distinction it is fully entitled to acceptance, provided it be so received as not to hide or extrude the fourfold division founded on the real moments or stages of the process of theological investigation.

Exegetical and practical theology. There are a considerable number of disciplines not included in the divisions indicated, yet for which the theological encyclopædist is bound to find appropriate places. The best classification of these is into exegetical and practical. So-called exegetical theology, however, is in all its departments simply instrumental and introductory to historical theology; and practical theology is in all its departments concerned with the use and application of religious knowledge, not with its acquisition and advancement. The former is not directly occupied with religion but with the records and documents from which its history must be ascertained; the latter is art and not science.

Considering theology, then, only as science directly engaged on religion, the following are the sciences which belong to general theology:—(1) the history of religions; (2) comparative theology; (3) psychology of religion; (4) theological apologetics; (5) natural theology; and (6) theological ethics. Those of Christian theology are—(1) Biblical history; (2) ecclesiastical history; (3) Biblical theology; (4) history of Christian doctrine; (5) symbolics; (6) Biblical and Christian psychology; (7) Christian apologetics; (8) Christian dogmatics; and (9) Christian ethics. The remainder of this article will be devoted to a brief indication of the nature of such of the above studies as have not already been treated of in separate articles.

History of religions and comparative theology. The history of religions and comparative theology differ from each other as sacred history and Biblical theology or ecclesiastical history and the history of Christian doctrines differ. That they should rarely be distinguished proves only that the ethnic sacred books have not yet been so closely studied as the Bible, and that the histories of the great ethnic religions are not yet so well known as the history of Christianity. As regards both the history of religions and comparative theology, see RELIGIONS.

Psychology of religion. The general psychology of religion should analyse the religious nature of man and trace the laws of its development. It has to ascertain the principles which guide reason in the search after God; to determine what subjective religion is, what elements it involves, and through what stages it may pass; and to show how the understanding and imagination, the emotions and affections, the qualities and energies of will, operate in religion and influence its character. While general psychology of religion thus treats man as framed and fitted for religion, the comparative psychology of religion treats of the psychological composition and peculiarities of the various concrete and collective manifestations of religion. It is related to the general psychology of religion as comparative psychology to general psychology. It must concern itself with the religions of the rudest peoples. It has to explain what is psychologically distinctive of fetichism, animal worship, naturalistic religions like the Vedic, anthropomorphic polytheisms like those of Greece and Rome, and pantheisms like Brahmanism and Buddhism. For example, in each of these forms of religion imagination works differently, and the comparative psychology of religion should give a complete view of the operations of imagination in the formation of the religions of humanity. So as regards all the chief intellectual principles and all the chief sentiments.

The psychological study of religion was not, as is often said, begun by Kant. Hume—in virtue of his *Natural History of Religion*, with its clear recognition of the distinction between the *causes* and the *reasons* of religion—is much more entitled to be considered initiator in this department, but even his claim may be contested. The department is one of which there is as yet no general survey, and of which many portions have been entirely overlooked. What the ordinary psychologists—*e.g.*, Bain, Sully, Thompson, Rabier, Fortlage, Strümpell, Volkmann, Wundt—say regarding it is very vague and meagre. The only two points which have been closely investigated are those as to the nature of religious cognition and the essence of religion, and as to both speculation has been frequently allowed to disturb and pervert psychological analysis. For some of the later literature on these points, see notes on article THEISM. Neither the general nor the comparative psychology of religion as yet exists in a separate and appropriate form. What religious psychology there is will be found chiefly in the writings of anthropologists like Bastian and Tylor, of comparative philologists like Max Müller and Steinthal, of philosophers like Spencer and Renouvier, of theologians of the school of Schleiermacher, and, above all, in the histories of religions and the philosophies of religion.[1]

Theological apologetics is not to be confounded with natural

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[1] Alliott's *Psychology and Theology*, Newman Smyth's *Religious Feeling*, Brinton's *Religious Sentiment*, Happel's *Anlage des Menschen zur Religion*, Ulrici's *Gott und Mensch*, and Lesbazeille's "Bases Psychologiques de la Religion" (two articles in *Rev. Phil.*, vol. xxi., 1886) may be specially mentioned.

Theological apologetics. theology, from which it is as distinct as Christian apologetics is from Christian dogmatics. It lays a foundation for natural theology, inasmuch as it vindicates religion by showing that it rests on objective spiritual truth. It presupposes a knowledge of religion as an historical and psychological phenomenon, but none of natural theology, which it, of course, leaves as a science to establish its own doctrines. It has the following tasks to perform. (1) To show that man is capable of apprehending the divine. This requires the refutation of agnosticism and the vindication of the principles implied in religious knowledge and certitude.[1] (2) To prove the reality of a revelation of the Divine in physical nature, mind, and history. The results of the various sciences will thereby be shown to be data of theology. It requires the refutation of atheism, materialism, positivism, and secularism, and of all principles which logically involve these systems. (3) To exhibit the reasons for the true conception of the Divine, and to expose the arguments employed in favour of false conceptions. The defence of theism, for example, must be accompanied by proof of the erroneousness and insufficiency of the polytheistic, dualistic, deistic, and pantheistic hypotheses. (4) To adduce whatever evidence may be contained in general revelation for the immortality of the soul and a future state of rewards and punishments.

Natural theology. Natural theology is the systematic exposition of the truths in natural or general revelation. Its data are the facts and laws of nature, as ascertained by physical, mental, and historical science. Its inductions and inferences relate to God, men, and their relationship. Its appearance as a distinct science may be dated from the publication of Raymond de Sobonde's *Theologia Naturalis* in 1436, although portions of it had been admirably presented by ancient philosophers, *e.g.*, Socrates, Plato, Aristotle, and Cicero. It flourished with extraordinary vigour in the latter half of the 17th and throughout the 18th century. It should endeavour to perform the following tasks. (1) To describe the nature, character, and attributes of God, so far as they are disclosed by the material world, mind, and history. (2) To treat of God in relation to the world and man, and of the world and man in relation to God, under which head all questions as to creation, providence, theodicée, optimism and pessimism, education of the human race, &c., will fall to be discussed from the standpoint of general revelation. (3) To determine, so far as can be done from general revelation, what man may reasonably hope for as to deliverance from sin and its consequences, and what he may reasonably believe as to the conditions of existence in a future world. As to this third point the view is prevalent that the light of nature discloses nothing regarding man's salvation or future destiny. But does this view not arise from overlooking that the kingdom of God is within, and from falsely supposing that salvation is entrance into an external, non-spiritual heaven on conditions which, being in themselves non-natural, cannot be naturally known? The heathen nations have certainly not supposed nature to be wholly silent and dark on the subject. In every developed ethnic religion there is a soteriology and eschatology as well as a theology. Man is nowhere necessarily without hope any more than without God in the world.[2]

Theological ethics. Theological ethics differs from natural theology in that it seeks in nature, viewed as a Divine revelation, laws of spiritual life, not merely religious doctrines. Its place is between moral philosophy and Christian ethics. It is unmistakably distinct from both, and may be more plausibly included in natural theology than in either. It should endeavour (1) to determine how religion and morality are distinct and how connected; (2) to ascertain how morality has been affected and modified by the various positive ethnic religions and the various religious but non-Christian philosophies; (3) to exhibit how the character of God, as delineated by natural theology, stands related to the moral law, the moral life, and the chief ethical end or supreme good of man; (4) to describe the duties which the light of nature shows that man owes directly to God; and (5) to trace how piety to God must influence personal and social virtue. Unlike moral philosophy and Christian ethics, it can hardly be said to have been yet treated as a separate discipline and presented as a whole. Daub and Marheineke have, indeed, written works nominally on *Theological Morals*, and Rothe and Von Hofmann on *Theological Ethics*, but in all these works it is really Christian ethics which is exhibited to us under certain speculative lights. There is, however, a very extensive literature relating to particular problems and portions of theological ethics. Thus what has been just indicated as problem first—that as to the relation of religion and morality—has been long much discussed.[3] The second problem demands wide and close historical research; it has been touched at a multitude of points, but only touched. With the third problem, or rather group of problems, almost all systems of Christian ethics have to some extent dealt; and with the fourth and fifth problems almost all systems of moral philosophy.

Biblical and church history. We now pass to Christian theology. Its historical section includes, besides the histories of Israel and the church (as to which see ISRAEL and CHURCH HISTORY), Biblical theology, the history of Christian doctrine, and Christian symbolics.

Biblical theology. All hermeneutical studies are auxiliary to exegesis, and all Biblical exegesis leads up to that comprehensive and connected view of the development of Biblical ideas which it is the aim of Biblical theology to set forth. Biblical theology is not to be understood as meaning a theology founded on the Bible—Christian dogmatics under another name. It does not assume that the Bible is either a source or standard of truth. It does not set forth the ideas which it exhibits as true in themselves, but only as truly in the Bible. It seeks no other truth than truth of exposition. It aims at doing no more than giving a true account of what are the religious ideas in the Bible, of how they are related as set forth in the Bible, and of what their history has been throughout the Biblical period. Its sole business is critically to ascertain and truthfully to exhibit what Scripture teaches, what each writer, even, of Scripture teaches, in a purely objective, organic, historical manner. It cannot possibly be confounded with Christian dogmatics by any one who has the slightest notion of what it is, although the latter must in great part rest on it and derive most of its materials from it. It is the ultimate direct result and the most comprehensive and perfect product of Biblical exegesis, and related to the history of religious ideas as a part to the whole in which it is included, comparative theology preceding and the history of Christian doctrine following it. It divides into theology of the Old Testament and theology of the New Testament; and its method is one appropriate to an historical discipline, and, therefore, chronological, genetic, analytic, and synthetic. It is a comparatively recently constituted department of theological science, both Catholic and Protestant divines having made for ages the enormous mistake of studying Scripture—so far as their interest therein was theoretical and not practical—primarily in order to find proof of the doctrines contained in their creeds and confessions. They failed to apprehend and appreciate the seemingly very simple thought that Scripture should be studied in the first instance with a single eye to find out what was really in it, and that to this end the study of it should be strictly and purely exegetical and historical. J. Ph. Gabler, in his thesis *De Justo Discrimine Theologiæ Biblicæ et Dogmaticæ*, published in 1787, was the first clearly to show the true character of Biblical theology as an essentially historical study. Since then it has been cultivated with great zeal by a host of able labourers.[4]

History of Christian doctrine. The history of Christian doctrine only began to be treated as a separate theological discipline in the latter part of the 18th century. Previously it was dealt with as an appendix to dogmatics or as a part of church history. It is not an appendix to dogmatics, but it includes its history and contributes to lay a foundation for it. No doctrine can be either correctly understood or rightly developed where there is ignorance of its history. The history of Christian doctrine is a part of the history of Christianity, namely, the history of Christian beliefs, as distinguished, on the one hand, from the history of Christian life and practice, and, on the other hand, from the outward history of the church. It is a part also of the history of religious thought, and of the history of thought in general, and therefore closely connected with the history of philosophy. Its development must be admitted to be ruled by the general laws of the intellectual history of man. It may be taken, however, in a wider or narrower sense,—in the former being the history of Christian thought and belief as such, and in the latter the history only of dogmas strictly so called, *i.e.*, of doctrines formulated and promulgated by ecclesiastical authority, and accepted either by the whole church or by large divisions of the church. There ought perhaps to be a history of doctrines in both senses. One in the former sense has only been undertaken recently by Harnack. The method of the history of Christian doctrine must be strictly historical, and at the same time both analytic and synthetic, seeing that both the history of the separate doctrines and the general and connected evolution of the doctrines require to be traced. Its periods will coincide with those of church history, but they ought to be determined from direct examination of the development of the doctrines. It is incorrect, therefore, to represent the discipline as having its general distribution into periods given it by church history.[1]

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[1] For the literature on agnosticism, see above, p. 246 note 2.

[2] For the literature of apologetics (theological and Christian), see Redford's *Christian Plea against Modern Unbelief*, pp. 497-538. For a list of the best works on theological apologetics and natural theology, see Cave's *Introduction to Theology*, pp. 149-161. Indications as to the history and literature of many particular questions and portions of both disciplines are given in the notes to Flint's *Theism* and *Antitheistic Theories*. One of the best sketches of the history of natural theology is that in Zöckler's *Theologia Naturalis*. Here it may be sufficient to mention the following works:—Butler's *Analogy*; Paley's *Natural Theology*; Chalmers's *Natural Theology*; the *Bridgewater Treatises*; Thompson's *Theism*; Tulloch's *Theism*; M'Cosh's *Method of the Divine Government*; Ulrici's *Gott und die Natur*; Jules Simon's *Natural Religion* (Eng. tr.); Janet's *Final Causes* (Eng. tr.); Caro's *Idée de Dieu*, 6th ed.; Gratry's *Connaissance de Dieu*, 7th ed.; and Margerie's *Théodicée*, 3d ed.

[3] The following references may be given:—the last chapter of Janet's *La Morale*; the first three chapters in Caro's *Morale Sociale*; many articles and reviews in Renouvier's *Critique Philosophique*; Martensen's *Christian Ethics*, §§ 5 14; Pfleiderer's *Moral and Religion*; Bradley's *Ethical Studies*, pp. 279-305; and Caird's *Introd. to Phil. of Rel.*, ch. ix.

[4] For the history of Biblical theology, see Briggs's *Biblical Study*; for the literature Cave, Hagenbach, Räbiger, or Zöckler; for a reference to some of the best works, see THEISM, *supra*, p. 260 notes 2 and 3.

Symbolics. Symbolics is the historico-comparative study of the dogmatic systems of the various Christian communions, as expressed and involved in their symbolical documents. It treats of the origin, history, and contents, and relations of difference and agreement, of the various creeds and confessions of Christendom. It was preceded by "polemics" and "controversial theology"—pre-scientific and anti-scientific kinds of theology. The older so-called systematic theologies and systems of divinity consisted largely of symbolical matter treated in an unscientific and ungenerous spirit. Christian dogmatics will never be properly purified until Christian symbolics receives intelligent and due recognition, and has relegated to it the subjects which properly belong to it. Christian symbolics may be said to have made its appearance as a separate scientific discipline with Marheineke's *Symbolik*, published in 1810. The chief reason why it appeared thus late was the difficulty of exercising in this sphere the impartiality of the true historical spirit. The arrangement of its material is determined partly by the order of succession in which the churches appeared in history and partly by the historical importance of the different churches. "In some treatises on symbolics the symbolical system of doctrine of each church is treated separately, while in others the several doctrines of the various churches are compared together. Each of these methods has its advantages and disadvantages. Their combination is requisite."[2]

Biblical psychology. The psychology of Christianity may be held to include Biblical psychology and the psychology of the Christian life. It must be admitted, however, that the right of the former to a place among psychological sciences is doubtful. It is universally admitted that it ought to present what is taught in the Bible as to the origin, nature, faculties, states, processes, and future development of the human spirit, and also elicit the conceptions implied and presupposed in the Biblical statements on these points. But if it do this in a merely historical manner, and do nothing beyond this, it must manifestly be regarded as simply a section of Biblical theology. To be entitled to be considered a separate psychologico-theological discipline it must at least also discuss the questions as to the truth of the ideas relative to the human spirit expressed and implied in Scripture, as to their accordance with the facts of mind, and their relationship to the conclusions of ordinary scientific psychology; and even then it may be held to be rather the result of a peculiar combination of history, apologetics, and psychology than a properly psychological discipline. However this may be, the study is an exceedingly interesting one. It has had a lengthened history, for in almost every generation since the 2d century treatises on some of its subjects have appeared. It was inaugurated by Melito and Tertullian, obtained in the 17th and 18th centuries distinct recognition under the designation of "psychologia sacra" or "psychologia e sacris literis collecta," and acquired fresh life and scientific form from the publication of Beck's *Umriss der biblischen Seelenlehre* in 1843.[3]

Christian psychology. The psychology of the Christian life is a much more comprehensive discipline than Biblical psychology, and one as to the precise place and scope of which no dubiety need be felt. Its work is to elucidate all the distinctively Christian phenomena both of the individual and of the collective life. As to the former it should evolve a theory of personal Christian experience, normal and abnormal, in its purity and in its perversions. As to the latter, it should explain the spiritual experience of Christian society—the development of Christian piety—in different ages, countries, and churches. For the accomplishment of the former task it will find help and material in religious poetry, religious biography and autobiography, and all other expressions and records of personal Christian experience; and for the accomplishment of the latter in all the sources and contents of church history, although these must be used in accordance with the psychological purpose in view. Christian psychology thus understood is a department of theology still to form. And the difficulties in the way of its formation must be allowed to be very great. They will only be overcome by men in whom profound psychological science and insight are combined with a rare susceptibility and richness of spiritual life.

For Christian apologetics, see APOLOGETICS. For Christian dogmatics, see DOGMATIC.

Christia ethics. Christian dogmatics and Christian ethics are the two disciplines included in Christian systematic theology. They ought to be separated and cultivated apart, and yet must be recognized to be closely connected, and each the necessary complement of the other. The former sees in Christ the truth and the way thereto; the latter sees in Him the life and the way thereto. Christian ethics is much the more recent discipline of the two, and it has not yet attained the same definiteness and homogeneousness. Alike as to method and distribution there is greater indecision and confusion. Among its earlier cultivators were Danæus, Calixtus, Perkins, Ames, Colville, Mosheim, Crusius, Stäudlin, and Von Ammon. Schleiermacher may justly be regarded as the founder of modern Christian ethics. His superiority to his predecessors was due chiefly to his profounder apprehension of the nature of the problems of philosophical ethics, and to his comprehensive and spiritual conception of the kingdom of God as the highest good, pervasive and regulative of every sphere of human life, industry and art, science and philosophy, family, church and state. The following may be given as a scheme of Christian ethics. I. Determination of the nature, limits, and method of the science, and of its relations to other disciplines, and especially to those which are ethical and theological. II. Presuppositions of the science: these are—(1) the ethical idea of God as revealed in nature and in Christ; (2) man as a moral being and in his relation to the law and revelation of God; (3) creation and providence as ethical systems; and (4) the kingdom of God in itself, in relation to creation and providence, and as the goal of moral life. III. The fundamental conceptions of the science: these are—(1) the Christian ethical law; (2) the Christian conscience; (3) the Christian ethical ideal; and (4) Christian virtue. IV. The reign of sin in the individual and society viewed in the light of Christianity. V. The origin and progress of the kingdom of God in the individual soul, and its manifestation in the virtues and graces of the Christian character. VI. The realization of the kingdom of God in the various spheres of society—the family, the church, the nation.[4] (R. F.)

THEOPHILUS. Nicholas Alemanni, in his notes to the first edition of the *Anecdota* of Procopius (see PROCOPIUS), published in 1623, repeatedly quotes a Life of Justinian, which he attributes to "Theophilus Abbas, præceptor Justiniani," but without telling us where he found this Life or who Theophilus was. Subsequent writers have continued to quote Theophilus from Alemanni's notes for the facts ascribed to him in those notes, and, among others, for the name Upravda, said to have been the original name of Justinian, and other proper names of members of the family of that emperor. Mr Bryce has, since the article JUSTINIAN was published, discovered in the Barberini library at Rome what appears to be the MS. of the so-called Life of Justinian used by Alemanni. It is in Latin, and purports to be an extract made by Ivan Tomco Marnavich, a Croatian ecclesiastic (1573–1639), from a Life of Justinian by a certain Bogomil (Græce *Theophilus*), who is alleged to have been the instructor of Justinian, and abbot of St Alexander at Prisrend (in Macedonia), and afterwards bishop of Sardica (now Sofia, in Bulgaria), the original of which Life, in Slavonic, is stated in the Barberini MS. to exist in the Slavonic monastery of Basilian monks on Mount Athos. No such Slavonic MS. (so far as is known) has ever been discovered in Athos or elsewhere; no Slavonic MS. of the age of Justinian could possibly exist; and the contents of the Latin extract preserved at Rome are of so legendary a character as to throw the greatest doubt on the facts cited from Theophilus by Alemanni, including the name Upravda above referred to, and the Slavonic origin of Justinian. It seems doubtful whether this Theophilus Abbas, whom the Roman MS. identifies with a certain Domnio, bishop of Sardica in 517 (see Marcellinus Comes, *Chronicon*, ad ann. 517), ever existed at all. Mr Bryce has printed this Roman MS., with his observations thereon, in the *Archivio Storico* of the R. Società Romana di Storia Patria, 1887.

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[1] Among the best general histories of Christian doctrine are those of Neander, Gieseler, Hagenbach, Baur, Nitzsch, Thomasius, Harnack, Haag, Shedd, and Sheldon. There is a multitudinous literature relating to doctrine in particular periods and to particular doctrines.

[2] See Lumby's *History of the Creeds*, 1873; Schaff's *Creeds of Christendom*, 3 vols., 4th ed., 1884; Winer's *Confessions of Christendom*; and the *Symbolics* of Möhler, Köllner, Guericke, Oehler, Hofmann, &c.

[3] The following are among the most useful books for the student of Biblical psychology:—Beck's *Outlines of Biblical Psychology* (Eng. tr.); Delitzsch's *System of Biblical Psychology*; Heard's *Tripartite Nature of Man*; Laidlaw's *Bible Doctrine of Man*; and Dickson's *Baird Lecture for 1883*.

[4] The history of Christian ethics has been written by Wuttke, *Christian Ethics*, vol. i., but much better by Gass, *Gesch. der christl. Ethik*, 3 vols., and by Ziegler, *Gesch. d. christ. Eth.*, 2 vols. Bestmann has written two volumes of a *Gesch. d. christl. Sitte*. Among well-known treatises on Christian ethics are those of De Wette, Schleiermacher, Hirscher, Harless, Rothe, Wuttke, Sartorius, Martensen, Oettingen, Lange, Hofmann, Frank, and Dorner. Those of Wuttke, Sartorius (*Doctrine of Holy Love*), Harless, and Martensen have been translated into English. German literature is extremely rich, while French and English literatures are miserably poor, in this department. Wardlaw's *Christian Ethics* may be mentioned, but merely because it is English.

THEOPHRASTUS, the successor of Aristotle in the Peripatetic school, was a native of Eresus, in Lesbos. The date of his birth is a matter of inference, and has been fixed between 373 and 368 B.C. It is said that his original name was Tyrtamus, and that the name Theophrastus was given him by Aristotle on account of his eloquence, but this story is quite as likely to be an afterthought suggested by the name at a later date. After receiving his first introduction to philosophy in Lesbos from one Leucippus or Alcippus, he proceeded to Athens, and became a member of the Platonic circle. After Plato's death he attached himself to Aristotle, and in all probability accompanied him to Stagira. The intimate friendship of Theophrastus with Callisthenes, the fellow-pupil of Alexander the Great, the mention made in his will of an estate belonging to him at Stagira, and the repeated notices of the town and its museum in the *History of Plants* are facts which point to this conclusion. Aristotle's affectionate confidence in his pupil and friend is proved by his making Theophrastus guardian of his children in his will, and designating him as his philosophic successor at the Lyceum on his own removal to Chalcis. Eudemus of Rhodes was not without claims to this position, but the master, according to the well-known story, delicately indicated his preference by the remark that the wines of Lesbos and Rhodes were both excellent, but the Lesbian was the sweeter. Aristotle also bequeathed to Theophrastus his library and the originals of his own works. Theophrastus presided over the Peripatetic school for thirty-five years, and died in 288 B.C. Under his guidance the school flourished greatly in point of numbers, and at his death he bequeathed to it his garden with house and colonnades as a permanent seat of instruction. His popularity was also shown in the regard paid to him by Cassander and Ptolemy and by the complete failure of a charge of impiety brought against him. He was honoured with a public funeral, in which the whole people took part.

Theophrastus's philosophical relation to Aristotle and his place in the development of Peripatetic doctrine have been sketched under the head PERIPATETICS. It remains to say a few words about his works. From the lists of the ancients it appears that the activity of Theophrastus extended over the whole field of contemporary knowledge. Logical, physical, biological, psychological, ethical, political, rhetorical, and metaphysical treatises are mentioned, most of which probably differed little from the Aristotelian treatment of the same themes, though supplementary in details. On the whole, Theophrastus seems to have developed by preference the observational and scientific side of his master, and of this character are the books and fragments that have come down to us. The most important of these are two large botanical treatises, *On the History of Plants* (περὶ φυτῶν ἱστορίας), in nine books (originally ten), and *On the Causes of Plants* (περὶ φυτῶν αἰτιῶν), in six books (originally eight). These constitute the most important contribution to botanical science till we come to modern times, and furnish proof of the author's extensive and careful observation combined with a considerable critical sagacity. We also possess fragments of a *History of Physics*, a fragmentary treatise *On Stones*, a work *On Sensation* (περὶ αἰσθήσεως) in the same condition, certain metaphysical ἀπορίαι, which probably once formed part of a systematic treatise, and the well-known *Ethical Characters* (ἠθικοὶ χαρακτῆρες), containing a delineation of moral types, probably an extract or compilation by a later hand from a larger ethical work of Theophrastus. Various smaller scientific fragments have been collected in the editions of J. G. Schneider (1818–21) and F. Wimmer (1866) and in Usener's *Analecta Theophrastea*.

THEOPHYLACT, a well-known Biblical commentator, was born most probably at Euripus, in Eubœa, about the middle of the 11th century. He became a deacon at Constantinople, and attained a high reputation as a scholar, as is shown by the fact that he became the tutor of Constantine Porphyrogenitus, son of Michael VII., for whom he wrote his Παιδεία βασιλική. About 1078 he went into Bulgaria as archbishop of Achris. In his letter he complains much of the rude manners of the Bulgarians, and he sought to be relieved of his office, but apparently without success. His death took place after 1107

His commentaries on the Gospels, Acts, the Pauline epistles, and the Minor Prophets are founded on those of Chrysostom, but deserve the considerable place they hold in exegetical literature for their appositeness, sobriety, accuracy, and judiciousness. His other extant works include seventy-five letters and various homilies and orations and other minor pieces. A splendid edition of the whole in Greek and Latin, with a preliminary dissertation, was published in 1754–63 by J. F. B. M. de Rossi (4 vols. fol., Venice).

THEOPHYLACT of Simocatta. See vol. iv. p. 613.

THEOPOMPUS of Chios, a celebrated historian and rhetorician, was born about 378 B.C. In early youth he seems to have spent some time at Athens, along with his father, who had been exiled on account of his Laconian sympathies. Here he became a pupil of Isocrates, and rapidly made great progress in rhetoric: we are told that Isocrates used to say that Ephorus required the spur but Theopompus the bit (Cic., *Brutus*, § 204). At first he appears to have composed epideictic speeches, in which he attained to such proficiency that in 352–351 he gained the prize of oratory given by Artemisia in honour of her husband, although Isocrates was himself among the competitors. It is said to have been the advice of his teacher that finally determined his career as an historian,—a career for which his abundant patrimony and wide knowledge of men and places (Fr. 26) had singularly fitted him. Through the influence of Alexander, he was restored to Chios about 333, and figured for some time as one of the boldest and most uncompromising leaders of the aristocratical party in his native town. After Alexander's death he was again expelled, and took refuge with Ptolemy in Egypt, where he appears to have met with a somewhat cold reception. The date of his death is unknown.

The works of Theopompus were chiefly historical, and later writers frequently cite them as authorities. They included an *Epitome of Herodotus's History*, the *Hellenics* (Ἑλληνικά, Ἑλληνικαὶ ἱστορίαι), the *History of Philip* (Φιλιππικά), and several panegyrics and hortatory addresses, the chief of which was the *Letter to Alexander*. The genuineness of the epitome of Herodotus has been called in question; we possess only five quotations from it, preserved by grammarians or lexicographers, and consisting only of single words. The *Hellenics* was a somewhat ambitious work in 12 books, extending from 411 (where Thucydides breaks off) to 394—the date of the battle of Cnidus. A few insignificant fragments remain, but do not suffice to give us any idea of the general character of the work. By far the most ambitious history written by Theopompus was the Φιλιππικά. In this he narrated the history of Philip's reign (360–336) in 58 books, with frequent digressions on the names and customs of the various races and countries of which he had occasion to speak. So numerous were these digressions that Philip III. of Macedon reduced the bulk of the history from 58 to 16 books by cutting out those parts which had no connexion with the achievements of the king. It was from this history that Diodorus and Trogus Pompeius derived much of their materials. Several fragments, chiefly anecdotes and strictures of various kinds upon the character of nations and individuals, are preserved by Athenæus, Plutarch, and others. Of the *Letter to Alexander* we possess one or two fragments cited by Athenæus, animadverting severely upon the immorality and dissipations of Harpalus. The *Attack upon Plato*, and the treatise *On Piety*, which are sometimes referred to as separate works, were perhaps only two of the many digressions in the history of Philip; some writers have doubted their authenticity.

The nature of the extant fragments fully bears out the criticisms of antiquity upon Theopompus. Their style is clear and pure, full of choice and pointed expressions, but lacking in the weight and dignity which only profound thought can supply. As we might expect in a pupil of Isocrates, he is especially careful to avoid hiatus. The artistic unity of his work suffered severely from the frequent episodes with which it was interspersed; his account of Sicily, for example, extended over several books. Another fault was his excessive fondness for romantic and incredible stories (Fr. 33, 66, 76, &c.); a collection of some of these was afterwards made and published under his name, with the title of Θαυμάσια

(Diog. Laert., i. 115). He was also severely blamed in antiquity for his censoriousness, and throughout his fragments no feature is more striking than this (Fr. 54, 65, &c.). On the whole, however, he appears to have been fairly impartial. Philip himself he censures severely for drunkenness and immorality (Fr. 136, 178, 262, 298), while Demosthenes receives his warm praise (Fr. 239, 263). There can be no doubt that in the *Philippica* the world has lost a great variety of pleasant tales and historians much valuable information upon many difficult points of Greek history and life.

See Müller, *Fragmenta Historicorum Græcorum*, i. 278–333, Paris, 1853.

THEORBO. See LUTE, vol. xv. p. 71.

THEOSOPHY, as its derivation implies, is a term used to denote those forms of philosophic and religious thought which claim a special insight into the Divine nature and its constitutive moments or processes. Sometimes this insight is claimed as the result of the operation of some higher faculty or some supernatural revelation to the individual; in other instances the theosophical theory is not based upon any special illumination, but is simply put forward as the deepest speculative wisdom of its author. But in any case it is characteristic of theosophy that it starts with an explication of the Divine essence, and endeavours to deduce the phenomenal universe from the play of forces within the Divine nature itself. It is thus differentiated at once from all philosophic systems which attempt to rise from an analysis of phenomena to a knowledge more or less adequate, of the existence and nature of God. In all such systems, God is the *terminus ad quem*, a direct knowledge of whom is not claimed, but who is, as it were, the hypothesis adopted, with varying degrees of certainty in different thinkers, for the explanation of the facts before them. The theosophist, on the other hand, is most at his ease when moving within the circle of the Divine essence, into which he seems to claim absolute insight. This, however, would be insufficient to distinguish theosophy from those systems of philosophy which are sometimes called "speculative" and "absolute," and which also in many cases proceed deductively from the idea of God. In a wide sense, the system of Hegel or the system of Spinoza may be cited as examples of what is meant. Both thinkers claim to exhibit the universe as the evolution of the Divine nature. They must believe, therefore, that they have grasped the inmost principles of that nature: so much is involved, indeed, in the construction of an absolute system. But it is to be noted that, though there is much talk of God in such systems, the known universe—the world that now is—is nowhere transcended; God is really no more than the principle of unity immanent in the whole. Hence, while the accusation of pantheism is frequently brought against these thinkers, the term theosophical is never used in their regard. A theosophical system may also be pantheistic, in tendency if not in intention; but the transcendent character of its Godhead definitely distinguishes it from the speculative philosophies which might otherwise seem to fall under the same definition. An historical survey shows, indeed, that theosophy generally arises in connexion with religious needs, and is the expression of religious convictions or aspirations. Now the specifically religious consciousness is not pantheistic in any naturalistic sense; God is rather regarded as the transcendent source of being and purity, from which the individual in his natural state is alienated and afar off. Theosophy accepts the testimony of religion that the present world lies in wickedness and imperfection, and faces the problem of speculatively accounting for this state of things from the nature of the Godhead itself. Theosophy is thus in some sort a mystical philosophy of the existence of evil; or at least it assumes this form in some of its most typical representatives.

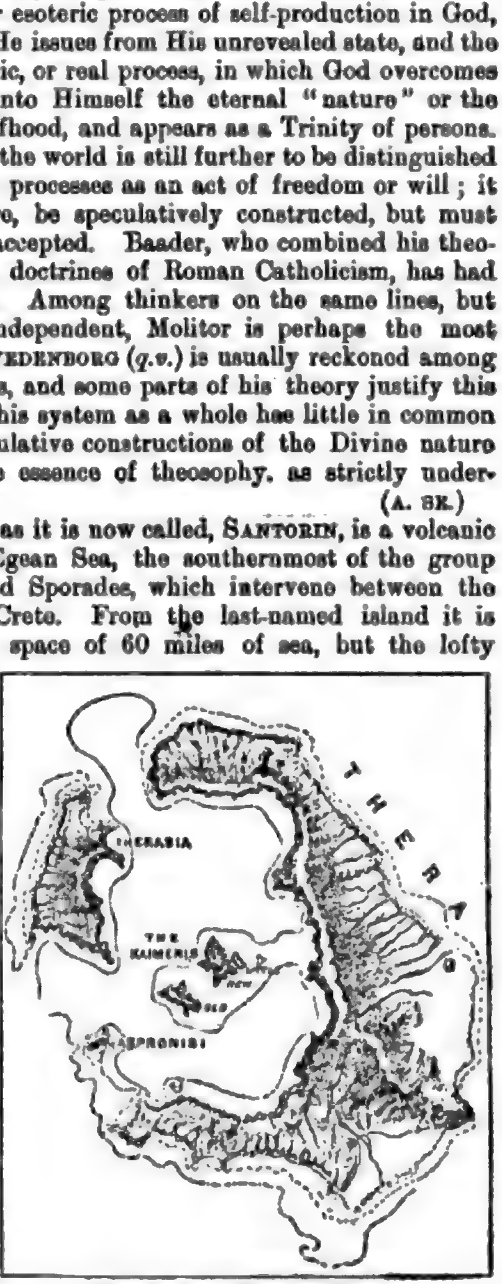
The name with which it is oftenest coupled is mysticism (see MYSTICISM). The latter term has properly a practical rather than a speculative reference; but it is currently applied so as to include the systems of thought on which practical mysticism was based. Thus, to take only one prominent example, the profound speculations of Meister ECKHART (*q.v.*) are always treated under the head of Mysticism, but they might with equal right appear under the rubric Theosophy. In other words, while an emotional and practical mysticism may exist without attempting philosophically to explain itself, speculative mysticism is almost another name for theosophy. There is still a certain difference observable, however, in so far as the speculative mystic remains primarily concerned with the theory of the soul's relation to God, while the theosophist gives his thoughts a wider scope, and frequently devotes himself to the elaboration of a fantastic philosophy of nature.

In the above acceptation of the term, the Neoplatonic doctrine of emanations from the supra-essential One, the fanciful emanation-doctrine of some of the Gnostics (the æons of the Valentinian system might be mentioned), and the elaborate esoteric system of the Kabbalah, to which the two former in all probability largely contributed, are generally included under the head of theosophy. In the two latter instances there may be noted the allegorical interpretation of traditional doctrines and sacred writings which is a common characteristic of theosophical writers. Still more typical examples of theosophy are furnished by the mystical system of Meister Eckhart and the doctrine of Jacob BOEHME (*q.v.*), who is known as "the theosophist" *par excellence*. Eckhart's doctrine asserts behind God a predicateless Godhead, which, though unknowable not only to man but also to itself, is, as it were, the essence or potentiality of all things. From it proceed, and in it, as their nature, exist, the three persons of the Trinity, conceived as stadia of an eternal self-revealing process. The eternal generation of the Son is equivalent to the eternal creation of the world. But the sensuous and phenomenal, as such, so far as they seem to imply independence of God, are mere privation and nothingness; things exist only through the presence of God in them, and the goal of creation, like its outset, is the repose of the Godhead. The soul of man, which as a microcosmos resumes the nature of things, strives by self-abnegation or self-annihilation to attain this unspeakable reunion (what Eckhart calls being buried in God). Regarding evil simply as privation, Eckhart does not make it the pivot of his thought, as was afterwards done by Boehme, but his notion of the Godhead as a dark and formless essence is a favourite thesis of theosophy. The followers of Eckhart are either practical mystics, or reproduce at most what may be called their master's speculative theology, till we come to Boehme.

Besides mystical theology, Boehme was indebted to the writings of Paracelsus. This circumstance is not accidental, but points to an affinity in thought. The nature-philosophers of the Renaissance, such as Nicholas of Cusa, Paracelsus, Cardan, and others, curiously blend scientific ideas with speculative notions derived from scholastic theology, from Neoplatonism, and even from the Kabbalah. Hence it is customary to speak of their theories as a mixture of theosophy and physics, or theosophy and chemistry, as the case may be. Boehme offers us a natural philosophy of the same sort. As Boehme is the typical theosophist, and as modern theosophy has nourished itself almost in every case upon the study of his works, his dominating conceptions supply us with the best illustration of the general trend of this mode of thought. His speculation turns, as has been said, upon the necessity of reconciling the existence and the might of evil with the existence of an all-embracing and all powerful God, without falling into Manichæanism on the one hand, or, on the other, into a naturalistic pantheism that denies the reality of the distinction between good and evil. He faces the difficulty boldly, and the eternal conflict between the two may be said to furnish him with the principle of his philosophy. It is in this connexion that he insists on the necessity of the Nay to the Yea, of the negative to the positive. Eckhart's Godhead appears in Boehme as the abyss, the eternal nothing, the essenceless quiet ("Ungrund" and "Stille ohne Wesen" are two of Boehme's phrases). But, if this were all, the Divine Being would remain an abyss dark even to itself. In God, however, as the condition of His manifestation, lies, according to Boehme, the "eternal nature" or the *mysterium magnum*, which is as anger to love, as darkness to light, and, in general, as the negative to the positive. This principle (which Boehme often calls the evil in God) illuminates both sides of the antithesis, and thus contains the possibility of their real existence. By the "Qual" or torture, as it were, of this diremption, the universe has qualitative existence, and is knowable. Even the three persons of the Trinity, though existing *idealiter* beforehand, attain reality only through this principle of nature in God, which is hence spoken of as their *matrix*. It forms also the matter, as it were, out of which the world is created; without the dark and fiery principle, we are told, there would be no creature. Hence God is sometimes spoken of as the father, and the eternal nature as the mother, of things. Creation (which is conceived as an eternal process) begins with the creation of the angels. The subsequent fall of Lucifer is explained as his surrender of himself to the principle of nature, instead of dwelling in the heart of God. He sought to make anger predominate over love; and he had his will, becoming prince of hell, the kingdom of God's anger, which still remains, however, an integral part of the Divine universe. It is useless to follow Boehme further, for his cosmogony is disfigured by a wild Paracelsian symbolism, and his constructive efforts in general are full of the uncouth straining of an untrained writer. In spite of these defects, his speculations have exercised a remarkable influence within the present century, notably upon the later phases of Schelling's philosophy, upon Franz von Baader, Molitor, and others.

Schelling's *Philosophical Inquiries into the Nature of Human Freedom* (1809) is almost entirely a reproduction of Boehme's ideas, and forms, along with Baader's writings, the best modern example of theosophical speculation. In his philosophy of identity Schelling (*q.v.*) had already defined the Absolute as pure indifference, or the identity of subject and object (of the ideal and the real), but without advancing further into theogony. He now proceeded to distinguish three moments in God, the first of which is the pure indifference which, in a sense, precedes all existence—the primal basis or abyss, as he calls it, in agreement with Boehme. But, as there is nothing before or besides God, God must have the ground or cause of His existence in Himself. This is the second moment, called nature in God, distinguishable from God, but inseparable from Him. It is that in God which is not God Himself; it is the yearning of the eternal One to give birth to itself. This yearning is a dumb unintelligent longing, which moves like a heaving sea in obedience to some dark and indefinite law, and is powerless to fashion anything in permanence. But in correspondence to the first stirring of the Divine existence there awakes in God Himself an inner reflexive perception, by means of which—since no object is possible for it but God—God beholds Himself in His own image. In this, God is for the first time as it were realized, although as yet only within Himself. This perception combines as understanding with the primal yearning, which becomes thereby free creative will, and works formatively in the originally lawless nature or ground. In this wise is created the world as we know it. In every natural existence there are, therefore, two principles to be distinguished—first, the dark principle, through which this is separated from God, and exists, as it were, in the mere ground; and, secondly, the Divine principle of understanding. The first is the particular will of the creature, the second is the universal will. In irrational creatures the particular will or greed of the individual is controlled by external forces, and thus used as an instrument of the universal. But in man the two principles are consciously present together, not, however, in inseparable union, as they are in God, but with the possibility of separation. This possibility of separation is the possibility of good and evil. In Boehme's spirit, Schelling defended his idea of God as the only way of vindicating for God the consciousness which naturalism denies, and which ordinary theism emptily asserts. This theosophical transformation of Schelling's doctrine was largely due to the influence of his contemporary Baader (*q.v.*). Baader distinguishes, in a manner which may be paralleled from Boehme, between an immanent or esoteric process of self-production in God, through which He issues from His unrevealed state, and the emanent, exoteric, or real process, in which God overcomes and takes up into Himself the eternal "nature" or the principle of selfhood, and appears as a Trinity of persons. The creation of the world is still further to be distinguished from these two processes as an act of freedom or will; it cannot, therefore, be speculatively constructed, but must be historically accepted. Baader, who combined his theosophy with the doctrines of Roman Catholicism, has had many followers. Among thinkers on the same lines, but more or less independent, Molitor is perhaps the most important. Swedenborg (*q.v.*) is usually reckoned among the theosophists, and some parts of his theory justify this inclusion; but his system as a whole has little in common with those speculative constructions of the Divine nature which form the essence of theosophy, as strictly understood. (A. SE.)

THERA, or, as it is now called, Santorin, is a volcanic island in the Ægean Sea, the southernmost of the group of islands, called Sporades, which intervene between the Cyclades and Crete. From the last-named island it is separated by a space of 60 miles of sea, but the lofty Cretan ranges of Dicte and Ida are clearly visible from it in fine weather. In shape Santorin forms a crescent, and encloses a bay on the north, east, and south, while on the western side lies the smaller island of Therasia. The encircling wall thus formed, which is elliptical in shape and 18 miles round in its inner rim, is broken in two places,—towards the north-west by a strait a mile in breadth, where the water is not less than 1100 feet deep, and towards the south-west by an aperture about



Thera and neighbouring Islands.

3 miles wide, where the water is shallow, and an island called Aspronisi or White Island, lying in the middle, serves as a stepping-stone between the two promontories. The cliffs rise perpendicularly from the waters of the bay, in some places to the height of 1000 feet; but towards the open sea, both in Santorin and Therasia, the ground slopes gradually away, and has been converted into broad level terraces, everywhere covered with tufaceous agglomerate, which, though extraordinarily bare and ashen to the eye, is the soil which produces the famous Santorin wine. Towards the south-east rises the limestone peak of Mount Elias, the highest point of the island (1887 feet), and the only part that existed before the volcano was formed. In the middle of the basin lie three small islands, which are the centre of volcanic activity, and are called Palæa, Mikra, and Nea Kaumene, or the Old, the Little, and the New Burnt Island; the highest of these, Nea Kaumene, is 351 feet above the sea-level. Owing to the depth of the water there is no anchorage, and vessels have to be moored to the shore, except at one point in the neighbourhood of the modern town, where there is a slight rim of shallow bottom. The cliffs both of Santorin and Therasia present an extraordinary appearance, being marked in horizontal bands by black lava, white porous tufa, and other volcanic strata, some parts of which are coloured dark red. The modern town of Thera (or Phera, as it is more commonly pronounced) is built at the edge of these, overlooking the middle of the bay at a height of 900 feet above the water, and the houses of which it is composed are themselves peculiar, for their foundations, and in some cases their sides also, are excavated in the tufa, so that occasionally they are hardly traceable except by their chimneys; and, owing to the absence of timber,—for, with the exception of the fig, the cactus, and the palm, there are hardly any trees in the island,—they are roofed with barrel vaults of stone and cement. Both wood and water have occasionally to be imported from the neighbouring islands, for there are no wells, and the rain water, which is collected in numerous cisterns, does not always suffice. The largest of the other towns or villages is that of Apanomeria, near the northern entrance, which is crowded together in a white mass, while the rocks below it are the reddest that are seen in the island.

Santorin has from the earliest times been a centre of volcanic agency, and is closely connected with the earthquake movements to which the countries in the neighbourhood of the Ægean are subject, and which have been the chief cause of the destruction of the public buildings of ancient Greece. It is hardly accurate to speak of the basin which forms the harbour as a crater, for most geologists, including Lyell, support the view that the whole of this space was once covered by a single volcanic cone, the incline of which is represented by the outward slope of Santorin and Therasia, while the position of the crater was that now occupied by the Kaumene Islands; and that, at some remote period, owing to the sinking of the strata beneath, the central portion of this, extending over an area which a French writer compares with that included within the fortifications of Paris at the time of the siege, fell in, by which convulsion the basin was formed. The principal eruptions that have taken place within historic times are that of 196 B.C., when, as we learn from Strabo (i. 3, § 16, p. 57), flames rose from the water halfway between Thera and Therasia for four days, and the island of Palæa Kaumene was ejected; that of 726 A.D., during the reign of the emperor Leo the Isaurian, when an addition was made to that island, and the pumice-stone that was cast forth was carried by the waves to the shores of Asia Minor and Macedonia; that of 1573, when Mikra Kaumene appeared; that of 1650, a fearful eruption, which destroyed many lives by its noxious exhalations, and ended in the upheaval of an island in the sea to the north-east of Santorin, which afterwards subsided and became a permanent reef below the sea-level; that of 1707, when Nea Kaumene arose; and, within the recollection of the present generation, that of 1866.

Santorin and Therasia have been recently the scene of a remarkable archæological discovery. In the southern parts of both these islands prehistoric dwellings have been found at some height above the sea, and there is no reasonable cause to doubt that these date from a period antecedent to the falling in of the crater and the formation of the bay. This is proved by their position underneath the layer of tufa which covers the islands, and, moreover, by these layers of tufa being broken off precipitously, in the same way as the lava-rocks, a fact which can only be explained by the supposition that they all fell in together. The foundations of the dwellings rested, not on the tufa, but on the lava below it; and here and there between the stones branches of wild olive were found, according to a mode of building that still prevails in the island, in order to resist the shocks of earthquakes. Part of the skeleton of a man was discovered, and large vases, some containing grain, others stone instruments very carefully worked. Some of these vases were of fine yellowish earth, ornamented with brown bands; some, of smaller size, were more elaborately decorated, sometimes with lines representing foliage, and in a few instances with figures of animals; some were of red earth, without ornament; while others, of pale red earth, were of very large dimensions. No implements of metal were found. Naturally it has been the subject of much discussion what was the origin of this very primitive art. The late M. Dumont, who was the leading authority on the subject (*Les Céramiques de la Grèce Propre*, pp. 74, 75, 209), though speaking with great caution on account of the insufficiency of the evidence, inclined to the belief that it was partly derived from Phœnician influence, but at the same time that there were evident traces of native originality. Comparing it in respect of date with the other prehistoric developments of art in the neighbourhood of the Ægean, he would place it later than that of Hissarlik, but earlier than those of Ialysus in Rhodes, and of Mycenæ.

In Greek legend the island of Thera was connected with the story of the Argonauts, for it was represented as sprung from a clod of earth which was presented to those heroes by Triton (Apollon., *Argonaut.*, iv. 1551 *sq.*, 1731 *sq.*). According to Herodotus (iv. 147), a Phœnician colony was established there by Cadmus—a story which proves at least the belief that there was an early settlement of that race in the island. It has even been conjectured (see vol. xviii. p. 806) that the alphabet was introduced into Greece, not, as was commonly believed, through Thebes, but by way of Thera. Subsequently, we are told, a colony from Sparta, including some of the Minyæ, was led thither by Theras, who gave the island his own name, in place of that of Calliste which it had borne before. But the one event which gave importance to Thera in ancient history was the planting of its famous colony of Cyrene on the north coast of Africa by Battus in 631 B.C., in accordance with a command of the Delphic oracle. The ancient capital, which bore the same name as the island, has been identified by an inscription as occupying a site on the eastern coast called Mesa-Vouno, between Mount Elias and the sea. The other remains of the classical period consist of walls and tombs, together with several *heroa* or small shrines, one of which, now dedicated to St Nicholas Marmorites, who is so called in honour of his marble structure, is an almost unique specimen of a perfect Greek temple, for even the roof remains intact. After the fourth crusade, when the Byzantine empire was partitioned among the Latins, this island formed a portion of the duchy of the Archipelago; and it was at this period that it received the name of Santorin, *i.e.*, St Irene, after the patron saint of the place, to whom Tournefort mentions that in his time nine or ten chapels were dedicated. At the present day Santorin is in a prosperous condition, for, in addition to the wine trade, which is highly remunerative, there is a large export of *pozzolana*, which has been much used for the works at Port Said in connexion with the Suez Canal, since, when mixed with lime, it forms a very hard cement which resists the action of the sea.

General information with regard to the Thera group will be found in Ross's *Inselreisen*, and in Lieut. Leycester's paper in vol. xx. of the *Journal of the R. Geogr. Soc.*; a very complete account of the scientific phenomena is given in Fouqué's *Santorin et ses Éruptions*. On the prehistoric antiquities, Lenormant, *Revue Archéologique*, new ser., vol. xiv., and Fouqué, *Archives des Missions*, 2d ser., vol. iv., and "Une Pompéi Antéhistorique," in the *Revue des Deux Mondes*, vol. lxxxiii., should be consulted. Of the life of the modern inhabitants a graphic account is given in Mr Bent's *Cyclades*. (H. F. T.)

THERAMENES, an Athenian who played a prominent part in the history of Athens towards the close of the Peloponnesian War and in the revolution which followed it. He was one of the conspirators who, in 411 B.C., abolished the democracy at Athens, and substituted the oligarchy of the Four Hundred. The adhesion of the army in Samos to the democracy, however, created dissensions among the oligarchs at Athens. Theramenes supported the more moderate section, and was the chief means of destroying a fortress which the extreme section had been building at the mouth of the harbour, ostensibly as a protection against any violent movement on the part of the democrats at Samos, but really, according to Theramenes, to admit the enemy. He further accused Antiphon and Archeptolemus, members of the extreme oligarchical party, who, according to Lysias, had been his own intimate friends, and secured their capital punishment. In 410 Theramenes commanded one of the three squadrons of the Athenian fleet in the victory over the Spartans at Cyzicus. In 409 he took part in the siege of Chalcedon and the capture of Byzantium. At the battle of Arginusæ in 406 he was one of the officers deputed by the generals in command to pick up the crews of the disabled ships; but the rescue was not effected, on account, it seems, of the storm. Nevertheless, on his return to Athens, Theramenes took a leading part in accusing and procuring the condemnation to death of the generals for neglecting to rescue the men. When Athens was besieged by the Peloponnesians, Theramenes conducted the negotiations for surrendering the city, traitorously prolonging them till starvation compelled the Athenians to accept the rigorous terms imposed by Sparta. After the surrender he formed one of the notorious Thirty who, backed by a Spartan garrison, misgoverned Athens. But by opposing their excesses he incurred their suspicions, and, being denounced by Critias, the most violent of the Thirty, he was, in defiance of the forms of law, put to death (404). He submitted to his fate with a fortitude which won the admiration of his contemporaries and of posterity, and which might well have graced the close of a better life. His ability and eloquence are recognized by Thucydides, and Aristotle is said by Plutarch (*Nic.*, 2) to have reckoned him one of the three best patriots of Athens. This latter judgment is not borne out by the facts as we know them. Rather Theramenes appears as a selfish and faithless trimmer, who deserved his nickname Cothurnus (a boot which fitted either foot).

The chief authorities for his life are Thucydides, viii.; Xenophon, *Hellenica*, i., ii.; Lysias, *Contra Erat.*; Diodorus, xiii., xiv.

THERAPEUTÆ. See MONACHISM, vol. xvi. p. 698.

THERESA, ST (1515–1582). Teresa de Cepeda, perhaps the favourite saint of modern Spain, was born at Avila, in Old Castile, on the 28th of March 1515,—at the very time, adds her biographer, "when Luther was secreting the poison which he vomited out two years later." She was one of a large family—eight sons and three daughters. Her father was a Spanish gentleman of good family, whose time was chiefly occupied with devotional reading and works of charity. Teresa's mother, his second wife, was a beautiful woman, confined generally to a sofa by delicate health. From her her daughter appears to have inherited both delicacy of health and a remarkably susceptible imagination. She delighted in the books of knight-errantry which abounded in the library, and her children sat up at night in their nursery over the same romances. But Teresa's imagination was judiciously diverted by her father to another form of heroism. She was soon as deep in the histories of the martyrs as she had been in the tales of chivalry. She learned from these histories that martyrs passed straight to heaven without any detention in purgatory; and, being eminently practical as well as imaginative, she resolved to secure that blessing for herself. When she was seven years old, she started off with her little brother to go and seek martyrdom in the country of the Moors. They had reached the bridge on the stream which runs through the town, when an uncle met them and brought them back. Balked thus of their desire, they played at hermits, making themselves cells in the garden, and giving away their pocket-money to beggars. Teresa lost her mother early, and as she grew up the vanities and flirtations of a pretty girl took the place of these pious imaginations. Her father deemed it best to send her to be educated in an Augustinian convent in the town, but without any thoughts of her adopting a religious life. She would probably have married like her sisters, had it not been for an attack of illness. She was sent away for change of air on a visit to one of her sisters, and on her way home spent some days with a saintly uncle, who was on the eve of entering a monastery, and who strongly urged her to withdraw from the world. Her father was greatly opposed to the step, but Teresa was not to be turned from what she conceived to be her duty. She was only eighteen when she left home one morning, and applied for admission at the Carmelite convent of the Incarnation. She was disappointed at first at the slackness of discipline. The sisters mixed freely in the society of Avila, receiving visits and returning them, and often absenting themselves from the cloister for months at a time. For the first three years she was constantly subject to attacks of sickness, fainting fits, and paroxysms of pain, but she prayed to St Joseph, after which she became comparatively better, though her nervous system was completely shaken. But she appears afterwards to have accommodated herself with tolerable success to the worldliness of her environment, though not without intervals of religious misgiving. "For twenty years," she says, "I was tossed about on a stormy sea in a wretched condition, for, if I had small content in the world, in God I had no pleasure. At prayer time I watched for the clock to strike the end of the hour. To go to the oratory was a vexation to me, and prayer itself a constant effort." At one time she abandoned prayer altogether, as she found it impossible to fix her thoughts, and she abhorred the hypocrisy of mechanically repeating a form of words. It was in the year 1554 (her noviciate dated from 1534), when she was thus nearly forty, that the event known as her conversion took place, and the second part of her life began. The death of her father roused her to serious reflexion, and one day, as she entered the oratory, she was struck by the image of the wounded Christ, placed there for an approaching festival. The blood was depicted as streaming over the face from the thorns and running from the side and the hands and feet. The spectacle of suffering pierced Teresa's breast; she fell in tears at the feet of the figure, and felt every worldly emotion die within her. The shock threw her into a trance, and these trances, accompanied by visions, recurred frequently in the subsequent part of her life. They have since been adduced as Divine attestations of her saintship, but the sisterhood in the convent set them down to possession by a devil; her new departure was due in their eyes to no worthier motive than the desire to be peculiar and to be reputed better than other people. Teresa herself was very humble, and thought their explanation might be true; she took her case to her confessor and to the provincial-general of the Jesuits. The latter put her under a course of discipline: she was to flog herself with a whip of nettles, to wear a haircloth plaited with broken wires that would tear the skin, and to meditate daily on the details of Christ's passion. One day, while thus occupied, her trance came upon her, and she heard a voice say, "Thou shalt have no more converse with men, but with angels." After this the trance or fit always returned when she was at prayers, and she felt that Christ was close to her. Presently she was able to see him, "exactly as he was painted rising from the sepulchre." Her confessor directed her to exorcise the figure, and she obeyed with pain, but, it is needless to say, in vain. The visions grew more and more vivid. The cross of her rosary was snatched from her hand one day, and when returned it was made of jewels more brilliant than diamonds, visible, however, to her alone. She had often an acute pain in her side, and fancied that an angel came to her with a lance tipped with fire, which he struck into her heart. The 27th of August is kept sacred in Spain to this mystery, which has also formed a favourite subject of Spanish painters; it forms the frontispiece of the biography which is put into the hands of Catholics. She had also visions of another description: she was shown hell with its horrors, and the devil would sit upon her breviary, belabour her with blows, and fill her cell with imps. For several years these experiences continued, and the verdict as to their source still remained far from unanimous. Meanwhile, on the broad stage of the world, the Reformation continued to spread and establish itself; and this great falling away became the subject of much searching of hearts to pious Catholics. Teresa reflected like the rest, and her experience led her to find the real cause of the catastrophe in the relaxation of discipline within the religious orders. If the ancient rules could be restored, it appeared to her that the evil might be stemmed; and she formed the project of founding a house in which all the original rules of the Carmelite order before its relaxation would be observed. She met, not unnaturally, with great opposition from the authorities of the order, and in particular from the prioress and sisters of the Incarnation, who looked upon the step as a reflexion upon themselves. Nevertheless, she persevered with her scheme, being encouraged to appeal to the pope by certain priests who saw the benefit which would accrue to the church from her zeal. A private house in Avila was secretly got ready to serve as a small convent, and, when the bull arrived from Rome, Teresa went out on leave from the Incarnation and installed four poor women in the new house dedicated to her patron St Joseph. It was on the 24th of August 1562 that mass was said in the little chapel and the new order constituted. It was to be an order of Descalzos or Barefoots, in opposition to the relaxed parent body, the Calzados. The sisters were not to be literally shoeless, but to wear sandals of rope; they were to sleep on straw, to eat no meat, to be strictly confined to the cloister, and to live on alms without regular endowment. After lodging her four sisters, Teresa returned to the Incarnation, as in duty bound; but, when the secret was discovered, Carmelites and townspeople were alike furious. Violence, however, was prevented, and the matter was referred to the council of state at Madrid. Philip II. referred it again to the pope, and after six months a fresh bull arrived from Pius V. The provincial of her order now gave her leave to remove and take charge of her sisterhood. The number of thirteen, to which on grounds of discipline she had limited the foundation, was soon filled up, and Teresa spent here the five happiest years of her life. Her visions continued, and, by command of her ecclesiastical superiors, she wrote her autobiography containing a full account of these experiences. She herself, however, profoundly as she believed in their reality, saw the danger which attaches to such experiences, and was far from basing any claim to holiness upon them. One of her visions about this time is interesting as illustrating what is called her mysticism. She fancied that she was a mirror without frame and without dimensions, with Christ shining in the centre of it, and the mirror itself, she knew not how, was in Christ. Teresa was now encouraged to carry her work still further, for the church was girding itself to the work of the Counter-Reformation. The general of the order visited her at Avila, and gave her powers to found other houses of Descalzos, for men as well as women. The last fifteen years of her life were spent mainly in journeys with this end and in the continually growing labour of organization. She travelled in a rude cart in all weathers, and the story of her hardships and misadventures impresses us with the strength of will that animated her old and shaken frame. Convents were founded at Medina, Malaga, Valladolid, Toledo, Segovia, and Salamanca, and two at Alva under the patronage of the famous duke. Then she had three years of rule, as prioress of her old convent of the Incarnation. She next went to Seville to found a house, thus overstepping for the first time the boundaries of the Castiles, to which her authorization limited her. The latent hostility of the old order was aroused; the general ordered the immediate suppression of the house at Seville, and procured a bull from Gregory XIII. prohibiting the further extension of the reformed houses (1575). But the movement against her came from Italy, and was resented by Philip and the Spanish authorities as undue interference; and, after a fierce struggle, during which Teresa was two years under arrest at Toledo, the Carmelites were divided into two bodies in 1580, and the Descalzos obtained the right to elect their own provincial-generals (see **Carmelites**). The few remaining years of Teresa's life were spent in the old way, organizing the order she had founded, and travelling about to open new convents. Sixteen convents and fourteen monasteries were founded by her efforts; she wrote a history of her foundations, which forms a supplement to her autobiography. At Burgos, during the whole of a wet autumn and winter, she endured terrible privations. Her own nuns, too, were not always as single-minded and obedient as the ideal sisterhood of her hopes had been. Those at St Joseph in Avila mutinied for a meat diet; the prioress at Medina answered her impertinently. Her last journey of inspection was cut short at Alva, where she died on the 29th of September 1582, and was laid in her first, but not her last, resting-place. A violet odour and a fragrant oil were said to distil from her tomb; and when it was opened nine months afterwards the flesh was found uncorrupted. A hand cut off by a fervent brother was found to work miracles, and the order became convinced that their founder had been a saint. It was resolved in 1585 to remove her remains to Avila, where she was born, the sisters at Alva being consoled by permission to retain the mutilated arm. But the family of the duke of Alva procured an order from the pope enjoining that the body should be restored to Alva, and she was accordingly laid there once more in a splendid tomb. But even then she was not allowed to rest: she was again disentombed, to be laid in a more magnificent coffin, and the greed of reverential relic-seekers made unseemly havoc of her bones.

Teresa was canonized by Gregory XV. in 1622. The honour was doubtless largely due to her asceticism and mystic visions. She called herself Teresa de Jesus, to signify the closeness of her relation to the heavenly Bridegroom, who directed all her actions. Though she deprecated excess of ascetic severity in others, she scourged herself habitually, and wore a peculiarly painful haircloth. But her life shows her to have been, besides, a woman of strong practicality and good sense, full of natural shrewdness, and with unusual powers of organization. "You deceived me in saying she was a woman," writes one of her confessors; "she is a bearded man." She was brave in the face of difficulties and dangers, pure in her motives, and her utterances, some of which have been quoted, have the true ethical ring about them. Her MSS. were collected by Philip II. and placed in a rich case in the Escorial, the key of which the king carried about with him. Besides her autobiography and the history of her foundations, her works (all written in Spanish) contain a great number of letters and various treatises of mystical religion, the chief of which are *The Way of Perfection* and *The Castle of the Soul*. Both describe the progress of the soul towards perfect union with God.

Her works, edited by two Dominicans, were first published in 1587, and have since appeared in various editions. They were soon afterwards translated into Italian, French, and Latin; an English translation of the *Life* and works (except the letters) by A. Woodhead appeared in 1669. More recently various translations of the *Life* have appeared,—by John Dalton (1851), who also translated the *Way of Perfection*, and by David Lewis (1870), followed in 1871 by the *Foundations* from the same hand. Biographies appeared soon after her death by the Jesuit Ribera, who had been her confessor (1602), and by Diego de Yepez, confessor to Philip II. (1599). Details are also given in Ribadeneyra's *Flos Sanctorum* and in Alban Butler's *Lives of the Saints*. A separate biography, with preface by Archbishop Manning, appeared in 1865, and an interesting and sympathetic account of her life is given in the *Quarterly Review* for October 1883. (A. SE.)

THERESIOPEL, or **Theresienstadt**. See **Szabadka**.

THERMAL SPRINGS, See **Geology**, vol. x. pp. 223, 270, and **Mineral Waters**.

THERMODYNAMICS. In a strict interpretation, this branch of science, sometimes called the Dynamical Theory of Heat, deals with the relations between heat and work, though it is often extended so as to include all transformations of energy. Either term is an infelicitous one, for there is no direct reference to force in the majority of questions dealt with in the subject. Even the title of Carnot's work, presently to be described, is much better chosen than is the more modern designation. On the other hand, such a German phrase as *die bewegende Kraft der Wärme* is in all respects intolerable.

It has been shown in a previous article (ENERGY) that Newton's enunciation of the conservation of energy as a general principle of nature was defective in respect of the connexion between work and heat, and that, about the beginning of the present century, this *lacuna* was completely filled up by the researches of Rumford and Davy (see also HEAT). In the same article Joule's experimental demonstration of the principle, and his determination of the work-equivalent of heat by various totally independent processes, have been discussed.

But the conservation of energy, alone, gives us an altogether inadequate basis for reasoning on the work of a heat-engine. It enables us to calculate how much work is equivalent to an assigned amount of heat, and *vice versa*, provided the transformation can be effected; but it tells us nothing with respect to the percentage of either which can, under given circumstances, be converted into the other. For this purpose we require a special case of the law of transformation of energy. This was first given in Carnot's extraordinary work entitled *Reflexions sur la Puissance Motrice du Feu*, Paris, 1824.[1]

The chief novelties of Carnot's work are the introduction of the idea of a cycle of operations, and the invaluable discovery of the special property of a *reversible cycle*. It is not too much to say that, without these wonderful novelties, thermodynamics as a theoretical science could not have been developed.

Carnot's work seems to have excited no attention at the time of its publication. Ten years later (1834) Clapeyron gave some of its main features in an analytical form, and he also employed Watt's diagram for the exhibition of others. Even this, however, failed to call attention properly to the extremely novel processes of Carnot, and it was reserved for Sir W. Thomson (in 1848, and more at length in 1849) to point out to scientific men their full value. His papers on Carnot's treatise, following closely after the splendid experimental researches of Colding and Joule, secured for the dynamical theory of heat its position as a recognized branch of science. James Thomson, by Carnot's methods, predicted in 1849 the lowering of the freezing point of water by pressure, which was verified experimentally in the same year by his brother. Von Helmholtz had published, two years before, a strikingly original and comprehensive pamphlet on the conservation of energy. The start once given, Rankine, Clausius, and W. Thomson rapidly developed, though from very different standpoints, the theory of thermodynamics. The methods adopted by Thomson differed in one special characteristic from those of his concurrents,—they were based entirely on the experimental facts and on necessary principles; and, when hypothesis was absolutely required, attention was carefully directed to its nature and to the reasons which appeared to justify it.

Three specially important additions to pure science followed almost directly from Carnot's methods:—(1) the *absolute* definition of temperature; (2) the thermodynamic function or entropy; (3) the dissipation of energy. The first (in 1848) and the third (in 1852) were given by W. Thomson. The second, though introduced by Rankine, was also specially treated by Clausius.

In giving a brief sketch of the science, we will not adhere strictly to any of the separate paths pursued by its founders, but will employ for each step what appears to be most easily intelligible to the general reader. And we will arrange the steps in such an order that the necessity for each may be distinctly visible before we take it.

1. *General Notions.*—The conversion of mechanical work into heat can always be effected completely. In fact, friction, without which even statical results would be all but unrealizable in practical life, interferes to a marked extent in almost every problem of kinetics,—and work done against friction is (as a rule) converted into heat. But the conversion of heat into work can be effected only in part, usually in very small part. Thus heat is regarded as the lower or less useful of these forms of energy, and when part of it is elevated in rank by conversion into work the remainder sinks still lower in the scale of usefulness than before.

There are but two processes known to us for the conversion of heat into work, viz., that adopted in heat-engines, where the changes of volume of the "working substance" are employed, and that of electromagnetic engines driven by thermoelectric currents (see ELECTRICITY, vol. viii. p. 96). To the latter we will not again refer. And for simplicity we will suppose the working substance to be fluid, so as to have the same pressure throughout, or, if it be solid, to be isotropic, and to be subject only to hydrostatic pressure, or to tension uniform in all directions and the same from point to point.

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[1] The author, N-L-Sadi Carnot (1796–1832), was the second son of Napoleon's celebrated minister of war, himself a mathematician of real note even among the wonderful galaxy of which France could then boast. The delicate constitution of Sadi was attributed to the agitated circumstances of the time of his birth, which led to the proscription and temporary exile of his parents. He was admitted in 1812 to the École Polytechnique, where he was a fellow-student of the famous Chasles. Late in 1814 he left the school with a commission in the Engineers, and with prospects of rapid advancement in his profession. But Waterloo and the Restoration led to a second and final proscription of his father; and, though Sadi was not himself cashiered, he was purposely told off for the merest drudgeries of his service; il fut "envoyé successivement dans plusieurs places fortes pour y faire son métier d'ingénieur, compter des briques, réparer des pans de murailles, et lever des plans destinés à s'enfouir dans les cartons," as we learn from a biographical notice written by his younger brother. Disgusted with an employment which afforded him neither leisure for original work nor opportunities for acquiring scientific instruction, he presented himself in 1819 at the examination for admission to the staff-corps (état-major), and obtained a lieutenancy. He now devoted himself with astonishing ardour to mathematics, chemistry, natural history, technology, and even political economy. He was an enthusiast in music and other fine arts; and he habitually practised as an amusement, while deeply studying in theory, all sorts of athletic sports, including swimming and fencing. He became captain in the engineers in 1827, but left the service altogether in the following year. His naturally feeble constitution, farther weakened by excessive devotion to study, broke down finally in 1832. A relapse of scarlatina led to brain fever, from which he had but partially recovered when he fell a victim to cholera. Thus died, at the early age of thirty-six, one of the most profound and original thinkers who have ever devoted themselves to science. The work named above was the only one he published. Though of itself sufficient to put him in the very foremost rank, it contains only a fragment of Sadi Carnot's discoveries. Fortunately his manuscripts have been preserved, and extracts from them have been appended by his brother to a reprint (1878) of the *Puissance Motrice*. These show that he had not only realized for himself the true nature of heat, but had noted down for trial many of the best modern methods of finding its mechanical equivalent, such as those of Joule with the perforated piston and with the internal friction of water and mercury. W. Thomson's experiment with a current of gas forced through a porous plug is also given. One sentence of extract, however, must suffice, and it is astonishing to think that it was written over sixty years ago. "On peut donc poser en thèse générale que la puissance motrice est en quantité invariable dans la nature, qu'elle n'est jamais, à proprement parler, ni produite, ni détruite. À la vérité, elle change de forme, c'est-à-dire qu'elle produit tantôt un genre de mouvement, tantôt un autre; mais elle n'est jamais anéantie."

The state of unit mass of such a substance is known by experiment to be fully determined when its volume and pressure are given, even if (as in the case of ice in presence of water, or of water in presence of steam) part of it is in one molecular state and part in another. But, the state being determinate, so must be the temperature, and also the amount of energy which the substance contains. This consideration is insisted on by Carnot as the foundation of his investigations. In other words, before we are entitled to reason upon the relation between the heat supplied to and the work done by the working substance, Carnot says we must bring that substance, by means of a *cycle* of operations, back to precisely its primitive state as regards volume, temperature, and molecular condition.

2. *Watt's Diagram.*—Watt's indicator-diagram (see STEAM-ENGINE) enables us to represent our operations graphically. For if OM (fig. 1) represent the volume, at any instant, of the unit mass of working substance, MP its pressure, the point P is determinate and corresponds to a definite temperature, definite energy, &c. If the points of any curve, as PP′, in the diagram represent the successive states through which the working substance is made to pass, the work done is (*loc. cit.*) represented by the area MPP′M′. Hence, a cycle of operations, whose essential nature is to bring the working substance back to its primitive state, is necessarily represented by a *closed* boundary, such as PP′Q′Q, in the diagram. The area enclosed is the excess of the work done by the working substance over that spent on it during the cycle. [This is positive if the closed path be described clockwise, as indicated by the arrow-heads.]

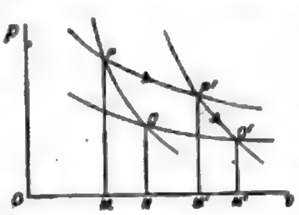

Fig. 1.

3. *Carnot's Cycle.*—For a reason which will immediately appear, Carnot limited the operations in his cycle to two kinds, employed alternately during the expansion and during the compression of the working substance. The first of these involves change of volume *at constant temperature*; the second, change of volume *without direct loss or gain of heat.* [In his hypothetical engine the substance was supposed to be in contact with a body kept at constant temperature, or to be entirely surrounded by non-conducting materials.] The corresponding curves in the diagram are called *isothermals*, or lines of equal temperature, and *adiabatic* lines respectively. We may consider these as having been found, for any particular working substance, by the direct use of Watt's indicator. It is easy to see that one, and only one, of each of these kinds of lines can be found for an assigned initial state of the working substance; also that, because in expansion at constant temperature heat must be constantly supplied, the pressure will fall off less rapidly than it does in adiabatic expansion. Thus in the diagram the adiabatic lines PQ, P′Q′ cut the lines of equal temperature PP′, QQ′ downwards and to the right. Thus the boundary of the area PP′Q′Q does not cross itself. To determine the behaviour of the engine we have therefore only to find how much heat is taken in along PP′ and how much is given out in Q′Q Their difference is *equivalent* to the work expressed by the area PP′Q′Q.

4. *Carnot's Principle of Reversibility.*—It will be observed that each operation of this cycle is strictly *reversible*; for instance, to take the working substance along the path P′P we should have to spend on it step by step as much work as it gave out in passing along PP′, and we should thus restore to the source of heat exactly the amount of heat which the working substance took from it during the expansion In the case of the adiabatics the work spent during compression is the same as that done during the corresponding expansion, and there is no question of loss or gain of heat directly.

If, however, a transfer of heat between the working substance and its surroundings have taken place on account of a finite difference of temperature, it is clear that such an operation is not reversible. Strictly speaking, isothermal expansion or contraction is unattainable in practice, but it is (without limit) more closely approximated to as the operation is more slowly performed. The adiabatic condition, on the other hand, is more closely approximated to in practice the more swiftly the operation is performed. We have an excellent instance of this in the compression and dilatation of air caused by the propagation of a sound-wave.

And now we have Carnot's invaluable proposition, *a reversible heat-engine is a perfect engine,*—perfect, that is, in the sense that no other heat-engine can be superior to it. Before giving the proof, let us see the immense consequences of this proposition. Reversibility is the sole test of perfection; so that all heat-engines, *whatever be the working substance*, provided only they be reversible, convert into work (under given circumstances) the same fraction of the heat supplied to them. The only circumstances involved are the temperatures of the source and condenser. Thus we are furnished with a general principle on which to reason about transformation of heat, altogether independently of the properties of any particular substance.

The proof, as Carnot gave it on the hypothesis of the materiality of heat, is *ex absurdo.* It is as follows. Suppose a heat-engine A to be capable of giving more work from a given amount of heat than is a reversible engine B, the temperatures of source and condenser being the same for each. Use the two as a compound engine, A working direct and B reversed. By hypothesis B requires to be furnished with part only of the work given by A to be able to restore to the source the heat abstracted by A, and thus at every complete stroke of the compound engine the source has its heat restored to it, while a certain amount of external work has been done. This would be the PERPETUAL MOTION (*q.v.*).

5. *The Basis of the Second Law of Thermodynamics.*—Carnot's reasoning, just given, is based on the hypothesis that heat (or caloric) is indestructible, and that (under certain conditions) it does work in being let down from a higher to a lower temperature, just as does water when falling to a lower level. It is clear from several expressions in his work that Carnot was not at all satisfied with this view, even in 1824, and we have seen that he soon afterwards reached the true theory. But it is also clear that such an assumption somewhat simplifies the reasoning, for in his hypothetical heat-engine all the heat which leaves the boiler goes to the condenser, and *vice versa* in the reversed working. The precise point of Carnot's investigation where the supposed indestructibility of heat introduces error is when, after virtually saying compress from Q′ to a state Q determined by the condition that the heat given out shall be exactly equal to that taken in during the expansion from P to P′, he assumes that, on farther compressing adiabatically to the original volume, the point P will be reached and the cycle completed. J. Thomson, in 1849, rectified this by putting it in the true form:—compress from Q′ to a state Q, such that subsequent adiabatic compression will ultimately lead to the state P.

We have now to consider that, if an engine (whether simple or compound) does work at all by means of heat, *less* heat necessarily reaches the condenser than left the boiler. Hence, if there be two engines A and B as before, and the joint system be worked in such a way that B constantly restores to the source the heat taken from it by

A, we can account for the excess of work done by A over that spent on B solely by supposing that *B takes more heat from the condenser than A gives to it.* Such a compound engine would transform into work heat taken solely from the condenser. And the work so obtained might be employed on B, so as to make it convey heat to the source while farther cooling the condenser.

Clausius, in 1850, sought to complete the proof by the simple statement that "this contradicts the usual behaviour of heat, which always tends to pass from warmer bodies to colder." Some years later he employed the axiom, "it is impossible for a self-acting machine, unaided by any external agency, to convey heat from one body to another at a higher temperature." W. Thomson, in 1851, employed the axiom, "it is impossible, by means of inanimate material agency, to derive mechanical effect from any portion of matter by cooling it below the temperature of the coldest of the surrounding objects." But he was careful to supplement this by further statements of an extremely guarded character. And rightly so, for Clerk-Maxwell has pointed out that such axioms are, as it were, only accidentally correct, and that the true basis of the second law of thermodynamics lies in the extreme smallness and enormous number of the particles of matter, and in consequence the *steadiness* of their average behaviour. Had we the means of dealing with the particles individually, we could develop on the large scale what takes place continually on a very minute scale in every mass of gas,—the occasional, but ephemeral, aggregation of warmer particles in one small region and of colder in another.

6. *The Laws of Thermodynamics.*—I. When equal quantities of mechanical effect are produced by any means whatever from purely thermal sources, or lost in purely thermal effects, equal quantities of heat are put out of existence, or are generated. [To this we may add, after Joule, that in the latitude of Manchester 772 foot-pounds of work are capable of raising the temperature of a pound of water from 50° F. to 51° F. This corresponds to 1390 foot-pounds per centigrade degree, and in metrical units to 425 kilogramme-metres per calorie (see HEAT).]

II. If an engine be such that, when it is worked backwards, the physical and mechanical agencies in every part of its motions are all reversed, it produces as much mechanical effect as can be produced by any thermodynamic engine, with the same temperatures of source and refrigerator, from a given quantity of heat.

7. *Absolute Temperature.*—We have seen that the fraction of the heat supplied to it which a reversible engine can convert into work depends *only* on the temperatures of the boiler and of the condenser. On this result of Carnot's Sir W. Thomson based his absolute definition of temperature. It is clear that a certain freedom of choice is left, and Thomson endeavoured to preserve as close an agreement as possible between the new scale and that of the air thermometer. Thus the definition ultimately fixed on, after exhaustive experiments, runs:—"The temperatures of two bodies are proportional to the quantities of heat respectively taken in and given out in localities at one temperature and at the other respectively, by a material system subjected to a complete cycle of perfectly reversible thermodynamic operations, and not allowed to part with or take in heat at any other temperature; or, the absolute values of two temperatures are to one another in the proportion of the heat taken in to the heat rejected in a perfect thermodynamic engine, working with a source and refrigerator at the higher and lower of the temperatures respectively."[1] If we now refer again to fig. 1, we see that, t and t' being the absolute temperatures corresponding to PP' and QQ', and H, H' the amounts of heat taken in during the operation PP' and given out during the operation Q'Q respectively, we have

$$H/t = H'/t',$$

whatever be the values of t and t'. Also, if heat be measured in terms of work, we have

$$H - H' = \text{area } PP'Q'Q.$$

Thus with a reversible engine working between temperatures t and t' the fraction of the heat supplied which is converted into work is $(t - t')/t$.

It is now evident that we can construct Watt's diagram in such a way that the lines of equal temperature and the adiabatics may together intercept a series of equal areas. Thus let PP' (fig. 2) be the isothermal t, and on it so take points P', P'', P''', &c., that, as the working substance passes from P to P', P' to P'', &c., t units of heat (the unit being of any assigned value) shall in each case be taken in. Let QQ', RR', &c., be other isothermals, so drawn that the successive areas PQ', QR', &c., between any two selected adiabatics, may be equal. Then, as it is clear that all the successive areas between each one pair of isothermals are equal (each representing the area $t-t'$), it follows that all the quadrilateral areas in the figure are equal.

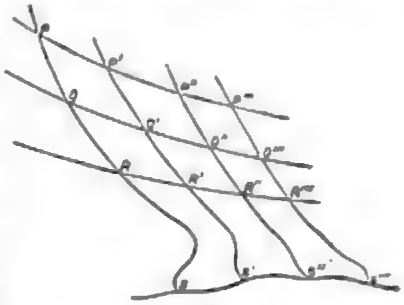

Fig. 2.

It is now clear that the area included between PP' and the two adiabatics PQR, P'Q'R' is essentially *finite*, being numerically equal to t. Thus the temperature for each isothermal is represented by the corresponding area. This is indicated in the cut by the introduction of an arbitrary line SS', supposed to be the isothermal of absolute zero. The lower parts of the adiabatics also are unknown, so that we may draw them as we please, subject to the condition that the entire areas PS', P'S'', P''S''', &c., shall all be equal. To find, on the absolute scale, the numerical value of two definite temperatures, such as the usually employed freezing and boiling points of water, we must therefore find their *ratio* (that of the heat taken and the heat rejected by a reversible engine working between these temperatures), and *assign* the number of degrees in the interval.

Thomson and Joule experimentally showed that this ratio is about 1·365. Hence, if we assume (as in the centigrade scale) 100 degrees as the range, the temperatures in question are 274 and 374 nearly. A full discussion of this most important matter will be found under HEAT.

8. *Entropy.*—Just as the lines PP', QQ', &c., are characterized by constant temperature along each, so we figure to ourselves a quantity which is characteristic of each adiabatic line,—being constant along it. The equation of last section at once points out such a quantity. If we write ϕ for its value along PQ, ϕ' for P'Q', we may define thus

$$\phi' - \phi = H/t.$$

From the statements as to the equality of the areas in fig. 2 the reader will see at once that the area bounded by t, t', ϕ, ϕ' is $(t - t')(\phi' - \phi)$. We are concerned only with the *changes* of ϕ, not with its actual magnitude, so that any one adiabatic may be chosen as that for which $\phi = 0$.

9. *The Dissipation of Energy.*—In the before-cited article ENERGY (vol. viii. p. 210) this part of the subject has already been treated. Since that article was written Sir William Thomson has introduced the term *thermodynamic motivity* to signify "the possession the waste of which is

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[1] *Trans. R.S.E.*, May 1854.

called dissipation." We speak of a distribution of heat in a body or system of bodies as having motivity, and we may regard it from without or from within the system.

In the first case it expresses the amount of work which can be obtained by means of perfect engines employed to reduce the whole system to some definite temperature, that, say, of the surrounding medium. In the second case the system is regarded as self-contained, its hotter parts acting as sources, and its colder parts as condensers for the perfect engine.

As an instance of internal motivity we may take the case of a system consisting of two equal portions of the same substance at different temperatures, say a pound of boiling water and a pound of ice-cold water. If we neglect the (small) change of specific heat with temperature, it is found that, when the internal motivity of the system is exhausted, the temperature is about 46° C., being the centigrade temperature corresponding to the geometrical mean of the original absolute temperatures of the parts. Had the parts been simply mixed so as to dissipate the internal motivity, the resulting temperature would have been 50° C. Thus the work gained (*i.e.*, the original internal motivity) is the equivalent of the heat which would raise two pounds of water from 46° C. to 50° C.

As an instance of motivity regarded from without we may take the simple case of the working substance in § 2, on the hypothesis that there is an assigned lower temperature limit. As there is no supply of heat, it is clear that the maximum of work will be obtained by allowing the substance to expand adiabatically till its temperature sinks to the assigned limit.

Thus if P (fig. 3) be its given position on Watt's diagram, PQ the adiabatic through P, and P′Q the isothermal of the lower temperature limit, Q is determinate, and the motivity is the area PQNM. If, again, we wish to find the motivity when the initial and final states P and P′ are given, with the condition that the temperature is not to fall below that of the state P′, the problem is reduced to finding the course PP′ for which the area PP′M′M is greatest. As no heat is supplied, the course cannot rise above the adiabatic PQ, and by hypothesis it cannot fall below the isothermal P′Q,—hence it must be the broken line PQP′. Thus, under the circumstances stated, the motivity is represented by the area MPQP′M′. If any other lawful course, such as PP′, be taken, there is an unnecessary waste of motivity represented by the area PQP′.

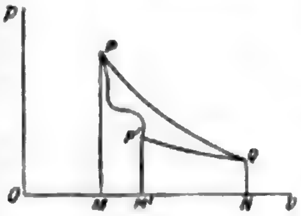

Fig 3.

10. *Elementary Thermodynamic Relations.*—From what precedes it is clear that, when the state of unit mass of the working substance is given by a point in the diagram, an isothermal and an adiabatic can be drawn through that point, and thus ϕ and t are determinate for each particular substance when p and v are given. Thus any two of the four quantities p, v, t, ϕ may be regarded as functions of the other two, chosen as independent variables. The change of energy from one state to another can, of course, be expressed as in § 9, above. Thus, putting E for the energy, we have at once

$$dE = td\phi - pdv \quad . \quad . \quad . \quad . \quad . \quad (1)$$

if ϕ and v be chosen as independent variables, and if heat be measured, as above, in units of work. This equation expresses, in symbols, the two laws of thermodynamics. For it states that the gain of energy is the excess of the heat supplied over the work done, which is an expression of the first law. And it expresses the heat supplied as the product of the absolute temperature by the gain of entropy, which is a statement of the second law in terms of Thomson's mode of measuring absolute temperature.

But we now have two equations in partial differential coefficients:—

$$\left(\frac{dE}{d\phi}\right) = t, \qquad \left(\frac{dE}{dv}\right) = -p$$

From these we have two expressions for the value of $\left(\frac{d^2E}{dvd\phi}\right)$. Equating them, we are led to the thermodynamic relation

$$\left(\frac{dt}{dv}\right) = -\left(\frac{dp}{d\phi}\right),$$

the differential coefficients being again partial.

This expresses a property of all "working substances," defined as in § 1. To state it in words, let us multiply and divide the right hand side by t, and it then reads:—

The rate at which the temperature falls off per unit increase of volume in adiabatic expansion is equal to the rate at which the pressure increases per dynamical unit of heat supplied at constant volume, multiplied by the absolute temperature.

To obtain a similar result with v and t as independent variables, we have only to subtract from both sides of (1) the complete differential $d(t\phi)$, so that

$$d(E - t\phi) = -\phi dt - pdv.$$

Proceeding exactly as before, we find

$$\left(\frac{d\phi}{dv}\right) = \left(\frac{dp}{dt}\right).$$

In words this result runs (when both sides are multiplied by t):—

The rate of increase of pressure with temperature at constant volume, multiplied by the absolute temperature, is equal to the rate at which heat must be supplied per unit increase of volume to keep the temperature constant.

Very slight variations of the process just given obtain the following varieties of expression:—

$$\left(\frac{dv}{d\phi}\right) = \left(\frac{dt}{dp}\right) \text{ and } \left(\frac{dv}{dt}\right) = -\left(\frac{d\phi}{dp}\right),$$

which are to be interpreted as above.

11. *Increase of Total Energy under various Conditions.*—The expression (1) of § 10 may be put in various forms, each convenient for some special purpose. We give one example, as sufficiently showing the processes employed. Thus, suppose we wish to find how the energy of the working substance varies with its volume when the temperature is kept constant, we must express dE in terms of dv and dt. Thus

$$dE = t\left(\frac{d\phi}{dt}\right)dt + t\left(\frac{d\phi}{dv}\right)dv - pdv.$$

But we have, by § 10, under present conditions

$$\left(\frac{d\phi}{dv}\right) = \left(\frac{dp}{dt}\right)$$

Hence
$$\left(\frac{dE}{dv}\right) = t\left(\frac{dp}{dt}\right) - p,$$

a result assumed in a previous article (RADIATION, vol. xx. p. 217).

If the working substance have the property (that of the so-called "ideal" perfect gas)

$$pv = Rt,$$

we see that, for it,

$$\left(\frac{dE}{dv}\right) = 0$$

The energy of (unit mass of) such a substance thus depends upon its temperature alone.

12. *Specific Heat of a Fluid.*—Specific heat in its most general acceptation is the heat required, under some given condition, to raise the temperature of unit mass by one degree. Thus it is the heat taken in while the working substance passes, by some assigned path, from one isothermal t to another $t+1$; and this may, of course, have as many values as there are possible paths. Usually, however, but two of these paths are spoken of, and these are taken parallel respectively to the coordinate axes in Watt's diagram, so that we speak of the specific heat at constant volume or at constant pressure. In what follows these will be denoted by c and k respectively.

Take v and p for the independent variables, as in the diagram and let κ be the specific heat corresponding to the condition

$$f(v, p) = \text{const.}$$

Then
$$\kappa dt = td\phi = t\left(\frac{d\phi}{dv}dv + \frac{d\phi}{dp}dp\right);$$

while
$$0 = \frac{df}{dv}dv + \frac{df}{dp}dp,$$

and
$$dt = \frac{dt}{dv}dv + \frac{dt}{dp}dp.$$

Thus
$$\kappa = t\,\frac{\dfrac{d\phi}{dv}\dfrac{df}{dp} - \dfrac{d\phi}{dp}\dfrac{df}{dv}}{\dfrac{dt}{dv}\dfrac{df}{dp} - \dfrac{dt}{dp}\dfrac{df}{dv}}.$$

This expression vanishes if f and ϕ vary together, *i.e.*, in adiabatic expansion, and becomes infinite if f and t vary together, *i.e.*, in isothermal expansion; as might easily have been foreseen. Otherwise it has a finite value. It is usual, however, to choose v and t as independent variables, while we deal analytically (as distinguished from diagrammatically) with the subject. From this point of view we have

$$\kappa dt = t\left(\frac{d\phi}{dv}dv + \frac{d\phi}{dt}dt\right).$$

But the last term on the right is, by definition, *cdt*; so that

$$(\kappa - c)dt = t\frac{d\phi}{dt}dv,$$

with the condition

$$\frac{df}{dt}dt + \frac{df}{dv}dv = 0.$$

Thus
$$\kappa - c = -t\frac{d\phi}{dv}\frac{df}{dt}\Big/\frac{df}{dv},$$

which is a perfectly general expression. As the most important case, let f represent the pressure, then we see, by § 10, that

$$\frac{d\phi}{dv} = \frac{dp}{dt},$$

and the formula becomes

$$k - c = -t\left(\frac{dp}{dt}\right)^2\Big/\frac{dp}{dv}.$$

13. *Properties of an Ideal Substance which follows the Laws of Boyle and Charles.*—Closely approximate ideas of the thermal behaviour of a gas such as air, at ordinary temperatures and pressures, may be obtained by assuming the relation

$$pv = \mathrm{R}t,$$

which expresses the laws of Boyle and Charles. Thus, by the formula of last section, we have at once

$$k - c = t\frac{\mathrm{R}^2}{v^2}\Big/\frac{p}{v} = \mathrm{R},$$

a relation given originally by Carnot.

Hence, in such a substance,

$$d\phi = c\frac{dt}{t} + (k-c)\frac{dv}{v},$$

or
$$\phi - \phi_0 = c\log t + (k-c)\log v.$$

In terms of volume and pressure, this is

$$\phi - \phi_0 = c\log p/\mathrm{R} + k\log v,$$

or
$$pv^{k/c} = \mathrm{R}\epsilon^{(\phi-\phi_0)/c},$$

the equation of the adiabatics on Watt's diagram.

This is (for ϕ constant) the relation between p and v in the propagation of sound. It follows from the theory of wave-motion (HYDROMECHANICS) that the speed of sound is

$$\sqrt{\frac{k}{c}\mathrm{R}t},$$

where t is the temperature of the undisturbed air. This expression gives, by comparison with the observed speed of sound, a very accurate determination of the ratio k/c in terms of R. The value of R is easily obtained by experiment, and we have just seen that it is equal to $k-c$; so that k and c can be found for air with great accuracy by this process,—a most remarkable instance of the indirect measurement of a quantity (c) whose direct determination presents very formidable difficulties.

14. *Effect of Pressure on the Melting or Boiling Point of a Substance.*—By the second of the thermodynamic relations in § 10, above, we have

$$\left(\frac{dp}{dt}\right) = \left(\frac{d\phi}{dv}\right),$$

so that

$$\delta p = \left(\frac{dp}{dt}\right)\delta t + \left(\frac{dp}{dv}\right)\delta v = \left(\frac{d\phi}{dv}\right)\delta t + \left(\frac{dp}{dv}\right)\delta v.$$

But, if the fraction e of the working substance be in one molecular state (say liquid) in which V_0 is the volume of unit mass, while the remainder $1-e$ is in a state (solid) where V_1 is the volume of unit mass, we have obviously

$$v = e\mathrm{V}_0 + (1-e)\mathrm{V}_1.$$

Let L be the latent heat of the liquid, then

$$\left(\frac{d\phi}{dv}\right) = \frac{td\phi}{t(\mathrm{V}_0 - \mathrm{V}_1)de} = \frac{\mathrm{L}}{t(\mathrm{V}_0 - \mathrm{V}_1)}.$$

Also, as in a mixture of the same substance in two different states, the pressure remains the same while the volume changes at constant temperature, we have $dp/dv = 0$, so that finally

$$\delta t = \frac{t(\mathrm{V}_0 - \mathrm{V}_1)}{\mathrm{L}}\delta p,$$

which shows how the temperature is altered by a small change of pressure.

In the case of ice and water, V_1 is greater than V_0, so the temperature of the freezing-point is lowered by increase of pressure. When the proper numerical values of V_0, V_1, and L are introduced, it is found that the freezing point is lowered by about 0°·0074 C. for each additional atmosphere.

When water and steam are in equilibrium, we have V_0 much greater than V_1, so that the boiling-point (as is well known) is raised by pressure. The same happens, and for the same reason, with the melting point, in the case of bodies which *expand* in the act of melting, such as beeswax, paraffin, cast-iron, and lava. Such bodies may therefore be kept solid by sufficient pressure, even at temperatures far above their ordinary melting points.

This is, in a slightly altered form, the reasoning of James Thomson, alluded to above as one of the first striking applications of Carnot's methods made after his work was recalled to notice.

15. *Effect of Pressure on Maximum Density Point of Water.*—One of the most singular properties of water at atmospheric pressure is that it has its maximum density at 4° C. Another, first pointed out by Canton in 1764, is that its compressibility (per atmosphere) is greater at low than at ordinary temperatures,—being, according to his measurements, 0·000,049 at 34° F., and only 0·000,044 at 64° F. It is easy to see (though it appears to have been first pointed out by Puschl in 1875) that the second of these properties involves the *lowering* of the maximum density point by increase of pressure. To calculate the numerical amount of this effect, note that the expansibility, like all other thermal properties, may be expressed as a function of any two of the quantities p, v, t, ϕ; say in the present case p and t. Then we have for the expansibility

$$e = \frac{1}{v}\left(\frac{dv}{dt}\right) = \left(\frac{d}{dt}\right)\log v = f(p, t).$$

Also the compressibility may be expressed as

$$c = -\frac{1}{v}\left(\frac{dv}{dp}\right) = -\left(\frac{d}{dp}\right)\log v.$$

The relation between small simultaneous increments of pressure and temperature, which are such as to leave the expansibility unchanged, is thus

$$\left(\frac{de}{dt}\right)\delta t + \left(\frac{de}{dp}\right)\delta p = 0.$$

Now the expansibility is zero at the maximum density point, for which therefore this equation holds. But the equations above give

$$\left(\frac{de}{dp}\right) = \left(\frac{d^2}{dpdt}\right)\log v = -\left(\frac{dc}{dt}\right);$$

so that

$$\left(\frac{de}{dt}\right)\delta t - \left(\frac{dc}{dt}\right)\delta p = 0.$$

The volume of water at low temperatures under atmospheric pressure varies approximately as

$$1 + \frac{(t-4)^2}{144{,}000}.$$

Thus we have $\left(\frac{de}{dt}\right) = \frac{1}{72{,}000}$ nearly; and from Canton's experimental result above stated we gather that (roughly at least)

$$\left(\frac{dc}{dt}\right) = -0{\cdot}000{,}005\frac{1{\cdot}8}{30} = -0{\cdot}000{,}000{,}3;$$

from which the formula gives −0°·02 C. nearly for the change of the maximum density point due to one additional atmosphere.

Recent investigations, carried out by direct as well as by indirect methods, seem to agree in showing that the true value is somewhat less than this, viz., about −0°·018 C.; so that water has its maximum density at 0° C. when subjected to about 223 atmospheres. Thus, taking account of the result of § 14 above, we find that the maximum density point coincides with the freezing point at −2°·8 C. under an additional pressure of about 377 atmospheres, or (say) 2·5 tons weight per square inch.

16. *Motivity and Entropy, Dissipation of Energy.*—The motivity of the quantity H of heat, in a body at temperature t, is

$$\mathrm{H}(t - t_0)/t,$$

where t_0 is the lowest available temperature.

The entropy is expressed simply as

$$\mathrm{H}/t,$$

being independent of any limit of temperature.

If the heat pass, by conduction, to a body of temperature t' (less than t, but greater than t_0), the change of motivity (*i.e.*, the dissipation of energy) is

$$\mathrm{H}t_0\left(\frac{1}{t} - \frac{1}{t'}\right),$$

which is, of course *loss*; while the corresponding change of entropy is the *gain*

$$\mathrm{H}\left(\frac{1}{t'} - \frac{1}{t}\right).$$

The numerical values of these quantities differ by the factor t_0, so that, if we could have a condenser at absolute zero, there could be no dissipation of energy. But we see that Clausius's statement that the entropy of the universe tends to a maximum is practically merely another way of expressing Thomson's earlier theory of the dissipation of energy.

When heat is exchanged among a number of bodies, part of it being transformed by heat-engines into work, the work *obtainable* (*i.e.*, the motivity) is

$$\Sigma(H) - t_0\Sigma(H/t) .$$

The work *obtained*, however, is simply

$$\Sigma(H) .$$

Thus the waste, or amount needlessly dissipated, is

$$- t_0\Sigma(H/t) .$$

This must be essentially a positive quantity, except in the case when perfect engines have been employed in *all* the operations. In that case (unless indeed the unattainable condition $t_0 = 0$ were fulfilled)

$$\Sigma(H/t) = 0 ,$$

which is the general expression of reversibility.

17. *Works on the Subject.*—Carnot's work has, as we have seen, been reprinted. The scattered papers of Rankine, Thomson, and Clausius have also been issued in collected forms. So have the experimental papers of Joule. The special treatises on *Thermodynamics* are very numerous; but that of Clerk-Maxwell (*Theory of Heat*), though in some respects rather formidable to a beginner is as yet far superior to any of its rivals. (P. G. T.)

THERMOELECTRICITY. See ELECTRICITY, vol. viii. pp. 94 *sq.*

THERMOMETER, an instrument for detecting and measuring differences in temperature. The name is usually restricted to instruments adapted for use at moderate temperatures; those for measuring high temperatures are termed pyrometers (see PYROMETER). Thermometry has been treated theoretically under HEAT (see vol. xi. p. 558 *sq.*). It here remains to trace the history of thermometers, and to describe the principal forms in use.

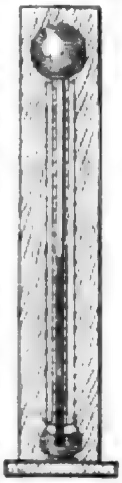

Fig. 1.

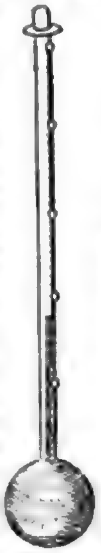

Fig. 2.

History.—The honour of inventing the thermometer has been given to several natural philosophers of the 16th century; the claims of Robert Fludd are more tangible than those of Drebbel and Santorio, but the instrument invented by Galileo before 1597 seems best entitled to be considered the precursor of accurate thermometers. All the early instruments were air thermoscopes, and, until the variations of atmospheric pressure were discovered, their use was only deceptive. Galileo's thermometer (fig. 1) consisted of a glass bulb containing air, terminating below in a long glass tube which dipped into a vessel containing a coloured fluid. The variations of volume of the enclosed air caused the fluid to fall or rise in the tube, to which an arbitrary scale was attached. The great step in advance of inventing the alcohol thermometer is also due to Galileo, but the date (probably 1611 or 1612) is not precisely known. Rinieri certainly had alcohol thermometers made before 1647, and they are referred to as familiarly known in the oldest memoirs of the Accademia del Cimento (1667). In form they resembled those now in use; they had large spherical (or, occasionally, cylindrical or helical) bulbs, and the degrees intended to represent thousandths of the volume of the reservoir were marked with beads of enamel fused on to the stem (fig. 2). All the Florentine instruments were graduated in the same way, but the scale was arbitrary, and the recorded readings were accordingly supposed for a long time to be useless. In 1829 the fortunate discovery by Antinori of a number of those early Florentine thermometers enabled their scale to be ascertained and translated into known degrees. The temperature of melting ice was marked by them as 13·5, while 50 corresponded with 55° C. No means of comparing observations made by thermometers of different manufacture existed until certain fixed points of universal accessibility were discovered. The thermal conditions of freezing water were studied with great care, but natural congelation was generally supposed to take place at variable temperatures, until Fahrenheit proved that, however much water could be cooled down without freezing, the temperature when ice began to form was always the same. Hooke, in 1665 (*Micrographia*, p. 38), describes the manufacture and graduation of comparable spirit thermometers with the freezing point of water as the zero of their scales, and he evidently recognized it as fixed. Halley in 1693 stated that the temperature of boiling water is constant, and this was again proved by Amontons in 1702. In 1694 Renaldeni of Padua proposed to graduate thermometers by taking as standards of temperature mixtures of definite volumes of ice-cold and boiling water. This method, although theoretically admirable (see HEAT, vol. xi. p. 559), is defective in practice. Seven years later Newton proposed anonymously (*Phil. Trans.*, 1701, vol. xxii. p. 824) a thermometer scale on which the temperature of freezing water was 0°, and that of the blood of a healthy man 12°. Continuing the graduation of a linseed-oil thermometer above this point, he found that water boiled at 34°. Fahrenheit in 1714 took as fixed points the temperature of the human body and that of a mixture of ice and sal ammoniac or common salt. In 1721 he made a mercury thermometer according to Halley's suggestion of 1693, and by means of it he proved the dependence of the boiling point on pressure. It was not until after Fahrenheit's death that the freezing and boiling points of water were universally accepted as fixed points on the thermometric scale. The thermometer has remained unchanged in its main features since the middle of the 18th century. Mercury has been found the most convenient fluid for ordinary use, in spite of the advantages (HEAT, vol. xi. p. 561 *sq.*) presented by lighter and more volatile liquids. Graduation of thermometers, by marking off volumes of the stem equal to a given fraction of the capacity of the bulb, although reintroduced by Réaumur in 1730, has now been entirely discontinued.

The idea of a self-registering thermometer early presented itself. Many forms were devised by natural philosophers and instrument-makers. That of Sixe, in 1782, a precursor of which, dating from the 17th century, is preserved amongst the instruments of the Florentine Academy, was the most successful.

Scales.—The absolute zero of temperature is the logical beginning of a thermometric scale, but some point easy of reference is desirable, and this is found in the temperature at which ice melts and water freezes. The second accepted fixed point is that at which distilled water boils under the pressure of 760 millimetres (29·92 in.) of mercury. For the division of the space between the two fixed points into degrees of convenient length only three of the innumerable methods proposed have survived, and one of these, the centigrade, is rapidly becoming universal. The oldest system, that of Fahrenheit, dates from 1724. It is used for meteorological purposes, and popularly, in Great Britain, the British colonies, and the United States. The freezing point is marked 32° and the boiling point of water 212°. At first Fahrenheit employed a scale of 180 degrees; the zero was placed at "temperate" (9° C.); 90° at "blood-heat," the point to which the alcohol rose when the thermometer was placed under the arm of a healthy man; and −90° at the temperature of a mixture of ice and salt, then believed to be the greatest possible cold. In 1714 Fahrenheit changed his scale at the suggestion of the Danish astronomer Roemer, placed 0° at his "absolute zero," and divided the space between that and the warmth of the human body into 24 degrees. The freezing point of water thus became 8°. For convenience, these long degrees were divided into quarters, which were afterwards termed degrees; thus the freezing point became 32° and blood heat 96°. A mercury thermometer graduated in this way, with divisions of equal length continued above blood heat, registered 212° in boiling water. Thus the Fahrenheit scale came from a duodecimal reckoning.

De Lisle, in 1724, introduced a scale in which the boiling point of water was marked 0° and the temperature of the cellars of the Paris Observatory 100°. He afterwards adopted the freezing point of water as his upper fixed point, and called it 150°. This scale was used for many years in Russia, but is now obsolete.

In 1730 Réaumur made alcohol thermometers with their zero at the freezing point of water, and degrees of one-thousandth of the volume of the bulb. On some of these the boiling point of water was 80°; but the instruments were defective in principle and very unequal in their indications. Deluc introduced mercury thermometers graduated from 0° in melting ice to 80° in boiling water, and these, with Réaumur's name attached, are in use for popular purposes in Germany, Holland, and other parts of the Continent.

Celsius adopted a centesimal scale in 1742. The boiling point was marked 0° and the freezing point of water 100°. Linnæus introduced the mode of reckoning from 0° in melting ice to 100° in boiling water, which is now known as the centigrade, and is used universally in laboratories, and in all except English-speaking countries for every scientific purpose.

Fahrenheit's scale is convenient for meteorological work on account of its short degrees, admitting of great accuracy in reading and compactness in recording, and on account of its low zero, which makes it possible in temperate climates to dispense with negative quantities. On the other hand, the centigrade scale is on the whole so convenient, its use is so nearly universal, and the advantage of a uniform system is so great that it must ultimately be adopted for all purposes.[1]

AIR THERMOMETER.—Under constant pressure gases expand equally for equal increments of heat. Hence, when an air thermometer is graduated between two fixed points the graduation may be continued above and below these points in degrees of the same length; and any number of air thermometers so made will agree amongst themselves at every temperature. The principle of air thermometers is treated of in HEAT (*ut sup.*), and examples of special forms are described in that article and in PYROMETER. The air thermometer is the ultimate standard of reference to which all other thermometers are referred.

ALCOHOL THERMOMETER.—Alcohol, the first liquid used for thermometric purposes, possesses numerous advantages, and on account of its low freezing point it is always used for observations in polar regions. Alcohol thermometers are graduated by fixing the freezing point in melting ice and by comparison with a mercury or air thermometer at several higher and lower temperatures. Recently low-temperature thermometers have been verified at Kew in melting mercury at the temperature of −40. The law of expansion of alcohol in glass at low temperatures is not known with such precision as to make the minimum indications of Arctic expeditions entirely trustworthy. The graduation of ordinary minimum alcohol thermometers used for meteorological purposes is effected by comparison with mercury standards, and their indications, so far as this source of uncertainty is concerned, may consequently be relied on.

MERCURY IN GLASS THERMOMETER.—The simplest form is the *Weight Thermometer*, a large glass bulb terminating in a capillary tube, and filled with a known weight of mercury at 0° C. The weight of mercury that escapes when the apparatus is heated to 100° is determined, and the temperature of any enclosure is then ascertained by placing in it the thermometer filled at zero, and weighing the liquid that runs out. Thermometers on this principle were used by Regnault in his celebrated researches on steam.

Standard Thermometers.—The tube is sometimes made with elliptical bore to ensure visibility of the mercury column, but it is usually circular in section. The internal diameter must be as nearly as possible uniform. This is tested by a preliminary calibration in which a short thread of mercury is measured in different parts of the tube. The length of stem and the range of the thermometer having been decided upon, the size of the bulb is calculated from the known expansibility of mercury and the section of the bore. The bulb is made as nearly as possible the required size, either by blowing it from a tube or preferably by forming it of a glass cylinder, and attached to the stem. The bulb is usually cylindrical in form and it must be uniform in thickness. The utmost care requires to be exercised to keep the bulb and stem dry and clean and to fill them with pure mercury recently distilled. The mercury is boiled in the thermometer for some time to drive out all traces of air and moisture, and the point of the stem is sealed off. If the thermometer is not intended to measure temperatures up to the boiling point of mercury, an expansion should be made at the top of the tube to prevent bursting from accidental overheating. Under HEAT (vol. xi. p. 561) the changes of volume which thermometer bulbs undergo in cooling and for a long time afterwards are discussed. The process of annealing by heating to a temperature exceeding 400° C. for some hours as originally proposed by Person,[2] or in vapour of mercury for several days as recently practised at Kew, renders the thermometer much less liable to suffer change of zero by the lapse of time or by heating to any lower temperature. All instruments of precision should be treated in this way, or kept for several years after they have been filled and sealed before they are graduated.

The first fixed point on the scale is marked at the place where the mercury stands when the thermometer is buried in melting ice from which the water is allowed to drain away, the second at the place where the mercury stands when the thermometer is immersed in steam of water boiling freely under the pressure of 760 mm. (29·92 inches) of mercury corrected to 0° C. The space between these may be graduated either in arbitrary equidistant divisions, as it is best to do in delicate instruments, or in degrees of any scale. Each degree centigrade is $\frac{1}{100}$ of the volume of the tube between the freezing and boiling points; if the tube is quite uniform in bore the degrees will be of equal length and may be marked off correctly by a dividing engine. If the preliminary calibration showed the tube to vary in diameter, the degree marks are often adjusted to correspond to intervals of equal volume. It is better in all cases, whether degrees or arbitrary divisions are adopted, to have them of equal length and correct the readings by the calibration curve. The scale may be continued above and beneath the fixed points in degrees or divisions of the same length.

Calibration consists in measuring the internal volume of the thermometer tube by means of a thread of mercury detached from the main column. There are several ways of doing this, for particulars of which reference may be made to the British Association *Report* on the subject (1882, pp. 145-204), where references to original memoirs are given. The best and simplest is Gay Lussac's "step by step" method.

The most recent and approved processes of manufacturing, testing, and using standard thermometers of great delicacy and high precision are described by Guillaume in his "Études Thermométriques" (*Travaux et Mémoires du Bureau International des Poids et Mesures*, v., 1886);[3] for additional information the work of Pickering cited below may also be consulted.

Comparison of Thermometers.—As the apparent expansion of mercury in glass from −39° to 100° C.[4] is very nearly proportional to the amount of heat imparted to it, a thermometer made and divided as indicated above is a natural standard. But the apparent expansion with different kinds of glass differs (see HEAT, vol. xi. pp. 563-4),[5] and, except at the fixed points or near them, mercury thermometers of different construction will only fortuitously agree absolutely among themselves or with the air thermometer. Bosscha[6] states that at 50° C. the mercury thermometer shows an error of 0°·5, other experimenters place it as high as 1°, but Mascart found it to amount only to 0°·06.[7] For purposes of ordinary experiment thermometers are compared at several temperatures with some standard instrument of known value—that of the Kew observatory for Great Britain,—and all results are stated in terms of the standard. The methods of comparison at Kew are described by Welsh (*Proc. R S.*, vi. 181) and Whipple (*Phil. Mag.*, [5], xxi., 1886, p. 27).

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[1] The process of converting readings of any one of the three existing scales into those of any other is a simple matter of proportion. They stand in the ratio of 80 : 100 : 180 (32 being subtracted from Fahrenheit temperatures before the calculation is made, and added to the result when converting from Réaumur or centigrade into Fahrenheit). An easy rule for changing centigrade readings into Fahrenheit mentally is—multiply the centigrade temperature by 2, subtract one-tenth of the product, and add 32: *e.g.*, 10° C. = 20 − 2 + 32 = 50° F. These rules are only to be applied to thermometers made with all modern precautions. When the boiling point was determined by immersing the bulb of the thermometer in boiling water or in steam at any pressure other than 760 mm. appropriate corrections have to be applied. For a detailed historical account, see Renou, Histoire du Thermomètre," *Annuaire Soc. Mét. de France*, 1876.

[2] *Comptes Rendus*, xix., 1844, p. 1314.

[3] Abstract by Guillaume in the *Séances de la Soc. Française de Physique*, 1886, p. 219.

[4] Ayrton and Perry, *Phil. Mag.* [5], xxii. 1886, p. 325.

[5] See also Kraffts, *Comptes Rendus*, xcv. 836.

[6] *Comptes Rendus*, lxix. 875. See Note by Regnault, *ibid.*, 879.

[7] Berthelot, *Mécanique Chimique*, i. 158.

The reading of thermometers is greatly facilitated by the process of enamelling the back, and still more by that of entirely surrounding the instrument with enamel except over a narrow strip through which the mercury is seen.[1] The enamel must not be allowed to encroach on the bulb, for that would endanger the homogeneity and strength of the glass

THERMOMETERS EMPLOYED FOR SPECIAL PURPOSES.—*Physical and Chemical Work.*—For all purposes of minute accuracy where thermometers are applicable standard instruments must be employed. They must be used in one position only. The stem is usually engraved with an arbitrary scale of equal divisions, the total range not exceeding 15° C., and readings are made by a cathetometer at some distance. The use of an intermediate bulb, first recommended by Person, enables the fixed points to be observed on instruments of very short range. Results of great accuracy, certainly to 0°·005 C., may be obtained in this way for comparative purposes if sufficient care be taken; but the greater the sensitiveness of a thermometer the more difficult is it to obtain a series of concordant readings (HEAT, vol. xi. p. 562). Pickering[2] uses thermometers of extreme sensitiveness, in which, by conveying the excess of mercury into an expansion at the top of the stem, he secures that the same part of the short arbitrary scale is used for every temperature that has to be measured. In physical researches thermoelectric junctions are more often used than thermometers for measuring very small differences of temperature.

For ordinary work in a chemical or physical laboratory thermometers are used which can be read easily to one-tenth of a degree centigrade, and have a range from 0° to 100°, or in some cases to 350° C. They are always either engraved on the stem or graduated on an included scale (see HEAT, figs. 4, 5), and are not mounted on frames of any kind. It is not necessary to calibrate such thermometers; but they should be compared with a standard at several temperatures and frequently verified in melting ice and steam of boiling water.

Zincke's chemical thermometer for high temperature has a scale commencing at 100° C. In Geissler's nitrogen thermometer the range is extended by raising the boiling point of the included mercury, the upper part of the tube being filled with rarefied nitrogen.

Meteorological.—The thermometer was early applied to the study of differences of climate, and this is still one of its most important uses. The wet and dry bulb thermometers placed in the shade give the temperature and humidity (see HYGROMETRY) of the surrounding air, but "shade" and "surrounding air" require to be defined. Shade is intended to exclude rain and prevent all radiation; and the surrounding air is that of the atmosphere in the neighbourhood of the thermometer outside any shelter that may be used. The simplest way of observing is to hang up a thermometer in the shadow of some rather distant object and leave it until it acquires a steady temperature; but this method has been found impracticable and does not give very exact results.

In different countries different patterns of thermometer shelter are employed and exposure takes place at a different height above the ground. Results so obtained cannot be critically compared, and the relative mean temperatures of the atmosphere in different countries are only known to within one or two degrees. The Stevenson double-louvred screen (see vol. xvi. p. 115), a box open below, provided with a solid roof, is used at all meteorological stations in Great Britain. It is placed 4 feet from the ground, and painted white outside and inside. The results derived from its use are comparable, because the conditions in which it is employed are the same, but the general introduction of a double roof would greatly add to its efficiency. Exposure outside windows or in wall boxes is the rule in Austria. In France the Renou screen is largely used; it is a flat roof one square metre in extent, and double; the thermometers are hung under it two metres from the ground. A similar roof, but of much larger size, is employed in Australia, in combination with a metal thermometer-box. A metallic box, constructed of double louvres with an air-space between, finds favour in Spain. In Russia and Switzerland Wild's shelter is extensively employed. The thermometers are enclosed in a case composed of two or three concentric zinc cylinders perforated to admit air, and placed 11 feet above the ground. They are protected by a large shelter of wood, the south wall and roof of which are double and made of solid boards, between which air circulates; the east and west sides are louvred, and the north side entirely open. A similar shelter is used in Canada, to cover a box of single sheet-iron louvres in which the thermometers are placed 4½ feet from the ground. Various systems of exposure were authorized in the United States until 1885. It was then decided, as the result of experiments[3] carried on for nearly two years, that a uniform pattern of shelter be adopted by the Signal Service. It is a single-louvred wooden box, 3 feet 6 inches long, 3 feet wide and high, with a movable bottom and a double roof. The louvres are provided with an upright flange on their inner side, designed to keep rain from the thermometers. The bottom of the shelter is to be fixed either 9 feet above a roof or 16 feet above grass.

All these screens are confessedly imperfect, although most of them are well adapted for the climates in which they are used. Numerous comparisons of different screens with each other have been made,[4] but in some cases sufficient precautions in the way of using instruments precisely similar and only dissimilarly situated have not been observed, and the results are uncertain. A critical comparison of the leading forms of thermometer shelter in use is still a desideratum.

The sling thermometer[5] (*thermomètre fronde*), a small thermometer whirled in the air at the end of a string, is often used as a standard, and gives more correct readings than most closed screens. All open screens are untrustworthy. Aitken[6] has devised a series of thermometer boxes on a new principle, radiation being taken advantage of to produce a constant draught over the thermometer bulbs by the use of a long blackened chimney. These give admirable results. Very small and bright objects are little affected by radiation: hence thermometers with bulbs of small diameter and coated with a bright deposit of gold or silver have been used without screens. The air temperature has also been calculated by means of a formula from the readings of two similar thermometers, the bulbs of which are unequally affected by radiation. Some form of sling thermometer should always be used for observations at sea; the Board of Trade screen generally employed is thoroughly objectionable, and can only give moderately good results by the exercise of great precautions on the part of the observer.[7]

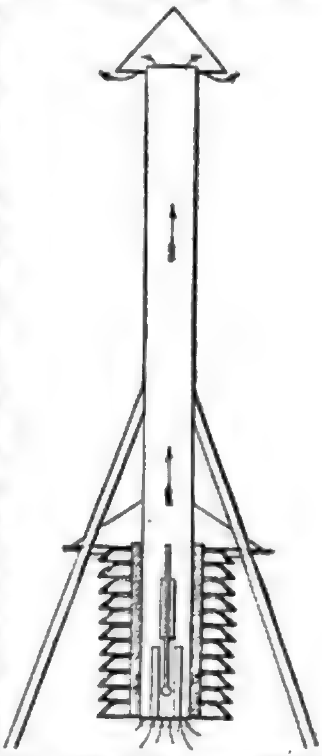

FIG. 3.—Aitken's Thermometer Screen for Maximum Thermometer.

As a rule, thermometers for meteorological purposes are made with spherical bulbs, although cylindrical reservoirs present certain advantages. To ensure perfect uniformity in registration, the bulbs should all be as nearly as possible of one size, constructed of one kind of glass, and the mounting perfectly uniform. Better-class instruments have the bulb clear of the frame, and the stem attached to a slab of metal, of porcelain, or of glass backed by wood; but sometimes they are simply fixed to a boxwood scale. In all cases they should be graduated on the stem, and compared with a standard, but in view of the uncertainty of the methods of thermometer exposure great delicacy is undesirable

The influence of height on thermometers for ascertaining the temperature of the air has been investigated with somewhat conflicting results;[8] the disparity is at least partly due to the use of dissimilar instruments.

Registering Thermometers.—Rutherford's maximum, invented before 1790,[9] was an ordinary mercury thermometer placed horizontally; the column pushed before it a small steel index, which was left at the highest point reached. It is little used now. The maximum thermometers in common use for meteorological purposes are Negretti & Zambra's and Phillips's. The former is a modified outflow thermometer. It is made with a constriction in the tube near the bulb, past which the mercury easily expands, but cannot return when the temperature falls, as the column breaks at the narrowed point when the fluid in the bulb begins to contract. The thermometer acts horizontally, but Everett devised a modification which is hung bulb uppermost, and the mercury, as it passes the constriction, falls down and stands as a column in the inverted tube. The thermometer is set by swinging it. Phillips's maximum, claimed also by Walferdin, has a portion of the mercury thread separated from the rest by a minute bubble of air. It is placed horizontally, and, as temperature increases, the detached portion of mercury is pushed forward and is not withdrawn when the main column retreats toward the bulb on cooling. It is set for a new observation by bringing it into a vertical position and tapping it slightly. By reducing the length of the index and the bore of the stem this thermometer may be made suitable for use in any position without altering its register. Walferdin's outflow maximum thermometer is a modification of that of Lord Charles Cavendish[1] and the type of a number of similar instruments. It is set by filling the stem entirely with mercury from a lateral chamber at the top (fig. 4). The instrument is placed vertically, and as temperature rises mercury overflows into the reservoir. To be read, the thermometer is brought back to its original temperature, then the number of degree spaces left vacant at the top of the tube shows the excess of maximum temperature above that at the time of setting.

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[1] Whipple, *Brit. Assoc. Reports*, 1883, p 937.

[2] *Phil. Mag.*, [5], xxi., 1886, p. 331, xxiii., 1887, pp. 401, 406.

[3] H. A Hazen, "Thermometer Exposure," *Prof. Papers of Signal Service*, No. xviii., 1886

[4] Gaster, *Quart. Weather Report for 1879* (1882), Appendix ii.; Wild, *Mittheil. der naturforsch. Gesellsch. in Bern*, 1860, 108; Marriott, *Quart. J. Roy. Met. Soc.*, 1879, v. 217; Stow, *ib.*, 1882, viii. 228, Gill, *ib.*, 1882, viii. 238; Mawley, *ib.*, 1884, x. 1; Aitken, *Proc. R. S. E.*, 1884, xii. 681; Dickson, *ib.*, 1885, xiii. 199; Hazen, *loc. cit.*

[5] The first use of this instrument is usually stated to have been by Arago (*Œuvres*, 1858, viii. p. 500), but Saussure employed it for wet-bulb observations and doubtless invented it (see *Voyages dans les Alpes*, 1796, iv. p. 267)

[6] *Proc. R S. E.*, 1884, xii 660; 1885, xiii. 199; 1886, xiii. 632.

[7] Caborne, *Quart J. Roy Met. Soc.*, 1881, vii. 10.

[8] Hazen, *loc. cit.*; Wild and Cantoni in *Report* of Vienna Meteorological Conference, 1874; Symons, *Proc. R. S.*, 1883, xxxv. 310; Omond, *Proc R. S. E.*, 1886–87.

[9] *Trans R. S. E.*, iii., 1794, p. 247.

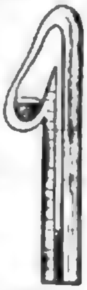

Fig. 4.

The minimum thermometer in most frequent use is that of John Rutherford, invented in 1790. It is a spirit thermometer, preferably filled with amyl alcohol to reduce risk of distillation, in the column of which a small porcelain index is included. The instrument is hung horizontally, and, as temperature falls, the index is drawn back by the surface tension of the fluid. When temperature rises, the liquid flows past the index easily, leaving it at the lowest point attained. Baudin invented a modification called the *thermomètre à marteau* in 1862; it acts vertically, the index being fixed by a spring, as in Sixe's thermometer, and set by a long glass needle included in the stem, which, when the instrument is inverted, falls on the index and drives it to the surface of the alcohol. The mercurial minimum of Casella is an instrument of great delicacy and beauty, extremely difficult to make, and requiring careful handling in its use. A side tube of wide bore *ac* (fig. 5) is joined to the stem of an ordinary mercurial thermometer near the bulb. This tube terminates in a small chamber *ab*, cut off by a perpendicular glass diaphragm which is perforated by a hole of greater diameter than the thermometer stem. When set, the mercury in the stem indicates the actual temperature, and the chamber is empty. On the principle of Balfour Stewart's fluctuation thermometer,[2] when the instrument is heated the mercury remains stationary in the stem but expands into the chamber *ab*. When cooled, the mercury passes out of the chamber; when this is empty, the temperature has returned to that at which the instrument was set, the surface attraction of glass and mercury prevents the fluid leaving the diaphragm *b*, and all subsequent contraction takes place from the stem. The position of the mercury column in the stem marks the minimum temperature since last setting. The instrument is set by raising the bulb end and allowing all the mercury to flow from the chamber.

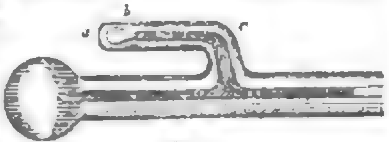

Fig. 5.

Thermometers which record the actual temperature at any required time, by a change of position produced by a clock, were employed by Blackadder[3] in 1826. His process was complicated and uncertain. Negretti & Zambra have a simpler arrangement that works well. Several of their reversing thermometers (see under *Deep-Sea Thermometers*) are pivoted on a frame, and held upright by catches which are withdrawn in turn at definite intervals by an electrical arrangement regulated by a clock. Each instrument, when it reverses, preserves the record of temperature at that moment until it is set again.

No thoroughly satisfactory self-registering maximum or minimum thermometer has yet been produced. In all existing forms the indications are liable to be disturbed by shaking. Where alcohol is the fluid used, it is apt to volatilize and accumulate at the top of the tube, so registering a much lower temperature than actually occurs. It is extremely difficult also to free alcohol thermometers from air, which gradually escapes from solution in the fluid and renders the instrument untrustworthy or even useless.

Radiation Thermometers.—The intensity of solar radiation is measured by the pyrheliometer, which usually consists of a body heated by the sun's rays and a thermometer to measure the rise of temperature. In meteorology radiation is measured by thermometers simply exposed with blackened bulbs. Results of the utmost diversity are given by different methods. As there is no means of determining the true measure of radiation, all that can be done is to have the instruments whose indications are to be compared constructed and exposed in the same way. The usual form, as suggested by Herschel, is a maximum thermometer with a spherical bulb half an inch in diameter coated with lampblack and placed in the centre of a spherical vessel of clear glass, 2½ inches in diameter, and exhausted of air. The state of the vacuum may be shown by including a small mercurial manometer, or a radiometer, or by soldering in platinum electrodes through which a discharge can be made in the interior. It is not essential that the vacuum be very perfect; some observers prefer to employ a globe filled with dry air. For separate instruments to be comparable, Whipple[4] and Ferrel[5] have shown that the bulbs must be truly spherical, of equal thickness and size (a difference of 8 per cent. in diameter produces variations of several degrees), blackened sufficiently to absorb all radiation falling on them, and placed accurately in the centre of perfectly spherical enclosures, which must also be of equal diameter. The stem should be as small as possible in proportion to the bulb; and before being used for comparative purposes all radiation thermometers should be compared with an arbitrary standard by daily exposure for several weeks to sunshine.

Minimum radiation thermometers, intended to measure radiation from the earth at night, are usually filled with alcohol, and much ingenuity has been expended on increasing their delicacy. The bulbs are made very large relatively to the bore, and constructed so as to expose a great surface, the reservoir being often helical, lenticular, annular, spoon-shaped, forked, or even like a gridiron.

Earth Thermometers.—Saussure introduced the use of sluggish thermometers packed in non-conducting material for taking the temperature of the soil at different depths. Symon's earth thermometer on this principle is a slow-action instrument cased in felt, and is lowered by a chain into an iron tube which has previously been sunk to the required depth. It may be withdrawn and read without changing its record. The underground temperature committee of the British Association have used both slow-action and self-registering thermometers for their observations in mines and shafts.[6]

Thermometers with very long stems, which can be read above ground, fitted in deep borings in the rock, are used at the observatories of Greenwich and Edinburgh for investigating earth temperature. Those at present established at the Royal Observatory, Edinburgh,[7] are the successors of a set fixed in the rock in 1837, and broken accidentally in 1876. They are placed with their bulbs at depths of 25, 12, 6, 3 feet beneath the surface respectively, and one has its bulb just covered. The readings of the intermediate thermometers supply data for correcting the long columns of alcohol in the deeper ones for the different temperatures of their different parts. Allowance may be made for this effect without calculation by utilizing the principle applied by Sainte-Claire Deville to pyrometers. A second stem, similar in every way to that of the thermometer, nearly filled with the same fluid, but hermetically sealed at the lower end, is fixed beside the thermometer stem. The fluctuations it shows are due solely to causes affecting the stem and not the bulb of the thermometer, and they are eliminated from the readings of the latter by taking account only of the difference of level of the fluid in the two tubes.

Deep-Sea Thermometers.—The earliest observations of warmth beneath the surface were made by raising samples of water in a valved box and noting the temperature when it was brought on board. Saussure, in addition to this, used sluggish thermometers, which he left immersed for several hours before reading. His latest thermometer for sea-work was filled with alcohol, and had a bulb more than an inch in diameter, which was imbedded in a mass of wax and enclosed in a stout wooden case. It attained the temperature of its surroundings very slowly, preserved it for a long time, and gave, in his hands, thoroughly trustworthy results. On the introduction of registering thermometers these were used, but the unsuspected magnitude of the effect of pressure at great depths made the earlier records entirely misleading.

A modification of Sixe's thermometer, protected from pressure by the addition of an outer bulb partially filled with a liquid, is now usually employed on deep-sea expeditions. Those used on the "Challenger," under the name of Miller-Casella thermometers, were of the form shown in fig. 6. The tube is U-shaped, the bend and part of each limb filled with mercury, the rest of the tube, the bulb, and part of the expansion on the other side with alcohol. A steel index, held in its place by the pressure of a hair, is immersed

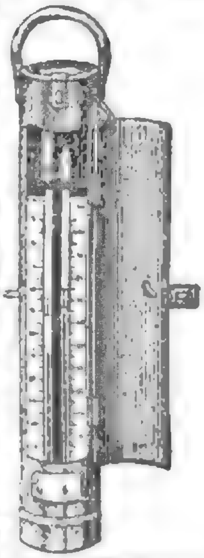

Fig. 6.—Miller-Casella Thermometer.

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[1] *Phil. Trans.*, L., 1757, p. 300. Henry Cavendish's register thermometer is on another principle and a much less practical instrument (see Wilson's *Life of Cavendish*, p. 477).

[2] *Proc. R. S.*, viii 196.

[3] *Trans. R. S. E.*, 1826, x. 337, 449.

[4] *Quart. J. R. Met. Soc.*, 1879, v. 143; 1884, x. 45.

[5] *Signal Service Prof. Papers*, No. xiii., 1884, p. 34.

[6] For a résumé of the methods and work of the committee, see *Brit. Assoc. Reports*, 1882, p. 74.

[7] *Trans. R. S. E.*, 1860, xxix. p. 637.

in the spirit in each limb above the mercury, which pushes one or other before it as the temperature is rising or falling, and leaves them at points denoting the highest and lowest temperatures passed through. The indexes are set by a magnet. The "Challenger" thermometers, which were not graduated on the stems, were secured side by side with porcelain temperature scales to vulcanite frames and placed in copper cases perforated to allow a circulation of water. Tait investigated the whole subject of pressure corrections after the return of the expedition, and found that the high result obtained by a previous experimenter was due mainly to heat developed by compression of the vulcanite, which affected the thermometer in the press, but would not do so at sea. The correction which had to be applied was rather less than ½ of a degree Fahr. per mile of depth.[1] These thermometers require to be immersed from twenty minutes to half an hour before they acquire the temperature of the water, they can only be read to quarter degrees Fahr., and they simply indicate the extreme temperatures through which they have passed. Buchanan has greatly improved the instrument by reducing the bore of the tube on the minimum side, which is that most frequently used, thus giving long degrees. An arbitrary scale is engraved on the stem.[2] His mercury piezometer is affected by temperature and by pressure, and enables the actual temperature at any known depth to be found.

Aimé in 1845[3] invented a very ingenious arrangement of outflow thermometers, which were inverted by a weight slipping down the line, and registered as they were being drawn up. His instruments were accurate, but very delicate and troublesome to manage. Within the last few years Negretti and Zambra have patented several forms of modified outflow thermometers. The first instrument of the kind was complicated and unmanageable, but that now before the public is both simple and convenient. It consists of a mercury thermometer with a cylindrical bulb and a stem AC (fig. 7) of wide bore terminating in a small pyriform aneurism. The stem is contracted and contorted just above the bulb, and when the instrument is turned upside down the mercury column breaks at this point and flows down into the tube, which is graduated in the inverted position. To protect it from pressure the thermometer is hermetically sealed in a strong glass tube, the portion of which surrounding the bulb contains a quantity of mercury secured by a ring of india-rubber cement. When the thermometer is made to turn over at any depth in water of any temperature, the record remains nearly unaltered, and, until set for a new observation, enables the actual temperature at the instant of reversal to be ascertained at any subsequent time and in any other place. The detached column standing in the tube changes its length slightly by change of temperature. A series of experiments with twelve instruments has shown that for 60° F. change of temperature there is a difference of one degree in the reading of the inverted thermometer. Hence a correction must be applied in all cases where the temperature at which the thermometer is read differs more than a few degrees from that at which it was inverted, contrary to the opinion of the German observers.[4] If a thermometer is inverted in water and read while wet, the temperature by which it should be corrected is obviously that given by the wet-bulb in air. In view of the great range of temperature experienced in deep-sea work in the tropics, the size of the little overflow cell B, which prevents mercury from the bulb from entering the tube must be considerably increased before the thermometer can be used with safety for such purposes. The Negretti and Zambra thermometer acquires the temperature of its surroundings very rapidly (two or three minutes are usually sufficient); it can be read easily to tenths of a degree Fahr.; and, above all, it ascertains temperature at exact points of depth, and has thus revealed layers of remarkably varying temperature[5] which could not have been detected by the other instruments in use.

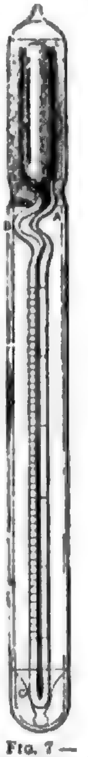

FIG. 7.—Negretti and Zambra's Deep-Sea Thermometer (inverted).

The loaded wooden frame originally employed for reversing the thermometer is unsatisfactory, and Magnaghi's reversing gear actuated by the revolution of a small propeller set in motion by the water when the thermometer is drawn up briskly, is not to be trusted in shallow water or where there are rapid currents. When the pin is withdrawn the thermometer case turns over and is clamped by a side-spring on the frame. Rung[6] adopted a simpler and better though somewhat clumsy frame, in which the thermometer was made to turn by slipping a weight down the line. The United States Fish Commission[7] employ the thermometer in a frame adapted for use on a wire sounding line, and also actuated by a messenger, but the thermometer is not clamped on turning over. The Scottish marine station produced[8] a modification of Magnaghi's frame, the propeller being replaced by a forked lever held down by a spiral spring and raised when the thermometer is to be reversed by the impact of a Rung's messenger (fig. 8). A messenger placed on the line below, and hung by a loop to the upper groove of the thermometer, is let go when the thermometer turns and reverses another instrument lower down. Instead of being lashed to the sounding line, the frame is retained by a ram's horn spiral below and clamped by a small vice at the upper end. Buchanan has modified and simplified the frame, combining its mode of attachment to the line with the American method of reversing.

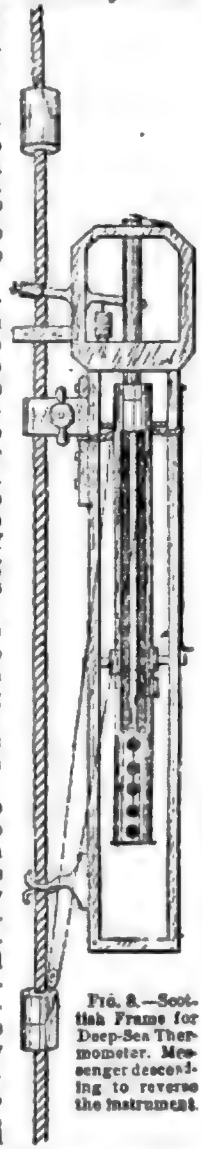

FIG. 8.—Scottish Frame for Deep-Sea Thermometer. Messenger descending to reverse the instrument.

Neumayer[9] has attempted to use a photographic thermograph for deep-sea work, the light being supplied by a Geissler tube excited by a small battery. Siemens's electrical thermometer has also been experimented with,[10] but has hardly been brought to a practicable state, and the same may be said for the use of thermoelectric junctions.

Hypsometer.—The boiling-point thermometer or hypsometer may be used to obtain an independent measure of the pressure of the atmosphere, and so to determine an altitude or verify an aneroid barometer. It consists of a very delicate mercury thermometer graduated only for 20 or 25 degrees Fahr. in the neighbourhood of the boiling point of water and divided on the stem into tenths. A large aneurism on the tube a little above the bulb should allow the freezing point to be verified from time to time on the portion of stem beneath it. The thermometer is hung in a cylindrical tin vessel in which water is boiled by a spirit lamp placed underneath. The bulb must be raised considerably above the level of the water, and the whole stem to the top of the mercury column immersed in the steam. After steam has been escaping freely for some time the temperature is read, and by reference to a table the barometric pressure, and consequently the altitude, is obtained.

Clinical Thermometers.—The first use to which thermometers were applied was the study of the temperature of the blood in fevers; and the constancy of the temperature of the healthy human body was for a century considered sufficient to entitle it to the position of a fixed point in graduating thermometers. The increased importance now attached to temperature in disease has led to the production of many forms of clinical thermometer. The large instruments intended to be read *in situ* are now entirely superseded by small maximum self-registering thermometers. Graduation is carried to one-fifth of a degree, and the usual range is about 25 degrees Fahr.—from 85° or 90° to 110° or 115°. Olive-shaped bulbs have been used, but a cylindrical form is most common. There should be an arrangement like that suggested for hypsometers to enable the freezing point to be verified. Casella's thermometer on Phillips's system has a small expansion on the stem, followed by a contraction, to prevent the index following the rest of the mercury into the bulb when the instrument is not in use. The "half-minute thermometer" is quick in action; it has a bulb of very small diameter and an extremely fine bore, the mercury thread being rendered visible by Hicks's arrangement of a lens-fronted stem. Immisch's avitreous thermometer is recommended for clinical use on account of its small size, convenient shape, and non-liability to get out of order.

Thermometers for Technical Purposes.—These are made in an infinite variety of forms, adapted to the various processes of manufacture and industry. The scale is often dispensed with in these instruments, a movable pointer being fixed at the point at which the mercury is to be kept. Air or steam thermometers (see PYROMETER) are rapidly superseding mercury instruments for all temperatures above the boiling point of water. The cheap German paper-scale thermometers are largely used, fitted in wooden cases, as dairy thermometers, and a larger size for brewing purposes. Alarm thermometers are often employed, in which electric contact is made and a bell rung when the temperature exceeds or falls short of a certain limit. Thermostats of various forms are made use of, in which a thermometer, by the position of the mercury in the stem, regulates the gas-supply of a burner and thus the heat of an enclosure.

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[1] "*Challenger*" *Narrative*, ii., App. I., 1882.

[2] For a general account of deep-sea thermometers, see Buchanan, *Proc. R. S. E.*, x. 1878, 77; and "*Chal.*" *Reports*, Narrative, vol. i., 1884, p. 84.

[3] *Ann. Chim. Phys.*, [3], 1845, xv. 1.

[4] *Ergebnisse der Untersuchungsfahrt der Drache*, Berlin, 1886, p. 2.

[5] Mill, *Jour. Scot. Met. Soc.* [3], 1886, No. 81, p. 189.

[6] *Den Tekniske Forenings Tidskrift*, 1883.

[7] *Report*, 1882.

[8] Mill, *Proc. R. S. E.*, xii., 1884, 928.

[9] *Nature*, viii. 195.

[10] "*Challenger*" *Reports* Narrative, 1884, i., p. 96

Metallic Thermometers.—Thermometers depending on change in length or form of composite metal bars, such as Crighton's zinc-iron bar and Bréguet's silver-gold-platinum spiral (see PYROMETER), are converted into registering instruments by the addition of two light pointers pushed forward by the index needle as it travels round the graduated arc to either side and left at their extreme points. Jürgensen in 1841 constructed a chronometer, the balance wheel of which was arranged so as to exaggerate the effects of change of temperature and thus to affect the rate. It furnished a very close approximation to the mean temperature between the intervals of rating, and was approved by Arago for use in observations. Hermann and Pfister's metallic thermometer[1] is probably the best adapted for meteorological purposes, and has given satisfactory results at the Zurich observatory. It is a flat spiral of brass and steel, which unrolls and coils up according to changes of temperature, moving an index on a divided horizontal circle and marking the maximum and minimum by light pointers. In order to secure regular results, the instrument must be annealed by heating for some time in boiling linseed oil.

Several instruments known popularly as metallic thermometers depend on a different principle, that of the change of form in a thin metallic enclosure containing liquid. Immisch's avitreous thermometer (fig. 9) is an example. A minute Bourdon's tube is fixed at one end, and the other bears on the short arm of a lever, the long arm of which acts by a rack on the pinion forming the axis of the pointer. It is only one inch in diameter and extremely accurate.

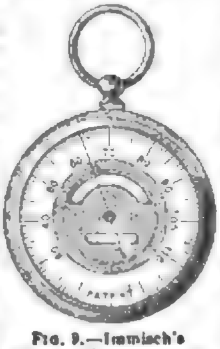

FIG. 9.—Immisch's Avitreous Thermometer.

Thermographs.—The first form of thermograph, due to Wheatstone, was an electrical apparatus. It has recently been improved by Van Rysselberghe, in whose hands it has assumed the following form. The thermometer is of rather wide bore and open above. At intervals of quarter of an hour a wire is moved gradually down the tube by a clock until it touches the mercury; an electric circuit is thus completed, and causes an indentation by a diamond point which moves in the same way as the wire down a rotating cylinder covered with thin sheet copper or zinc. The metal sheet is renewed at each revolution of the cylinder, and it is sufficient to join the indented points with a graver to have a plate from which any number of copies of the record may be printed. Cripp's thermograph records hourly on a revolving cylinder. It consists essentially of a mercury thermometer coiled into a flat spiral and suspended on a horizontal axis. Any change of temperature displaces the centre of gravity of the system, and the instrument rotates through an arc, moving a pencil as it does so. A perfectly continuous record is produced by the photographic thermograph. Wet and dry bulb thermometers are so arranged that a beam of light passes through an air-speck, which separates part of the mercury thread, or through the vacant part of the tube, and falls on a rotating cylinder covered with photographic paper on which it traces the curve of temperature fluctuation. This apparatus is probably the most perfect of its kind. In Bowkett's thermograph the change of form of a curved tube containing oil moves a pencil radially over a card turned horizontally by a clock. The resulting curve is referable to polar instead of rectangular coordinates; the radius measures temperature, the angle time. Richard's thermograph is also actuated by means of a sealed metallic capsule containing fluid. It draws a continuous curve in ink on a revolving drum on which one sheet lasts for seven days. This instrument is largely employed in observatories to check eye-observations, and is peculiarly adapted for use in positions to which access can only be had occasionally. It is made in many forms, one of which is specially adapted for marine work, the sealed capsule being rolled into the form of a cylinder and exposed to the water on both surfaces. (H. R. M.)

THÉROIGNE DE MÉRICOURT, ANNE JOSEPH (1762-1817), was born at Marcourt (from a corruption of which name she took her usual designation), a small town in Luxembourg, on the banks of the Ourthe, on 13th August 1762. She was the daughter of a well-to-do farmer, Peter Théroigne. She appears to have been well educated, having been brought up in the convent of Robermont; she was quick-witted, strikingly handsome in appearance, and intensely passionate in temper; and she had a strong and almost volcanic power of eloquence, which she used with great effect upon the mobs of Paris during that short space of her life (1789-93) which alone is of historical interest. The story of her having been betrayed by a young *seigneur*, and having in consequence devoted her life to avenge her wrongs upon aristocrats, a story which is told by Lamartine and others, is unfounded, the truth being that she left her home on account of a quarrel with her stepmother. She went to Paris, and, on the outbreak of the Revolution, she was surrounded by a coterie of well-known men, chief of whom were Pétion and Desmoulins. She belonged to their party to the last,—became in fact the "Fury of the Gironde." On 14th July 1789 she came prominently into notice at the fall of the Bastille, and for about four years thereafter she was seen in many of the stormiest scenes of the Revolution, being known as "la belle Liégoise," and singularly attired in a riding habit, a plume in her hat, pistols in her belt, and a sword dangling by her side. Early in October she took a leading part in the march to Versailles, and the return journey with the king and queen to the capital. No horror appalled her, and the violence of her language and her power with the mob were no less remarkable than the influence which she was able, by combining cajolery, threats, and money, successfully to exert on the royalist soldiers, so winning them over to the Revolution. Being justly accused of dangerous conduct, her arrest was ordered in the following year (1790), and she left Paris for Marcourt, whence after a short stay she proceeded to Liége, in which town she was seized by warrant of the Austrian Government, and conveyed first to Tyrol and thereafter to Vienna, accused of having been engaged in a plot against the life of the queen of France. After an interview, however, with Leopold II., she was released; and she returned to Paris, crowned of course with fresh laurels because of her captivity, and resumed her influence. In the clubs of Paris her voice was often heard, and even in the National Assembly she would violently interrupt the expression of any moderatist views. She commanded in person the 3d corps of the so-called army of the faubourgs on 20th June 1792, and again won the gratitude of the people. She shares a heavy responsibility for her connexion with the riots of the 10th of August. A certain contributor to Desmoulins's journal, the *Acts of the Apostles*, Suleau by name, earned her savage hatred by associating her name, for the sake of the play upon the word, with a deputy named Populus, whom she had never seen. On the 10th of August, just after she had watched approvingly the massacre of certain of the national guard in the Place Vendôme, Suleau was pointed out to her. She sprang at him, dragged him among the infuriated mob, and he was stabbed to death in an instant. But the time came when her party was in peril at the hands of one more extreme, and she now wildly urged the mob to more moderate courses. Then the furies of the "Mountain" seized the fury of the Gironde, and they stripped her naked, and flogged her in the public garden of the Tuileries. The infamous affront drove her mad. She was removed to a private house, thence in 1800 to La Salpetrière for a month, and thence to a place of confinement called the Petites Maisons, where she remained—a raving maniac—till 1807. She was then again removed to La Salpetrière, where she died, never having recovered her reason, on 9th June 1817.

THESEUS, the great hero of Attic legend,[2] son of

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[1] *Repert. für Meteorologie*, i. pt. i. p. 7.

[2] All the passages in the *Iliad* and *Odyssey* in which his name or allusions to his legend occur are regarded with more or less probability as spurious.

Ægeus, king of Athens, and Æthra, daughter of Pittheus, king of Trœzen. Thus through his father he was descended from Erechtheus and the autochthones of Attica; through his mother he came of the Asiatic house of Pelops. Ægeus, being childless, went to Delphi to consult the god, who gave him an ambiguous answer. He went to Trœzen, and told the oracle to Pittheus, who, seeing its bearing, contrived that Ægeus should have intercourse with his daughter Æthra. Ægeus then departed to Athens, and in due time Æthra, who remained at Trœzen, brought forth Theseus. It was given out that the child's father was Poseidon, the great god of Trœzen, and in after ages the Trœzenians pointed to the Holy Isle as the place where Poseidon and Æthra met, and where Æthra raised a temple to Athene Apaturia, at which Trœzenian maids dedicated their girdles before marriage. For his tutor and guardian young Theseus had one Cannidas, to whom, down to Plutarch's time, the Athenians were wont to sacrifice a black ram on the eve of the festival of Theseus. On passing out of boyhood, Theseus, in accordance with custom, went to Delphi, and there cut off his front hair. Ægeus had deposited his sword and boots under a heavy rock, telling Æthra that, if she gave birth to a son who, on attaining manhood, should be able to lift the rock and remove the sword and boots, she was to send him with all secrecy to his father at Athens. Theseus now lifted the rock, removed the sword and boots, and set out for Athens. He encountered many adventures on the way. First he met Periphetes, surnamed Corynetes (Clubman). Him Theseus slew, and carried off his club. At the isthmus of Corinth dwelt Sinis, called the Pine-Bender, because he killed his victims by fastening them to the top of a pine-tree (or two pine-trees), which he had bent down and then suffered to fly up. Theseus hoisted the Pine-Bender on his own pine-tree. Now, the deceased Pine-Bender had a pretty daughter, who ran and hid herself in a thicket where asparagus grew plentifully; and, when Theseus came to look for her, she prayed to the asparagus, and promised that if it would hide her she would never injure asparagus any more. Theseus wiled her from the thicket, and from their union sprang the family of the Ioxids, who worshipped asparagus. Next Theseus despatched the Crommyonian sow (or boar), a dreadful monster. Then he flung over the cliff the wicked Sciron, who, while his guests were perforce washing his feet, used to kick them over into the sea. In Eleusis Theseus wrestled with and killed Cercyon. A little farther on he slew Procrustes, who had only one bed for all comers: if his guest was too short for the bed, he stretched him out; if he was too long, he cut him down to the requisite length. At the Cephissus Theseus was met by the Phytalid family, who purified him from the taint of bloodshed. As he passed through the streets of Athens, his curls and long garment reaching to his ankles drew on him the derision of some masons, who were putting on the roof of the new temple of Apollo Delphinius: "Why," they asked, "was such a pretty girl out alone?" In reply Theseus took the bullocks out of their cart and flung them higher than the roof of the temple. He found his father married to Medea, who had fled from Corinth. Being a witch, she knew Theseus before his father did, and tried to persuade Ægeus to poison his son; but Ægeus at last recognized him by his sword, and took him to his arms. Theseus was now declared heir to the throne, and the Pallantids, who had hoped to succeed to the childless king, conspired against Theseus, but he crushed the conspiracy. He then attacked the flame-spitting bull of Marathon and brought it alive to Athens, where he sacrificed it to Apollo Delphinius. Now comes the adventure of the Cretan Minotaur (see MINOS), whom Theseus slew by the aid of **ARIADNE** (*q.v.*). While Theseus was in Crete, Minos, wishing to see whether Theseus was really the son of Poseidon, flung his ring into the sea. Theseus dived and brought it up, together with a golden crown, the gift of Amphitrite. On the return voyage the ship touched at Naxos, and there Theseus abandoned Ariadne. He landed also at Delos, and there he and the youths danced the crane dance, the complicated movements of which were meant to imitate the windings of the Labyrinth.[1] In historical times this dance was still danced by the Delians round the horned altar—an altar entirely composed of left-sided horns. Theseus had promised Ægeus that, if he returned successful, the black sail with which the fatal ship always put to sea[2] should be exchanged for a white one. But he forgot his promise; and, when from the Acropolis at Athens Ægeus descried the black sail out at sea, he flung himself from the rock, and died. Hence at the festival which commemorated the return of Theseus there was always weeping and lamentation. Theseus now carried out a political revolution in Attica by abolishing the semi-independent powers of the separate townships and concentrating those powers at Athens, and he instituted the festival of the Panathenæa,[3] as a symbol of the unity of the Attic race. Further, according to a democratic tradition, he abolished the monarchy, and substituted in its place a popular government; but, to obviate the evils of a pure democracy, he instituted the three classes or castes of the eupatrids (nobles), geomori (husbandmen), and demiurgi (artisans). He also minted coins bearing the figure of an ox. He extended the territory of Attica as far as the isthmus of Corinth.

He was the first to celebrate in their full pomp the Isthmian games in honour of Poseidon; for the games previously instituted by Hercules in honour of Melicertes had been celebrated by night, and had partaken of the nature of mysteries rather than of a festival. Of Theseus's adventures with the Amazons there were different accounts. According to some, he sailed with Hercules to the Euxine, and there won the Amazon Antiope as the meed of valour; others said that he sailed on his own account, and captured Antiope by stratagem. Thereafter the Amazons attacked Athens. Antiope fell fighting on the side of Theseus, and her tomb was pointed out on the south side of the acropolis. By Antiope Theseus had a son, Hippolytus. On the death of Antiope, Theseus married Phædra. She fell in love with her stepson Hippolytus, who, resisting her advances, was accused by her to Theseus of having attempted her virtue. Theseus in a rage imprecated on his son the wrath of Poseidon. His prayer was answered: as Hippolytus was driving beside the sea, a bull issuing from the waves terrified his horses, and he was thrown and killed. This tragic story is the subject of one of the extant plays of Euripides.

The famous friendship between Theseus and Pirithous, king of the Lapiths, originated thus. Hearing of the strength and courage of Theseus, Pirithous desired to put them to the test. Accordingly he drove away from Marathon some cows which belonged to Theseus. The latter pursued, but, when he came up with the robber, the two heroes were so filled with admiration of each other that they swore brotherhood. At the marriage of Pirithous to Hippodamia (or Deidamia) a fight broke out between the Lapiths and Centaurs, in which the Lapiths, assisted by Theseus, were victorious, and drove the Centaurs out of the country. Theseus and Pirithous now carried off Helen from Sparta, and when they drew lots for her she fell to the lot of Theseus, who took her to Aphidnæ, and left her in charge of his mother Æthra and his friend Aphidnus. He now descended to the lower world with Pirithous, to help his friend to carry off Proserpine. But the two were caught, and confined in Hades till Hercules came and released Theseus. Meantime Castor and Pollux had captured Aphidnæ, and carried off their sister Helen and Æthra. When Theseus returned to Athens, he found that a sedition had been stirred up by Menestheus, a descendant of Erechtheus, one of the old kings of Athens. Failing to quell the outbreak, Theseus in despair sent his children to Eubœa, and, after solemnly cursing the Athenians, sailed away to the island of Scyrus, where he had ancestral estates. But Lycomedes, king of Scyrus, took him up to a high place, and cast him into the sea, that he died. Others said that he fell of himself over the cliff as he was taking his evening walk. Menestheus reigned at Athens, but, when he died before Troy, the sons of Theseus recovered the kingdom. Long afterwards, at the battle of Marathon (490 B.C.), many of the Athenians thought they saw the phantom of Theseus, in full armour, charging at their head against the Persians. When the Persian war was over, the Delphic oracle bade the Athenians fetch the bones of Theseus from Scyrus, and lay them in Attic earth. It fell to Cimon's lot in 469 B.C. to discover the hero's grave at Scyrus, and bring back his bones to Athens. They were deposited in the heart of Athens, and henceforth escaped slaves and all persons in peril sought and found sanctuary at the grave of him who in his life had been a champion of the oppressed. His chief festival was on the 8th of the month Pyanepsion (October 21st), but the 8th day of every month was also sacred to him.

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[1] The Ostiaks of Siberia have an elaborate crane dance, in which the dancers are dressed up with skins and the heads of cranes (Pallas, *Reise durch verschiedene Provinzen des russischen Reichs*, iii. 65).

[2] So, too, the ship that sailed annually from Thessaly to Troy with offerings to the shade of Achilles put to sea with sable sails (Philostratus, *Heroica*, xx. 25). The ship that was to bring Iseult to the mortally wounded Tristram was to hoist a white sail if she was on board, a black sail if she was not. The black sails recur in the modern Greek version of the tale of Theseus. Compare *Asiatick Researches*, ix. 97.

[3] Besides the Panathenæa, Theseus is said to have instituted the festival of the *Synoikia* or *Metoikia*. Wachsmuth ingeniously supposes that the latter festival commemorated the local union in a single city of the separate settlements on the Acropolis and its immediate neighbourhood, while the Panathenæa commemorated the political union of the whole of Attica (C. Wachsmuth, *Die Stadt Athen im Alterthum*, p. 453 *sq.*).

Whatever we may think of the historical reality of Theseus, his legend seems to contain recollections of historical events, *e.g.*, the *συνοικισμός*, whether by this we understand the political centralization of Attica at Athens or a local union of previously separate settlements on the site of Athens. The birth of Theseus at Trœzen points to the immigration of an Ionian family or tribe from the south. With this agrees the legend of the contest between Athene and Poseidon for supremacy on the acropolis of Athens, for Theseus is intimately connected with Poseidon, the great Ionian god. Ægeus, the father of Theseus, has been identified by some modern scholars with Poseidon.

The Athenian festival in October, popularly supposed to commemorate the return of Theseus from Crete, is interesting, as some of its features are identical with those of harvest-festivals still observed in the north of Europe. Thus the *eiresione*, a branch of olive wreathed with wool and decked with fruits, bread, &c., which was carried in procession and hung over the door of the house, where it was kept for a year, is the *Erntemai* (Harvest-may) of Germany.[1]

The well-preserved Doric temple to the north of the acropolis at Athens, commonly known as the Theseum, was long supposed to be the sanctuary in which the bones of Theseus reposed. But archæologists are now much divided on this question. It is agreed, however, that the temple is of the 5th century B.C., and that the date of its construction cannot differ widely from that of the Parthenon.[2] There were several (according to Philochorus, four) temples or shrines of Theseus at Athens. Milchhöfer thinks he has found one of them in the neighbourhood of Piræus.[3]

Our chief authority for the legend of Theseus is the life by Plutarch, which is a compilation from earlier writers. G Gilbert, who has investigated the sources from which Plutarch drew for his life of Theseus, believes that his chief authority was the *Atthis* of Ister, and that Ister mainly followed Philochorus. See *Philologus*, xxxiii., 1874, p. 46 *sq*

There is a modern Greek folk-tale which preserves some features of the legend of Theseus and the Minotaur, but for the Minotaur has been substituted a seven-headed snake. See Bernard Schmidt, *Griechische Märchen, Sagen, und Volkslieder*, p. 118 *sq.* (J. G. FR.)

THESMOPHORIA, an ancient Greek festival, celebrated by women only in honour of Demeter Θεσμοφόρος. At Athens, Abdera, and perhaps Sparta, it lasted three days. At Athens the festival took place on the 11th, 12th, and 13th of the month Pyanepsion (24th, 25th, and 26th October), the first day being called Anodos (ascent), or, according to others, Kathodos (descent), the second Nesteia (fast), and the third Kalligeneia (fair-born).[4] If to these days we add the Thesmophoria, which were celebrated on the 10th at Halimus, a township on the coast near Athens, the festival lasted four days.[5] If further we add the festival of the Stenia, which took place on the 9th, the whole festival lasted five days.[6] The Stenia are said by Photius to have celebrated the return of Demeter from the lower world (Anodos), and the women railed at each other by night.[7] The Thesmophoria at Halimus seem to have included dances on the beach.[8] The great feature of the next day (the Anodos) is generally assumed to have been a procession from Halimus to Athens, but this assumption seems to rest entirely on an interpretation of the name Anodos, and it loses all probability when we observe that the day was by others called Kathodos.[9] Probably both names referred to the descent of Demeter or Proserpine to the nether world, and her ascent from it.[10] The next day, Nesteia, was a day of sorrow, the women sitting on the ground and fasting.[11] As to what took place on the Kalligeneia we have no information. Nor can we define the time or nature of the secret ceremony called the "pursuit," or the "Chalcidian pursuit," and the sacrifice called the "penalty."[12]

During the Thesmophoria (and for nine days previously, if Ovid, *Met.*, x. 434, is right, and refers to the Thesmophoria) the women abstained from intercourse with their husbands, and to fortify themselves strewed their beds with *Agnus castus* and other plants. The women of Miletus strewed their beds with pine branches, and put fir-cones in the sanctuaries of Demeter.[1] Whether unmarried women were admitted to the festival seems doubtful; in Lucian's time it would appear that they were.[2] The women of each deme (township) elected two married women of their number to preside over them at the festival; and every married man in the township who possessed property to the value of three talents had to provide a feast for the women on behalf of his wife.[3] During the festival the women seem to have been lodged by twos in tents or huts, probably erected within the sacred precincts of the Thesmophorium.[4] They were not allowed to eat the seeds of the pomegranate or to wear garlands of flowers.[5] Prisoners were released at the festival,[6] and during the Nesteia the law-courts were closed and the senate did not meet.[7] Aristophanes's play on the festival sheds little light on the mode of its celebration.

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[1] See W. Mannhardt, *Antike Wald- und Feld-Kulte*, p. 212 *sq.*

[2] For the literature on the subject, see Milchhöfer, in Baumeister's *Denkmäler des classischen Alterthums*, i. p. 170.

[3] See *Erläuternder Text* to the *Karten von Attika* (Berlin, 1881), i. p. 37 *sq.*

[4] Schol. on Aristoph., *Thesmophoriazusæ*, 80 and 585; Diog. Laer., ix. 43; Hesychius, s.v. *τριήμερος* (the reading here is uncertain) and *ἄνοδος*; Alciphron, iii. 39; Athenæus, 307*f*. Plutarch (*Vit. Demosth.*, 30) states that the Nesteia took place on the 16th of Pyanepsion, but in this he stands alone.

[5] Schol. on Aristoph., *Thesm.*, 80; Photius, *Lex.*, s.v. Θεσμοφορίων ἡμέραι δ′ (where Naber should not have altered the MS. reading δ′ into ιδ′); Hesychius, s.v. *τρίτη Θεσμοφορίων*.

[6] Schol. on Aristoph., *Thesm.*, 834.

[7] Photius, *Lex.*, s.v. *στήνια*; *cf.* Apollodorus, i. 5, 1.

[8] Plut., *Solon*, 8; for this passage probably refers to the Thesmophoria, the Cape Colias mentioned being near Halimus (see *Erläuternder Text* to the *Karten von Attika*, ii. 1 *sq.*). The Thesmophorium at Halimus is mentioned by Pausanias (i. 31, 1).

[9] Hesychius (s.v. *ἄνοδος*) and the Schol. on Arist., *Thesm.*, 585, suppose that the day was so called because the women ascended to the Thesmophorium, which (according to the scholiast) stood on a height. But no ancient writer mentions a procession from Halimus. For the name *Kathodos*, see Schol., *loc. cit.*; Photius, *Lex.*, s.v. Θεσμοφορίων ἡμέραι δ′. For the statement that at one part of the festival (commonly assumed, by the writers who accept the statement, to be the Anodos) the women carried on their heads the "books of the law," we have only the authority of the scholiast on Theocritus, iv. 25, who displays his ignorance by describing the women as virgins (see below), and saying that they went in procession to Eleusis. The statement may therefore be dismissed as an etymological fiction. Aristophanes, *Eccles.*, 222, is no evidence for the book-carrying.

[10] The Bœotian festival of Demeter, which was held at about the same time as the Athenian Thesmophoria, and at which the *megara* (see below) were opened, is distinctly stated by Plutarch (*De Is. et Osir.*, 69) to have been a mourning for the descent (Kathodos) of Proserpine.

[11] Plut., *Dem.*, 30; Id., *De Is. et Osir.*, 69.

[12] Hesychius, s.v. *δίωγμα*; Suidas, s.v. *χαλκιδικὸν δίωγμα*; Hesychius, s.v. *ζημία*. For flight and pursuit as parts of religious ceremonies, *cf.* Plutarch, *Quæst. Græc.*, 38; Id., *Quæst. Rom.*, 68; Id., *De Def. Orac.*, 15; Ælian, *Nat. An.*, xii. 34; Pausanias, i. 24, 4; Id., viii. 53, 3; Diodorus, i. 91; Lobeck, *Aglaophamus*, p. 676; Marquardt, *Staatsverwaltung*, 2d ed., iii. 328.

At Thebes Thesmophoria were celebrated in summer on the acropolis (Cadmeia); at Eretria during the Thesmophoria the women cooked their meat, not at fires, but by the heat of the sun, and they did not invoke Kalligeneia (which seems to mean that they did not celebrate the last day of the festival); at Syracuse, during the festival, cakes called *mylloi*, made of sesame and honey in the shape of *pudenda muliebria*, were handed round.[8] Agrigentum, Ephesus, and Dryme, in Phocis, had also their Thesmophoria.[9]

The above was nearly all that was known about the Thesmophoria down to 1870. In that year E. Rohde published in the *Rheinisches Museum* (N. F. 25, p. 548 *sq.*) a scholion on Lucian (*Dial. Meretr.*, ii. 1), which he discovered in the Vatican MS. Palatinus 73, and which furnishes some curious details about the Thesmophoria. It also explains two obscure and corrupt passages of Clemens Alexandrinus and Pausanias, the true meaning of which had been divined by Lobeck (*Aglaophamus*, p. 828 *sq.*). The substance of the scholion is this. When Proserpine was carried off by Pluto, a swineherd called Eubuleus was herding his swine at the spot, and his herd was engulfed in the chasm down which Pluto had vanished with Proserpine. Accordingly at the Thesmophoria it was customary, in memory of Eubuleus, to fling pigs into the "chasms of Demeter and Proserpine." (These "chasms" may have been natural caverns or perhaps vaults. The scholiast speaks of them also as *adyta* and *megara*.[10]) In these chasms or adyta there were supposed to be serpents, which guarded the adyta and consumed most of the flesh of the pigs that were thrown in. The decayed remains of the flesh were afterwards fetched by women called "drawers" (*antletriai*), who, after observing rules of ceremonial purity for three days, descended into the caverns, and, frightening away the serpents by clapping their hands, brought up the remains and placed them on the altars.[11] Whoever got a portion of this decayed flesh and sowed it with the seed in the ground was supposed thereby to secure a good crop.[12] The rest of the scholion is obscure, and perhaps corrupt, but the following seems to be the sense. The ceremony above described was called the arretophoria, and was supposed to exercise the same quickening and fertilizing influence on men as on fields. Further, along with the pigs, sacred cakes made of dough, in the shape of serpents and of phalli, were cast into the caverns, to symbolize the productivity of the earth and of man. Branches of pines were thrown in[13] for a similar reason.

The custom described in this important scholion is clearly the same as that referred to by Clemens Alexandrinus (*Protrep.*, § 17) and Pausanias (ix. 8, 1). From the latter we learn that the pigs were sucking pigs, and from the former (if we adopt Lobeck's emendation *μεγάροις ζῶντας* for *μεγαρίζοντες*) that they were thrown in alive. From Pausanias we may further perhaps infer (though the passage is corrupt) that the remains of the pigs thrown down in one year were not fetched up till the same time next year (cp. Paus., x. 32, 14). The question remains, At what point of the Thesmophoria did the ceremony described by the scholiast on Lucian take place? Rohde thinks that it formed part of the ceremonies at Halimus, his chief ground being that Clemens (*Protrep.*, 34) and Arnobius (v. 28) mention phalli in connexion with the "mysteries at Halimus"; but it is not certain that these mysteries were the Thesmophoria. The legend of Eubuleus seems to show that the ceremony commemorated the descent of Proserpine to the nether world; and, if we are right in our interpretation of the name Kathodos as applied to the first day of the Thesmophoria proper, the ceremony described would naturally fall on that day. Further, if our interpretation of Pausanias is correct, the same day must have witnessed the descent of the living pigs and the ascent of the rotten pork of the previous year. Hence the day might be indifferently styled Kathodos or Anodos ("descent" or "ascent"); and so in fact it was.

It is usual to interpret Thesmophorus "lawgiver" and Thesmophoria "the feast of the lawgiver." But the Greek for "lawgiver" is not Thesmophorus but Thesmothetes (or Nomothetes, when *nomos* displaced *thesmos* in the sense of "law"). If we compare such names of festivals as Oschophoria, Lampadephoria, Hydrophoria, Scirophoria ("the carryings of grapes, of torches, of water, of umbrellas") with the corresponding Oschophorus, Lampadephorus, Hydrophorus, also Thallophorus and Kanephorus, we can scarcely help concluding that Thesmophoria must originally have meant in the literal and physical sense the carrying of the *thesmoi*, and Thesmophorus the person who so carried them; and, in view of the ceremony disclosed by the scholiast on Lucian (compared with the analogous ceremony observed by the Arrephoroi at Athens), we are strongly tempted to suppose that the women whom he calls Antletriai may have been also known, at one time or other, as Thesmophoroi, and that the *thesmoi* were the sacra which they carried and deposited on the altar. The word would then be used in its literal sense, "that which is set down." How the name Thesmophorus should have been transferred to the goddess from her ministers is of course a difficulty, which is hardly disposed of by pointing to the epithets Amallophorus ("sheaf-bearing") and Melophorus ("apple-bearing"), which were applied to men as well as to the goddess.

As to the origin of the Thesmophoria, Herodotus (ii. 171) asserts that they were introduced into Greece from Egypt by the daughters of Danaus; while, according to Plutarch (*Fragments*, p. 55, ed. Dübner), the feast was introduced into Athens by Orpheus the Odrysian. From these statements we can only infer the similarity of the Thesmophoria to the Orphic rites and to the Egyptian representation of the sufferings of Osiris, in connexion with which Plutarch mentions them. The Thesmophoria would thus form one of that class of rites, widely spread in Western Asia and in Europe, in which the main feature appears to be a lamentation for the annual decay of vegetation or a rejoicing at its revival. This seems to have been the root, *e.g.*, of the lamentations for Adonis and Attis. See W. Mannhardt, *Antike Wald- und Feld-Kulte*, p. 264 *sq.*

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[1] Ælian, *Nat. An.*, ix. 26; Schol. on *Theocr.*, iv. 25; Hesychius, s.v. *κνέωρον*; Pliny, *N. H.*, 24, 59; Dioscorides, i. 135 (134, ed. Sprengel); Schol. on Nicander, *Ther.*, 70 *sq.*; Galen, xi. 808, ed. Kühn; Steph. Byz., s.v. Μίλητος.

[2] Lucian, *Dial. Meretr.*, ii. 1. On the other hand, we read in Strabo (i. 3, 20) of virgins at Alponus ascending a tower as spectators (*κατὰ θέαν*) of the Thesmophoria, which would seem to imply that they did not participate in it.

[3] Isæus, *De Cironis Hered.*, 19; Id., *De Pyrrhi Hered.*, 80.

[4] Aristoph., *Thesm.*, 624, 658, with the Schol. *ad ll.* As to the custom of camping out at festivals, Plutarch (*Quæst. Conviv.*, iv. 6, 2) compares the Jewish Feast of Tabernacles with the Greek Dionysia; from which we may perhaps infer that the worshippers camped out at the Dionysia. Cp. Gumilla, *Histoire de l'Orenoque*, i. p. 256 *sq.*

[5] Clem. Alex., *Protrep.*, 19.; Schol. on Sophocles, *Œd. Col.*, 681.

[6] Marcellinus on Hermogenes, in *Rhetores Græci*, ed. Walz, iv. 462; Sopater, *ibid.*, viii. 67.

[7] Aristoph., *Thesm.*, 80. The word *τρίτη* seems to mean the Nesteia, as the Schol. *ad l.* takes it. That the "middle day" was the Nesteia we know from Athenæus, 307*f*.

[8] Xenophon, *Hellen.*, v. 2, 29; Plutarch, *Quæst. Gr.*, 31; Athenæus, 647*a*.

[9] Polyænus, v. 1, 1; Herodotus, vi. 16; Pausanias, x. 33, 12.

[10] Mr C. T. Newton discovered in the sanctuary of Demeter and the Infernal Deities at Cnidus a chamber which may have been one of the *megara* referred to by the scholiast. It contained bones of pigs and marble figures of pigs. The chamber was not, however, originally subterranean. See Newton's *Discoveries at Halicarnassus, &c.*, ii. p. 383 *sq.*; Id., *Travels and Discoveries in the Levant*, ii. p. 180 *sq.* According to Porphyry (*De Antro Nympharum*, 6) the Infernal Deities had *megara*, as the Olympian had temples, and the sacrificial pits of the former corresponded to the altars of the latter.

[11] Compare the functions of the two Arrephoroi at Athens (Paus., i, 27, 3). For serpents in connexion with Demeter, compare Strabo, ix. 1, 9.

[12] This, as Mr Andrew Lang has pointed out, resembles the Khond custom of burying the flesh of the human victim in the fields to fertilize them. The human victim was with the Khonds, like the pig with the Greeks, a sacrifice to the Earth goddess. See W. Macpherson, *Memorials of Service in India*, p. 129.

[13] Reading *ἐμβάλλουσι*, with Rohde, for *λαμβάνουσι*. Compare the custom of Miletus *supra*. The pine-tree played an important part in the worship of Cybele. Cp. Marquardt, *Staatsverwaltung*, iii. 371.

On the Thesmophoria, see Meursius, *Græcia Feriata*, p. 151 sq.; L. Preller, *Demeter und Persephone*, p. 335 sq.; Id., *Griech. Myth.*, (3), i. 639 sq.; Fritzsche's ed. of the *Thesmophoriazusæ*, p. 577 sq.; Aug. Mommsen, *Heortologie*, p. 287 sq.; *Rheinisches Museum*, xxv. (1870), p. 548; *Gazette Archéologique*, 1880, p. 17; Mr Andrew Lang, in *Nineteenth Century*, April 1887. (J. G. FR.)

THESPIÆ, an ancient Greek city of Bœotia. It stood on level ground commanded by the low range of hills which runs eastward from the foot of Mount Helicon to Thebes. In the Persian invasion the Thespian contingent of 700 men voluntarily stayed with the Spartans at Thermopylæ, and shared their fate. For its resistance to the Persians, the city was burned by Xerxes (480 B.C.). Nevertheless, in the next year 1800 Thespians shared in the great victory of Platæa. At the battle of Delium (424) the flower of the Thespians fell fighting against Athens on the side of Thebes, and in the following year the jealous Thebans availed themselves of the weakness of their gallant confederate to pull down the walls of Thespiæ. The walls were restored by the Spartans under Agesilaus in 378, but were again destroyed by the Thebans, apparently before the battle of Leuctra (371).[1] After the battle the Thespians, who had taken no part in it, withdrew to a strong place, Ceressus, from which, however, they were expelled by the Thebans. In 343 the city was not yet restored; but it must have been subsequently, for it is mentioned in the Roman wars.

In the 2d century Pausanias mentions that Thespiæ contained a theatre, a market-place (*agora*), and sanctuaries of Aphrodite, the Muses, and Hercules. Love (Eros) was the deity most venerated by the Thespians; they possessed a very ancient image of him in the shape of an unhewn block of stone. The marble statue of Love by Praxiteles was the great sight at Thespiæ, and drew crowds to the place. It was carried off to Rome by Caligula, restored by Claudius, and again carried off by Nero. There was also a bronze statue of Love by Lysippus. From an inscription we learn that one of the deities worshipped was Demeter Achea, the "Mater Dolorosa." The Thespians also worshipped the Muses, and celebrated a festival in their honour in the sacred grove on Mount Helicon. Remains of what was probably the ancient citadel are still to be seen, consisting of an oblong or oval line of fortification, solidly and regularly built. The adjacent ground to the east and south is covered with foundations, bearing witness to the extent of the ancient city. The neighbouring village Eremokastro, on higher ground, was thought by Ulrichs to be probably the site of the ancient Ceressus. In 1882 there were discovered, about 1200 yards east of Eremokastro, on the road to Arkopodi (Leuctra), the remains of a *polyandrion*, including a colossal stone lion. The tomb dates from the 5th century B.C., and is probably that of the Thespians who fell at Platæa, for those who fell at Thermopylæ were buried on the field.

See Leake, *Travels in Northern Greece*, ii. 479 sq.; Dodwell, *Tour through Greece*, i. 253; Bursian, *Geogr. von Griechenland*, i. 237 sq.; Ulrichs, *Reisen u. Forschungen in Griechenland*, ii. 84 sq.; *Mittheil. d. deutsch. archäol. Inst. in Athen*, 1879, pp. 190 sq., 273 sq.; Πρακτικὰ τῆς ἐν Ἀθήναις ἀρχαιολογικῆς ἑταιρίας, 1882, pp. 65–74.

THESSALONIANS, EPISTLES TO THE. Thessalonica, now SALONICA (*q.v.*), was in the time of the Romans the most important town of Macedonia. In consequence of its advantageous situation, on a good harbour and on the Via Egnatia, the great trade road which connected the Adriatic with the Hellespont, the town had surpassed the old capital Pella, and had indeed become one of the chief commercial centres of the ancient world. Since the Roman conquest the seat of the Roman provincial government had been here. Here, as in Corinth, the conditions were favourable for the reception of Christianity. The population was not purely Greek, but cosmopolitan, a mixture of divers nationalities. Such a population is always more susceptible to religious novelties for good and for evil than one of old, firmly established national growth. The apostle Paul experienced this to his great joy and satisfaction here also, as he for the first time set foot on the shores of Europe with the message of Jesus Christ. It was about the year 52 or 53 that he, on his arrival from Philippi, preached the gospel of Christ in the rich merchant city. As in other places, he began with the Jews. There was a Jewish congregation at Thessalonica, as at all the great ports and trading centres of the Mediterranean, with their own synagogue and regular service. For three Sabbaths Paul stood up in the synagogue, proving by the Scriptures that Jesus was the promised and expected Messiah (Acts xvii. 1–3). He had not much success with the Jews, but this was more than compensated by the number of "devout Greeks" (*i.e.*, Gentiles who already had some connexion with Judaism) whom he won to a belief in Christ. He found hearing especially with the chief women (Acts xviii. 4). But Paul had also converted a not smaller number of real heathens. Indeed, they must have constituted the majority of the Christian church there formed, for in his first epistle he says quite generally that his readers, in consequence of his preaching, had turned from idols to the one true God (1 Thess. i. 9).

Paul's stay in Thessalonica was short. The plots of the Jews soon obliged him to leave the town, and he betook himself to Berœa (Acts xvii. 10), thence to Athens (Acts xvii. 15), and finally to Corinth (Acts xviii. 1). The two epistles were written to the church of Thessalonica during a stay of a year and a half in Corinth (Acts xviii. 11), about 53–54, not before this in Athens, as is asserted in the subscription of both epistles in the Codex Alexandrinus and other MSS. For when Paul wrote the first epistle some time had elapsed since the formation of the church: some members were already dead (1 Thess. iv. 13), and Paul had worked for some time, not only in Macedonia, but also in Achaia (i. 7, 8). On the other hand, the church appears to be comparatively young; the conversions are still spoken of everywhere in Macedonia and Achaia (i. 9). All this points to the conclusion that the first epistle was written in Corinth, and this is confirmed by the opening salutation (i. 1), in which Silvanus (Silas) and Timotheus are named as joint authors, for they were in Corinth with Paul (Acts xviii. 5).

The first epistle gives us a very clear picture of the disposition and state of such a young church, composed of former heathens. They had received with enthusiasm the gospel of Jesus Christ, the Bringer of salvation, the Saviour in the approaching day of judgment (i. 9, 10). But the realization of this salvation is now awaited with impatience, and a sense of disappointment is experienced because some members of the church have died without having seen the advent of the Lord (iv. 13). At the same time many there are still living in gross heathen sins and vices (iv. 1–8). Paul had sent back Timotheus from Athens to Thessalonica in order to advise the young inexperienced church, and to obtain news concerning it (iii. 1–5). He has just returned to Paul (iii. 6), and the information received through this source is the occasion of the first epistle,[2] designed to supply the place of Paul's personal presence and bring new exhortation and instruction from the apostle to the young church, which still much needed guidance.

We have no information concerning the effect of this letter. It is conceivable, however, that the church required yet further advice and direction from the apostle, and so far it is not remarkable that Paul saw the need for a second similar letter of teaching and exhortation. This second epistle also, if it is genuine, was written during Paul's stay of a year and a half at Corinth, very soon after the first. For it also is written in the conjoined names of Silvanus and Timotheus, who were still with Paul, while we must understand from Acts xviii. 18 that after Paul's departure from Corinth they ceased to be his companions. The occasion of this epistle seems especially to have arisen from the circumstance that the church had been put into fear and anxiety about the advent of Christ, perhaps by a pretended letter from Paul. Two passages point to the existence of such a thing: in ii. 2, Paul says that the church shall not let itself be alarmed "by word or by letter as from us" (*i.e.*, nominally coming from us), and in iii. 17 again Paul lays emphasis on his signature by his own hand as the token (of genuineness) to be noticed in each letter. In any case the chief aim of the epistle is to tranquillize the church concerning the advent of Christ, which is not yet immediately imminent. He particularly exhorts them not to let themselves be shaken in mind, as that the day of Christ is at hand (ii. 1, 2). For before this day comes the "man of sin" must first appear, who seats himself in the temple of God, and gives himself out for God (ii. 3–5). And he too is for the present kept back by another power (ii. 6, 7). Only when the latter is taken out of the way shall "that wicked" be revealed, and the great falling away shall follow (ii. 8–12).

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[1] Xenophon (*Hellen.*, vi. 3. 1 and 5) and Diodorus (xv. 46) speak of Thespiæ as if it had been destroyed and its inhabitants driven away before the battle of Leuctra; but, as the Thespian troops were present with the Thebans immediately before the battle (Paus., ix. 13, 8), it would seem that only the walls, not the city itself, had been previously destroyed. See Grote, *Hist. of Greece*, ix. p. 379.

[2] According to Acts xvii. 14–15 and xviii. 5, Silas and Timotheus had remained behind in Berœa, and first met Paul again in Corinth. But according to 1 Thess. iii. 1–5 it must be understood that Timotheus was in Athens with Paul, and had been sent thence to Thessalonica.

The genuineness of the two epistles has not remained unquestioned by the newer criticism. Baur declared himself against the genuineness of both epistles,[1] and he is followed by Van der Vies[2] and several others.[3] But in general the predominant opinion of impartial criticism at present is that the genuineness of the first epistle is certain, while that of the second must be given up.

This is the opinion of Hilgenfeld (*Z. f. wiss. Theol.*, 1862, p. 225–264; 1866, p. 295–301; 1869, p. 441 *sq.*; 1870, p. 244 *sq.*), Van Manen (*Onderzoek naar de echtheid van Paulus tweeden brief aan de Thessalonicensen*, Utrecht, 1865), S. Davidson (*Introd. to the New Testament*, 2d ed., 1882, i. 4–16, 336–351), Weizsäcker (*Das apostolische Zeitalter*, 1886, p. 249–261); and Holtzmann also leans to the same view, without, however, definitely committing himself (*Einl. in d. N. T.*, 2d ed., 1886, p. 233–241). The genuineness of the first epistle is vindicated by Lipsius (*Theol. St. u. Kr.*, 1854, p. 905–934), Von Soden (*ibid.*, 1885, p. 263–310), and Paul Schmidt (*Der erste Thessalonicherbrief neu erklärt*, Berlin, 1885), while, on the other hand, Kern (*Tübing. Zeitschr. f. Theol.*, 1839, ii. 145–214) and Bahnsen (*Jahrb. für prot. Theol.*, 1880, p. 681–705) attack that of the second. Grimm (*Theol. St. u. Kr.*, 1850, p. 753–816) and Westrik (*De echtheid van den tweeden brief aan de Thessalonicensen*, Utrecht, 1879) have entered the lists for the genuineness of both epistles.

The final decision of the newer criticism is justified by the evidence. No real difficulties can be brought against the genuineness of the first epistle, but they certainly can against that of the second. When Baur finds that the epistles lack the characteristic Pauline ideas, he is only so far right that the doctrine of justification by faith is not dealt with, for which, however, no occasion arises. It has been asserted that there are traces of imitation of the epistles to the Corinthians, but the points of resemblance are not such as to justify this conclusion. The connexion of the passage in 1 Thess. ii. 16 (the wrath of God is already come upon the Jews) with the destruction of Jerusalem rests on an arbitrary, nay false, interpretation. And it cannot be maintained on impartial examination that in 1 Thess. ii. 14, 15, the Jewish churches of Palestine are set forth in a way unlike Paul, as an example for the heathen churches.

The objections to the second epistle are much weightier, though here also not all the arguments adduced by hostile critics are valid. It has been often said that the author, like the author of the Apocalypse, regards Nero as the Antichrist, expecting him to reappear as the arch-enemy of Christ. But this interpretation of the short statement of our epistle cannot be proved. The assumption that before the dawn of salvation godlessness would reach its height, through the appearance of an arch-enemy of God and His church is, so to speak, a dogmatic postulate which rests on the prophecies of Daniel and other prophets of the Old Testament. And, in so far as the picture of this arch-enemy is endowed with historical features, they can quite as well have been drawn from Caligula as from Nero. For Caligula had already laid claim to the honours of a god, and because of this appeared to the Jews to be the embodiment of godlessness. The assumption of such an Antichrist would not be striking in Paul. Even if it is correct (as is generally and with reason taken for granted) that by the hindrance which keeps back the appearance of Antichrist (2 Thess. ii. 6, 7) the established might of the Roman emperor and empire is to be understood, this view would be quite in keeping with Paul's views about the Roman dominion (Rom. xiii. 1–7). Yet it must be conceded that the statements on this head create real difficulty, if we compare them with those of the first epistle, in which all stress is laid on the fact that the day of the Lord comes as a thief in the night, and that man must be prepared for it at any moment (1 Thess. v. 1–11). In the second epistle it is pointed out with equal emphasis that the day of the Lord is not immediately imminent, and that certain events must come first (2 Thess. ii. 1–10). It is certainly very striking that Paul, so soon after the admonitions of the first kind, should have given the quieting assurances of the second. And 2 Thess. ii. 2 and iii. 7 can hardly be explained except by the supposition that the readers had been thrown into alarm by a pretended epistle from Paul. Could this have been dared in that early time, almost under the eyes of the apostle? Finally, it is not to be denied that the style of the second epistle is different from that of the first, and that the contents often appear a mere imitation, except in the eschatological passages on account of which it was written. It must therefore be admitted that weighty if not conclusive considerations have been produced against its genuineness. (E. SC.)

THESSALONICA. See SALONICA.

See vol. xi. Plates I. and II. and vol. xv. Pl. III.

THESSALY is the district of northern Greece which intervenes between Macedonia and the more purely Hellenic countries towards the south, and between the upland region of Epirus and the Ægean Sea. It forms an irregular square, extending for about sixty miles in each direction, and this area, which is for the most part level, is enclosed by well-marked boundaries—by the Cambunian Mountains on the north, and by Othrys on the south, while on its western side runs the massive chain of Pindus, which is the backbone of this part of Greece, and towards the east Ossa and Pelion stand in a continuous line; at the north-eastern angle Olympus rises, and is the keystone of the whole mountain system. The elevation of some of the summits in these ranges is considerable, for three of the peaks of Pindus are over 5000 feet, and Olympus, Ossa, and Pelion reach respectively the height of 9754, 6407, and 5310 feet. The country that is contained within these limits is drained by a single river, the Peneius, which, together with the water of its numerous confluents, passes into the sea through the Vale of Tempe. This place, which the Greeks were accustomed to associate with rural delights, is a chasm, cloven in the rocks, as the fable tells us, by the trident of Poseidon, between Olympus and Ossa; but though it possesses every element of the sublime, yet its features are soft and beautiful, from the broad winding river, the luxuriant vegetation, and the glades that at intervals open out at the foot of the cliffs. It is about four miles and a half long, and towards the middle of the pass, where the rocks are highest, the precipices in the direction of Olympus fall so steeply as to bar the passage on that side; but those which descend from Ossa are the loftiest, for they rise in many places not less than 1500 feet from the valley. Owing to the length and narrowness of the ravine, it was a position easily defended, but still it offered a practicable entrance to an invading force, in consequence of which a number of castles were built at different times at the strongest points. On the north side of Thessaly there was an important pass from Petra in Pieria by the western side of Olympus, debouching on the plain northward of Larissa; it was by this that Xerxes entered, and we learn from Herodotus (vii. 173) that, when the Greeks discovered the existence of this passage, they gave up all thoughts of defending Tempe. On the side of Epirus the main line of communication passed over that part of Pindus which was called Mount Lacmon, and descended the upper valley of the Peneius to Æginium in the north-west angle of Thessaly, near which place now stand the extraordinary monasteries of Meteora. This was the route by which Julius Cæsar arrived before the battle of Pharsalia. Another pass through the Pindus chain was that of Gomphi, farther south, by means of which there was communication with the Ambracian Gulf. The great southern pass was that of Cœla, which crosses Mount Othrys nearly opposite Thermopylæ. These Thessalian passes were of the utmost importance to southern Greece, as commanding the approaches to that part of the country.

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[1] *Paulus der Apostel Jesu Christi*, 1845, and *Theologische Jahrbücher*, 1855, p. 141–168, reprinted in 2d ed. of *Paulus*, ii. 341–369.

[2] *De beide brieven aan de Thessalonicensen*, Leyden, 1865.

[3] Holsten also (*Jahrb. f. prot. Theol.*, 1877, p. 731 *sq.*) and Steck (*Jahrb. f. prot. Theol.*, 1883, p. 509–524) dispute the genuineness of the first epistle, presupposing the spuriousness of the second.

Though Thessaly is the most level district of Greece, it does not present a uniform unbroken surface, but is composed of a number of sections which open out into one another, divided by ranges of hills. The principal of these were called Upper and Lower Thessaly, the former comprising the western and south-western part, which contains the higher course of the Peneius and all those of its tributaries that flow from the south—the Enipeus, the Apidanus, the Onochonus, and the Pamisus; while the latter, which reaches eastward to the foot of Ossa and Pelion, is inundated in parts at certain seasons of the year by the Peneius, the flood-water from which forms the lake Nessonis, and, when that is full, escapes again and pours itself into the Lake of Bœbe. The chief city of the latter of these districts was Larissa; and the two were separated from one another by a long spur, which runs southwards from the Cambunian Mountains on the western side of that city. Again, when Thessaly is entered from the south by the pass of Cœla, another plain, containing a small lake, which was formerly called Xynias, intervenes, and a line of low hills has to be crossed before the town of Thaumaci is reached, which from its commanding position overlooks the whole of the upper plain. The view from this point has been described by Livy in the following remarkable passage:—"When the traveller, in passing through the rugged districts of Thessaly, where the roads are entangled in the windings of the valleys, arrives at this city, on a sudden an immense level expanse, resembling a vast sea, is outspread before him in such a manner that the eye cannot easily reach the limit of the plains extended beneath" (xxxii. 4). To the north-eastwards of this, where a portion of the great plain begins to run up into the mountains, the Plain of Pharsalia is formed, which is intersected by the river Enipeus; and still farther in the same direction is the scene of another great battle, Cynoscephalæ. Thessaly was further subdivided into four districts, of which Pelasgiotis embraced the lower plain of the Peneius, and Hestiæotis and Thessaliotis respectively the northern and the southern portions of the upper plain; while the fourth, Phthiotis, which lies towards the south-east, was geographically distinct from the rest of the country, being separated from it by a watershed. The determining feature of this is the Pagasæus Sinus (Gulf of Volo), a landlocked basin, extending from Pagasæ at its head to Aphetæ at its narrow outlet, where the chain of Pelion, turning at right angles to its axis at the end of Magnesia, throws out a projecting line of broken ridges, while on the opposite side rise the heights of Othrys. In the heroic age this district was of great importance. It was the birthplace of Greek navigation, for this seems to be implied in the story of the Argonauts, who started from this neighbourhood in quest of the golden fleece. From it the great Achilles came, and, according to Thucydides (i. 3), it was the early home of the Hellenic race. The site of Iolcus, the centre of so many poetic legends, is at no great distance from the modern Volo. Near that town also, at a later period, the city of Demetrias was founded by Demetrius Poliorcetes, who called it one of the three fetters of Greece, Chalcis and Corinth being the other two.

The history of Thessaly is closely connected with its geography. The fertility of the land offered a temptation to invaders, and was thus the primary cause of the early migrations. It was this motive which first induced the Thessalians to leave their home in Epirus and descend into this district, and from this movement arose the expulsion of the Bœotians from Arne, and their settlement in the country subsequently called Bœotia; while another wave of the same tide drove the Dorians also southward, whose migrations changed the face of the Peloponnese. Again, this rich soil was the natural home of a powerful aristocracy, such as the families of the Aleuadæ of Larissa and the Scopadæ of Crannon; and the absence of elevated positions was unfavourable to the foundation of numerous cities, which might have fostered the spirit of freedom and democracy. The plains, also, were suited to the breeding of horses, and consequently the force in which the Thessalian nation was strong was cavalry, a kind of troops which has usually been associated with oligarchy. The wealth and the semi-Hellenic character of the people—for in race, as in geographical position, the Thessalians held an intermediate place between the non-Hellenic Macedonians and the Greeks of pure blood—caused them to be wanting in patriotism, so that at the time of the Persian wars we find the Aleuadæ making common cause with the enemies of Greece. When they were united they were a formidable power, but, like other half-organized communities, they seldom combined for long together, and consequently they influenced but little the fortunes of the Greeks.

For several centuries during the Middle Ages Roumanian immigrants formed so large a part of the population of Thessaly that that district was called by the Byzantine writers Great Walachia (Μεγάλη Βλαχία): the Jewish traveller, Benjamin of Tudela, who passed through the country in the latter half of the 12th century, describes them as then occupying it. At the present day only a few colonies of that race remain, the principal of which are found on the western side of Olympus and in some of the gorges of Pindus. The Turkish inhabitants are settled in the larger towns, and here and there in the country districts, the most important colony being those called Koniarates, who were brought from Konieh in Asia Minor shortly before the taking of Constantinople, and planted under the south-west angle of Olympus. The Greeks, however, form the vast majority of the population, so much so that, even while the country belonged to the Ottomans, Greek was employed as the official language. In accordance with the provisions of the Berlin treaty, Thessaly was ceded to the Greeks by the Porte in 1881, and since that period it has formed a portion of the Hellenic kingdom. (H. F. T.)

THETFORD, an ancient borough and market-town, partly in Norfolk and partly in Suffolk, is situated on the Thet and Little Ouse, and on the Great Eastern Railway line between Cambridge and Norwich, 36 miles south-west of Norwich, 12 north of Bury St Edmunds, to which there is a branch line, and 96 north-north-east of London. The Little Ouse, which divides the counties, is crossed by a cast-iron bridge erected in 1829. In the time of Edward III. the town had twenty churches and eight monasteries. There are now three churches—St Peter's, St Cuthbert's, and St Mary's; of these St Mary's, on the Suffolk side, is the largest. There are various monastic remains in the town. The most important relic of antiquity is the castle hill, a mound 1000 feet in circumference and 100 feet in height, probably the largest of the Celtic earthworks in England. The grammar school was founded in 1610. In King Street is the mansion-house occupied as a hunting lodge by Queen Elizabeth and James I. Brewing and tanning are carried on; and there are also manure and chemical works, brick and lime kilns, flour-mills, and agricultural implement works. The Little Ouse is navigable from Lynn for barges. The population of the municipal borough (area 7296 acres) in 1871 was 4166 and in 1881 it was 4032.

Thetford is supposed to have been the *Sitomagus* of the Romans. In the time of the Saxons, by whom it was called Theodford, it was the capital of East Anglia. During the heptarchy it was frequently desolated by the Danes. It was burned by them in 998 after a drawn battle between Swend and Ulfcytel, and again after Ulfcytel's second battle at Ringmere, 10th May 1004. From the reign of Athelstan to that of King John it possessed a mint. The see of Elmham was removed to it in 1070, but it was transferred to Norwich in 1094. At Domesday it had five burgesses, but by the time of Edward III. they had increased to 953. It was incorporated by Elizabeth in 1578. It returned two members to parliament from the time of Edward VI., but was disfranchised in 1868.

THEVENOT, Jean de (1633–1667), an eminent Oriental traveller, was a native of Paris, where he received his education in the college of Navarre. The perusal of works of travel[1] moved him to go abroad, and his circumstances permitted him to please himself. Leaving France in 1652, he first visited England, Holland, Germany, and Italy, and at Rome he fell in with D'Herbelot, who invited him to be his companion in a projected voyage to the Levant. D'Herbelot was detained by private affairs, but Thevenot sailed from Rome in May 1655, and, after vainly waiting five months at Malta, took passage for Constantinople alone. He remained in Constantinople till the end of the following August, and then proceeded by Smyrna and the Greek islands to Egypt, landing at Alexandria on New Year's Day 1657. He was a year in Egypt, then visited Sinai, and, returning to Cairo, joined the Lent pilgrim caravan to Jerusalem. He visited the chief places of pilgrimage in Palestine, and, after being twice taken by corsairs, got back to Damietta by sea, and was again in Cairo in time to view the opening of the canal on the rise of the Nile (August 14, 1658). In January 1659 he sailed from Alexandria in an English ship, taking Goletta and Tunis on the way, and, after a sharp engagement with Spanish corsairs, one of which fell a prize to the English merchantman, reached Leghorn on April 12. He now spent four years at home in studies useful to a traveller, and in November 1663 again sailed for the East, calling at Alexandria and landing at Sidon, whence he proceeded by land to Damascus, Aleppo, and then through Mesopotamia to Mosul, Baghdad, and Mendeli. Here he entered Persia (August 27, 1664), proceeding by Kirmanshahan and Hamadan to Ispahan, where he spent five months (October 1664–February 1665), and then, joining company with the merchant Tavernier (*q.v.*), proceeded by Shiraz and Lar to Bender-Abbas, in the hope of finding a passage to India. This was difficult, because of the opposition of the Dutch, and, though Tavernier was able to proceed, Thevenot found it prudent to return to Shiraz, and, having visited the ruins of Persepolis, made his way to Basra, and sailed for India November 6, 1665, in the ship "Hopewell," arriving at the port of Surat January 10, 1666. He was in India for thirteen months, and crossed the country by Golconda to Masulipatam, returning overland to Surat, from which he sailed to Bender-Abbas and went up to Shiraz.[2] He passed the summer of 1667 at Ispahan, disabled by an accidental pistol shot, and in October started for Tebriz, but died on the way at Miyan, (November 28, 1667).

Thevenot was an accomplished linguist, skilled in Turkish, Arabic, and Persian, and a curious and diligent observer. He was also well skilled in the natural sciences, especially in botany, for which he made large collections in India. His personal character was admirable, and his writings are still esteemed, though it has been justly observed that, unlike Chardin, he saw only the outside of Eastern life. The account of his first journey was published at Paris in 1665; it forms the first part of his collected *Voyages*. The licence is dated December 1663, and the preface shows that Thevenot himself arranged it for publication before leaving on his second voyage. The second and third parts were posthumously published from his journals in 1674 and 1684 (all 4to). A collected edition appeared at Paris in 1689, and a second in 12mo at Amsterdam in 1727 (5 vols.). There is an indifferent English translation by A. Lovell (fol., London, 1687).

THIAN-SHAN, or Celestial Mountains. See Asia (vol. ii. p. 686), Syr-Daria, and Turkestan.

THIBAUT, Anton Friedrich Justus (1774–1840), one of the greatest of German jurists, was born at Hameln, in Hanover, January 4, 1774, that is, ten years after his contemporary and rival Hugo, about a year before Feuerbach, and five years before Savigny. Thibaut's father was an officer in the Hanoverian army, a skilful mathematician, and, like his son, a man of much force of character. His mother was the daughter of the oberbürgermeister of the town. The Thibauts were of French descent; they came from a family which had been driven out of France on the revocation of the edict of Nantes. As a child and youth, Thibaut lived in Hameln, Harburg, and Hanover. He was fond of rowing, skating, and swimming, and, above all, of music, which remained his passion through life. As a lad he set his heart, chiefly for romantic reasons, on being a forester, and he actually spent two years as such. But he soon became disenchanted, and in 1792 went to Göttingen to study. In 1793 he moved to Königsberg, where Kant still taught. Thibaut was deeply affected by the critical philosophy; his very latest writings bear traces of it, and it is not unimportant in the history of jurisprudence in Germany that Hugo was equally influenced by it. From Königsberg Thibaut moved in 1794 to Kiel, where he formed a friendship with Niebuhr, at that time a student there. They lived for a year in the same house, taking their meals together, and holding much converse on literature and politics. Both already displayed the bent of their minds—Niebuhr despondent and affrighted at the progress of the French Revolution, Thibaut hopeful, undismayed, and certain that eventually all would be well. In 1798 he was appointed extraordinary professor of civil law, and in the same year appeared his *Versuche über einzelne Theile der Theorie des Rechts* (Kiel, 1798), a collection of essays, of which by far the most important was entitled "Ueber die Einfluss der Philosophie auf die Auslegung der Positiven Gesetze." Taking as his text an observation of Leibnitz, he sought to show that history without philosophy could not interpret and explain law. The essay was partly by anticipation a corrective of the teaching of the historical school of jurists. It enters into speculations on the possibility of forming an ideal body of law as a measure and mode of exposition of particular law,—speculations which have never been continued, certainly not by Thibaut. In 1799 he was made ordinary professor of civil law. In that year was published his *Theorie der logischen Auslegung des römischen Rechts*, one of his most remarkable works, a favourite book of Austin's, and, as his well-annotated copy in the Inner Temple library shows, one which he had most carefully studied. In 1800 Thibaut married the daughter of Professor Ehlers at Kiel. In 1802 he published a short criticism of Feuerbach's theory of criminal law. It is an excellent illustration of his good sense; it discriminates between what is good and what is unsound and crude in the writings of criminal law reformers; it recalls in many ways the speculations of Bentham. The same year appeared Thibaut's essay *Ueber Besitz und Verjährung*. In 1803 Thibaut was called to Jena, where he spent three years, made happier than they otherwise would have been by intercourse with Goethe and Schiller. At the invitation of the grand-duke of Baden he went to Heidelberg to fill the chair of civil law and to assist in organizing the university; and he never quitted that town, though he received in after years, as his fame grew, invitations to Göttingen, Munich, and Leipsic. His class was large, his influence great; and, except Hugo and Savigny, no civilian of his time was so well known. In the work of the university he took an active part; and he cultivated with rare devotion his favourite art. In 1814 appeared his *Civilistische Abhandlungen*, of which the principal was his famous essay, the parent of so much literature, on the necessity of a national code for Germany. He had no wish to enter into official or practical life. "I am Professor Thibaut, and wish to be nobody else." In 1819 he was appointed representative in the first chamber of the Baden parliament. He was also made member of the Scheidungsgericht. In 1825 appeared anonymously his work *Ueber die Reinheit der Tonkunst*, in which he eulogized the old music, and especially that of his favourite master, Palestrina. It involved him in a contest with Nägeli and other admirers of the new school of music, whose merits Thibaut was somewhat slow to own. This has been translated into English by W. H. Gladstone. In 1836 Thibaut published his *Erörterungen des römischen Rechts*. One of his last works was a contribution in 1838 to the *Archiv für die civilistische Praxis*, of which he was one of the editors (see below). He died peacefully, full of years and honour, on the 29th of March 1840.

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[1] His uncle Melchisedech had similar tastes, and published a well-known collection of *Voyages* (fol., Paris, 1663, *sq.*).

[2] It was at this time that he met Chardin near Persepolis, but that somewhat envious scholar is wrong in saying that this was Thevenot's only visit to the ruins (Chardin, *Voyages*, ed. Langlès, viii. 345). See Thevenot, pt. ii. bk. 3, chap. 6.

Thibaut was of the middle height and broad-shouldered, his eyes bright and piercing, his head noble and striking; his whole appearance told of power, simplicity, and reserve. All who knew him speak of his strong personality, his manly consistent nature. Young men loved him, and he drew to the young. If he sometimes signed his letters "*Semper idem* A. F. J. Thibaut," it was not a phrase. Every incident told of him has a curious flavour. He was much more than a jurist: he deserves to be remembered in the history of music. Palestrina and the early composers of church music were his delight. "Jurisprudence is my business; my music room is my temple." His friend, Dr Baumstark, has left an interesting record of his musical pursuits and of the work of his "Sangverein" at Heidelberg. Among the masters of German prose Thibaut holds no mean place. Nothing could be clearer, more unpedantic and unpretentious, than his exposition; his prose is scarcely inferior to Lessing's. Like his speech, his written style was simple and manly, but it is simplicity marked by care, and is rich in the happy accidents of expression which come only to true artists. He liked the old classical models; he read and reread the classics, ancient and modern, his taste being catholic enough to include Plato and Chrysostom, Montaigne, Hume's *Essays*, Adam Smith's works, Ferguson's *Essay on the History of Civil Society* (which he particularly admired), and the later developments of German literature.

Most of Thibaut's works have already been mentioned. Several of them, however, deserve further notice. And first as to his essay on the necessity of a code for Germany ("Ueber die Nothwendigkeit eines allgemeinen bürgerlichen Rechts für Deutschland"). No more persuasive argument for codification was ever advanced. It has all the vigour of Bentham's arguments for the same cause, but is without his pamphleteering recklessness of expression. Unlike Hugo, whose education dated back to the time when French literature was supreme in Germany and who felt himself somewhat a stranger to later German culture, Thibaut was of his own time, sensitive to the great change which had come over Germany after the battle of Leipsic, conscious of the insufficiency of Roman law, and eager to promote the greatness of his country. In his contribution to the *Archiv für die civilistische Praxis*, in 1838, on "the so-called historical and unhistorical school," he tells the history of his memorable essay on the necessity of a code for Germany. He had seen many German soldiers in 1814 about to march to Paris. He realized the change which this denoted; and out of the fulness of his heart he wrote the essay in a fortnight. The mode of treatment is more comprehensive than the theme; and to-day, perhaps partly for this reason, the essay is as readable as it ever was; jurists have not yet carried out all the suggestions which it contains. For Germany, its soil freed and its honour vindicated, a happy future had, he predicted, been opened up. "The division into small states was inevitable, and not to be deplored. The existence of great states is always in a sense unnatural; it implies a warm life only at one point,—a constant repression of individuals for a common object, and no real unity between the rulers and the subjects. In a land of small states, on the other hand, the peculiarity of each has full play; there is development of variety, and the unity of princes and people is deeper and more living." The only unity practicable and needful in Thibaut's judgment was one of law; and for such all the German Governments should labour. His review of the state of jurisprudence in Germany is severe; it recalls the contemporaneous criticisms passed by Bentham on English law. Thibaut pointed out luminously the contrast between the fundamental conceptions of Roman and German society, and the inadequacy of Roman law to supply defects in German jurisprudence. It was not pleasing to many jurists to be told that a few lectures on the laws of the Persians and Chinese would do more to awaken a true judicial sense than minute disquisitions on the Roman law of intestacy—observations the full effect of which Thibaut himself did not perhaps conceive. The essay was as much a condemnation of the entire state of jurisprudence as an argument for codification; it was a challenge to civilians to justify their very existence. Savigny took up the challenge thus thrown down; and a long controversy as to points not very clearly defined took place. The glory of the controversy belonged to Savigny; the real victory rested with Thibaut. By recent legislation Germany has carried out some of the ideas of Thibaut; and others indicated but not developed in his essay remain to be completed by a scientific school of jurists. One of his works best worth reading is his *Theory of Construction*. Though directly applicable to Roman law, it is of general use. The subject is divided into two branches—"Interpretation nach der Absicht des Gesetzgeber" and "Interpretation nach dem Grunde des Gesetzes," or, as Austin expresses the distinction in a marginal note on his copy, "What the legislator would have contemplated had he conceived his purpose completely and distinctly, and what the legislator actually contemplated." It would be interesting to compare the rules of interpretation stated by Thibaut with the rules of construction, familiar to English lawyers, laid down by Coke in Heydon's Case, 3, 7*b*, *Reports*. Thibaut's best-known work is on the Pandects (*System des Pandektenrechts*, 3 vols., 1803), a part of which was translated by Lord-Justice Lindley. He was one of the earliest to criticize the divisions found in the Institutes, and he carried on with Hugo a controversy as to these points. Thibaut's own classification earlier is unsatisfactory. He divided the subject into public law (that which treats of the relations between Government and subjects), private law, and international law. Public law he subdivided into constitutional law (*Staatsrecht*, the laws binding on the sovereign) and administrative law (*Regierungsrecht*, or criminal law, and laws relating to finance and police). The laws relating to civil process were dealt with partly under administrative law and partly under private law. Status was placed partly in the former partly in the latter; and the law as to guardianship and parental authority is treated as a part of the law of police. Thibaut, however, abandoned in practice this unscientific division. One of his most interesting works is his posthumous treatise on the "Code Civil," *Lehrbuch des französischen Civilrechts in steter Vergleichung mit dem römischen Civilrecht*. While criticizing the code, which he designates as in the highest degree unsystematic, he recognizes in it merits which German jurists of his time were reluctant to admit.

In modern German legal literature Thibaut's influence is not very perceptible. Even at Heidelberg it was quickly superseded by that of his successor, Vangerow, and in Germany his works are now little used as text-books. But those best able to judge Thibaut have most praised him. Austin, who owed much to him, describes him as one "who for penetrating acuteness, rectitude of judgment and depth of learning, and eloquence of exposition may be placed, by the side of Von Savigny, at the head of all living civilians; and elsewhere he praises Thibaut's indefatigable perseverance and "sagacity not surpassable." High though such eulogies are, they are scarcely adequate. In Thibaut's works are promises which he did not fulfil, and they contain fertile suggestions which future jurists may utilize. It was not the least of his merits that he introduced scientific methods into legal practice and practical sense into jurisprudence. (J. Mt.)

THIELT, a town of Belgium, in the province of West Flanders, 15 miles south-south-east of Bruges, on a branch line between Ingelmunster and Deynze. It manufactures linen and woollen goods, gloves, vinegar and spirits, and has tanneries and bleacheries. There is also some trade in cattle and grain. The town was of considerable importance in the Middle Ages, but was almost entirely destroyed by fire in 1383, a calamity from which it never wholly recovered. The population in 1876 was 10,527.

THIERRY, the name of two excellent French historians, brothers (Augustin and Amédée), both of whom, though their literary and historical faculty was not quite equal, displayed the same devotion to historical study.

I. Jacques Nicolas Augustin Thierry (1795–1856), the elder and most gifted, was born at Blois on the 10th May 1795. He had no advantages of birth or fortune, but was greatly distinguished at the Blois grammar school, and entered the École Normale, an establishment which, designed on the best principles to supply France with perfectly equipped teachers, has on the whole done more service to journalism and literature than to pedagogy. He appears to have been very susceptible to personal influences, and was for a time docile to St Simon and afterwards to Comte. But his real bent was towards more solid studies, and, under the impulse of the strong current setting at the time towards mediæval research, he began, and in 1825 published, his *History of the Norman Conquest of England*, much altered and improved in the later edition of 1840. Two years later he published important *Lettres sur l'Histoire de France*, attacking the traditional method of history-writing, and recommending recourse to the original documents. About this time the heavy calamity of blindness threatened him, and by 1830 he had totally lost his sight. His marriage, however, with Julie de Quérengal, a woman of ability, considerably lightened his misfortune, and about the same time he was elected to the Académie des Inscriptions. He continued to pursue his historical studies, now through other eyes, and in 1834 published *Dix Ans d'Études Historiques*, which was followed by his capital work, the *Récits Merovingiens*, in 1840. His later years were chiefly occupied in the study of the history of the Tiers État, which bore fruit in more than one publication. He died at Paris on May 22, 1856.

The duller school of picturesque Dryasdusts (a rather miraculous combination) who have profited by Thierry's labours and continued his work have sometimes charged both him and his brother with having entered on history with their minds full of Walter Scott, and with having subordinated facts to graphic presentation. The charge is entirely unjust, and is generally found in the mouths of those who are particularly ill qualified to make it, inasmuch as they owe Thierry nearly everything in style. By others he is described as the founder of the picturesque school, and in this capacity, no doubt, he has much to answer for. His own work, however, is of a very high and remarkable character. He had hardly any forerunners, unless Gibbon may be counted as one, and his freedom from the besetting sin of his own school—the subordination of sober history to picturesque description and romantic narrative—is best seen by comparing him with his contemporary Barante, who, however, is himself not to be named otherwise than *honoris causa*.

II. Amédée Simon Dominique Thierry (1797–1873) was the younger brother of Augustin, and was born on the 2d August 1797. He began life as a journalist (after an essay, like his brother, at schoolmastering), was connected with the famous romantic harbinger the *Globe*, and obtained a small Government clerkship. His first book was a brief history of Guienne in 1825, and three years later appeared the *Histoire des Gaulois*, which was received with much favour, and obtained him, from the royalist premier Martignac, a history professorship at Besançon. He was, however, thought too liberal for the Government of Charles X., and his lectures were stopped, with the result of securing him, after the revolution, the important post of prefect of the Haute-Saône, which he held eight years. During this time he published nothing. In 1838 he was transferred to the council of state as master of requests, which post he held through the revolution of 1848 and the *coup d'état* till 1860, when he was made senator—a paid office, it must be remembered, and, in effect, a lucrative sinecure. He also passed through all the ranks of the Legion of Honour, became a member of the Académie des Inscriptions in 1841, and in 1862 received the honorary degree of D.C.L. at Oxford. He had, except during the time of his prefecture, never intermitted his literary work, being a constant contributor to the *Revue des Deux Mondes*, his articles (usually worked up afterwards into books) almost all dealing with Roman Gaul and its period. The chief were the *Histoire d'Attila* (1856), frequently reprinted, the *Histoire de la Gaule sous l'Administration Romaine* (1840–2), a *Tableau de l'Empire Romain*, and, in imitation of his brother, certain *Récits* of Roman history, a book on St Jerome in 1867, and one on *Chrysostom and Eudoxia* in 1873. He died March 27, 1873.

His literary and historical genius was perhaps inferior to his brother's, and he exhibits more of the defects of the anecdotic method of writing history, but he shared Augustin's passion for going to the fountainhead and for animating the dry bones of mere chronicles and mere academic discussions with accounts of the life of peoples.

THIERS, a town of France, chef-lieu of an arrondissement in the department of Puy-de-Dôme, on the railway between Clermont and St Étienne, 24 miles east-north-east of the former town. It is most picturesquely situated on the side of a hill, at the foot of which the Durolle rapidly descends through a narrow valley into the Dore, in its turn a tributary of the Allier. The streets, rising in steep rows, contain many wooden and gabled houses, some of which are as old as the 15th century, and a fine view of the Plain of Limagne and the Dôme Hills is obtainable from the terraces. All the processes of making cutlery may be seen at Thiers, giving employment to 12,000 workmen in the town and the villages within a radius of 6 to 7 miles. Sheath-making, tanning, and paper-making (chiefly stamps and playing cards) employ 8000 hands, and the business done reaches £1,200,000 per annum. The church of Le Moutier, so named from a Benedictine monastery of which it formed part, contains building of the 7th, 8th, and 11th centuries; the tower is more modern. There were 12,005 inhabitants in 1886 (commune 16,754).

Thiers was sacked in 523 by the soldiers of Thierry, the son of Clovis; and Gregory of Tours speaks of a wooden chapel which then existed here (on the site of the present church of Le Moutier). The church of St Genez was built in 573 by Avitus, bishop of Clermont, on the site of the ancient *Tigernum Castrum*, was rebuilt in 1016 by Wido, lord of Thiers, and again in the 12th century. There is some curious mosaic work of the 12th century, and a fine tomb of the 13th. The commercial importance of Thiers was greatly increased three centuries ago, when the manufacture of the larger kinds of cutlery was introduced from Chateldon, between Vichy and Thiers.

THIERS, Louis Adolphe (1797–1877), "liberator of the territory," as even the short-lived gratitude of France continues to call him, was born at Marseilles on April 16, 1797. His family are somewhat grandiloquently spoken of as "cloth merchants ruined by the Revolution," but it seems that at the actual time of his birth his father was a locksmith. His mother belonged to the family of the Chéniers, and he was well educated, first at the Lycée of Marseilles, and then in the faculty of law at Aix. Here he began his life-long friendship with Mignet, and was called to the bar at the age of 23. He had, however, little taste for law and much for literature; and he obtained (it is said by an ingenious trick, and in spite of unfair and prejudiced attempts to deprive him of it) an academic prize at Aix—for a discourse on Vauvenargues. In the early autumn of 1821 Thiers went to Paris, and was quickly introduced as a contributor to the *Constitutionnel*, at first on literary and then on general and especially political subjects, as well as art and the drama. In each of the years immediately following his arrival in Paris he collected and published a volume of his *Constitutionnel* articles, the first on the salon of 1822, the second on a tour in the Pyrenees. He was put out of all need of money by the singular benefaction of Cotta, the well-known Stuttgart publisher, who was part-proprietor of the *Constitutionnel*, and made over to Thiers his dividends, or part of them. Meanwhile he became very well known in Liberal society, especially in the house of Laffitte, and he had begun and was rapidly compiling (at first with the assistance of M. Felix Bodin and afterwards alone) the celebrated *Histoire de la Révolution Française*, which founded his literary and helped his political fame. The first two volumes appeared in 1823, the last two (of ten) in 1827. The book brought him little profit at first, but became immensely popular. The well-known sentence of Carlyle, that it is "as far as possible from meriting its high reputation," is in strictness justified, not merely in regard to this, but in regard to all Thiers's historical work, which is only too frequently marked by extreme inaccuracy, by prejudice which passes the limits of accidental unfairness and sometimes seems to approach those of positive dishonesty, and by an almost complete indifference to the merits as compared with the successes of his heroes. But Carlyle himself admits that Thiers is "a brisk man in his way, and will tell you much if you know nothing." In other words, the *Histoire de la Révolution* (again like its author's other work) possesses in a very high degree the gifts of clearness, liveliness, and intelligible handling which so often distinguish French writing. Coming as it did just when the reaction against the Revolution was about to turn into another reaction in its favour, it was assured of success.

For a moment it seemed as if the author had definitely chosen the lot of a literary man, even of a literary hack. He planned an *Histoire Générale*, and was about to survey mankind from China to Peru on the deck of a French man-of-war as a preliminary process. But the accession to power of the Polignac ministry in August 1829 changed his projects, and at the beginning of the next year Thiers, with Armand Carrel, Mignet, and others, started the *National*, a new opposition newspaper, which openly attacked the older Bourbon line and was foremost in provoking the famous and fatal Ordonnances of July. Thiers himself was the soul (or at least one of the souls) of the actual revolution. What share he had in the process sometimes attributed to him of "overcoming the scruples of Louis Philippe" is no doubt a debateable question, with the problem *in limine* of the debate whether Louis Philippe had any scruples to overcome. At any rate Thiers had his reward. He ranked, if not at once, yet very soon, as one of the radical though not republican supporters of the new dynasty, in opposition to the party of which his rival Guizot was the chief literary man, and Guizot's patron the duke of Broglie the main pillar among the nobility, and which might be called by comparison Conservative. At first Thiers, though elected deputy for Aix, obtained only subordinate places in the ministry of finance. After the overthrow of his patron Laffitte, he seemed to change his politics and became much less radical, and, after the troubles of June 1832, this tendency was strengthened or rewarded by his appointment to the ministry of the interior. He repeatedly changed his portfolio, but remained in office for four years, became president of the council and in effect prime minister, and began the series of quarrels and jealousies with Guizot which make one of the chief and not the most creditable features of the politics of the reign. At the time of his resignation in 1836 he was foreign minister, and, as usual, wished for a spirited policy in Spain, which he could not carry out. He travelled in Italy for some time, and it was not till 1838 that he began a regular campaign of parliamentary opposition, which in March 1840 made him president of the council and foreign minister for the second time. But he held the position barely six months, and, being unable to force on the king an anti-English and anti-Turkish policy, resigned on October 29, after having, as was generally thought, with the direct purpose of stirring up Anglophobia, begged the body of Napoleon from England. This was made the occasion of the ceremony immortally ridiculed by Thackeray, and, it is said, condemned by Thiers himself as unworthy of the occasion. He now had little to do with politics for some years, and spent his time on the preparation, on a much larger scale than his first work, of his *Histoire du Consulat et de l'Empire*, the first volume of which appeared in 1845, and which continued to occupy him for more than twenty years of composition and nearly twenty of publication. During the interval, though he was still a member of the chamber, he spoke rarely, but after the beginning of 1846 his appearances were more frequent, and he was evidently bidding once more for power on the liberal and reforming side. Immediately before the revolution of February he went to all but the greatest lengths, and when it broke out he and Odillon Barrot were summoned by the king, but it was too late. Thiers was unable to govern the forces he had helped to gather, and he resigned.

Under the republic he took up the position of conservative republican, which he ever afterwards maintained (his acceptance of the republic being not much more heartfelt than his subsequent acceptance, after an interval, of the empire), and he never took office. But the consistency of his conduct, especially in voting for Prince Louis Napoleon as president, was often and sharply criticized, one of the criticisms leading to a duel with a fellow deputy, Bixio. On the whole, his conduct during these years, and still more during the last years of Louis Philippe, may be said to have been not wholly creditable. He was arrested at the *coup d'état* (when some malicious and apparently false stories were spread as to his cowardice), was sent to Mazas, and then escorted out of France But in the following summer he was allowed to return. For the next decade his history was almost a blank, his time being occupied for the most part on *The Consulate and the Empire*. It was not till 1863 that he re-entered political life, being elected by a Parisian constituency in opposition to the Government candidate. For the seven years following he was the chief speaker among the small band of anti-Imperialists in the French chamber, and was regarded generally as the most formidable enemy of the empire,—all the more formidable because he never gave occasion for taking any violent steps against him. It has been pointed out that, while nominally protesting against the foreign enterprises of the empire, he perpetually harped on French loss of prestige, and so contributed more than any one else to stir up the fatal spirit which brought on the war of 1870, and that, while constantly criticizing and weakening the Government of his country, he gave it no help nor even offered any. Even when the Liberal-Imperialist Ollivier ministry was formed, he maintained at first an anything but benevolent neutrality, and the an open opposition, and it would be pleasant to feel more certain than we can feel that his vigorous denunciation of the war with Prussia was the result of honest conviction, and not merely of the fact that it was not *his* war. At any rate, it brought him great unpopularity for the moment, with a corresponding reaction of gratitude when the crash came. Again it is impossible to be sure whether mere "canniness," or something better, kept him from joining the Government of the National Defence, of which he was in a manner the author.

Nevertheless the collapse of the empire was a great opportunity for Thiers, and it was worthily accepted. He undertook in the latter part of September and the first three weeks of October a circular tour to the different courts of Europe, in the hope (which he probably knew to be a vain one, though the knowledge neither daunted his spirit nor relaxed his efforts) of obtaining some intervention, or at least some good offices. The mission was unsuccessful; but the negotiator was on its conclusion immediately charged with another—that of obtaining, if possible, an armistice directly from Prince Bismarck. For a time this also failed, as the Provisional Government would not accept the German conditions; but at last France was forced to yield. The armistice having been arranged, and the opportunity having been thus obtained of electing a National Assembly, Thiers was chosen deputy by more than twenty constituencies (of which he preferred Paris), and was at once elected by the Assembly itself practically president, nominally "chef du pouvoir exécutif." He lost no time in choosing a coalition cabinet, and then personally took up the negotiation of peace. Probably no statesman has ever had a more disgusting task; and the fact that he discharged it to the satisfaction of a vast majority, even in a nation popularly reputed the vainest, the least ballasted with common sense, and the most ungrateful to public servants who are unsuccessful, is the strongest testimony to Thiers's merits. After contesting the matter, on the one side with the determination of Germany to have the pound of flesh, on the other with the reluctance of the Assembly to submit to the knife, he succeeded in convincing the deputies that the peace was necessary, and it was (March 1, 1871) voted by more than five to one.

Thiers held office for more than two years after this event,—a length of tenure which, in the circumstances and considering the French temper, is very surprising, and shows the strength of the general conviction that he alone could be trusted. He had at first to meet and crush at once the mad enterprise of the Paris commune; and the severity which was undoubtedly shown in doing this is more than justified by two considerations,—first, that failure to suppress it would have meant anarchy throughout France; and, secondly, that the Germans would almost to a certainty have made it a pretext for further demands. Soon after this was accomplished, Thiers became (August 30) in name as well as in fact president of the republic, and he set himself with vigour and success to the tasks of rearranging the army, the finances (including the paying off of the war indemnity), and the civil service, and of procuring the withdrawal of the German army of occupation.

The strong personal will and inflexible opinions of the president had much to do with the resurrection of France; but the very same facts made it inevitable that he should excite violent opposition. It seems to be generally acknowledged that to him personally were due the establishment and retention of the republican rather than the monarchical form of government, to which latter the Assembly as first elected was notoriously disposed. He was a confirmed protectionist, and free-trade ideas had made great way in France under the empire: he was an advocate of long military service, and the devotees of *la revanche* were all for the introduction of general and compulsory but short service. Both his talents and his temper made him utterly indisposed to maintain the distant, Olympian, apparently inactive, attitude which is supposed to be incumbent on a republican president; and (for his tongue was never a carefully governed one) he sometimes let drop expressions scarcely consistent with constitutional theories of the relation of the chief of the state, whether president or king, to parliament. In January 1872 he formally tendered his resignation; but the country was then in too manifestly disorganized a condition to allow even his enemies to accept it. His position, however, was clearly one not tenable for long in such a country as France. The Right (and not merely the Extreme Right) hated him for his opposition to the restoration of the monarchy, and with some justice reminded him of former declarations and opinions on the subject; the Extreme Left could not forgive the suppression of the commune, while some radical leaders, who may have had little sympathy with the commune itself, saw in his great reputation and imperious personality a bar to their own accession to power. His chief supporters—men like Rémusat, Barthélemy Saint-Hilaire, and Jules Simon—were men rather of the past than of the present; and he had few younger adherents.

The year 1873 was, as a parliamentary year in France, occupied to a great extent with attacks on Thiers. In the early spring regulations were proposed, and on April 13 were carried, which were intended to restrict the executive and especially the parliamentary powers of the president. On the 27th of the same month a contested election in Paris, resulting in the return of the opposition candidate, M. Barodet, was regarded as a grave disaster for the Thiers Government, and that Government was not much strengthened by a dissolution and reconstitution of the cabinet on May 19. Immediately afterwards the question was brought to a head by an interpellation moved by the duke of Broglie. The president declared that he should take this as a vote of want of confidence; and in the debates which followed a vote of this character (though on a different formal issue, and proposed by M. Ernoul) was carried by 16 votes in a house of 704. Thiers at once resigned (May 24).

He survived his fall four years, continuing to sit in the Assembly, and, after the dissolution of 1876, in the Chamber of Deputies, and sometimes, though rarely, speaking. He was also, on the occasion of this dissolution, elected senator for Belfort, which his exertions had saved for France; but he preferred the lower house, where he sat as of old for Paris. On May 16, 1877, he was one of the "363" who voted want of confidence in the Broglie ministry (thus paying his debts), and he took considerable part in organizing the subsequent electoral campaign. But he was not destined to see its success, being fatally struck with apoplexy at St Germain-en-Laye on September 3. Thiers had long been married, and his wife and sister-in-law, Mlle. Dosne, were his constant companions; but he left no children, and had had only one—a daughter,—who long predeceased him. He had been a member of the Academy since 1834. His personal appearance was remarkable, and not imposing, for he was very short, with plain features, ungainly gestures and manners, very near-sighted, and of disagreeable voice; yet he became (after wisely giving up an attempt at the ornate style of oratory) a very effective speaker in a kind of conversational manner, and in the epigram of debate he had no superior among the statesmen of his time except Lord Beaconsfield.

Thiers is by far the most gifted and interesting of the group of literary statesmen—not statesmen who have had a *penchant* for literature, but men of letters whose literary distinction has made them politicians—which forms a unique feature in the French political history of this century. Numerous as these are, there are only two who are at all comparable to him—Guizot and Lamartine; and as a statesman he stands far above both. Nor is this eminence merely due to his great opportunity in 1870; for Guizot might under Louis Philippe have almost made himself a French Walpole, at least a French Palmerston, and Lamartine's opportunities after 1848 were, for a man of political genius, illimitable. But both failed, —Lamartine almost ludicrously,—while Thiers in hard conditions made a striking if not a brilliant success. A devil's advocate may indeed urge that his egotist and almost gasconading temperament stood him in stead in the trying circumstances of his negotiations with the powers and with Prince Bismarck,—but this is not really to his discredit. No less masterful methods than his would have sufficed to bring France into order from the chaos succeeding the fall of the empire and the invasion of the Germans. But Thiers only showed well when he was practically supreme. Even as the minister of a constitutional monarch his intolerance of interference or joint authority, his temper at once imperious and intriguing, his inveterate inclination towards *brigue*, that is to say, underhand rivalry and caballing for power and place, showed themselves unfavourably; and his constant tendency to inflame the aggressive and chauvinist spirit of his country, though it may fairly claim to have been a kind of patriotism, neglected fact, was not based on any just estimate of the relative power and interests of France, and led his country more than once to the verge—once, though he affected to warn her off, over the verge—of a great calamity. In opposition, both under Louis Philippe and under the empire, and even to some extent in the last four years of his life, his worse qualities were always manifested. But with all these drawbacks he conquered and will retain a place in what is perhaps the highest, as it is certainly the smallest, class of statesmen—the class of those to whom their country has had recourse in a great disaster, who have shown in bringing her through that disaster the utmost constancy, courage, devotion, and skill, and who have been rewarded by as much success as the occasion permitted.

As a man of letters Thiers is very much smaller. He has not only the fault of diffuseness, which is common to so many of the best-known histories of this century, but others as serious or more so. The charge of dishonesty is one never to be lightly made against men of such distinction as his, especially when their evident confidence in their own infallibility, their faculty of ingenious casuistry, and the strength of will which makes them (unconsciously, no doubt) close and keep closed the eyes of their mind to all inconvenient facts and inferences supply a more charitable explanation. But it is certain that from Thiers's dealings with the men of the first Revolution to his dealings with the battle of Waterloo, constant, angry, and well-supported protests against his unfairness were not lacking. Although his search among documents was undoubtedly wide, its results are by no means always accurate, and his admirers themselves admit great inequalities of style in him. These characteristics reappear (accompanied, however, by frequent touches of the epigrammatic power above mentioned, which seems to have come to Thiers more readily as an orator or a journalist than as an historian) in his speeches, which have, since his death, been collected in many volumes, by his widow. Sainte-Beuve, whose notices of Thiers are generally kindly, says of him, "M. Thiers sait tout, tranche tout, parle de tout," and this omniscience and "cocksureness" (to use the word of a prime minister of England contemporary with this prime minister of France) are perhaps the chief pervading features both of the statesman and the man of letters.

His histories, in many different editions, and his speeches, as above, are easily accessible; his minor works and newspaper articles have not, we believe, been collected in any form. Works on him, by M. Laya, M. de Mazade, his colleague and friend M. Jules Simon, and others, are numerous. But a thorough biographical study of him has not yet been made; and, though monuments enough have been raised in his own country, it is even there often complained that the incessant and futile political struggles of the last ten years have too much obscured the reputation and weakened the memory of the last great statesman of France. (G. SA.)

THIRLWALL, Connop (1797-1875), bishop of St David's, was born at Stepney on 11th January 1797, and was the son of the Rev. Thomas Thirlwall, at the time lecturer at St Dunstan's, Stepney, and afterwards rector of Bowers Gifford, in Essex. The family were of Northumbrian extraction. Young Connop showed the most remarkable precocity, learning Latin at three, reading Greek at four, and writing sermons at seven. When he was twelve his admiring father published his *Primitiæ*, sermons and poems, the thoughts of an imitative boy in the style of a grown man. No especial greatness could have been safely predicted from these performances, which Thirlwall assiduously strove to suppress in after years. He shortly afterwards went to the Charterhouse, where he wrote a number of letters to a friend named John Candler, some of which have been preserved. They display the same extraordinary prematurity, but are barren of anything original except what he himself calls "sensibility to the great and beautiful in morality." By a curious coincidence his future rival in Greek history, Grote, and Hare, his coadjutor in the translation of Niebuhr, were among his schoolfellows. He took up his residence at Trinity College, Cambridge, in October 1814, and gained the Craven university scholarship, one of three recorded instances of this honour being obtained by freshmen, and the chancellor's classical medal. In October 1818 he was elected to a fellowship, and immediately went for a year's travel on the Continent. At Rome he gained the friendship of Bunsen, which had a most important influence on his life. On his return, "distrust of his own resolutions and convictions" led him to abandon for the time his intention of being a clergyman, and he settled down to the study of the law, "with a firm determination not to suffer it to engross my time so as to prevent me from pursuing other branches of knowledge." This was not the way to become lord chancellor, and, though he afterwards says, "My aversion to the law has not increased," he adds, "It scarcely could." How little his heart was with it was shown by the labour he soon imposed upon himself of translating and prefacing Schleiermacher's essay on the Gospel of St Luke, "very injudiciously," says Maurice, who seems to think that it may have cost Thirlwall the archbishopric of Canterbury. The translation, nevertheless, marks an era in English theology. He further, probably influenced by Hare, who had already translated Tieck, rendered two of the latter's most recent *Novellen* into English. In 1827 he at length made up his mind to quit his uncongenial profession, and was ordained deacon the same year. Beyond all question he might have obtained the highest distinction both as jurist and advocate, had law interested him more, or other things less. No one ever possessed a more judicial mind. Of his oratory, Mill, whom he opposed at a debating society, says, "Before he had uttered ten sentences I set him down as the best speaker I had ever heard, and I have never since heard any one whom I placed above him."

It is not often that a scholar twice makes an epoch by a translation. Such was Thirlwall's destiny: he joined with Hare in translating Niebuhr's *History of Rome*; the first volume appeared in 1828. The translation was attacked in the *Quarterly* as favourable to scepticism, and the translators jointly replied. In 1831 the friends established the *Philological Museum*, which lived through only six numbers, though among Thirlwall's contributions was his masterly paper on the irony of Sophocles,—"the most exquisite criticism I ever read," says Sterling. On Hare's departure from Cambridge in 1832, Thirlwall became assistant college tutor, which led him to take a memorable share in the great controversy upon the admission of Dissenters which arose in 1834. Dr Turton, the regius professor of divinity, had written a pamphlet objecting to the admission, on the pretext of the apprehended unsettlement of the religious opinions of young churchmen. Thirlwall replied by pointing out that no provision for theological instruction was in fact made by the colleges except compulsory attendance at chapel, and that this was mischievous. This attack upon a time-hallowed piece of college discipline brought upon him a demand for the resignation of his office as assistant tutor. He complied at once; his friends generally thought that he ought to have tested the master's power. The occurrence marked him out for promotion from a Liberal Government, and in the autumn he received the chancellor's living of Kirby-under-Dale, in Yorkshire. Though devoted to his parochial duties, he found time to begin the book which has remained the principal work of one whose performance, however great, rarely rose to the level of his power. His *History of Greece*, unfortunately for him and for us, was a commission from Lardner's *Cabinet Cyclopædia*, and was originally intended to have been condensed into two or three duodecimo volumes. The scale was enlarged, but Thirlwall always felt cramped. He seems a little below his subject, and a little below himself. Yet, such was his ability that his history is usually allowed to fall only just short of Grote's, a work undertaken with far greater enthusiasm, and executed with far greater advantages. Sterling pronounces him "a writer as great as Thucydides and Tacitus, and with far more knowledge than they." The first volume was published in 1835, the last in 1847. A noble letter from Thirlwall to Grote, and Grote's generous reply, are published in the life of the latter.

In 1840 Thirlwall was raised to the see of St David's. The promotion was entirely the act of Lord Melbourne, an amateur in theology, who had read Thirlwall's introduction to Schleiermacher, and satisfied himself of the propriety of the appointment. "I don't intend to make a heterodox bishop if I know it," he said. Thirlwall so little expected the honour that he was absent on a pedestrian tour, and it was some days before he could be found. In most essential points he was a model bishop, and in acquainting himself with Welsh, so as to preach and conduct service in that language, he performed a feat which few bishops could have imitated. It cannot be said that he was greatly beloved by his clergy, who felt their intellectual distance too great, and were alternately frozen by his taciturnity and appalled by his sarcasm. The great monument of his episcopate is the eleven famous charges in which he from time to time reviewed the position of the English Church with reference to whatever might be the most pressing question of the day,—addresses at once judicial and statesmanlike, full of charitable wisdom and massive sense. No similar productions, it may safely be said, were ever so eagerly looked for, or carried with them such weight of authority. His endeavours to allay ecclesiastical panic, and to promote liberality of spirit, frequently required no ordinary moral courage. He was one of the four prelates who refused to inhibit Bishop Colenso from preaching in their dioceses, and the only one who withheld his signature from the addresses calling upon Colenso to resign his see. He took the liberal side in the questions of Maynooth, of the admission of Jews to parliament, of the Gorham case, and of the conscience clause. He was the only bishop who voted for the disestablishment of the Irish Church, though but as a painful necessity. Concurrent endowment would have been much more agreeable to him. For many years he was the only statesman on the bench; it would have been a great benefit to the Church of England had it been possible to have raised him to the primacy upon the death of Archbishop Howley. But such was the complexion of ecclesiastical politics that the elevation of the most impartial prelate of his day would have been resented as a piece of party spirit.

Thirlwall's private life was happy and busy. He never married, but found sufficient outlet for his deep affectionateness of nature in his tenderness to the children of others, and to all weak things except weak-minded clergymen. He was devoted to animals, and rivalled Southey and Jeremy Bentham in his love for cats. Perhaps the most durable monument to his memory will be his incomparable volume of letters to a friend, Miss Johnes of Dolaucothy, a young lady in every way worthy to be the correspondent of such a man. Even as letters these rank with the best in the language; but as letters from age to youth, sympathizing with all its feelings, entering into all its pleasures, at once inspiring and amusing, guiding without seeming to direct, and entertaining without seeming to condescend, they are unique in their delightful branch of literature. They are also important as revealing Thirlwall's mind on numerous subjects which he has not elsewhere treated, and most interesting from their picture of simplicity of character associated with greatness of intellect, and of the multiplicity of his intellectual interests, from which novels and fine art were by no means excluded. During his latter years he took great interest in the revision of the authorized version of the Bible, and was chairman of the revisers of the Old Testament. He resigned his see in May 1874, and retired to Bath, where he died on July 27, 1875.

As scholar, critic, and ecclesiastical statesman Thirlwall is almost above praise. He was not a great original thinker; he lacked the creative faculty and the creative impulse. The world owes such vestiges of his power as it possesses to a series of fortunate accidents—an importunate editor, vexatious church controversies, and an admirable friend. Though not most fully exerted, the force of his mind is perhaps best appreciated in the volume of his letters edited by Dean Perowne. His treatment of every question is consummate; the largest and the smallest seem alike to him. His character, with its mixture of greatness and gentleness, was thus read by Carlyle:—"a right solid honest-hearted man, full of knowledge and sense, and, in spite of his positive temper, almost timid."

Thirlwall's *History of Greece* remains a standard book. His literary and theological remains have been edited by Dean Perowne in three volumes, two of which are occupied by his charges. His letters on literary and theological subjects, with a connecting memoir, have been published by Dean Perowne and the Rev. Louis Stokes. His *Letters to a Friend* were originally published by Dean Stanley, and there is a revised and corrected edition. For a general view of Thirlwall's life and character, see the *Edinburgh Review*, vol. cxliii.; for a picture of him in his diocese, *Temple Bar*, vol. lxxvi. The review of his letters in *Blackwood's Magazine* for 1852 is by the late Rev. W. Lucas Collins. (R. G.)

THIRSK, a market-town in the North Riding of Yorkshire, is situated on the North Eastern Railway, and on the Codbeck, a branch of the Swale, 21 miles south of Darlington, 11 north-east of Ripon, and 210 north of London. The Codbeck is crossed by two stone bridges connecting the old and the new town. The church of St Mary, in the Perpendicular style, with parvise, chancel, nave, aisles, porch, and tower 80 feet in height, is the noblest church in the Riding. The chancel was repaired in 1844, and the whole building restored in 1877. The moat of the ancient castle built by the Mowbrays about 980 still remains. The principal modern buildings are the assembly rooms (1849), the mechanics' institute (1852), and the new court-house (1886). Standing in the fertile district of the Vale of Mowbray, the town has an extensive home and foreign agricultural implement trade. Ironfounding, engineering, tanning, and brickmaking are carried on, and there are large flour-mills. The population of the parliamentary borough, now disfranchised (area 11,828 acres), in 1871 was 5734, and in 1881 it was 6312. The population of the township in 1881 was 3337.

Thirsk owes its origin to the castle of the Mowbrays, and here Roger de Mowbray erected his standard, in conjunction with the king of Scotland, against Henry II. Upon the suppression of the revolt the castle was destroyed. In the reign of Henry VII., Henry Percy, earl of Northumberland, is said to have been put to death beneath an elm tree which formerly grew on St James's Green. Thirsk was a borough by prescription, but was never incorporated. It first returned members to parliament in the reign of Edward I., but not again till the last parliament of Edward VI. In 1832 the number of representatives was reduced to one, and in 1885 it ceased to be separately represented.

THISTLE. This term, as generally employed, is of vague application, being given to almost any herbaceous plant that is of a spiny character. More strictly, it is applied to the species of *Carduus*. These are Composite herbs with very spiny leaves, and similar bracts surrounding a head of purplish-white, tubular, 5-parted flowers seated on a pitted and hairy receptacle. The anthers have appendages both at the apex and at the base. The style has a ring of hairs at the point of bifurcation of the two stigmata. The fruit is surmounted by a tuft of silky white hairs. The species are numerous, and some are of great beauty, though not unnaturally looked on with disfavour by the farmer. The Cotton Thistle, remarkable for its covering of white down, is *Onopordon Acanthium*; the Blessed Thistle is *Carduus benedictus*; the Holy Thistle, the leaves of which are spotted with white, is *C. Marianus*. The common *C. lanceolatus* seems to be the most suitable prototype for the Scotch Thistle, though that honour is also conferred on *Onopordon Acanthium*, the cotton thistle, a doubtful native, and on other species. The great objection to thistles from an agricultural point of view resides in the freedom with which they produce seed, and in the vigour of their underground growth, which makes their uprooting a matter of difficulty. Partial uprooting may indeed, in the case of the perennial species, increase the mischief, for each fragment left behind may grow into a distinct plant. Annual species might be kept in check were they cut down before the flowers appear, but unless all the cultivators in a particular district co-operate the efforts of individuals are of little avail. The Globe Artichoke and Cardoon are very near allies of the thistles. The Safflower, *Carthamus*, another thistle, yields a serviceable dye; the Burdock, *Arctium lappa*, has an edible root; and numerous allied species have medicinal properties.

THISTLE, ORDER OF THE. See KNIGHTHOOD, vol. xiv. p. 123.

THISTLEWOOD CONSPIRACY, or CATO STREET CONSPIRACY, a plot formed in 1820 to murder Lord Castlereagh and other ministers of the British crown, and to seize the Bank and Mansion-House and proclaim a provisional government. Its chief instigator was Arthur Thistlewood, or properly Thistlewaite, born in 1770, the son of a civil engineer in Lincolnshire, who had held a commission in the militia and afterwards in the line in the West Indies. In America and in France he had imbibed revolutionary views, and, having lost his wife's fortune in speculation and on the turf, had planned the desperate scheme probably for his own benefit as well as the good of the nation. The intention was to murder the ministers in the house of the earl of Harrowby in Mansfield Street on the evening of the 23d February. For this purpose between twenty and thirty men assembled in a stable in Cato Street, Edgeware Road, but while they were arming themselves they were pounced upon by the police, and a large number captured, though the majority, including Thistlewood, escaped. A reward of £1000 having been offered for Thistlewood, he was arrested next day at 10 White Street. After a trial Thistlewood and four others were executed on the 1st May, while five were transported. On being asked on the scaffold if he repented, Thistlewood replied, "No, not at all; I shall soon know the last grand secret."

See the *Trials of Arthur Thistlewood, James Ings, John Thomas Brunt, Richard Tidd, William Davidson, and others at the Session of the Old Bailey 17-28 April 1820*, 2 vols., 1820; and the *Gentleman's Magazine* for the same year.

THOLUCK, FRIEDRICH AUGUST GOTTREU (1799–1877), German theologian and preacher, was born at Breslau, March 30, 1799, in humble circumstances. He received his education at the grammar school and university of his native town, and early distinguished himself by wonderful versatility of mind, a phenomenal power of acquiring languages, and an omnivorous appetite for books. A romantic love of the East and its literature led him to exchange the university of Breslau for that of Berlin, that he might study Oriental languages to greater advantage, and there he was received into the house of the Orientalist Von Dietz. He was introduced to Pietistic circles in Berlin, and came specially under the influence of Baron Von Kottwitz, who became his "spiritual father," and of the historian Neander. Before deciding on the career of theological professor, he had in view that of a missionary in the East. Meanwhile he was feeling the influence to a certain degree of the romantic school, and of Schleiermacher and Hegel too, though he never sounded the depths of their systems. At length, in his twenty-first year, he finally decided to adopt the academical calling. From December 1820 to April 1826 he was "privat-docent" and "prof. extraordinarius" of theology in Berlin, though he was at the same time most active in the work of home and foreign missions. He lectured on the Old and New Testaments, theology, apologetics, and the history of the church in the 18th century. The first fruit of his Oriental studies and his introduction to his profession was his work *Ssufismus, sive Theosophia Persarum Pantheistica* (1821); following the same line of study he published *Blütensammlung aus der morgenländischen Mystik* (1825) and *Speculative Trinitätslehre des späteren Orients* (1826). His well-known essay on the nature and moral influence of heathenism (1822) was published by Neander, with high commendation, in his *Denkwürdigkeiten*; and his *Commentary on the Epistle to the Romans* (1824) secured him a foremost place amongst the most suggestive, if not the most accurate, Biblical interpreters of that time. Another work, which was soon translated into all the principal European languages, *Die Lehre von der Sünde und vom Versöhner* (1823), the outcome of his own religious history, procured for him the position which he ever after held of the modern Pietistic apologist of evangelical Christianity. In 1825, with the aid of the Prussian Government, he visited the libraries of England and Holland, and on his return was appointed professor of theology at Halle, the centre of German rationalism. Here he made it his aim to combine in a higher unity the learning and to some extent the rationalism of Semler with the devout and active pietism of Francke; and, in spite of the opposition of the theological faculty of the university, he succeeded in changing the character of its theology. This he effected partly by his lectures, particularly his exegetical courses, but, above all, by his personal influence upon the students, and, after 1833, by his preaching. His theological position was that of a mild and large-hearted orthodoxy, which laid more stress upon Christian experience than upon rigid dogmatic belief. On the two great questions of miracles and inspiration he made great concessions to modern criticism and philosophy. The battle of his life was on behalf of personal religious experience, in opposition to the externality of rationalism, orthodoxy, or sacramentarianism. He fought this battle with weapons taken in the first instance from his own personal history, but also from the wide world of human culture, ancient and modern. Carl Schwarz happily remarks that, as the English apologists of the 18th century were themselves infected with the poison of the deists whom they endeavoured to refute, so Tholuck absorbed some of the heresies of the rationalists whom he tried to overthrow. As a preacher Tholuck ranked amongst the foremost of his time. He was also one of the prominent members of the Evangelical Alliance, and few men were more widely known or more beloved throughout the Protestant churches of Europe and America than he. He died at Halle, June 10, 1877.

After his commentaries (on Romans, the Gospel of John, the Sermon on the Mount, and the Epistle to the Hebrews) and several volumes of sermons, his best-known books are *Stunden christlicher Andacht* (1839, 8th ed. 1870), intended to take the place of Zschokke's standard rationalistic work with the same title, and his reply to Strauss's *Life of Jesus* (*Glaubwürdigkeit der evangelischen*

Geschichte, 1887). He published at various times valuable contributions towards a history of rationalism,—*Vorgeschichte des Rationalismus* (1853–62), *Geschichte des Rationalismus*, i. (1865), and a number of essays connected with the history of theology and especially of apologetics. His views of inspiration were indicated in his work *Die Propheten und ihre Weissagungen* (1860), in his essay on the "Alte Inspirationslehre," *Deutsche Zeitschrift für christliche Wissenschaft* (1850), and in his *Gespräche über die vornehmsten Glaubensfragen der Zeit* (1846, 2d ed. 1867).

See *Das Leben Tholucks*, by L. Witte, 2 vols., 1884–1886; *A. Tholuck, ein Lebensabriss*, by M. Kähler (1877), and the same author's art. "Tholuck," in Herzog's *Real-Encyklopädie*; "Zur Erinnerung an Tholuck," by C. Siegfried, *Protestantische Kirchzeitung*, 1885 No. 45, and 1886, No. 47; Carl Schwarz, *Zur Geschichte der neuesten Theologie* (4th ed., 1869); Nippold's *Handbuch der neuesten Kirchengeschichte*

THOMAS, St, one of the twelve apostles. The synoptical Gospels give only his name, associating him in their lists with Matthew (Mat. x. 3; Mark iii. 18; Luke vi. 15); in Acts i. 13 he is coupled with Philip. In the Gospel of John (xi. 16; xiv. 5; xx. 24 *sq.*; xxi. 2) he appears in a characteristic light, full of personal devotion and ready to die with his Master, but slow to grasp the true significance of the redeeming death of Jesus, and incredulous of the resurrection till direct evidence convinces him of its truth and at the same time of the Divinity of his risen Lord. John translates the Aramaic name or surname Thomas (תאומא) by the Greek equivalent Didymus (twin) Tradition has it that he was the twin brother of a sister Lysia (his parents being Diophanes and Rhoa, and his birthplace Antioch; "XII. Apost. Patriæ," in *Chron. Pasch.*, ii. 142), or of a brother Elieser (*Hom. Clem.*, ii. 1), or, according to the *Acta Thomæ* (ed. Bonnet, pp. 11, 23), of Jesus Himself. The last form of the tradition seems to be derived from the name Judas Thomas, which he bears in Edessene legend (*cf.* Eusebius, *H. E.*, i. 13, 10), and implies the identification of Thomas with Judas, the brother of the Lord. The most ancient tradition makes Thomas the evangelist of Parthia (Eus., *H. E.*, iii. 1, 1); and at Edessa, which claimed to possess his bones, it was related that their missionary Thaddæus (Eus., *H. E.*, i. 13, 10), or Addai (*Doctrine of Addai*, ed. Phillips, 1876, p. 5), was sent to them by him. Later tradition, originating with the Gnostic *Acta Thomæ*, and accepted by catholic teachers from the middle of the 4th century, makes him proceed to India and there suffer martyrdom. The Indian king Gundaphorus of the *Acta* is, however, certainly identical with the historical Gondophares (see Persia, vol. xviii. p. 603), whose dynasty was Parthian, though his realm included regions loosely reckoned to India. The Parthian and Indian missions of Thomas may perhaps therefore be regarded as derived from a single tradition. Later authors, but not the *Acta*, give as the scene of his martyrdom the city of Calamina, which the modern Christians of St Thomas (see below) identify with Mylapur, but which Gutschmid would connect with the Calama of Nearchus, on the coast of Gedrosia, which was under the sceptre of Gondophares. Other names of historical persons and places can be traced with more or less probability in the *Acta*, but these do not alter the utterly apocryphal character of the legend, which indeed is in many respects easier to understand if we accept the bold hypothesis of Gutschmid, that it was borrowed by the Gnostic author from a Buddhist story of the conversion of Arachosia (*N. Rhein. Mus.*, xix. 161 *sq.*).

The *Acta Thomæ*, very imperfectly published by Thilo (1823) and Tischendorf (1851), have been edited in Greek, together with the Latin *De Miraculis* and *Passio S. Thomæ*, by Bonnet (Leipsic, 1883), and in Syriac, with an English translation, by W. Wright (*Apocryphal Acts*, 2 vols., London, 1871). See also Lipsius, *Die apocryphen Apostelgeschichten*, vol. i. (Brunswick, 1883), for these and other versions of the legend. The *Acta* are said by Photius to be a part of the Περίοδοι τῶν ἀποστόλων of the Gnostic Leucius Charinus, but this unknown personage is to be thought of as a collector of Gnostic "Acts of Apostles," rather than as the first author. In spite of extensive catholic revision, they form one of the most interesting monuments of early Gnosticism. Internal evidence assigns them with great probability to the school of Bardesanes, and the very ancient allegorical hymn about the soul which is inserted in the Syriac text (p. 274 *sq.*, Eng. tr., p. 238 *sq.*) is perhaps by Bardesanes himself (*cf.* Noldeke in *Z. D. M G.*, 1871, p. 676). It is one of the most remarkable pieces in Syriac literature.

Christians of St Thomas is a name often applied to the members of the ancient Christian churches of southern India, which claim him as their first founder, and honour as their second founder a certain Thomas of Jerusalem, who is said to have led a Christian colony to Malabar in 345 A.D.[1] According to their tradition, St Thomas went from Malabar to Mylapur, now a suburb of Madras, where the shrine of his martyrdom, rebuilt by the Portuguese in 1547, still stands on Mount St Thomas, and where a miraculous cross is shown with a Pahlavi inscription which may be as old as the end of the 7th century. We know from Cosmas Indopleustes that there were Christian churches of Persian (East-Syrian) origin, and doubtless of Nestorian creed, in Ceylon, in Malabar, and at Caliana (north of Bombay) before the middle of the 6th century, and even then St Thomas, the reputed apostle of Persia, may have been their special saint. The ancient churches of southern India never died out or wholly lost their sense of connexion with their mother church, for we find them sending deputies in 1490 to the Nestorian patriarch Simeon, who furnished them with bishops (Assemani, *Bib. Or.*, iii. 1, 590 *sq.*). Hard pressed by the Moslems, they welcomed the approach of the Portuguese, but proved by no means tractable to efforts to bring them within the Roman obedience. At length a formal union with Rome was carried through in the synod of Diamper (1599). Syriac was to remain the ecclesiastical language, but the service books were corrected and purified from error. A century and a half of foreign Jesuit rule followed, but the love of independence was not lost. A great schism took place in 1653, and of 200,000 Christians of St Thomas only 400 remained loyal to Rome, though many of their churches were soon won back by the Carmelites. Those who remained independent fell under the influence of the Jacobite Mar Gregorius, styled patriarch of Jerusalem, who reached Malabar in 1665 as an emissary from Ignatius, patriarch of Antioch. From his time the independent Christians have been Jacobites, the counter-efforts of the Nestorians under Mar Gabriel, bishop of Adharbaijan, having apparently come to nothing after his death in 1730. Since the visit of Claudius Buchanan, whose *Christian Researches in Asia* (1811) excited great interest, much has been done for the Christians of South India by English missionary effort, and Anglicans have cultivated friendly relations with the clergy of the independent native church, while discouraging dependence on the Jacobite patriarch of Antioch.

A valuable though tedious and ill-arranged history of the Christians of St Thomas has been written by W. Germann, *Die Kirche der Thomaschristen*, Gütersloh, 1877. See also La Croze, *Histoire du Christianisme des Indes*, The Hague, 1724; Alexius de Menezes, *Historia Ecclesiæ Malabaricæ*, Latin by F. Raulin, Rome, 1745 (especially for the synod of Diamper); Paulinus a S. Bartholomæo, *India Orientalis Christiana*, 4to, Rome, 1794.

THOMAS, St, of Aquino. See Aquinas.

THOMAS BECKET, or À Becket. See À Becket

THOMAS of Celano, the contemporary and supposed biographer of Francis of Assisi, was born probably towards the end of the 12th century, and died about 1255. He derives his surname from Celano (*q.v.*), in the Abruzzo Ulteriore. His name does not occur among those of the earliest disciples of Francis, but he is recorded by some historians of the order, though not by all, to have held the office of custos in various Franciscan houses (Cologne, Mainz, Worms, Spires) from 1221 onwards. An old biography of Francis, which is incorporated in the *Acta Sanctorum*, is attributed to Thomas with much probability, and nothing cogent has been urged against his authorship of the *Dies Iræ* (see Hymns, vol. xii. p. 583), although, so far as is at present known, his name is not associated with that remarkable poem by any writer earlier than 1385.

THOMAS of Erceldoune, called also the Rhymer (*c.* 1225–*c.* 1300), occupies a prominent place as a poet and prophet in the mythical and legendary literature of Scotland. The historical person of that name figures in two charters of the 13th century, and from these it appears that he owned lands in Erceldoune (now Earlston), in Berwickshire, which were made over by his son and heir to the cloister of the Holy Trinity at Soltra, or Soutra, on

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[1] See the sketch in Syriac of the history of the church of Malabar printed and translated by Land, *Anecd. Syr.*, i. 24 *sq.* It was sent to Schaaf at Leyden in 1720 by Mar Gabriel, the last Nestorian bishop in Malabar (see Germann, p. 542).

Digiti

the borders of the same county. He figures in the works of Barbour and Blind Harry as the sympathizing contemporary of their heroes, and Wyntoun tells how he prophesied a battle. In the folk-lore of Scotland his name is associated with numerous fragments of rhymed or alliterative verse of a more or less prophetic and oracular character; but the chief extant work with which his name is associated is the poem of *Sir Tristrem*, edited from the Auchinleck MS. by Sir Walter Scott in 1804, and again in 1886 for the Scottish Text Society by Mr G. P. M'Neill. In the latter edition the claim of Thomas to the authorship of this work (conceded by both editors) is fully discussed.

THOMAS A KEMPIS. See Kempis.

THOMASIUS, Christian (1655–1728), German jurist and publicist, was born at Leipsic January 1, 1655, and educated by his father Jacob Thomasius, professor of philosophy and eloquence, a learned man, and friend of Spener. Through his father's lectures Christian came under the influence of the political philosophy of Grotius and Pufendorf, and continued the study of law under Stryck at Frankfurt on the Oder. In 1681 he commenced the career of professor of law at Leipsic, and soon attracted attention by his abilities, but particularly by his daring attack upon all ancient prejudices. His views on matters of law were heretical; he made the daring innovation of lecturing in German instead of Latin; he published a monthly periodical in which he ridiculed with vast wit and humour the pedantic weaknesses of the learned; he took valiantly the side of the Pietists in their controversy with the orthodox, and defended mixed marriages of Lutherans and Calvinists. In consequence of these and other sins, he was preached against from the pulpits, forbidden to lecture or to write (May 10, 1690), and his arrest was soon commanded. He escaped the latter by flight to Berlin, and the elector Frederick III. offered him a refuge in Halle, with a salary of 500 thalers and the right to lecture there. He took part in founding the university of Halle (1694), where he became second and then first professor of law and director of the university. He was one of the most esteemed university teachers and influential writers of his day. He died, after a singularly successful and honourable career, in his 74th year, September 23, 1728.

Though not a profound and systematic philosophical thinker, but rather a clever eclectic of the common-sense school, Thomasius prepared the way for great reforms in philosophy, and, above all, in law, literature, social life, and theology. It was his mission to bring all the high matters of divine and human sciences into close and living contact with the everyday world. He made learning, law, philosophy, and theology look at everything from a rational common-sense point of view, and speak of everything in vigorous German. He thus created an epoch in German literature, philosophy, and law, and Spittler opens with him the modern period of ecclesiastical history. Tholuck pronounces him "the personified spirit of illuminism." He made it one of the aims of his life to free politics and jurisprudence from the control of theology. He fought bravely and consistently for freedom of thought and speech on religious matters. He is often spoken of in German works as the author of the "territorial system," or Erastian theory of ecclesiastical government. But he taught that the state may interfere with legal or public duties only, and not with moral or private ones. He introduced a new definition of heresy, and pronounced it a bugbear of the theologians. He would not have even atheists punished, though they should be expelled the country. He came forward as an earnest opponent of the prosecution of witches and of the use of torture. In theology he was not a naturalist or a deist, but a believer in the necessity of revealed religion for salvation. He felt strongly the influence of the Pietists at times, particularly of Spener, and there was a mystic vein in his thought; but other elements of his nature were too powerful to allow him to attach himself finally to that party.

Thomasius's most popular and influential German publications were his periodical *Monatsgespräche, vornehmlich über neue Bücher* (1688); *Einleitung zur Vernunftlehre* (1691, 5th ed. 1719); *Vernünftige Gedanken über allerhand auserlesene, gemischte, philosophische, und juristische Händel* (1723–26); *Geschichte der Weisheit und Thorheit* (3 vols., 1693); *Kurze Lehrsätze von dem Laster der Zauberei mit dem Hexenprocess* (1704); *Weitere Erläuterungen der neueren Wissenschaft Anderer Gedanken kennen zu lernen* (1711).

See Heinrich Luden's *Christian Thomasius nach seinen Schicksalen und Schriften*, 1805; Zeller's *Geschichte der Philosophie in Deutschland*, 2d ed., 1875, pp. 162–171; Gass, *Geschichte der Protestantischen Dogmatik*, ii. 484 sq.; the histories of German literature, especially Hettner's *Geschichte der deutschen Lit. im 18ten Jahrh.*; Tholuck's article in Herzog's *Real-Encyklop.*

THOMPSON, Sir Benjamin, Count Rumford (1753–1814), an eminent man of science, enlightened philanthropist, and sagacious public administrator, was born at Woburn, in Massachusetts, in 1753, and died at Auteuil, near Paris, in 1814. His family had been settled in New England since the middle of the century preceding his birth, and belonged to the class of moderately wealthy farmers. His father died while Thompson was very young, and his mother speedily married a second time. But he seems to have been well cared for, and his education was so far from neglected that, according to his own statement, he was at the age of fourteen sufficiently advanced "in algebra, geometry, astronomy, and even the higher mathematics," to calculate a solar eclipse within four seconds of accuracy. In 1766 he was apprenticed to a storekeeper at Salem, in New England, and while in that employment occupied himself in chemical and mechanical experiments, as well as in engraving, in which he attained to some proficiency. The outbreak of the American war put a stop to the trade of his master, and he thereupon left Salem and went to Boston, where he engaged himself as assistant in another store. He afterwards applied himself to the study, with a view to the practice, of medicine, and then (although, as he affirms, for only six weeks and three days) he became a school teacher—it is believed at Bradford on the Merrimack. Thompson was at that period between eighteen and nineteen years old, and at nineteen, he says, "I married, or rather I was married." His wife was the widow of a Colonel Rolfe, and the daughter of a Mr Walker, "a highly respectable minister, and one of the first settlers at Rumford," now called Concord, in New Hampshire. His wife was possessed of considerable property, and was his senior by fourteen years. This marriage was the foundation of Thompson's success. Within three years of it, however, he left his wife in America to make his way to wealth and distinction in Europe, and, although his only child by her, a daughter, subsequently joined him, he never saw and, so far as anything appears to the contrary, never attempted or desired to see her again.

Soon after his marriage Thompson became acquainted with Governor Wentworth of New Hampshire, who, struck by his appearance and bearing, conferred on him the majority of a local regiment of militia. He speedily became the object of distrust among the friends of the American cause, and it was considered prudent that he should seek an early opportunity of leaving the country. On the evacuation of Boston by the royal troops, therefore, in 1776, he was selected by Governor Wentworth to carry despatches to England. On his arrival in London he almost immediately attracted the attention of Lord George Germaine, secretary of state, who appointed him to a clerkship in his office. Within a few months he was advanced to the post of secretary of the province of Georgia, and in about four years he was made under-secretary of state. His official duties, however, did not materially interfere with the prosecution of scientific pursuits, and in 1779 he was elected a fellow of the Royal Society. Among the subjects to which he especially directed his attention were the explosive force of gunpowder, the construction of firearms, and the system of signalling at sea. In connexion with the last, he made a cruise in the Channel fleet, on board the "Victory," as a volunteer under the command of Admiral Sir Charles Hardy. On the resignation of Lord North's administration, of which Lord George Germaine was one of the least lucky and most unpopular members, Thompson left the civil service, and was nominated to a cavalry command in the revolted provinces of America. But the War of Independence was practically at an end, and in 1783 he finally quitted active service, with the rank and half-pay of a lieutenant-colonel. He now formed the design of joining the Austrian army, for the purpose of campaigning against the Turks, and so crossed over from Dover to Calais with Gibbon, who, writing to his friend Lord Sheffield, calls his fellow-passenger "Mr Secretary-Colonel-Admiral-Philosopher Thompson." At Strasburg he was introduced to Prince Maximilian, afterwards elector of Bavaria, and was by him invited to enter the civil and military service of that state. Having obtained the leave of the British Government to accept the prince's offer, he received the honour of knighthood from George III., and during eleven years he remained at Munich as minister of war, minister of police, and grand chamberlain to the elector. His political and courtly employments, however, did not absorb all his time, and he contributed during his stay in Bavaria a number of papers to the *Philosophical Transactions*. But that he was sufficiently alert as the principal adviser of the elector the results of his labours in that capacity amply prove. He reorganized the Bavarian army; he suppressed mendicity and found employment for the poor; and he immensely improved the condition of the industrial classes throughout the country by providing them with work and instructing them in the practice of domestic economy. Of the prompt and the business-like manner in which he was wont to carry his plans into execution a single example may serve as an illustration. The multitude of beggars in Bavaria had long been a public nuisance and danger. In one day Thompson caused no fewer than 2600 of these outcasts and depredators in Munich and its suburbs alone to be arrested by military patrols, and transferred by them to an industrial establishment which he had prepared for their reception. In this institution they were both housed and fed, and they not only supported themselves by their labours but earned a surplus for the benefit of the electoral revenues. The principle on which their treatment proceeded is stated by Thompson in the following memorable words:—"To make vicious and abandoned people happy," he says, "it has generally been supposed necessary first to make them virtuous. But why not reverse this order? Why not make them first happy, and then virtuous?" In 1791 he was created a count of the Holy Roman Empire, and chose his title of Rumford from the name as it then was of the American township to which his wife's family belonged. In 1795 he visited England, one incident of his journey being the loss of all his private papers, including the materials for an autobiography, which were contained in a box stolen from off his postchaise in St Paul's Churchyard. During his residence in London he applied himself to the discovery of methods for curing smoky chimneys and the contrivance of improvements in the construction of fireplaces. But he was quickly recalled to Bavaria, Munich being threatened at once by an Austrian and a French army. The elector fled from his capital, and it was entirely owing to Rumford's energy and tact that a hostile occupation of the city was prevented. It was now proposed that he should be accredited as Bavarian ambassador in London; but the circumstance that he was a British subject presented an insurmountable obstacle. He, however, again came to England, and remained there in a private station for several years. In 1799 he, in conjunction with Sir Joseph Banks, projected the establishment of the Royal Institution, which received its charter of incorporation from George III. in 1800. Rumford himself selected Sir Humphry Davy as the first scientific lecturer there. Until 1804, when he definitively settled in France, Rumford lived at the Royal Institution in Albemarle Street, or at a house which he rented at Brompton, where he passed his time in the steady pursuit of those researches relating to heat and light and the economy of fuel on which his scientific fame is principally based. He then established himself in Paris, and married (his first wife having been dead for many years) as his second wife the wealthy widow of Lavoisier, the celebrated chemist. With this lady he led an extremely uncomfortable life, till at last they agreed to separate. Rumford took up his residence at Auteuil, where he died suddenly in 1814. in the sixty-second year of his age.

He was the founder and the first recipient of the Rumford medal of the London Royal Society. He was also the founder of the Rumford medal of the American Academy of Arts and Sciences and of the Rumford professorship in Harvard university. His complete works were published by the American Academy of Arts and Sciences at Boston in 1872; and a full and extremely interesting memoir of the author which was issued with them was republished in London by Messrs Macmillan in 1876. (F. DR.)

THOMPSON, Thomas Peronnet (1783–1869), mathematician and political writer, was born at Hull in 1783. He was educated at the Hull grammar school, and in October 1798 entered Queens' College, Cambridge. He entered the navy as midshipman in the "Isis" in 1803, but in 1806 exchanged to the army. Through his acquaintance with Wilberforce, he was appointed governor of Sierra Leone in 1808, but was recalled on account of his hostility to the slave trade. In 1812 he returned to his military duties, and, after serving in the south of France, was in 1815 attached as Arabic interpreter to an expedition against the Wahhabees of the Persian Gulf, with whom he negotiated a treaty (dated January 1820) in which the slave trade was for the first time declared piracy. He was promoted major in 1825, lieutenant-colonel in 1829, and major-general in 1854. He entered parliament as member for Hull in 1835, and afterwards sat for Bradford. He took a prominent part in the corn-law agitation, his *Catechism of the Corn Laws* (1827) being by far the most effective pamphlet published on the subject. He was joint-editor of the *Westminster Review*, to which he contributed a large number of articles, republished in 1824 in six volumes, under the title *Exercises, Political and Others*. His mathematical publications were of a somewhat eccentric kind. He published a *Theory of Parallels* (1844), and was also the author of *Geometry without Axioms*, in which he endeavoured to "get rid" of axioms and postulates. His new *Theory of Just Intonation* (1850) is, however, a contribution of great value to the science of musical acoustics, and has gone through many editions. It may be said to form the basis of the tonic sol-fa system of music. He died 6th October 1869.

THOMSON, Sir Charles Wyville (1830–1882), was born at Bonsyde, Linlithgowshire, became professor of natural history in Aberdeen, Cork, Belfast, and finally Edinburgh, and will be specially remembered as a student of the biological conditions of the depths of the sea. Being interested in crinoids, and stimulated by the results of the dredgings of Sars in the deep sea off the Norwegian coasts, which had conclusively disposed of the error of Edward Forbes, that animal life ceased at a depth of a few hundred fathoms, he succeeded, along with Dr W. B. Carpenter, in obtaining the loan of H.M.S. "Lightning" and "Porcupine," for successive deep-sea dredging expeditions in the summers of 1868 and 1869. It was thus shown that animal life existed in abundance down to depths of 650 fathoms, that all invertebrate groups were represented (largely by Tertiary forms hitherto believed to be extinct), and, moreover, that deep-sea temperatures are by no means so constant as was supposed, but vary considerably, and indicate an oceanic circulation. Further dredging expeditions at greater and greater depths followed. The remarkable results gained for hydrography as well as zoology, in association with the practical needs of ocean telegraphy, soon led to the granting of H.M.S. "Challenger" for a circumnavigating expedition, and Thomson sailed at the end of 1872 as director of the scientific staff, the cruise lasting three years and a half. On his return he received many academic honours, and was knighted. In 1877 he published two volumes of a preliminary account of the results of the voyage, meanwhile carrying on his administrative labours in connexion with the disposition of the special collections and publication of the monographs of these. His health, never robust, was meanwhile giving way; from 1879 he ceased to perform the duties of his chair, and he died in 1882.

See obituary notice in *Proc. Roy. Soc. Edin.*, 1883, also Thomson's *Voyage of H.M.S. Challenger*, London, 1877, and Thomson and Murray, *Reports of the Voyage of H.M.S. Challenger*, Edinburgh, 1885.

THOMSON, JAMES (1700-1748), author of *The Seasons*, was a native of the Scottish Border country, his father being successively minister of the parishes of Ednam and Southdean, in Roxburghshire. He was born at Ednam on September 11, 1700, and was reared at a distance from the social influences and literary fashions that helped to form and fix the manner of the "classical" school, the monotony of which he was the first to break. Amidst the bare breezy hills and glens of a Border parish, his youth was safe against the ascendency of the taste established in the metropolis. Jedburgh school and Edinburgh university gave him his book learning of the ordinary type; and he was fortunate enough to have neighbours of extraordinary accomplishment, who opened his eyes to the poetic side of nature, and encouraged him in verse-making. The teacher from whom he learnt most was a Mr Riccalton, or Riccaulton, a graduate of Edinburgh, who had taken to farming, but was afterwards persuaded to enter the church, and made some contributions to theological literature. This scholarly enthusiast taught Latin to the boys of Jedburgh in an aisle of the church, and encouraged Thomson in his poetical turn by example as well as precept. We have the poet's own acknowledgment that the first hint of the *Seasons* came from a striking dramatic poem by Riccaulton entitled *A Winter's Day.* As a schoolboy Thomson wrote verses, and at the university he continued the practice, but his early efforts were not particularly promising. He was intended for the ministry, and was for five years a student of divinity; but in 1725 he determined to follow his friend and classfellow David Mallet to London, and seek his fortune there. Through the influence of Lady Grizel Baillie, herself a song-writer, he obtained a tutorship in the family of Lord Binning; but the plain-looking and plain-mannered poet had not the adroitness of his friend Mallet, and he gave up the post after a few months. It was while he lingered in the neighbourhood of Barnet, without employment, without money, with few friends, saddened by the loss of his mother (his father had died when he was eighteen), that Thomson conceived the idea of the first of his poems on the Seasons, *Winter.* The lines—

> Welcome, kindred glooms,
> Congenial horrors, hail!

came from the heart; they expressed his own forlorn mood on the approach of the winter of 1725. *Winter* appeared in the spring of 1726. A publisher, Millan,—not Millar, who afterwards published for him,—gave him three guineas for the poem. The tradition is that it attracted no notice for a month, but that, at the end of that time, a literary clergyman, Whatley, chanced to take it up from a bookseller's counter and at once rushed off to the coffee-houses to proclaim the discovery of a new poet. The town received the discovery with acclamation; in another month a second edition was called for. No time could have been better suited for the appreciation of Thomson's striking qualities; they were so entirely unlike what the public had for many years been accustomed to. The fresh treatment of a simple theme, the warm poetical colouring of commonplace incidents, the freedom and irregularity of the plan, the boldness of the descriptions, the manly and sincere sentiment, the rough vigour of the verse, took by surprise a generation accustomed to witty satire and burlesque, refined diction, translations from the classics, themes valued in proportion to their remoteness from vulgar life. Thomson at once became famous, and, his naturally easy temper roused to full exertion, vigorously followed up his success with *Summer* and an *Ode to the Memory of Sir Isaac Newton.* *Spring* was completed and published in 1728. A longer interval elapsed before the appearance of *Autumn*; it was published in 1730, and followed presently by a handsome edition of the whole four *Seasons.* Meantime, drawn into the ardent political strife of the time, he had produced, in 1729, his *Britannia*, and early in 1730 had made his first attempt as a dramatist with *Sophonisba.* From this time there was a manifest slackening either in his will or in his power to produce. He was appointed travelling tutor to the son of Sir Charles Talbot, travelled with his pupil on the Continent, and in 1733 obtained a small sinecure in the Court of Chancery. It may have been this removal of the spur of necessity that made him take longer over his poems. But it is a fair theory that the rigid taste of the time for finish, which he had unconsciously defied with triumphant results, began to make good an ascendency over him, and that he wrote less because he was cramped by fear of the critics. None of the other *Seasons* have the same large and careless freedom as *Winter*; *Autumn* especially, the last of them, is much more laboured, and his revisions and enlargements in successive editions show an anxious ambition after the finish of the classical school. However this may be, he hesitated long over his next poem, *Liberty*; the first part was published in 1734 and the conclusion in 1736. He intended it to be his masterpiece, but with all his care and pains it has fallen into deserved oblivion. In 1737 he lost his sinecure by the death of his patron, but was recompensed by a pension from the prince. Poverty, rather than natural fitness or inclination, drove him again to dramatic composition. *Agamemnon* was produced in 1738, with indifferent success. Next year a play, written in the interest of the prince and the opposition, was interdicted by the lord chamberlain. The masque of *Alfred*, written by Thomson in conjunction with Mallet, and containing the song *Rule Britannia*, was produced in 1740, *Tancred and Sigismunda* in 1745. A year before this last event the "poetical posture" of the poet's income was improved by his appointment to the sinecure office of surveyor-general of the Leeward Islands. The *Castle of Indolence* was his last work. It was not published till the year of his death (1748), but he had been long engaged upon it. The poem is full of character and humour, with here and there passages of elaborately rich description; it is fuller than any other of the personality of the poet, of the good-nature, generosity, and solid wisdom which gained him the affection of so many friends; but still it is in the *Seasons*, and especially in the first of them, that Thomson is seen at his best and strongest.

Till the advent of Scott and Byron, Thomson was the most widely popular poet in our language; and as late as the middle of this century a sumptuous edition, illustrated by the Etching Club, was printed three times within ten years (1842-52). The popular verdict on Thomson has been unanimously justified by critics. (W. M.)

THOMSON, James (1834–1882), author of *The City of Dreadful Night*, was born at Port Glasgow, in Renfrewshire, on November 23, 1834, the eldest child of a mate in the merchant shipping service. His mother was a deeply religious woman of the Irvingite sect, and it is not improbable that it was from her the son inherited his sombre and imaginative temperament. On her death, James, then in his seventh year, was procured admission into the Caledonian Orphan Asylum, from which he went out into the world as an assistant army schoolmaster. At the garrison at Ballincollig, near Cork, he encountered the one brief happiness of his life: he fell passionately in love with, and was in turn as ardently loved by, the daughter of the armourer-sergeant of a regiment in the garrison, a girl of very exceptional beauty and cultivated mind. Two years later, when Thomson was at the training college at Chelsea, he suddenly received news of her fatal illness and death. The blow prostrated him in mind and body; and the former endured a hurt from which it never really recovered. Henceforth his life was one of gloom, disappointment, misery, and poverty, rarely alleviated by episodes of somewhat brighter fortune. While in Ireland he had made the acquaintance of Mr Charles Bradlaugh, then a soldier stationed at Ballincollig, and it was under his auspices (as editor of the *London Investigator*) that Thomson first appealed to the public as an author, though actually his earliest publication was in *Tait's Edinburgh Magazine* for July 1858, under the signature "Crepusculus." In 1860 was established the paper with which Mr Bradlaugh has been so long identified, *The National Reformer*, and it was here, among other productions by James Thomson, that appeared (1863) the powerful and sonorous verses "To our Ladies of Death," and (1874) his chief work, the sombre and imaginative *City of Dreadful Night*. In October 1862 Thomson left the army, and through Mr Bradlaugh (with whom for some subsequent years he lived) gained employment as a solicitor's clerk. In 1869 he enjoyed what has been described as his "only reputable appearance in respectable literary society," in the acceptance of his long poem, "Sunday up the River," for *Fraser's Magazine*, on the advice, it is said, of Charles Kingsley. In 1872 Thomson went to the Western States of America, as the agent of the shareholders in what he ascertained to be a fraudulent silver mine; and the following year he received a commission from *The New York World* to go to Spain as its special correspondent with the Carlists. During the two months of his stay in that distracted country he saw little real fighting, and was himself prostrated by a sunstroke. On his return to England he continued to write in *The Secularist* and *The National Reformer*, under the at last well-known initials "B. V."[1] In 1875 he severed his connexion with *The National Reformer*, owing to a disagreement with its editor; henceforth his chief source of income (1875–1881) was from the monthly periodical known as *Cope's Tobacco Plant*. Chiefly through the exertions of his friend and admirer, Mr Bertram Dobell, Thomson's best known book, *The City of Dreadful Night, and other Poems*, was published in April 1880, and at once attracted wide attention; it was succeeded in the autumn by *Vane's Story, and other Poems*, and in the following year by *Essays and Phantasies*. All his best work was produced between 1855 and 1875 ("The Doom of a City," 1857; "Our Ladies of Death," 1861; *Weddah and Om-el-Bonain*: "The Naked Goddess," 1866–7; *The City of Dreadful Night*, 1870–74). In his latter years Thomson too often sought refuge from his misery of mind and body in the Lethe of opium and alcohol. His mortal illness came upon him in the house of a poet friend; and he was conveyed to University College hospital, in Gower Street, where shortly after he died (June 3, 1882). He was buried at Highgate cemetery, in the same grave, in unconsecrated ground, as his friend Austin Holyoake.

To the productions of James Thomson already mentioned may be added the posthumous volume entitled *A Voice from the Nile, and other Poems* (1884), which has the advantage of Mr Bertram Dobell's valuable prefatory memoir and an etched portrait of the poet. This volume contains much that is interesting, but nothing to increase Thomson's reputation. If an attempt be made to point to the most apparent literary relationship of the author of *The City of Dreadful Night*, one might venture the suggestion that James Thomson was a younger brother of De Quincey. If he has distinct affinity to any writer it is to the author of *Suspiria de Profundis*; if we look further afield, we might perhaps discern shadowy prototypes in Leopardi, Heine, and Baudelaire. But, after all, Thomson holds so unique a place as a poet that the effort at classification may well be dispensed with. If he maintains his own lonely little height, it will be as a distinct individuality. His, it is absolutely certain, was no literary pessimism, no assumed gloom. The poem "Insomnia" is a distinct chapter of biography; and in "Mater Tenebrarum" and elsewhere among his writings self-revelative passages are frequent. The merits of Thomson's poetry are its imaginative power, its sombre intensity, its sonorous music; to these characteristics may be added, in his lighter pieces, a Heine-like admixture of strange gaiety, pathos, and caustic irony. Much the same may be said of his best prose. His faults are a monotony of epithet, the not infrequent use of mere rhetoric and verbiage, and perhaps a prevailing lack of the sense of form, to these may be added an occasional vulgar recklessness of expression, as in parts of *Vane's Story* and in some of his prose writings. Time will reduce his noteworthy work within a narrow compass, but within that limit it will be found as remarkable as it is unique.

THOMSON, John (1778–1840), amateur landscape painter—Thomson of Duddingston, as he is commonly styled,—was born on September 1, 1778, at Dailly, Ayrshire. His father, grandfather, and, as we are informed, great-grandfather also, were clergymen of the Church of Scotland. The father determined that his son should follow the ancestral profession, and, greatly against his natural bent,—for all his thoughts turned instinctively towards art,—he acceded to the parental wish. He studied in the university of Edinburgh; and, residing with his elder brother, Thomas Thomson, afterwards celebrated as an antiquarian and feudal lawyer, he made the acquaintance of Francis Jeffrey and other young members of the Scottish bar afterwards notable. The pursuit of art, however, was not abandoned; during the recess he sketched in the country, and, while attending his final college session, he studied for a month under Alexander Nasmyth. After his father's death he became, in 1800, his successor as minister of Dailly; and in 1805 he was translated to the parish of Duddingston, close to Edinburgh. The practice of art was now actively resumed, and it came to be continued throughout life—apparently without any very great detriment to pastoral duties. Thomson's popularity as a painter increased with his increasing artistic skill; and, having mastered his initial scruples against receiving artistic fees, on being offered £15 for a landscape—reassured by "Grecian" Williams's stout assertion that the work was "worth thrice the amount"—the minister of Duddingston began to dispose of the productions of his brush in the usual manner. In 1830 he was made an honorary member of the Royal Scottish Academy. Besides that of art, Thomson had other singularly varied tastes and aptitudes. He was an accomplished performer on violin and flute, an exact and well-read student of physical science, and one of the writers on optics in the early numbers of the *Edinburgh Review*. His life passed peacefully away in the kindly and charitable discharge of his clerical duties, varied by the enthusiastic pursuit of his art, and the enjoyment of intercourse with a singularly wide and eminent circle of friends, which, among artists, included Turner and Wilkie, and among men of letters Wilson and Scott,—the latter of whom desired that Thomson, instead of Turner, should have illustrated the collected edition of his works. He died at Duddingston on the 27th of October 1840 (not the 20th, as stated by some authorities). Thomson was twice married, and his second wife, the widow of Mr Dalrymple of Cleland, was herself also a skilful amateur artist.

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[1] Bysshe Vanolis: "Bysshe," as the commonly used Christian name of Shelley, Thomson's favourite writer; and "Vanolis," an anagram of Novalis, the pseudonym of F. von HARDENBERG (*q.v.*).

Thomson holds an honourable position as the first powerful landscapist that Scotland produced, and he is still among her greatest. His styled was founded, in the first instance, upon the practice of the Dutch masters; but ultimately he submitted to the influence of the Poussins and the Italians, rightly believing that their method—in the richer solemnity of its colour and the deeper gravity of its chiaroscuro—was more truly fitted for the portrayal of the scenery of Scotland, more in harmony with the gloom and the glory of its mountains and its glens and the passion of its wave-vexed cliffs. But to the study of the art of the past he joined a close and constant reference to nature which kept his own work fresh and original, though, of course, he never even approached such scientific accuracy in the rendering of natural form and effect as is expected from even the tyro in our recent schools of landscape. His art is clearly distinguished by "style"; at their best, his works show skilful selection in the leading lines of their composition and admirable qualities of abstract colour and tone. Thomson is fairly represented in the Scottish National Gallery; and the Aberlady Bay of that collection, with the soft infinity of its clouded grey sky, and its sea which leaps and falls again in waves of sparkling and of shadowed silver, is fit to rank among the triumphs of Scottish art.

THOR. See Æsir, vol. i. p. 210, and Mythology, vol. xvii. p. 156.

THOREAU, Henry David (1817–1862), one of the most strongly-marked individualities of modern times, spent the greater part of his life in the neighbourhood of the place where he was born—Concord, a village town of Massachusetts, pleasantly situated some twenty miles north-west of Boston, amidst a pastoral country of placid beauty. To Thoreau this Concord country contained all of beauty and even grandeur that was necessary to the worshipper of nature: he once journeyed to Canada; he went west on one occasion; he sailed and explored a few rivers; for the rest, he haunted Concord and its neighbourhood as faithfully as the stork does its ancestral nest. John Thoreau, his father, who married the daughter of a New England clergyman, was the son of a John Thoreau of the isle of Jersey, who, in Boston, married a Scottish lady of the name of Burns. This last-named John was the son of Philippe Thoreau and his wife Marie le Gallais, persons of pure French blood, settled at St Helier, in Jersey. From his New England Puritan mother, from his Scottish grandmother, from his Jersey-American grandfather, and from his remoter French ancestry Thoreau inherited distinctive traits: the Saxon element perhaps predominated, but the "hauntings of Celtism" were prevalent and potent. The stock of the Thoreaus was a robust one; and in Concord the family, though never wealthy nor officially influential, was ever held in peculiar respect. As a boy, Henry drove his mother's cow to the pastures, and thus early became enamoured of certain aspects of nature and of certain delights of solitude. At school and at Harvard university he in nowise distinguished himself, though he was an intelligently receptive student; he became, however, proficient enough in Greek, Latin, and the more general acquirements to enable him to act for a time as a master. But long before this he had become apprenticed to the learning of nature in preference to that of man: when only twelve years of age he had made collections for Agassiz, who had then just arrived in America, and already the meadows and the hedges and the stream-sides had become cabinets of rare knowledge to him. On the desertion of schoolmastering as a profession Thoreau became a lecturer and author, though it was the labour of his hands which mainly supported him through many years of his life: professionally he was a surveyor. In the effort to reduce the practice of economy to a fine art he arrived at the conviction that the less labour a man did, over and above the positive demands of necessity, the better for him and for the community at large; he would have had the order of the week reversed,—six days of rest for one of labour. It was in 1845 he made the now famous experiment of Walden. Desirous of proving to himself and others that man could be as independent of his kind as the nest-building bird, Thoreau retired to a hut of his own construction on the pine-slope over against the shores of Walden Pond,—a hut which he built, furnished, and kept in order entirely by the labour of his own hands. During the two years of his residence in Walden woods he lived by the exercise of a little surveying, a little job-work, and the tillage of a few acres of ground which produced him his beans and potatoes. His absolute independency was as little gained as if he had camped out in Hyde Park; relatively he lived the life of a recluse. He read considerably, wrote abundantly, thought actively if not widely, and came to know beasts, birds, and fishes with an intimacy more extraordinary than was the case with St Francis of Assisi. Birds came at his call, and forgot their hereditary fear of man; beasts lipped and caressed him; the very fish in lake and stream would glide, unfearful, between his hands. This exquisite familiarity with bird and beast would make us love the memory of Thoreau, if his egotism were triply as arrogant, if his often meaningless paradoxes were even more absurd, if his sympathies were even less humanitarian than we know them to have been. His *Walden*, the record of this fascinating two years' experience, must always remain a production of great interest and considerable psychological value. Some years before Thoreau took to Walden woods he made the chief friendship of his life, that with Emerson. He became one of the famous circle of the transcendentalists, always keenly preserving his own individuality amongst such more or less potent natures as Emerson, Hawthorne, and Margaret Fuller. From Emerson he gained more than from any man, alive or dead; and, though the older philosopher both enjoyed and learned from the association with the younger, it cannot be said that the gain was equal. There was nothing electrical in Thoreau's intercourse with his fellow-men; he gave off no spiritual sparks. He absorbed intensely, but when called upon to illuminate in turn was found wanting. It is with a sense of relief that we read of his having really been stirred into active enthusiasm anent the wrongs done the ill-fated John Brown. With children he was affectionate and gentle, with old people and strangers considerate. In a word, he loved his kind as animals, but did not seem to find them as interesting as those furred and feathered. In 1847 Thoreau left Walden Lake abruptly, and for a time occupied himself with lead-pencil making, the parental trade. He never married, thus further fulfilling his policy of what one of his essayist-biographers has termed "indulgence in fine renouncements." At the comparatively early age of forty-five he died, on 6th May 1862. His grave is in the beautiful cemetery of Sleepy Hollow, beside those of Hawthorne and Emerson.

Thoreau's fame will rest on *Walden*, the *Excursions*, and his *Letters*, though he wrote nothing which is not deserving of notice. Up till his thirtieth year he dabbled in verse, but he had little ear for metrical music, and he lacked the spiritual impulsiveness of the true poet. He had occasional flashes of insight and could record beautifully, notwithstanding: his little poem "Haze" is surcharged with concentrated loveliness. His weakness as a philosopher is his tendency to base the laws of the universe on the experience-born, thought-produced convictions of one man—himself. His weakness as a writer is the too frequent striving after antithesis and paradox. If he had had all his own originality without the itch of appearing original, he would have made his fascination irresistible. As it is, Thoreau holds a unique place. He was a naturalist, but absolutely devoid of the pedantry of science; a keen observer, but no retailer of disjointed facts. He thus holds sway over two domains: he has the adherence of the lovers of fact and of the children of fancy. He must always be read, whether lovingly or interestedly, for he has all the variable charm, the strange saturninity, the contradictions, austerities, and delightful surprises, of Nature herself.

See W. E. Channing, *Thoreau the Poet Naturalist*, Boston, 1873; F. B. Sanborn, *Biography of Thoreau* (American Men of Letters Series); H. A. Page, *Biography of Thoreau*; Emerson, Introduction to *Excursions*; J. Russell Lowell, *My Study Windows*; Will. H. Dircks, Introduction to *Walden*; Professor Nichol, *American Literature*, pp. 312 *sq.*; Mr Burroughs; Mr Henry James, &c. After Thoreau's death were published (besides the *Excursions*, 1863) *The Maine Woods* (1864); *Cape Cod* (1865); *Letters and Poems* (1865); *A Yankee in Canada* (1866). In the *Atlantic Monthly*, in 1862, appeared "Walking," "Autumn Tints," and "Wild Apples"; in 1863 "Night and Moonlight." His best known work, *Walden*, constitutes the second volume of the series called *The Camelot Classics*; otherwise Thoreau's productions are not widely known in Britain.

THORIUM, in chemistry, is the name of the as yet unisolated radical of *thoria*, one of the now numerous "rare earths." Thoria was discovered by Berzelius in 1828 in the mineral now called thorite. It is present also in pyrochlor, monazite, orangite, and euxenite. Being similar to the oxides TiO_2 and ZrO_2 of titanium and zirconium, thoria is assumed to be a binoxide ThO_2. The atomic weight, according to Cleve, is $Th = 233$, O being 16.

THORN (Polish *Toruñ*), an interesting old town in the province of West Prussia, is situated on the right bank of the Vistula, near the point where the river enters Prussian territory, 26 miles south-east of Bromberg and 92 miles south of Dantzic. Its position near the frontier of Russian Poland makes it a strategic point of importance; and, strongly fortified since 1818, in 1878 it was converted into a fortress of the first class. The "old town," founded in 1231, and the "new town," founded thirty-three years later, were united in 1454, and both retain a number of quaint buildings dating from the 15th and 16th centuries, when Thorn was a flourishing member of the Hanseatic League. The town-house, of the 14th and 16th centuries, the churches of St John and the Virgin, with aisles as lofty as the nave, the ruined castle of the Teutonic order, and the gates, leaning tower, and fragments of the walls, all of the 13th century, are among the most interesting edifices. The ancient wooden bridge, now burned down, at one time the only permanent bridge across the lower Vistula, has been succeeded by a massive iron railway viaduct, half a mile long. Thorn carries on an active trade in grain, timber, wine, colonial wares, and iron, and has manufactures of leather, hats, starch, candles, and numerous other articles. It is famous for its "Pfefferkuchen," a kind of gingerbread. Part of the trade is carried on by vessels on the Vistula. In 1885 the population was 23,914 (in 1816 7909), about three-fifths being Protestants and two-fifths (chiefly Poles) Roman Catholics.

Thorn, founded in 1231 by the Teutonic order as an outpost against the Poles, was colonized mainly from Westphalia. The first peace of Thorn, between the order and the Poles, was concluded in 1411. In 1454 the townspeople revolted from the knights of the order, destroyed their castle, and attached themselves to the king of Poland. This resulted in a war, which was terminated in 1466 by the second peace of Thorn. In the 15th and 16th centuries Thorn was a Hanse town of importance, and received the titles of "queen of the Vistula" and "the beautiful." It embraced the Reformation in 1557, and in 1645 it was the scene of a "colloquium charitativum," or discussion betwixt the doctors of the rival creeds, which, however, resulted in no agreement. In 1724 a riot between the Protestant and Roman Catholic inhabitants was seized upon by the Polish king as a pretext for beheading the burgomaster and nine other leading Protestant citizens, an act of oppression which is known as the "bloodbath of Thorn." The second partition of Poland conferred Thorn upon Prussia; by the treaty of Tilsit it was assigned to the duchy of Warsaw; but since the congress of Vienna it has again been Prussian. Copernicus was born at Thorn in 1473.

THORNBACK is the name given to a species of ray (*Raja clavata*) which is found all round the coasts of Europe, and locally abundant; it derives its name from the peculiar armature of the skin of its body, the upper and lower surfaces of the body of the female being armed with scattered, more or less numerous, large round osseous bucklers, each with a spine in the centre; the tail also is armed with rows of similar bucklers. In the male fish these bucklers are absent, or nearly so. The thornback does not grow to the same large size as the skates, a specimen three feet across being considered large. It is more valued as food than the other rays, and consumed in large quantities, fresh as well as salted.

THORNHILL, Sir James (1676-1734), historical painter, was born at Melcombe Regis, Dorset, in 1676, coming of an ancient but impoverished county family. His father died while he was young, but he was befriended by his maternal uncle, the celebrated Dr Sydenham, and apprenticed to Thomas Highmore, sergeant-painter to King William III., a connexion of the Thornhill family. Little is known regarding his early career. About 1715 he visited Holland, Flanders, and France; and, having obtained the patronage of Queen Anne, he was in 1719-20 appointed her serjeant-painter in succession to Highmore, and was ordered to decorate the interior of the dome of St Paul's with a series of eight designs, in chiaroscuro heightened with gold, illustrative of the life of that apostle,—a commission for which Louis Laguerre had previously been selected by the commissioners for the repair of the cathedral. He also designed and decorated the saloon and hall of Moor Park, Herts, and painted the great hall at Blenheim, the princesses' apartments at Hampton Court, the hall and staircase of the Southsea Company, the chapel at Wimpole, the staircase at Easton-Neston, Northamptonshire, and the hall at Greenwich Hospital, usually considered his most important and successful work, upon which he was engaged from 1708 to 1727. Among his easel pictures are the altar-pieces of All Souls and Queen's College chapels, Oxford, and that in Melcombe Regis church; and he executed such portrait subjects as that of Sir Isaac Newton, in Trinity College, Cambridge, and the picture of the House of Commons in 1730, now in the possession of the earl of Hardwicke, in which he was assisted by Hogarth, who married Jane, his only daughter. He also produced a few etchings in a slight and sketchy but effective manner, and executed careful full-size copies of Raphael's cartoons, which now belong to the Royal Academy. About 1724 he drew up a proposal for the establishment of a royal academy of the arts, and his scheme had the support of the lord treasurer Halifax, but Government declined to furnish the needful funds. Thornhill then opened a drawing-school in his own house in James Street, Covent Garden, where instruction continued to be given till the time of his death. He acquired a considerable fortune by his art, and was enabled to repurchase his family estate of Thornhill, Dorsetshire. In 1715 he was knighted by George I., and in 1719 he represented Melcombe Regis in parliament, a borough for which Sir Christopher Wren had previously been member. Having been removed from his office by some court intrigue, and suffering from broken health and repeated attacks of gout, he retired to his country seat, where he died on the 4th of May 1734. His son James was also an artist. He succeeded his father as serjeant-painter to George II., and was appointed "painter to the navy."

The high contemporary estimate of Sir James Thornhill's works has not since been confirmed; in spite of Dr Young, "late times" do *not*

> Understand
> How Raphael's pencil lives in Thornhill's hands."

He is weak in drawing,—indeed, when dealing with complicated figures he was assisted by Thomas Gibson; and, ignorant of the great monumental art of Italy, he formed himself upon the lower model of Le Brun. It must, however, be admitted that, in the departments of art which he chose for his own, he was the best native painter of his time.

THORWALDSEN, BERTEL (1770–1844), a very able Danish sculptor, was the son of an Icelander who had settled in Copenhagen, and there carried on the trade of a wood-carver. While very young, Bertel Thorwaldsen learnt to assist his father; at the age of eleven he entered the Copenhagen school of art, and soon began to show his exceptional talents. In 1792 he won the highest prize, the travelling studentship, and in 1796 he started for Italy in a Danish man-of-war. On the 8th of March 1797 he arrived in Rome, where Canova was at the height of his popularity. Thorwaldsen's first success was the model for a statue of Jason, which was highly praised by Canova, and he received the commission to execute it in marble from Thomas Hope, a wealthy English art-patron. From that time Thorwaldsen's success was assured, and he did not leave Italy for twenty-three years. In 1819 he returned to Denmark, where he was received with the greatest enthusiasm. He was there commissioned to make the colossal series of statues of Christ and the twelve apostles which are now in the Fruenkirche in Copenhagen. These were executed after his return to Rome, and were not completed till 1838, when Thorwaldsen again returned to Denmark. He died suddenly in the Copenhagen theatre in 1844, and bequeathed a great part of his fortune for the building and endowment of a museum in Copenhagen, and also left to fill it all his collection of works of art, and the models for all his sculpture,—a very large collection, exhibited to the greatest possible advantage. Thorwaldsen is buried in the courtyard of this museum, under a bed of roses, by his own special wish.

On the whole Thorwaldsen was the most successful of all the imitators of classical sculpture, and many of his statues of pagan deities are modelled with much of the antique feeling for breadth and purity of design. His attempts at Christian sculpture, such as the tomb of Pius VII. in St Peter's and the Christ and Apostles at Copenhagen, are less successful, and were not in accordance with the sculptor's real sympathies, which were purely classic. Thorwaldsen's private life was not admirable: he worked sometimes with feverish eagerness; at other times he was idle for many months together. A great number of his best works exist in private collections in England. His not very successful statue of Lord Byron, after being refused a place in Westminster Abbey, was finally deposited in the library of Trinity College, Cambridge The most widely popular among Thorwaldsen's works have been some of his bas-reliefs, such as the Night and the Morning, which he is said to have modelled in one day. In the main his popularity is now a thing of the past, owing chiefly to the reaction against the pseudo-classic style of sculpture.

A well-illustrated account of Thorwaldsen and his works is given by Eugène Plon, *Thorwaldsen, sa Vie, &c.*, Paris, 1880; see also Andersen, *B. Thorwaldsen*, Berlin, 1845; Killerup, *Thorwaldsen's Arbeiten, &c.*, Copenhagen, 1852; and Thiele, *Thorwaldsen's Leben*, Leipsic, 1852–56.

THOU, JACQUES AUGUSTE DE (1553–1617), sometimes known by the Latinized form THUANUS, as his great history is by the name *Thuana*, was born at Paris on October 8, 1553. He belonged to a family of distinction in the Orléanais, of which the elder branch had, he tells us, been *noblesse d'épée*, though he gives no particulars except of those who had for some generations been *noblesse de robe*. He and his were closely connected by birth, marriage, and friendship with several of those great legal families—the Harlays, the Huraults, the Brularts, the Lamoignons, and others—which for many generations furnished France with by far her most valuable class of public men. The historian's father was Christophe de Thou, first president of the parlement of Paris, a man whose strong legal and religious prejudices against the Huguenots have rather obscured, in the eyes of historians, his undoubted ability and probity. Christophe's brothers, Adrien and Nicolas, were both men of mark, the former being also a lawyer, and the latter ultimately becoming bishop of Chartres in which capacity he "instructed" Henry IV. at his conversion. De Thou's mother was Jacqueline Tuleu, dame de Céli. He was a delicate child, and seems by his own account to have been rather neglected by his parents; perhaps it was for this reason that, though he grew stronger with age, he was destined for the church. He took minor orders, and obtained some benefices. It was, however, to the legal side of the ecclesiastical profession that he was devoted, and, after being at school at the Collége de Bourgogne, he studied law at Orleans, Bourges, and Valence, being at the last two places under the tuition of jurists no less celebrated than Hotman and Cujas. It was not, however, till he approached middle life that he definitely renounced the clerical profession, married, and accepted lay offices. Meanwhile he had travelled much and discharged important duties. In 1573, that he might profit by seeing foreign parts, he was attached to the suite of Paul de Foix, who was sent on a circular mission of compliment to the Italian princes, and with him De Thou visited Turin, Milan, Mantua, Venice, Rome, Florence, and many minor places. On his return he studied for four years, travelling to the Netherlands in the interval, and in 1579 to Germany. Two years later he was appointed to a royal commission in Guienne, and made the acquaintance of Henry of Navarre and of Montaigne. He had already become the friend of most of the eminent men of letters of the time, from Ronsard downwards, and was particularly intimate with Pierre Pithou, the soul of the future *Satire Menippée*. De Thou, by all his sympathies, belonged to that later and better phase of the *politique* party which devoted itself to the maintenance of royalty as the one hope of France; and, when Henry III. was driven from his capital by the violence of the Guises and the League, De Thou followed him to Blois. After his renunciation of orders, he had been made, first, master of requests, and then president *à mortier*, which was the highest dignity he ever attained. After the death of Henry III. he attached himself closely to his successor, and in 1593 was appointed (he was a great bibliophile) *grand maître* of the royal library, in succession to Amyot, the translator of Plutarch and Longus. It was in this same year that he began his history, the composition of which was interrupted, not only by his regular official duties, but by frequent diplomatic missions at home and abroad. His most important employment of all was on the commission which, in face of the greatest difficulties on both sides, successfully carried through the negotiations for the edict of Nantes. Nor were his duties as a diplomatist intermitted by the death of Henry IV., though the Government of Marie de' Medici refused him the place of *premier président* which he desired, and hurt his feelings by appointing him instead a member of the financial commission which succeeded Sully. This appointment he rather strangely chose to think a degradation. It is, however, absurd to say that the affair, which he survived six years, had anything to do with his death. That, as far as it was hastened by any mental affliction, seems to have been rather due to grief at the death of his second wife, Gasparde de La Châtre, of whom and of his sons and daughters by her (his first marriage with Marie de Barbançon had been childless) he was extremely fond. His eldest son, François Auguste, was the friend of Cinq Mars, and shared his downfall and fate. But this was a quarter of a century after De Thou's own death, which happened on May 7, 1617.

Although a distinguished ornament of France, De Thou has nothing to do, properly speaking, with French literature. Besides minor works in Latin (a poem on hawking, some paraphrases of the Bible, &c.), he wrote also in Latin the great history which has made his name known Entitled *Historiæ Sui Temporis*, it begins shortly before the author's birth (in 1546), and extends to 1607, ten years before his death. The first part, in eighteen books, was published in 1604; the second, third, and fourth appeared in 1606 and the two following years. The last part, which makes a total of 138 books, did not appear till 1620, under the care of the author's friends Rigault and Dupuy, whom he had named his literary executors. The first named likewise put final touches to De Thou's autobiography, which, also written in Latin, appears in French in most collections of French memoirs. It contains minute details of the author's life down to 1607, mixed with rather miscellaneous descriptions of interesting places which he had visited (such as Mont St Michel, an eagle's eyrie in Dauphiné, &c.); and its composition is said to have been partly determined by the obloquy cast by bigoted adherents of the papacy on the *History*. De Thou was indeed obnoxious to these on many grounds. He had helped to negotiate the edict of Nantes; he had opposed the acknowledgment in France of the decrees of Trent; he had been a steady Anti-Leaguer; and he was accused of speaking in the *History* itself of Protestants and Protestantism, not merely with criminal mildness, but with something like sympathy. It is needless to say that these blots in the *History* have seemed beauties to later and more dispassionate students. There is no doubt that the charges of partiality on minor and mostly personal points are either disprovable or unimportant; and the whole seems to be as fair and as carefully accurate as at such a time was possible. On the other hand, the work is undoubtedly planned and executed on much too large a scale, and the inclusion of events in foreign countries, on which the author was often but ill-informed, has not improved it. But it is clearly and on the whole excellently written, and will always be, as far as any general contemporary history can be so called, the great authority for at least the French part of its subject and period. It was first published as a whole when, as above mentioned, the last part appeared in 1620, and it was several times reprinted. More than a hundred years later, in 1733, an Englishman, Samuel Buckley, working in part on the materials of Thomas Carte, produced at London what is recognized as the standard edition of the original, in 7 vols. folio. The standard French translation was made immediately afterwards by a group of literary men, the best known of whom were the Abbé Desfontaines and Prévost, the author of *Manon Lescaut*. A choice copy of the first edition of the first part, with the arms of Henry IV. on the binding, is in the British Museum library.

THOUSAND AND ONE NIGHTS. The *Thousand and One Nights*, commonly known in English as *The Arabian Nights' Entertainments*, is a collection of tales written in Arabic, which first became generally known in Europe in the early part of last century through the French translation by Antoine GALLAND (*q.v.*), and rapidly attained such universal popularity that it is unnecessary to describe the contents of the book. But the origin of the *Arabian Nights* claims discussion in this place. In the *Journal Asiatique* for 1827, p. 253, Von Hammer drew attention to a passage in the *Golden Meadows* of Mas'údí (ed. Barbier de Meynard, iv. 89 *sq.*), written in 943 A.D., in which certain stories current among the old Arabs are compared with "the books which have reached us in translations from Persian, Indian, and Greek, such as the book of *Hezár Afsáne*, a title which, translated from Persian into Arabic, means 'the thousand tales.' This book is popularly called *The Thousand and One Nights*, and contains the story of the king and his vizier and of his daughter Shírazád and her slave girl Dínázád. Other books of the same kind are the book of *Ferza and Simás*, containing stories of Indian kings and viziers, the book of Sindibad, &c." Von Hammer concluded that the *Thousand and One Nights* were of Persian or Indian origin. Against this conclusion De Sacy protested in a memoir (*Mém. de l'Acad. des Inscr.*, 1833, x. 30 *sq.*), demonstrating that the character of the book we know is genuinely Arabian, and that it must have been written in Egypt at a comparatively recent date. Von Hammer in reply adduced, in *Jour. As.*, 1839, ii. p. 175 *sq.*, a passage in the *Fihrist* (987 A.D.), which is to the following effect:—

> "The ancient Persians were the first to invent tales, and make books of them, and some of their tales were put in the mouths of animals. The Ashghanians, or third dynasty of Persian kings, and after them the Sásánians, had a special part in the development of this literature, which found Arabic translators, and was taken up by accomplished Arabic literati, who edited it and imitated it. The earliest book of the kind was the *Hezár afsán* or *Thousand Tales*, which had the following origin. A certain Persian king was accustomed to kill his wives on the morning after the consummation of the marriage. But once he married a clever princess called Shahrazád, who spent the marriage night in telling a story which in the morning reached a point so interesting that the king spared her, and asked next night for the sequel. This went on for a thousand nights, till Shahrazád had a son, and ventured to tell the king of her device. He admired her intelligence, loved her, and spared her life. In all this the princess was assisted by the king's stewardess Dínázád. This book is said to have been written for the princess Homái (MSS. Ḥomání), daughter of Bahman. . . . It contains nearly two hundred stories, one story often occupying several nights. I have repeatedly seen the complete book, but it is really a meagre and uninteresting production" (*Fihrist*, ed. Flügel, p. 304).

Persian tradition (in Firdausí) makes Princess Ḥomái the daughter and wife of Bahman Ardashír, *i.e.*, Artaxerxes I. Longimanus. She is depicted as a great builder, a kind of Persian Semiramis, and is a half-mythical personage already mentioned in the Avesta, but her legend seems to be founded on the history of Atossa and of Parysatis. Firdausí says that she was also called Shahrazád (Mohl, v. 11). This name and that of Dínázád both occur in what Mas'údí tells of her. According to him, Shahrazád was Ḥomái's mother (ii. 129), a Jewess (ii. 123). Bahman had married a Jewess (i. 118), who was instrumental in delivering her nation from captivity. In ii. 122 this Jewish maiden who did her people this service is called Dínázád, but "the accounts," says our author, "vary." Plainly she is the Esther of Jewish story. Ṭabarí (i. 688) calls Esther the mother of Bahman, and, like Firdausí, gives to Ḥomái the name of Shahrazád. The story of Esther and that of the original *Nights* have in fact one main feature in common. In the former the king is offended with his wife, and divorces her; in the *Arabian Nights* he finds her unfaithful, and kills her. But both stories agree that thereafter a new wife was brought to him every night, and on the morrow passed into the second house of the women (Esther), or was slain (*Nights*). At length Esther or Shahrazád wins his heart and becomes queen. The issue in the Jewish story is that Esther saves her people; in the *Nights* the gainers are "the daughters of the Moslems," but the old story had, of course, some other word than "Moslems." Esther's foster-father becomes vizier, and Shahrazád's father is also vizier. Shahrazád's plan is helped forward in the *Nights* by Dínázád, who is, according to Mas'údí, her slave girl, or, according to other MSS., her nurse, and, according to the *Fihrist*, the king's stewardess. The last account comes nearest to Esther ii. 15, where Esther gains the favour of the king's chamberlain, keeper of the women. It is also to be noted that Ahasuerus is read to at night when he cannot sleep (Esther vi. 1). And it is just possible that it is worth notice that, though the name of Ahasuerus corresponds to Xerxes, Josephus identifies him with Artaxerxes I.

Now it may be taken as admitted that the book of Esther was written in Persia, or by one who had lived in Persia, and not earlier than the 3d century B.C. If now there is real weight in the points of contact between this story and the *Arabian Nights*—and the points of difference cannot be held to outweigh the resemblances between two legends, each of which is necessarily so far removed from the hypothetical common source—the inference is important for both stories. On the one hand, it appears that (at least in part) the book of Esther draws on a Persian source; on the other hand, it becomes probable that the *Nights* are older than the Sásánian period, to which Lane, iii. 677, refers them.

It is a piece of good fortune that Mas'údí and the *Fihrist* give us the information cited above. For in general the Moslems, though very fond of stories, are ashamed to recognize them as objects of literary curiosity. In fact, the next mention of the *Nights* is found only after a lapse of three centuries. Maḳrízí, describing the capital of Egypt, quotes from a work of Ibn Sa'íd (c. 1250 A.D.), who again cites an older author (Al-Korṭobí), who, in speaking of a love affair at the court of the caliph Al-Ámir (1097–1130), says "what is told about it resembles the romance of Al-Baṭṭál, or the *Thousand and One Nights*" (*Ḥiṭaṭ*, Búláḳ ed., i. 485, ii. 181).

That the *Nights* which we have are not the original translation of the *Hezár Afsáne* is certain, for the greater part of the stories are of Arabian origin, and the whole is so thoroughly Mohammedan that even the princes of remote ages who are introduced speak and act as Moslems. It might be conceived that this is due to a gradual process of modernization by successive generations of story-tellers. But against this notion, which has been entertained by some scholars, Lane has remarked with justice that, much as MSS. of the *Nights* differ from one another in points of language and style, in the order of the tales, and the division into nights, they are all so much at one in essentials that they must be regarded as derived from a single original. There is no trace of a recension of the text that can be looked on as standing nearer to the *Hezár Afsáne*. And the whole local colour of the work, in point of dialect and also as regards the manners and customs described, clearly belongs to Egypt as it was from the 14th to the 16th century. Some points, as De Sacy and Lane have shown, forbid us to place the book earlier than the second half of the 15th century. Galland's MS. copy, again, was in existence in 1548. Lane accordingly dates the work from the close of the 15th century or the beginning of the 16th, but this date appears to be too late. For Abu'l-Maḥásin, an Egyptian historian who died in 1470, writing of Ḥamdi, a famous highwayman of Baghdad in the 10th century, remarks that he is probably the figure who used to be popularly spoken of as Ahmed al-Danaf (ed. Juynboll, ii. 305). Now in the *Nights* Ahmed al-Danaf really plays a part corresponding to that of the historical Ḥamdi, being now a robber (Lane, ii. 404) and again a captain of the guard (Lane, ii. 249). It would seem that Abu'l-Maḥásin had read or heard the stories in the *Nights*, and was thus led to compare the historical with the fictitious character. And, if this be so, the *Nights* must have been composed very soon after 1450.[1]

No doubt the *Nights* have borrowed much from the *Hezár Afsáne*, and it is not improbable that even in the original Arabic translation of that work some of the Persian stories were replaced by Arab ones. But that our *Nights* differ very much from the *Hezár Afsáne* is further manifest from the circumstance that, even of those stories in the *Nights* which are not Arabian in origin, some are borrowed from books mentioned by Mas'údí as distinct from the *Hezár Afsáne*. Thus the story of the king and his son and the damsel and the seven viziers (Lane, chap. xxi. note 51) is in fact a version of the *Book of Sindbád*,[2] while the story of Jalíád and his son and the vizier Shammás (M'Naghten, iv. 366 *sq.*; *cf.* Lane, iii. 530) corresponds to the book of *Ferza and Simás*.[3]

Not a few of the tales are unmistakably of Indian or Persian origin, and in these poetical passages are rarely inserted. In other stories the scene lies in Persia or India, and the source is foreign, but the treatment thoroughly Arabian and Mohammedan. Sometimes, indeed, traces of Indian origin are perceptible, even in stories in which Hárún al-Rashíd figures and the scene is Baghdad or Basra.[4] But most of the tales, in substance and form alike, are Arabian, and so many of them have the capital of the caliphs as the scene of action that it may be guessed that the author used as one of his sources a book of tales taken from the era of Baghdad's prosperity.

The late date of the *Nights* appears from sundry anachronisms. In the story of the men transformed into fish—white, blue, yellow, or red according as they were Moslems, Christians, Jews, or Magians (Lane, i. 99),—the first three colours are those of the turbans which, in 1301, Mohammed b. Keláún of Egypt commanded his Moslem, Christian, and Jewish subjects respectively to wear.[5] Again, in the story of the humpback, whose scene is laid in the 9th century, the talkative barber says, "this is the year 653" (=1255 A.D.; Lane, i. 332, writes 263, but see his note), and mentions the caliph Mostanṣir (died 1242), who is incorrectly called son of Mostaḍí.[6] In the same story several places in Cairo are mentioned which did not exist till long after the 9th century (see Lane, i. 379).[7] The very rare edition of the first 200 nights published at Calcutta in 1814 speaks of cannon, which are first mentioned in Egypt in 1383; and all editions sometimes speak of coffee, which was discovered towards the end of the 14th century, but not generally used till 200 years later. In this and other points, *e.g.*, in the mention of a mosque founded in 1501 (Lane, iii. 608), we detect the hand of later interpolators, but the extent of such interpolations can hardly perhaps be determined even by a collation of all copies. For the nature and causes of the variations between different copies the reader may consult Lane, iii. 678, who explains how transpositions actually arise by transcribers trying to make up a complete set of the tales from several imperfect copies.

Many of the tales in the *Nights* have an historical basis, as Lane has shown in his notes. Other cases in point might be added: thus the chronicle of Ibn al-Jauzí (died 1200 A.D.) contains a narrative of Ḳamar, slave girl of Shaghb, the mother of Al-Moḳtadir, which is the source of the tale in Lane, i. 310 *sq.*, and of another to be found in M'Naghten, iv. 557 *sq.*; the latter is the better story, but departs so far from the original that the author must have had no more than a general recollection of the narrative he drew on.[8] There are other cases in the *Nights* of two tales which are only variations of a single theme, or even in certain parts agree almost word for word. Some tales are mere compounds of different stories put together without any art, but these perhaps are, as Lane conjectures, later additions to the book; yet the collector himself was no great literary artist. We must picture him as a professional story-teller equipped with a mass of miscellaneous reading, a fluent power of narration, and a ready faculty for quoting, or at a push improvising, verses. His stories became popular, and were written down as he told them,—hardly written by himself, else we should not have so many variations in the text, and such insertions of "the narrator says," "my noble sirs," and the like. The frequent coarseness of tone is proper to the condition of Egyptian society under the Mameluke sultans, and would not have been tolerated in Baghdad in the age to which so many of the tales refer. Yet with all their faults the *Nights* have beauties enough to deserve their popularity, and to us their merit is enhanced by the pleasure we feel in being transported into so entirely novel a state of society.

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[1] The hypothesis of gradual and complete modernization is also opposed to the fact that the other romances used by Cairene story-tellers (such as those of 'Antar and of Saif) retain their original local colour through all variations of language and style.

[2] On this famous book, the Syriac *Sindibán*, the Greek *Syntipas*, and the *Seven Sages* of the European West, see SYRIAC LITERATURE (vol. xxii. p. 850) and SPAIN (vol. xxii. p. 354).

[3] De Sacy and Lane suppose that the original title of the Arabic translation of the *Hezár Afsáne* was *The Thousand Nights*. But most MSS. of Mas'údí already have *The Thousand and One Nights*, which is also the name given by Makrízí. Both ciphers perhaps mean only "a very great number," and Fleischer (*De Glossis Habichtianis*, p. 4) has shown that 1001 is certainly used in this sense.

[4] Gildemeister, *De Rebus Indicis*, p. 89 *sq.*

[5] Quatremère, *Sultans Mamlouks*, ii. 2, p. 177 *sq.*

[6] Lane, i. 342, arbitrarily writes "Montasir" for "Mostansir."

[7] See also *Edinb. Review*, July 1886, p. 191 *sq.*

[8] See De Goeje in *Gids*, 1876, ii. pp. 397–411.

The original of some of the most interesting tales in Galland's version, as "Aladdin and the Wonderful Lamp," "Ali Baba and the Forty Thieves," has just been discovered by Dr Zotenberg in a MS. recently acquired by the National Library at Paris. A careful examination of this MS. and of the Wortley-Montagu MS. in the Bodleian may lead perhaps to a more certain conclusion as to the time of composition.

The *Thousand and One Nights* became known in Europe through A. Galland's French version (12 vols., 12mo, Paris, 1704–12); the publication was an event in literary history, the influence of which can be traced far and wide. This translation, however, left much to be desired in point of accuracy, and especially failed to reproduce the colour of the original with the exactness which those who do not read merely for amusement must desire. It was with a special view to the remedying of these defects that Lane produced in 1840 his admirably accurate, if somewhat stilted, translation, enriched with most valuable notes and a discussion of the origin of the work (new edition, with some additional notes, 3 vols., 8vo., London, 1859). Lane's translation omits the tales which he deemed uninteresting or unfit for a European public. No full translation into English can be published, and, though two such have been privately printed, and one of these (by Sir R. Burton) is being reproduced in an expurgated form, Lane's version is still unsuperseded for all serious use. Of the Arabic text of the *Nights* the principal editions are—(1) M'Naghten's edition, 4 vols., 8vo, Calcutta, 1839–42; (2) the Breslau edition, 12 vols., 12mo, 1835–43, the first 8 vols. by Habicht, the rest by Fleischer (compare as to the defects of Habicht's work, Fleischer, *De Glossis Habichtianis*, Leipsic, 1836); (3) the first Búlák edition, 4 vols., 1862–3. (M. J. DE G.)

THRACE is a name which was applied at various periods to areas of different extent, but for the purposes of this article it will be taken in its most restricted sense, as signifying the Roman province which was so called (Thracia, see Plate of the Roman empire in vol. xx.) after the district that intervened between the river Ister (Danube) and the Hæmus Mountains (Balkan) had been formed into the separate province of Mœsia, and the region between the rivers Strymon and Nestus, which included Philippi, had been added to Macedonia. The boundaries of this were—towards the N. the Hæmus, on the E. the Euxine Sea, on the S. the Propontis, the Hellespont, and the Ægean, and towards the W. the Nestus. The most distinguishing features of the country were the chain of Rhodope (Despoto-dagh) and the river Hebrus (Maritza). The former separates at its northernmost point from the Hæmus, at right angles, and runs southward at first, nearly parallel to the Nestus, until it approaches the sea, when it takes an easterly direction: this bend is referred to by Virgil in the line (*Georg.*, iii. 351)—

> Quaque *redit* medium Rhodope porrecta sub axem.

The summits of this chain are higher than those of Hæmus, and not a few of them range from 5000 to 8000 feet; the highest point, so far as is at present known (for these mountains have been imperfectly explored), rises towards the north-west, near the point where now stands the famous Bulgarian monastery of Rilo. The Hebrus, together with its tributaries which flow into it from the north, east, and west, drains nearly the whole of Thrace. It starts from near the point of junction of Hæmus and Rhodope, and at first takes an easterly direction, the chief town which lies on its banks in the earlier part of its course being Philippopolis; but, when it reaches the still more important city of Hadrianopolis, it makes a sharp bend towards the south, and enters the sea nearly opposite the island of Samothrace. The greater part of the country is hilly and irregular, though there are considerable plains; but besides Rhodope two other tolerably definite chains intersect it, one of which descends from Hæmus to Adrianople, while the other follows the coast of the Euxine at no great distance inland. One district in the extreme north-west of Thrace lay beyond the watershed that separates the streams that flow into the Ægean from those that reach the Danube: this was the territory of Sardica, the modern Sophia. In the later Roman period two main lines of road passed through the country. One of these skirted the southern coast, being a continuation of the Via Egnatia, which ran from Dyrrhachium to Thessalonica, thus connecting the Adriatic and the Ægean; it became of the first importance after the foundation of Constantinople, because it was the direct line of communication between that city and Rome. The other followed a north-westerly course through the interior, from Constantinople by Hadrianopolis and Philippopolis to the Hæmus, and thence by Naissus (Nisch) through Mœsia in the direction of Pannonia, taking the same route by which the post-road now runs from Constantinople to Belgrade. The climate of Thrace was regarded by the Greeks as very severe, and that country was spoken of as the home of the north wind, Boreas. The coast in the direction of the Euxine also was greatly feared by sailors, as the harbours were few and the sea proverbially tempestuous; but the southern shore was more attractive to navigators, and here we find the Greek colonies of Abdera and Mesambria on the Ægean, Perinthus on the Propontis, and, the most famous of all, Byzantium, at the meeting-point of that sea and the Bosphorus. Another place which proved attractive to colonists of that race was the curious narrow strip of ground, called the Thracian Chersonese, that intervened between the Hellespont and the Bay of Melas, which penetrates far into the land on its northern side. Among the cities that occupied it, Sestos and Callipolis (Gallipoli) are the most worthy of mention. In order to prevent the incursions of the Thracians, a wall was built across its isthmus, which was less than five miles in breadth. The north-eastern portion of the Ægean, owing to its proximity to the coast of Thrace, was known as the Thracian Sea, and in this were situated the islands of Thasos, Samothrace, and Imbros.

There is no sufficient evidence to determine the ethnological affinities of the Thracian race. Their language has perished, and the information respecting them which has come down to us hardly furnishes more than material for conjecture, so that the most that we can affirm on the subject is that they belonged to the Indo-European family. The most striking archæological monuments of the prehistoric period are the sepulchral mounds, which have been compared in appearance to the tumulus on the plain of Marathon; these are found by thousands in various parts of the country, especially in the neighbourhood of the ancient towns. As Roman implements and ornaments have been found in some of them, it is plain that this mode of burial continued to be practised until a late period. The deity whose worship prevailed most extensively in the country was Dionysus. The most powerful Thracian tribe was that of the Odrysæ, whose king, Teres, in the middle of the 5th century B.C. extended his dominion so as to include the greater part of Thrace. During the Peloponnesian War his son Sitalces was an ally of some importance to the Athenians, because he kept in check the Macedonian monarch, who opposed the interests of the Athenians in the Chalcidic peninsula. On the death of that prince his kingdom was divided, and the power of the Thracians was consequently diminished; but in the time of Philip of Macedon we find Cersobleptes, who ruled the south-eastern portion of the country, exercising an important influence on the policy of Athens. During the early period of the Roman empire the Thracian kings were allowed to maintain an independent sovereignty, while acknowledging the suzerainty of Rome, and it was not until the reign of Vespasian that the country was reduced to the form of a province. From its outlying position in the northern part of the Balkan peninsula, it was much exposed to the inroads of barbarian invaders, so that it was overrun by the Goths on several occasions, and subsequently by the Huns; but its proximity to Constantinople caused its fortunes to be closely connected with those of that city, from the time when it became the capital of the Eastern empire. In the course of time its inhabitants seem to have been thoroughly Romanized, and to have adopted the Latin language, and there is much probability in the view that they were the progenitors of the Vlachs, or Roumanians south of the Danube, whose language is of Latin origin, and who at various periods formed an important factor in the countries to the northward of Greece. The first evidence of the development of this nationality is found in a curious story told by Theophanes at the end of the 6th century. At that time a khan of the Avars had overrun the Eastern empire and appeared before the walls of Constantinople; but two generals of the imperial forces, who had concealed themselves in the Balkan, succeeded in mustering a considerable body of troops, and were on their way to surprise the rear of the Avars when their project was brought to an end by the following occurrence. One of the beasts of burden happened to fall down in the line of march, on which some one close by called out to its driver, in the language of the country, "Torna, torna, fratre," that is, "Turn him round, brother." The driver did not hear this, but the other soldiers did; and, thinking the enemy were upon them, and that this was the sign for retreat, they took up the cry "Torna, torna," and the whole force fled precipitately. It seems probable that the men who used these words were Roumanian inhabitants of the Balkan. In the course of the Middle Ages the northern parts of Thrace and some other districts of that country were occupied by a Bulgarian population; and in 1361 the Ottomans, who had previously established themselves in Europe, made themselves masters of Adrianople, which for a time became the Turkish capital. When Constantinople fell in 1453, the whole country passed into the hands of the Turks, and in their possession it remained until 1878, when, in accordance with the provisions of the treaty of Berlin, the northern portion of it was placed under a separate administration, with the title of Eastern Roumelia; this province has now become, to all intents and purposes, a part of the principality of Bulgaria. The population of Thrace at the present day is composed of Turks, Greeks, and Bulgarians. (H. F. T.)

THRALE. See Piozzi.

THRASYBULUS, an Athenian who played a distinguished part in the latter years of the Peloponnesian War and in the restoration of the democracy at Athens. In 411 B.C., as an officer in the Athenian armament at Samos, he energetically opposed the oligarchical conspiracy of the Four Hundred, and was mainly instrumental in keeping the fleet and army loyal to the democracy and in procuring the recall of the banished Alcibiades. At the battle of Cynnosema, in the same year, he commanded the right wing of the Athenian fleet, and to his valour and conduct the Athenian victory was largely due. He took an active part in the naval operations of the following years, being present at the victories of Cyzicus (410) and Arginusæ (406). In 407 he commanded a squadron on the Thracian coast, where he reduced places which had gone over to the Lacedæmonians. When the infamous Thirty Tyrants were at the height of their power in Athens, Thrasybulus, who as a democrat had been banished, marched from Thebes with about seventy men, with the connivance of Thebes, and established himself at Phyle, a strong place in the rear of Athens. There he repulsed an attack directed against him by the Thirty; his numbers increased, and, after surprising and routing a body of foot and horse, he seized Piræus, the port of Athens, but, finding the circuit of the walls too great to be defended by his small force, he retired into the adjoining Munychia. Here he was attacked by the troops of the Thirty, but in the street-fighting the democrats had the best of it, and the Thirty were in consequence deposed and retired to Eleusis. Hostilities, however, continued until Pausanias, one of the kings of Sparta, intervened, and by force and craft effected a reconciliation. The democrats marched into Athens with all the pomp of war, and sacrificed to Athene on the Acropolis. This restoration of the democracy by Thrasybulus ranked henceforward with the memorable deeds of Athenian history. To his counsels seems due in part the credit for the wise moderation with which the democrats used their victory, and the inviolate good faith with which they observed the political amnesty. The grateful citizens rewarded their champion with an olive crown. In 395, when Thebes was threatened by Sparta, the Athenians, stimulated by Thrasybulus, repaid the friendly shelter which the Thebans had afforded them in exile by resolving to stand by Thebes against Sparta, and by actually sending a force under Thrasybulus to her aid. In 390, while the war known as the Corinthian was still dragging on, Thrasybulus was sent with a fleet to check the growing power of Sparta in the Ægean. He substituted a democracy for an oligarchy at Byzantium, and won the friendship of Chalcedon; then, landing in Lesbos, he defeated a joint force of Lacedæmonians and Lesbians. In the following spring he prepared to assist Rhodes, which was threatened by the Lacedæmonians; but to recruit his forces he levied contributions from various cities. At Aspendus, in Pamphylia, an outrage committed by some of his men roused the anger of the people, who fell on him by night, and slew him in his tent. He was buried at Athens, in the Ceramicus, near the graves of Pericles and Phormio.

THREADWORMS. See Nematoidea.

THREE RIVERS, the third city of Quebec province, Canada, and capital of St Maurice county, is situated at the confluence of the rivers St Maurice and St Lawrence. The St Maurice flows in from the north, and, being divided at its mouth by two islands, the channels give the town its name. It is on the line of the Canadian Pacific Railway, 78 miles south-west of Quebec, and 92 north-east of Montreal. Founded in 1634, Three Rivers is one of the oldest towns in Quebec. It is the centre of a large lumber trade, which is carried on by the St Maurice and its tributaries. Three leagues from the city are the St Maurice forges, where iron wares were formerly manufactured extensively. Other industries are furniture and cabinet making, boot and shoe making, and those carried on in the spool factories, brass and lead foundries, sawmills, and carriage factories. The city is the residence of the Roman Catholic bishop whose diocese bears the same name. The chief trade is in lumber, grain, cattle, &c., which find sale in South America, the West Indies, Great Britain, and the United States. The city sends one member to the Canadian House of Commons and one to the Legislative Assembly. The population of the city in 1881 was 8670 (males 4173, females 4497). The district of Three Rivers comprises the counties of St Maurice, Nicolet, Champlain, and Maskinongé.

THROAT DISEASES. These form a large and important class, and include some of the most serious and fatal of maladies (see Croup and Diphtheria). The present article will be devoted mainly to a general account of the more common diseases affecting the upper part of the respiratory passages, but certain morbid conditions of the back of the mouth and of the gullet will also be referred to. The diagnosis of not a few of these diseases has been greatly aided by the introduction into medical practice of the laryngoscope; but, while the use of this instrument is a part of the education of every well-equipped medical practitioner, the minute investigation and the treatment of the more occult and serious maladies affecting the throat are by general consent, and with much advantage, relegated to the specialist.

Laryngitis, or inflammation of the mucous membrane of the *Larynx*, may be either acute or chronic.

Acute laryngitis is usually produced by exposure to cold directly, or by a catarrh extending either from the nasal or from the bronchial mucous membrane into that of the larynx. It is an occasional accompaniment of certain of the infectious diseases in which the throat is liable to suffer, such as small-pox, measles, scarlet fever, and erysipelas. Excessive use of the voice, as in loud speaking or singing, sometimes gives rise to laryngitis. Further, the inhalation of irritating particles, vapours, &c., and the local effects of swallowing very hot fluids, are well-recognized causes. The chief changes in the larynx are great redness, with swelling of the parts, which affect the whole interior of the cavity, but are specially marked where the tissues are lax, such as the neighbourhood of the epiglottis and of the vocal cords. The effect is to produce narrowing of the channel for the entrance of air, and to this the chief dangers are due. The symptoms vary with the intensity of the attack, but, along with more or less feverishness and constitutional disturbance, there is usually a sense of heat, dryness, and pain in the throat, attended with some difficulty in the act of swallowing. Cough is a constant symptom, and is either loud, barking, or clanging, or else husky and toneless. It is at first dry, but afterwards is accompanied with expectoration. The voice, like the cough, is rough or husky. The breathing shows evidence of laryngeal obstruction, both inspiration and expiration being prolonged and difficult, with a somewhat hissing sound, and with almost no interval between the two acts. In severe cases the face and surface generally become livid, and suffocation threatens, particularly during the paroxysms of coughing. In favourable cases, which form the majority, the attack tends to abate in a few days, but on the other hand death may occur suddenly in a suffocative paroxysm, particularly in the case of children. Many cases of acute laryngitis are so comparatively slight as to make themselves known only by hoarseness and the character of the cough; nevertheless in every instance the attack demands serious attention. The treatment consists in keeping the patient in bed in an atmosphere of 60° to 70° F., made moist by steam. The use of warm gargles, and the frequent inhalation of the vapour of hot water, containing such soothing substances as benzoin, conium, hop, &c., and the application of hot fomentations to the throat, will be found of much value. Internally diaphoretics, such as small doses of antimony or Dover's powder, are also to be recommended. Such remedies usually suffice to relieve the attack, but in very severe cases more active interference may be necessary. When there is much swelling of the mucous membrane in the upper portion of the larynx, scarification of the parts with the aid of the laryngoscope may afford relief, but tracheotomy should not be neglected where death appears to be imminent from suffocation. Attacks of laryngitis may be largely prevented in those liable to them by a regimen calculated to invigorate the system, such as the cold bath, regular open-air exercise, &c.

Chronic laryngitis may occur as a result of repeated attacks of the acute form, or may arise independently from such causes as habitual exposure (especially where along with this there is over-indulgence in alcohol), the habitual overuse of the vocal organs, &c. The changes taking place in the parts are more permanent than in the acute form, consisting mainly in thickening of the mucous membrane, vocal cords, &c. With it may be ulceration, and also sometimes destruction, of the cartilaginous parts of the larynx. The symptoms vary according to the extent and amount, as well as the duration, of the inflammation. Thus there may simply be a certain huskiness or hoarseness on attempts at the use of the voice, this condition being well exemplified in the so-called clergyman's sore throat (*dysphonia clericorum*); while, on the other hand, there may be, not only complete loss of voice, but severe pain in the act of swallowing and great difficulty in breathing, accompanied sometimes with expectoration of large quantities of matter in the cases where ulceration is present. Under this variety of the disease may be included the ulceration due to syphilis and that occurring in the course of phthisis, both of which are attended with the symptoms now mentioned. The diagnosis and the treatment of all such cases is greatly aided by the use of the laryngoscope, by which a view of the affected parts can be obtained, and the proper remedies more readily applied. In the treatment of the chronic forms of laryngitis rest to the parts is essential, any attempts at continuing the use of the voice only aggravating the condition; while tonic remedies and regimen should be diligently employed to strengthen the system generally. Applications to the affected parts in the forms of solutions of silver, alum, zinc, tannin, &c., either by means of a sponge-probang introduced into the cavity or by the simpler method of spraying, are often beneficial. The insufflation of powders, such as iodoform, or starch mixed with a minute quantity of morphia, is also of service, as are likewise inhalations of vapours of iodine, carbolic acid, turpentine, eucalyptus, &c. In aggravated forms of this disease tracheotomy is occasionally necessary to relieve threatened suffocation.

Symptoms similar to those already described are produced by tumours and other growths in the larynx. Such growths may be of simple character, in the form of isolated fibrous formations attached by a peduncle to some portion of the laryngeal mucous membrane, or as warty excrescences occurring upon or in the neighbourhood of the vocal cords. They are detected by means of the laryngoscope, and can often be dealt with effectually by the surgeon. In the more serious malignant tumours (epitheliomatous or cancerous), which either take origin in the larynx, or spread into it from adjacent parts, interference by surgical measures can only afford temporary relief.

Certain affections of the larynx are of purely nervous origin, and occur independently of any local disease. One of the most important of these is *laryngismus stridulus*, otherwise called *child-crowing* or *spasmodic croup*. This condition occurs chiefly during the early years of childhood, often in infants during dentition, and manifests itself after premonitory symptoms of a common catarrh, lasting a day or two, by the occurrence of a violent suffocative attack due to sudden spasmodic approximation of the vocal cords, and consequent interruption to the breathing. The symptoms are not connected with any local inflammatory condition, but are the result of reflex irritation affecting the nerves supplying the laryngeal muscles. Such disturbance appears specially apt to occur in rickety or otherwise unhealthy children, in connexion either with dentition or with disorders of the alimentary canal. The onset is sudden, resembling a convulsive seizure, and symptoms of suffocation are at once developed. The child makes strong efforts to inspire, which are accompanied with stridulous or crowing sounds, but, notwithstanding, very little air can enter the chest owing to the spasm of the glottis, and unless relief speedily comes death may be very rapid. In most cases, however, the attack quickly passes off, and the child seems little the worse. A liability to this disorder is sometimes observed in families, and in such instances the attacks are apt to occur in their more serious and fatal forms. Treatment to be of any avail must be promptly applied. It consists mainly in the employment of means to allay the spasm. The use of the warm bath is very serviceable for this purpose, as is also chloroform inhalation. But one of the simplest and most effectual measures is putting the finger back into the child's mouth, which is sufficient in many cases to relax the spasm of the glottis, and permit the entrance of air. In impending asphyxia the dashing of cold water over the face and chest, and the use of artificial respiration, should be tried, and even tracheotomy or laryngotomy if practicable. In all cases every effort should be made to discover any causes likely to produce nervous irritation, such as teething, intestinal worms, &c., and to deal with these by appropriate remedies.

Symptoms not unlike those now described sometimes occur in adults as the result of irritation of the recurrent laryngeal nerve, by the pressure upon it of a thoracic aneurism or other tumour. Such pressure, if long continued, results in paralysis of the nerve, occasioning more or less constant trouble in breathing.

In the condition known as *nervous aphonia*, which occurs mostly in women of hysterical habit or in circumstances of enfeebled health, the voice becomes reduced to a whisper, but there is seldom any affection of the breathing, or cough, and the laryngoscope reveals a perfectly healthy state of the parts. In such cases the remedies must be directed to the improvement of the general health. The use of electricity (faradism) applied to the neck is often attended with marked benefit.

Diseases affecting the *Trachea* are usually associated with laryngeal affections on the one hand or bronchial on the other, and their separate consideration is unnecessary.

The *Tonsils* are frequently the seat of inflammation, and *acute tonsillitis* or *quinsy* is one of the most common forms of sore throat. This affection is usually induced by cold, but it would appear to arise under other conditions also, such as digestive disturbances, &c. It is said to be more common in persons of rheumatic constitution, and one attack predisposes to others. The symptoms come on somewhat suddenly and sharply, with chill followed by fever, the temperature frequently attaining a high point of elevation. Pain is experienced in the act of swallowing from the outset. The inflammation is usually at first confined to one tonsil, but on examining the throat there is seen to be considerable redness and swelling of the whole surrounding mucous membrane, the uvula, soft palate, &c., while a copious secretion accumulates at the parts, and causes much discomfort. The act of swallowing becomes increasingly difficult, and fluids are apt to regurgitate through the nose. Pain is felt along the Eustachian tube towards the ear, and there are tenderness and swelling in the neck about the angle of the jaw on the affected side. The voice acquires a peculiar and very characteristic snuffling tone, and there may be some embarrassment to the breathing. In a few days the inflamed tonsil shows signs of suppurating, and an abscess is seen to be bulging forward into the mouth. When this bursts or is evacuated, speedy relief is obtained, and the patient is soon restored to his usual health. Occasionally, however, the inflammation passes from the one tonsil to the other, and a similar experience has to be gone through again. An attack of quinsy rarely lasts beyond a week or ten days, and is not as a rule attended with danger to life, although it is said that suffocation has occasionally occurred owing to the bursting of a large tonsillar abscess during sleep, and the passage of its contents into the trachea. The treatment for a quinsy is much the same as that for an ordinary catarrh or cold,—confinement to the house, the employment of diaphoretics or mild laxatives, together with light diet, being all that is necessary as regards general management. For the relief of the local inflammation the frequent employment of warm gargles of milk and water or glycerin and water or the inhalation of vapour afford much relief, as do also hot applications to the neck. Some authorities recommend the sucking of ice and the external application of cold compresses, but on the whole warmth appears to be the more soothing remedy. When an abscess has formed it may be punctured, but care requires to be observed in doing this that no injury be inflicted on any important blood-vessel.

The tonsils are frequently the seat of permanent enlargement (*chronic tonsillitis*), which may result from frequent attacks of quinsy or may exist independently. They are often seen in delicate young people, and, in the case of some at least, denote a strumous tendency. They give trouble from the mechanical impediment they present to swallowing and clear articulation, and when very large they cause the breathing to be more or less noisy at all times, but especially during sleep, while again they may give rise to a measure of deafness. They are treated by remedies which promote the general nutrition, such as cod-liver oil, iron, &c., by the use of astringent gargles, and when necessary by excision.

The *Pharynx* or upper portion of the gullet (seen to a large extent on looking at the back of the mouth) is frequently the seat of a chronic inflammatory condition, usually associated with derangements of the digestive organs, and sometimes the result of excessive tobacco smoking. On inspection the mucous membrane is seen to be unduly red and glazed looking, with the enlarged follicles standing out prominently. It produces considerable irritation, cough, and discomfort, which may be of long continuance unless subjected to appropriate treatment. This consists in removing any local source of irritation, in rectifying by diet and other remedies (see STOMACH DISEASES) any gastric disturbance, and by the application to the parts of silver or other mild caustic solution.

The *Œsophagus* or gullet may be the seat of catarrhal or inflammatory conditions, but the more important ailments affecting this tract are those which arise from local injuries, such as the swallowing of scalding or corrosive substances. This may cause ulceration followed with cicatrization which narrows the passage and produces the symptoms of stricture of the œsophagus,—namely, pain and difficulty in swallowing, with regurgitation of the food. The severity of the case will necessarily depend upon the amount of narrowing and consequent mechanical obstruction, but in some instances this has occurred to such an extent as practically to occlude the canal. Cases of œsophageal stricture of the kind now referred to may sometimes be relieved by the diligent use of the bougie, but not unfrequently, in order to prevent death by starvation, surgical interference is requisite to form an opening into the stomach by means of which food may be introduced.

A still more serious and frequent cause of œsophageal stricture is that due to cancerous growth in the canal, which may occur at any part, but is most common at the lower end, in the vicinity of the entrance into the stomach. The symptoms of this condition are increasing difficulty in the passage downwards of the food, the steady decline in strength, and the development of the cancerous cachexia, together with enlargements of the glands in the neck; while the diagnosis is rendered the more certain by the absence of any cause, such as local injury, for the formation of a stricture, and by the age (as a rule at or beyond middle life). Treatment here can only be palliative while life continues, which in general is not long. Feeding by the bowel (enemata) may be advantageously resorted to as supplementary to efforts to administer liquid nutriment in the usual way. It is to be observed in all cases of organic stricture that the food does not necessarily return at once, but seems as if it had passed into the stomach. In reality, however, it has passed into the dilated or pouched portion of the canal, which is almost always present immediately above the seat of stricture, where it remains until, from its amount, it regurgitates back into the mouth, when it can be seen, by the absence of any evidence of digestion, that it has never been within the cavity of the stomach. While in this way a large quantity of the food returns, it often happens that a small amount of the liquid portion does trickle through the narrowed canal into the stomach, and thus life may be prolonged for a considerable time.

Strictures of the œsophagus may also be produced by the pressure of tumours or aneurisms within the cavity of the chest but external to the canal. Further, a variety of œsophageal stricture is not unfrequently met with which is due entirely to nervous causes, and is quite unconnected with organic disease,—namely, that form occurring in hysterical females termed spasmodic stricture. Here the attack of difficulty in swallowing comes on usually when the patient is at meals, and the food cannot pass down. The absence, however, of all history of any organic source of disease, and especially the perfect facility with which the œsophageal tube or bougie is passed, together with other manifestations of hysteria commonly present, serve readily to establish the diagnosis. The remedies most suitable are tonics and the frequent passage of the stomach-tube, which as a rule soon entirely removes the tendency to spasm.

Finally, difficulty in swallowing sometimes occurs in certain serious nervous diseases from paralysis affecting the nerves supplying the muscular coats of the œsophagus, which thus loses its propulsive power. When such complications occur they usually denote an advanced stage of the central disease with which they are connected, and a speedily fatal termination. (J. O. A.)

THRONDHJEM, or TRONDHJEM (DRONTHEIM), the third town of Norway, capital of the Throndhjem stift and of the South Throndhjem amt, is pleasantly situated on the southern shore of the Throndhjem fjord, at the mouth of the Nid, 348 miles by rail to the north of Christiania, in 63° 25′ 52″ N. lat. and 10° 33′ 19″ E. long. In front of the town is the islet of Munkholm, formerly a monastery and now a fortress; on the high ground to the east is the small stronghold of Christiansten. The houses of Throndhjem, principally of wood, are substantial, spacious, and well lighted; and the streets are wide, regular, and scrupulously clean. The principal building is the cathedral, partly dating from about 1090, but chiefly belonging to the 12th and 13th centuries (*c.* 1161–1248). Its extreme length was 325 feet and its extreme breadth 124 feet; but in the 14th, 15th, and 17th centuries it suffered greatly from repeated fires; after the last of these the nave was completely abandoned, and soon became a heap of ruins. The building, which still ranks as the finest ecclesiastical edifice in Norway, and is the place of coronation of the Norwegian sovereigns, is now undergoing extensive but judicious restoration. The workmanship of its eastern windows and of the marble or steatite columns of the choir is specially noteworthy. Throndhjem possesses three churches in all, and among its other public buildings may be mentioned the residences of the stiftsamtmand and the bishop, the grammar school, the real school, the head office of the Bank of Norway, the deaf and dumb institute, the hospital, and the theatre. It is the seat of the royal Norwegian scientific society, in connexion with which are an excellent library and a good zoological and antiquarian museum. Throndhjem, which has steamboat communication with Christiania, Hamburg, and Hull, and is connected with Sweden by the Meraker Railway (63 miles), carries on an extensive trade in copper (from the Röros mines), timber, oil, and dried and salted fish; the industries include shipbuilding, sawmilling, distilling, tanning, rope-making, and ribbon-making. The population in 1875 was 22,152; in 1885 it was estimated at 24,000.

Throndhjem, originally Nidaros, was founded by Olaf Tryggvason, who built a royal residence and a church here in 996. It was made an archbishopric in 1152. The city attained its highest development about the latter half of the 13th century, by which time it had become an important pilgrimage centre and had as many as fifteen churches. It has sustained frequent sieges, as well as devastating conflagrations. Its importance declined about the time of the Reformation, when it ceased to be a resort of pilgrims. At the beginning of the present century its inhabitants numbered only 8832.

THRUSH (A. S. *þrysce*, Icel. *þröstr*, Norw. *Trast*, O. H. Germ. *Drosce*, whence the modern German *Drossel*, to be compared with the analogous English form THROSTLE,[1] now almost obsolete, both being apparently diminutives), the name that in England seems to have been common to two species of birds, the first now generally distinguished as the Song-Thrush, but known in many districts as the Mavis,[2] the second called the Mistletoe-Thrush, but having many other local designations, of which more presently.

The former of these is one of the finest songsters in Europe, but it is almost everywhere so common that its merits in this respect are often disregarded, and not unfrequently its melody, when noticed, is ascribed to the prince of feathered vocalists, the NIGHTINGALE (vol. xvii. p. 498). The Song-Thrush is too well known to need description, for in the spring and summer there is hardly a field, a copse, or a garden that is not the resort of a pair or more; and the brown-backed bird with its spotted breast, hopping over the grass for a few yards, then pausing to detect the movement of a worm, and vigorously seizing the same a moment after, is one of the most familiar sights. Hardly less well known is the singular nest built by this bird—a deep cup, lined with a thin but stiff coating of fragments of rotten wood ingeniously spread, and plastered so as to present a smooth interior—in which its sea-green eggs spotted with black are laid. An early breeder, it builds nest after nest during the season, and there can be few birds more prolific. Its ravages on ripening fruits, especially strawberries and gooseberries, excite the enmity of the imprudent gardener who leaves his crops unprotected by nets, but he would do well to stay the hand of revenge, for no bird can or does destroy so many snails, as is testified to the curious observer on inspection of the stones that it selects against which to dash its captures,—stones that are besmeared with the slime of the victims and bestrewn with the fragments of their shattered shells. Nearly all the young Thrushes reared in the British Islands—and this expression includes the storm-swept isles of the Outer Hebrides, though not those of Shetland—seem to emigrate as soon as they are fit to journey, and at a later period they are followed by most of their parents, so that many parts of the kingdom are absolutely bereft of this species from October to the end of January. On the continent of Europe the autumnal influx of the birds bred in the North is regarded with much interest, as has been already stated (BIRDS, vol. iii. p. 765), for they are easily ensnared and justly esteemed for the table, while their numbers make their appearance in certain districts a matter of great importance.

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[1] For many interesting facts connected with the words "Thrush" and "Throstle" which cannot be entered upon here, the reader should consult Prof. Skeat's *Etymological Dictionary*.

[2] Cognate with the French *Mauvis*, though that is nowadays almost restricted to the REDWING (vol. xx. p. 318). Its diminutive is *Mauviette*, the modern table-name of the Skylark, and perhaps *Mavis* was in English originally the table-name of the Thrush.

The second species to which the name applies is distinguished as the Mistletoe-Thrush, or, by corrupt abbreviation, the Missel-Thrush.[1] It is known also in many districts as the "Storm-cock," from its habit of singing in squally weather that silences almost all other birds, and "Holm- (*i.e.*, Holly-) Thrush," while the harsh cries it utters when angry or alarmed have given it other local names, as "Screech," "Shrite," and "Skrike," all traceable to the Anglo-Saxon *Scric.*[2] This is a larger species than the last, of paler tints, and conspicuous in flight by the white patches on its outer tail-feathers. Of bold disposition, and fearless of the sleety storms of spring, as of predatory birds, the cock will take his stand on a tall tree, "like an enchanter calling up the gale" (as Knapp happily wrote), and thence with loud voice proclaim in wild and discontinuous notes the fervour of his love for his mate; nor does that love cease when the breeding-season is past, since this species is one of those that appear to pair for life, and even when, later in the year, it gathers in small flocks, husband and wife may be seen in close company. In defence of nest and offspring, too, few birds are more resolute, and the Daw, Pie, or Jay that approaches with an ill intent speedily receives treatment that causes a rapid retreat, while even the marauding cat finds the precincts of the "master of the coppice" (*Pen y llwyn*), as the Welsh name this Thrush, unsuitable for its stealthy operations. The connexion of this bird with the mistletoe, which is as old as the days of Aristotle, is no figment, as some have tried to maintain. Not only is it exceedingly fond of the luscious viscid berries, but it seems to be almost the only bird that will touch them. Of other British Thrushes, the FIELDFARE (vol. ix. p. 142), REDWING (vol. xx. p. 318), and the Blackbird and RING-OUSEL (vol. xviii. p. 76) have been before noticed in these pages, as has been (under the first of those headings) the so-called "Robin" of North America.

The Thrushes have been generally considered to form a distinct Family, *Turdidæ*, which is placed by some taxonomers the highest in rank among birds. An attempt has already been made (ORNITHOLOGY, vol. xviii. pp. 30, 48) to point out the fallacy of this view, and space is here wanting to dwell longer on the matter. This is the more to be regretted, for, though many modern systematists will admit the close connexion of the *Turdidæ* and some of the so-called Family *Sylviidæ* or WARBLERS (*q.v.*), the abolition or modification of the latter, by wholly or partially merging it in the former, has not yet been satisfactorily effected, and Mr Seebohm, in his portion of the British Museum *Catalogue of Birds* (v. p. 1), being compelled by the conditions previously laid down by Mr Sharpe (*op. cit.*, iv. pp. 6, 7) to unite them, protests against doing so. His own assignment of the Subfamily *Turdinæ* is into 11 genera, of which, however, 6 only would be commonly called Thrushes, and it must be borne in mind that in establishing these he regards coloration as the most valid character. They are *Geocichla* with 40 species, *Turdus* with 48, *Merula* with 52, *Mimocichla* with 3, *Catharus* with 12, and *Monticola* with 10. These last, well known as Rock-Thrushes, make a very near approach to the NIGHTINGALE (vol. xvii. p. 498), REDSTART (vol. xx. p. 317), and WHEATEAR (*q.v.*). (A. N.)

THUCYDIDES. Thucydides was the greatest historian of antiquity, and, if not the greatest that ever lived, as some have deemed him, at least the historian whose work is the most wonderful, when it is viewed relatively to the age in which he did it. The most important facts which we know about him are those which he has told us himself. It matters very little, fortunately, that the biographical materials are scanty. For posterity, his life is represented by his life's labour, the *History of the Peloponnesian War*; and the biographical facts are of interest chiefly as aids to the appreciation of that history. He was probably born in or about 471 B.C. The only definite testimony on the subject is contained in a passage of Aulus Gellius, who says that in 431 Hellanicus "seems to have been" sixty-five years of age, Herodotus fifty-three, and Thucydides forty (*Noct. Att.*, 15, 23). The authority for this statement was Pamphila, a compiler of biographical and historical notices, who lived in the reign of Nero. She must have had access to Greek sources of the 4th century B.C.; and her precision—though qualified, in the version of Gellius, by the word "seems"—would warrant the supposition that she had taken some pains to secure accuracy. Further, the date which she assigns is in good accord with an inference fairly deducible from the language of Thucydides himself, viz., that in 431 he had already reached the full maturity of his powers. Krüger, indeed, would place his birth earlier than 471, and Ullrich later, but for reasons, in each case, which can scarcely outweigh the ancient authority.

Date of birth.

The parentage of Thucydides was such as to place him in a singularly favourable position for the great work to which he afterwards devoted his life. His father Olorus, a citizen of Athens, belonged to a family which derived wealth and influence from the possession of gold mines at Scaptesyle, on the Thracian coast opposite Thasos, and was a relative of his elder namesake, the Thracian prince whose daughter Hegesipyle married the great Miltiades, so that Cimon, son of Miltiades, was a cousin, perhaps first cousin, once removed, of Thucydides. It was in the vault of the Cimonian family at Athens, and near the remains of Cimon's sister Elpinice, that Plutarch saw the grave of Thucydides. Thus the fortune of birth secured three signal advantages to the future historian: he was rich; he had two homes—one at Athens, the other in Thrace,—no small aid to a comprehensive study of the conditions under which the Peloponnesian War was waged; and his family connexions were likely to bring him from his early years into personal intercourse with the men who were shaping the history of his time.

Parentage.

The development of Athens during the forty years from 471 to 431 was, in itself, the best education which such a mind as that of Thucydides could have received. In the first two decades of his life the expansion and consolidation of Athenian power was proceeding; between his twentieth and fortieth year the inner resources of the city were being applied to the embellishment and ennoblement of Athenian life. As Cimon had been the principal agent in the former period, so Pericles was the central

The years 471–431 B.C.

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[1] There is no doubt of the bird taking its name from the plant Mistletoe (*Viscum album*), about the spelling of which there can be no uncertainty—A.S. *Misteltan*, the final syllable originally signifying "twig," and surviving in the modern "tine," as of a fork or of a deer's antler.

[2] It seems quite possible that the word SHRIKE (vol. xxi. p 645), though now commonly accepted as the equivalent, in an ornithological sense, of *Lanius*, may have been originally applied to the Mistletoe-Thrush. In several of the Anglo-Saxon *Vocabularies* dating from the 8th to the 11th century, as printed by Thomas Wright, the word *Scric*, which can be hardly anything else than the early form of "Shrike," is glossed *Turdus*.

figure of the latter. A consciousness of such periods may be traced in the passage of the Funeral Oration where Pericles refers, first, to the acquisition of empire by the preceding generation, and then to the improvement of that inheritance by his own contemporaries (ii. 36. 5). It is a natural subject of regret, though it is not a just cause of surprise or complaint, that the History tells us nothing of the literature, the art, or the social life under whose influences its author had grown up. The Funeral Oration contains, indeed, his general testimony to the value and the charm of those influences. There we have the very essence of the Athenian spirit condensed into a few pregnant sentences, which show how thoroughly the writer was imbued with that spirit, and how profoundly he appreciated its various manifestations. But he leaves us to supply all examples and details for ourselves. Beyond a passing reference to public "festivals," and to "beautiful surroundings in private life," he makes no attempt to define those "recreations for the spirit" which the Athenian genius had provided in such abundance. No writer of any age, perhaps, has rendered a more impressive tribute to the power of the best art than is implied in the terse phrase of Thucydides, when, speaking of the works which the Athenian daily saw around him, he declares that "the daily delight of them banishes gloom" (*ὧν καθ' ἡμέραν ἡ τέρψις τὸ λυπηρὸν ἐκπλήσσει*). But it is not to Thucydides that we owe any knowledge of the particular forms in which that art was embodied. He alludes to the newly-built Parthenon only as containing the treasury; to the statue of Athene Parthenos which it enshrined, only on account of the gold which, at extreme need, could be detached from the image; to the Propylæa and other buildings with which Athens had been adorned under Pericles, only as works which had reduced the surplus of funds available for the war. Among the illustrious contemporaries whose very existence would be unknown from his pages are the dramatists Æschylus, Sophocles, Euripides, Aristophanes; the architect Ictinus; the sculptor Phidias; the physician Hippocrates; the philosophers Anaxagoras and Socrates. If Thucydides had mentioned Sophocles as a general in the Samian War, it may be doubted whether he would have noticed the circumstance that Sophocles also wrote dramas, unless it had been for the purpose of distinguishing him from a namesake. And, had he lived to carry his story down to the debate in the Athenian ecclesia after the battle of Arginusæ, we may conjecture that Socrates, if named at all, would have been barely mentioned as the one prytanis out of fifty who resisted an unconstitutional act,—with some expression, perhaps, of praise, but without any fuller characterization. We think of the countless occasions which Herodotus, if he had dealt with this period, would have found for invaluable digressions on men and manners, on letters and art; we feel the severity of the loss which the reticence of Thucydides has caused to us; and we might almost be tempted to ask whether the more genial, if laxer, method of Herodotus does not indeed correspond better with a liberal conception of the historian's office. No one can do full justice to Thucydides, or appreciate the true completeness of his work, who has not faced this question, and found the answer to it. It would be a hasty judgment which inferred from the omissions of the History that its author's interests were exclusively political. Thucydides was not writing the history of a period. His subject was an event—the Peloponnesian War,—a war, as he believed, of unequalled importance, alike in its direct results and in its political significance for all time. To his task, thus defined, he brought an intense concentration of all his faculties. He worked with a constant desire to make each successive incident of the war as clear as possible. To take only two instances: there is nothing in literature more graphic than his description of the plague at Athens, or than the whole narrative of the Sicilian expedition. But the same temper made him resolute in excluding irrelevant topics. The social life of the time, the literature and the art, find no place in his picture simply because they did not belong to his subject. His work was intended to be "a possession for ever." He could conceive a day when Sparta should be desolate, and when only ruins of Athens should remain. But his imagination never projected itself into a time when the whole fabric of Hellenic civilization should have perished. Could his forecast have extended to an age when men of "barbarian" races and distant climes would be painfully endeavouring to reconstruct a picture of that civilization,—when his own narrative would need the help of sidelights which seemed to him wholly unnecessary,—then, assuredly, he would have added all that such readers could require. But he would not have done this in the manner of Herodotus, by free indulgence in digression; rather he would have gathered up the social and intellectual phenomena of his day in a compact and systematic introduction, specially designed for the non-Hellenic reader.

Thucydides and Antiphon.

Style of Thucydides.

The biography which bears the name of Marcellinus states that Thucydides was the disciple of Anaxagoras in philosophy and of Antiphon in rhetoric. Such statements were often founded on nothing more than a desire to associate distinguished names, and to represent an eminent man as having profited by the best instruction in each kind which his contemporaries could afford. In this case there is no evidence to confirm the tradition. But it may be observed that Thucydides and Antiphon at least belong to the same rhetorical school, and represent the same early stage of Attic prose. Both writers use words of an antique or decidedly poetical cast; both point verbal contrasts by insisting on the precise difference between terms of similar import; and both use metaphors somewhat bolder than were congenial to Greek prose in its riper age. The differences, on the other hand, between the style of Thucydides and that of Antiphon arise chiefly from two general causes. First, Antiphon wrote for hearers, Thucydides for readers; the latter, consequently, can use a degree of condensation, and a freedom in the arrangement of words, which would have been hardly possible for the former. Again, the thought of Thucydides is often more complex than any which Antiphon undertook to interpret; and the greater intricacy of the historian's style exhibits the endeavour to express each thought.[1] Few things in the history of literary prose are more interesting than to watch that vigorous mind in its struggle to mould a language of magnificent but immature capabilities. The obscurity with which Thucydides has sometimes been reproached often arises from the very clearness with which a complex idea is present to his mind, and his strenuous effort to present it in its entirety, when the strong consciousness of logical coherence will make him heedless of grammatical regularity. He never sacrifices the thought to the language, but he will sometimes sacrifice the language to the thought. A student of Thucydides may always be consoled by the reflexion that he is not engaged in unravelling a mere rhetorical tangle. Every light on the sense will be a light on the words; and, when, as is not seldom the case, Thucydides comes victoriously out of this struggle of thought and language, having achieved perfect expression of his meaning in a sufficiently lucid form, then his style rises into an intellectual brilliancy—thoroughly manly, and also penetrated with intense feeling—which nothing in Greek prose literature surpasses.

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[1] See Jebb's *Attic Orators*, vol. i. p. 35.

His relation to public life.

The History shows not only a thorough insight into the political ideas of Pericles, but also a sympathy with him, and an admiration for his character, which indicate personal friendship. If, before 431, Thucydides had wished to take a prominent part in the public life of Athens, everything was in his favour. But there is no trace of his having done so; and it is possible that his opportunities in this respect were modified by the necessity of frequent visits to Thrace, where the management of such an important property as the gold mines must have claimed the occasional presence of the proprietor. The manner in which he refers to his personal influence in that region is such as to suggest that he had sometimes resided there (iv. 105. 1). He was at Athens in the spring of 430, when the plague broke out. If his account of the symptoms has not enabled physicians to agree on a diagnosis of the malady, it is at least singularly full and vivid. He had himself been attacked by the plague; and, as he briefly adds, "he had seen others suffer." The tenor of his narrative would warrant the inference that he had been one of a few who were active in ministering to the sufferers—in that fearful time when religion and morality lost all control over the despairing population of Athens—when all the ordinary decencies of life were set at nought, and when even the nearest relatives failed in the duties of humanity towards the dying.

430. The plague.

424.

The turning-point in the life of Thucydides came in the winter of the year 424. He was then forty-seven (if his birth has been rightly placed in 471), and for the first time he is found holding an official position. He was one of two generals entrusted with the command of the regions towards Thrace (τὰ ἐπὶ Θρᾴκης), a phrase which denotes the whole Thracian seaboard from Macedonia eastward to the vicinity of the Thracian Chersonese, though often used with more special reference to the Chalcidic peninsula. One reason why Thucydides had been chosen for the post was the local influence which he possessed among the people of the Thracian seaboard, through his family connexions and his ownership of the gold mines. His colleague in the command was Eucles. About the end of November 424 Eucles was in the city of Amphipolis, on the river Strymon. That city was not merely more important to Athens than any other place in the region,—it was the stronghold of Athenian power in the north. To guard it with all possible vigilance was a matter of peculiar urgency at that moment. The ablest of Spartan leaders, Brasidas, was then in Thrace with a Peloponnesian army,—not, indeed, close to Amphipolis, but still within a distance which imposed special caution on Athenian officers. He was in the Chalcidic peninsula, where he had already gained rapid success; and part of the population between that peninsula and Amphipolis was already known to be disaffected to Athens. Under circumstances so suggestive of possible danger, we might have expected that Thucydides, who had seven ships of war with him, would have been near his colleague Eucles, and ready to co-operate with him at a moment's notice. It appears, however, that, with his ships, he was at the island of Thasos, several miles distant from the Thracian coast. Brasidas, making a forced march from the Chalcidic peninsula, suddenly appeared before Amphipolis. Eucles sent in all haste for Thucydides, who arrived with his ships from Thasos just in time to beat off the enemy from Eion at the mouth of the Strymon, but not in time to save Amphipolis. Only a few hours before, it had capitulated to Brasidas, who had offered exceptionally favourable terms. The profound vexation and dismay felt at Athens found expression in the punishment of the commander who seemed primarily responsible for so grave a disaster. For the next twenty years—*i.e.*, till 404—Thucydides was an exile from Athens. It is not improbable that the charge brought against him was that of treason (προδοσία), for which the penalty was death, and that he avoided this penalty by remaining in banishment. A special *psephism* is said to have been required before Thucydides could return in 404, which would have been regular if a capital sentence had been on record against him, but not so if he had been merely under sentence of exile. Cleon is said to have been the prime mover in his condemnation; and this is likely enough. Eucles was probably punished also. Grote was the first modern writer to state the reasons for thinking that Thucydides may have been really guilty of culpable negligence on this occasion, and that his punishment—which had usually been viewed as the vindictive act of a reckless democracy—may have been well deserved. Everything turns on the question why he was at Thasos just then, and not at Eion. No one disputes that, after the summons from Eucles, he did all that was possible. It is true that the facts of the situation, so far as we know them, strongly suggest that he ought to have been at Eion, and do not disclose any reason for his being at Thasos. But it is only fair to remember, in a case of this kind, that there may have been other facts which we do not know. There is some presumptive evidence of carelessness; but we can hardly say more than that. The absence of Thucydides from the neighbourhood of Amphipolis at that precise juncture may have had some better excuse than now appears.

Fall of Amphipolis.

Exile of Thucydides.

423–404. Travels.

From 423 to 404 the home of Thucydides was on his property in Thrace, but much of his time appears to have been spent in travel. He visited the countries of the Peloponnesian allies,—recommended to them by his quality as an exile from Athens; and he thus enjoyed the rare advantage of contemplating the great war from a point of view opposite to that at which he had previously been placed. He speaks of the increased leisure which his banishment secured to his study of events. He refers partly, doubtless, to detachment from Athenian politics, partly, also, we may suppose, to the opportunity of visiting places signalized by recent events, and of examining their topography in the light of such information as he could collect on the spot. The local knowledge which is often apparent in his Sicilian books may have been acquired at this period. The banishment of Thucydides was the most fortunate event that could have occurred for him and for us, when it enabled him, in this way, to look at his subject all round. If it is always hard for an historian to be impartial, it is especially so for the historian of a great war in which his own country has been one of the combatants. The mind of Thucydides was naturally judicial, and his impartiality—which seems almost superhuman by contrast with Xenophon's *Hellenica*—was in some degree a result of temperament. But it cannot be doubted that the evenness with which he holds the scales was greatly assisted by the experience which, during these years of exile, must have been familiar to him—that of hearing the views and aims of the Peloponnesians set forth by themselves, and of estimating their merits otherwise than would have been easy for an observer in a hostile camp.

404. Return to Athens.

His own words make it clear that he returned to Athens, at least for a time, in 404. Classen supposes that his return took place in the autumn of that year, about six months after Athens had surrendered to Lysander, and while the Thirty were still in power. Finding that the rule of the oligarchy was becoming more and more violent, Thucydides again left Athens, and retired to his property in Thrace, where he lived till his death, working at his History. The preponderance of testimony certainly goes to show that he died in Thrace, and by violence. It would seem that, when he wrote chapter 116 of his third book, he was ignorant of an eruption of Etna which took place in 396. There is some reason then, for believing that he did not survive his seventy-fifth year. According to ancient tradition, he was killed by robbers. His relics were brought to Athens, and laid in the vault of Cimon's family, where Plutarch saw their resting-place. The abruptness with which the History breaks off agrees with the story of a sudden death. The historian's daughter is said to have saved the unfinished work, and to have placed it in the hands of an editor. This editor, according to one account, was Xenophon, to whom Diogenes Laertius assigns the credit of having "brought the work into reputation, when he might have suppressed it." The tradition is however, very doubtful. In its origin, it may have been merely a guess, suggested by a feeling that no one then living could more appropriately have discharged the office of literary executor than the writer who, in his *Hellenica*, continued the narrative.

Death: before 396 B.C. (?).

Conception of the History.

At the outset of the History Thucydides has indicated his general conception of his work, and has stated the principles which governed its composition. His purpose had been formed at the very beginning of the war, in the conviction that it would prove more important than any event of which Greeks had record. The leading belligerents, Athens and Sparta, were both in the highest condition of effective equipment. The whole Hellenic world—including Greek settlements outside of Greece proper—was divided into two parties, either actively helping one of the two combatants or meditating such action. Nor was the movement confined within even the widest limits of Hellas; the "barbarian" world also was affected by it,—the non-Hellenic populations of Thrace, Macedonia, Epirus, Sicily, and, finally, the Persian kingdom itself. The aim of Thucydides was to preserve an accurate record of this war, not only in view of the intrinsic interest and importance of the facts, but also in order that these facts might be permanent sources of political teaching to posterity. His hope was, as he says, that his History would be found profitable by "those who desire an exact knowledge of the past as a key to the future, which in all probability will repeat or resemble the past. The work is meant to be a possession for ever, not the rhetorical triumph of an hour." As this context shows, the oft-quoted phrase, "a possession for ever," had, in its author's meaning, a more definite import than any mere anticipation of abiding fame for his History. It referred to the permanent value of the lessons which his History contained. Thucydides stands alone among the men of his own days, and has no superior of any age, in the width of mental grasp which could seize the general significance of particular events. The political education of mankind began in Greece, and in the time of Thucydides their political life was still young. Thucydides knew only the small city-commonwealth on the one hand, and on the other the vast barbaric kingdom; and yet, as has been well said of him, "there is hardly a problem in the science of government which the statesman will not find, if not solved, at any rate handled, in the pages of this universal master."[1]

Permanent interest of the war.

Such being the spirit in which he approached his task, it is interesting to inquire what were the points which he himself considered to be distinctive in his method of executing it. His Greek predecessors in the recording of events had been, he conceived, of two classes. First, there were the epic poets, with Homer at their head, whose characteristic tendency, in the eyes of Thucydides, is to exaggerate the greatness or splendour of things past—as, for instance, conceding the historical character of the Trojan war, he supposes the strength of the Greek fleet to be overstated in the *Iliad*. Secondly, there were the Ionian prose writers whom he calls "chroniclers" (λογογράφοι). These writers are directly known to us only by meagre fragments; but Dionysius of Halicarnassus has described their general characteristics in a manner which serves to illustrate the differences indicated by Thucydides between their work and his own. Their general object was to diffuse a knowledge of legends preserved by oral tradition, and of written documents—usually lists of officials or genealogies—preserved in public archives; and they published their materials as they found them, without any attempt at sifting fact from fable. Thucydides describes their work by the word ξυντιθέναι, but his own by ξυγγράφειν,—the difference between the terms answering to that between compilation of a somewhat mechanical kind and historical composition in a higher sense. The vice of the "chroniclers," in his view, is that they cared only for popularity, and took no pains to make their narratives trustworthy. In contrast with these predecessors, Thucydides has subjected his materials to the most searching scrutiny. The ruling principle of his work has been strict adherence to carefully verified facts. "As to the deeds done in the war, I have not thought myself at liberty to record them on hearsay from the first informant or on arbitrary conjecture. My account rests either on personal knowledge or on the closest possible scrutiny of each statement made by others. The process of research was laborious, because conflicting accounts were given by those who had witnessed the several events, as partiality swayed or memory served them."

The epic poets.

The prose chroniclers.

Distinctive aim of Thucydides.

Herodotus and Thucydides.

A period of at least twenty years must have elapsed between the date at which Herodotus ceased to write and that at which the History of Thucydides received its present form. There can be no doubt that Thucydides knew the History of Herodotus, and that in some places he alludes to it. The diligence and the honesty of Herodotus are alike beyond question, and would, we may be sure, have been fully recognized by Thucydides. The work of Herodotus was distinct in kind from that of the Ionian chroniclers, and was of an immeasurably higher order. While they dealt, in a bold fashion, with the annals of separate cities or peoples, Herodotus set the first example of multifarious knowledge subordinated to the execution of a great historical plan, and also showed for the first time that a prose history could have literary charm. But Thucydides doubtless thought of Herodotus as having certain traits in common with the Ionian chroniclers, and as being liable, so far, to the same criticism. One such trait would be the inadequate sifting of evidence; another, the mixture of a fabulous element with historical fact; and another, perhaps, the occasional aiming at rhetorical effect. Of this last trait the chief instances would be those imaginary dialogues or speeches with which Herodotus sometimes enlivens his narrative. This brings us to an important topic,—the purpose with which Thucydides himself has admitted speeches into his History, and the manner in which they have been composed.

The speeches.

The speeches constitute between a fourth and a fifth part of the History. If they were eliminated, an admirable narrative would indeed remain, with a few comments, usually brief, on the more striking characters and events. But we should lose all the most vivid light on the inner workings of the Greek political mind, on the motives of the actors, and the arguments which they used,—in a word, on the whole play of contemporary feeling and opinion. To the speeches is due in no small measure the imperishable intellectual interest of the History, since it is chiefly by the speeches that the facts of the Peloponnesian War are so lit up with keen thought as to become illustrations of general laws, and to acquire a permanent suggestiveness for the student of politics. When Herodotus made his persons hold conversations or deliver speeches, he was following the precedent of epic poetry; his tone is usually colloquial rather than rhetorical; he is merely making thought and motive vivid in the way natural to a simple age. Thucydides is the real founder of the tradition by which historians were so long held to be warranted in introducing set speeches of their own composition. His own account of his practice is given in the following words. "As to the speeches made on the eve of the war, or in its course, I have found it difficult to retain a memory of the precise words which I had heard spoken; and so it was with those who brought me reports. But I have made the persons say what it seemed to me most opportune for them to say in view of each situation; at the same time I have adhered as closely as possible to the general sense of what was actually said." So far as the language of the speeches is concerned, then, Thucydides plainly avows that it is mainly or wholly his own. As a general rule, there is little attempt to mark different styles. The case of Pericles, whom Thucydides must have repeatedly heard, is probably an exception; the Thucydidean speeches of Pericles offer several examples of that bold imagery which Aristotle and Plutarch agree in ascribing to him, while the Funeral Oration, especially, has a certain majesty of rhythm, a certain union of impetuous movement with lofty grandeur, which the historian has given to no other speaker. Such strongly marked characteristics as the curt bluntness of the Spartan ephor Sthenelædas, or the insolent vehemence of Alcibiades, are also indicated. But the dramatic truth of the speeches generally resides in the matter, not in the form. In regard to those speeches which were delivered at Athens before his banishment in 424,—and seven such speeches are contained in the History,—Thucydides could rely either on his own recollection or on the sources accessible to a resident citizen. In these cases there is good reason to believe that he has reproduced the substance of what was actually said. In other cases he had to trust to more or less imperfect reports of the "general sense"; and in some instances, no doubt, the speech represents simply his own conception of what it would have been "most opportune" to say. The most evident of such instances occur in the addresses of leaders to their troops. The historian's aim in these military harangues—which are usually short—is to bring out the points of a strategical situation; a modern writer would have attained the object by comments prefixed or subjoined to

Their language.

Their matter.

The military speeches.

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[1] Freeman, *Historical Essays*, 2d ser., iii.

Voltaire's criticism.

The Greek view.

his account of the battle. The comparative indifference of Thucydides to dramatic verisimilitude in these military orations is curiously shown by the fact that the speech of the general on the one side is sometimes as distinctly a reply to the speech of the general on the other as if they had been delivered in debate. We may be sure, however, that, wherever Thucydides had any authentic clue to the actual tenor of a speech, he preferred to follow that clue rather than to draw on his own invention. Voltaire has described the introduction of set speeches as "a sort of oratorical falsehood, which the historian used to allow himself in old times." The strongest characteristic of Thucydides is his devotion to truth,—his laborious persistence in separating fact from fiction; and it is natural to ask why he adopted the form of set speeches, with the measure of fiction which it involved, instead of simply stating, in his own person, the arguments and opinions which he conceived to have been prevalent. The question must be viewed from the standpoint of a Greek in the 5th century B.C. Epic poetry had then for many generations exercised a powerful influence over the Greek mind. Homer had accustomed Greeks to look for two elements in any complete expression of human energy,—first, an account of a man's deeds, then an image of his mind in the report of his words. The Homeric heroes are exhibited both in action and in speech. Further, the contemporary readers of Thucydides were men habituated to a civic life in which public speech played an all-important part. Every adult citizen of a Greek democracy was a member of the assembly which debated and decided great issues. The law-courts, the festivals, the drama, the market-place itself, ministered to the Greek love of animated description. To a Greek of that age a written history of political events would have seemed strangely insipid if speech "in the first person" had been absent from it, especially if it did not offer some mirror of those debates which were inseparably associated with the central interests and the decisive moments of political life. In making historical persons say what they might have said, Thucydides confined that oratorical licence to the purpose which is its best justification: with him it is strictly dramatic, an aid to the complete presentment of action, by the vivid expression of ideas and arguments which were really current at the time. Among later historians who continued the practice, Polybius, Sallust, and Tacitus most resemble Thucydides in this particular; while in the Byzantine historians, as in some moderns who followed classical precedent, the speeches were usually mere occasions for rhetorical display. Botta's *History of Italy* from 1780 to 1814 affords one of the latest examples of the practice, which was peculiarly suited to the Italian genius.

The eight books.

The present division of the History into eight books is one which might well have proceeded from the author himself, as being a natural and convenient disposition of the contents. The first book, after a general introduction, sets forth the causes of the Peloponnesian War. The first nine years of the war are contained in the second, third, and fourth books,—three years in each. The fifth book contains the tenth year, followed by the interval of the "insecure peace." The Sicilian expedition fills the sixth and seventh books. The eighth book opens that last chapter of the struggle which is known as the "Decelean" or "Ionian" War, and breaks off abruptly—in the middle of a sentence, indeed—in the year 411. The words in which Grote bids farewell, at that point, to Thucydides well express what every careful student must feel. "To pass from Thucydides to the *Hellenica* of Xenophon is a descent truly mournful; and yet, when we look at Grecian history as a whole, we have great reason to rejoice that even so inferior a work as the latter has reached us. The historical purposes and conceptions of Thucydides, as set forth by himself in his preface, are exalted and philosophical to a degree altogether wonderful, when we consider that he had no pre-existing models before him from which to derive them. And the eight books of his work (in spite of the unfinished condition of the last) are not unworthy of these large promises, either in spirit or in execution."

Origin of that division.

The principal reason against believing that the division into eight books was made by Thucydides himself is the fact that a different division, into thirteen books, was also current in antiquity, as appears from Marcellinus (§ 58). It is very improbable—indeed hardly conceivable—that this should have been the case if the eight-book division had come down from the hand of the author. We may infer, then, that the division of the work into eight books was introduced at Alexandria,—perhaps in the 3d or 2d century B.C. That division was already familiar to the grammarians of the Augustan age. Dionysius of Halicarnassus, who recognizes it, has also another mode of indicating portions of the work, viz., by *stichometria*, or the number of lines which they contained. Thus, in the MS. which he used, the first 87 chapters of book i. contained about 2000 lines (equivalent to about 1700 lines in Bekker's stereotyped 8vo text).

Order of compo

Ullrich has maintained with much acuteness that Thucydides composed the first three books and about half of book iv. in the years 421–413, and the rest of the work after 404. His general ground is the existence in i.–iv. of passages which seem to imply ignorance of later events. Classen has fully examined the evidence, and, as a result, has arrived at the following conclusion. It is possible that a first rough draft of the History, down to 413, may have been sketched by Thucydides before 405. But the whole History, from the first book onwards, was worked up into its present form only after 404. This view is confirmed by some passages, found even in the earliest books, which imply that the writer already knew the latest incidents, or the final issue, of the war. We have seen that, after 404, Thucydides may have enjoyed some six or seven years of leisure. Several peculiarities of expression or statement in book viii. suggest that it had not yet received the author's final revision at the time when death broke off the work. The absence of speeches from the eighth book has also been remarked. But it should be observed that much of the eighth book is occupied with negotiations, either clandestine or indecisive, or both. Its narrative hardly presents any moment which required such dramatic emphasis as the speeches usually impart. The mere misrepresentations by which Alcibiades and Chalcideus prevailed on the Chians to revolt certainly did not claim such treatment.

Mode of reckoning time.

The division of the war by summers and winters (*κατὰ θέρος καὶ χειμῶνα*)—the end of the winter being considered as the end of the year—is perhaps the only one which Thucydides himself used, for there is no indication that he made any division of the History into books. His "summer" includes spring and autumn, and extends, generally speaking, from March or the beginning of April to the end of October. His "winter"—November to February inclusive—means practically the period during which military operations, by land and sea, are wholly or partly suspended. When he speaks of "summer" and "winter" as answering respectively to "half" the year (v. 20. 3), the phrase is not to be pressed: it means merely that he divides his year into these two parts. The mode of reckoning is essentially a rough one, and is not to be viewed as if the commencement of summer or of winter could be precisely fixed to constant dates. For chronology, besides the festivals, he uses the Athenian list of archons, the Spartan list of ephors, and the Argive list of priestesses of Hera.

There is no reference to the History of Thucydides in the extant Greek writers of the 4th century B.C.; but Lucian has preserved a tradition of the enthusiasm with which it was studied by Demosthenes. The great orator is said to have copied it out eight times, or even to have learnt it by heart. It is at least beyond doubt that the study of Thucydides contributed a very powerful influence to the style of Demosthenes, though that influence rather passed into the spirit of his oratory than showed itself in any marked resemblances of form. The Alexandrian critics acknowledged Thucydides as a great master of Attic. Sallust, Cornelius Nepos, Cicero, and Quintilian are among the Roman writers whose admiration for him can be traced in their work, or has been expressly recorded. The most elaborate ancient criticism on the diction and composition of Thucydides is contained in three essays by Dionysius of Halicarnassus.

MSS.,

Among the best MSS. of Thucydides, the Codex Vaticanus 126 (11th cent.) represents a recension made in the Alexandrian or Roman age. In the first six books the number of passages in which the Vaticanus alone has preserved a true reading is comparatively small; in book vii. it is somewhat larger; in book viii. it is so large that here the Vaticanus, as compared with the other MSS., acquires the character of a revised text. Other important MSS. are the Palatinus 252 (11th cent.): the Casselanus (1252 A.D.); the Augustanus Monacensis 430 (1301 A.D.). A collation, in books i. ii., of two Cambridge MSS. of the 15th century (Nn. 3. 18, Kk. 5. 19) has been published by Shilleto. Several Parisian MSS. (H. C. A. F.), and a Venetian MSS. (V.) collated by Arnold, also deserve mention. The Aldine edition was published in 1502. It was formerly supposed that there had been two Juntine editions. Shilleto, in the "Notice" prefixed to book i., first pointed out that the only Juntine edition was that of 1526, and that the belief in an earlier Juntine, of 1506, arose merely from the accidental omission of the word *vicesimo* in the Latin version of the imprint.

Of recent editions, the most generally useful is Classen's, in the Weidmann series (Berlin, 1862-78); each book can be obtained separately. Arnold's edition (1848-51) contains much that is still valuable. For books i. and ii. Shilleto's edition (1872-76) furnishes a commentary which, though not full, deals admirably with many difficult points. Among other important editions, it is enough to name those of Duker, Bekker, Goeller, Poppo, and Krüger. Bétant's lexicon to Thucydides (2 vols., Geneva, 1843) is well executed. Jowett's translation (Oxford, 1881) is supplemented by a volume of notes. Dale's version (Bohn) also deserves mention for its fidelity, as Crawley's (London, 1876) for its vigour. *Hellenica* (London, 1880) contains an essay on "The Speeches of Thucydides," pp. 266-323, which has been translated into German. The best clue to Thucydidean bibliography is in Engelmann's *Scriptores Græci*, pp. 745 sq., 8th ed., 1880. (R. C. J.)

THUGS. That the Sanskrit root *sthag* (Pali, *thak*), "to cover," "to conceal," was mainly applied to fraudulent concealment, appears from the noun *sthaga*, "a cheat," which has retained this signification in the modern vernaculars, in all of which it has assumed the form *thag* (commonly written *thug*), with a specific meaning. The Thugs were a well-organized confederacy of professional assassins, who in gangs of from 10 to 200 travelled in various guises through India, wormed themselves into the confidence of wayfarers of the wealthier class, and, when a favourable opportunity occurred, strangled them by throwing a handkerchief or noose round their necks, and then plundered and buried them. All this was done according to certain ancient and rigidly prescribed forms and after the performance of special religious rites, in which the consecration of the pick-axe and the sacrifice of sugar formed a prominent part. From their using the noose as an instrument of murder they were also frequently called *Phânsigârs*, or "noose-operators." Though they themselves trace their origin to seven Mohammedan tribes, Hindus appear to have been associated with them at an early period; at any rate, their religious creed and practices as staunch worshippers of Devi (Kâli, Durgâ), the Hindu goddess of destruction, had certainly no flavour of Islam in them. Assassination for gain was with them a religious duty, and was considered a holy and honourable profession. They had, in fact, no idea of doing wrong, and their moral feelings did not come into play. The will of the goddess by whose command and in whose honour they followed their calling was revealed to them through a very complicated system of omens. In obedience to these they often travelled hundreds of miles in company with, or in the wake of, their intended victims before a safe opportunity presented itself for executing their design; and, when the deed was done, rites were performed in honour of that tutelary deity, and a goodly portion of the spoil was set apart for her. The fraternity possessed also a jargon of their own (Ramâsi), as well as certain signs by which its members recognized each other in the remotest parts of India. Even those who from age or infirmities could no longer take an active part in the operations continued to aid the cause as watchers, spies, or dressers of food. It was owing to their thorough organization, the secrecy and security with which they went to work, but chiefly to the religious garb in which they shrouded their murders, that they could, unmolested by Hindu or Mohammedan rulers, recognized as a regular profession and paying taxes as such, continue for centuries to practise their craft. Both the fractions into which they were divided by the Nerbudda river laid claim to antiquity: while the northern, however, did not trace their origin farther back than the period of the early Mohammedan kings of Delhi, the southern fraction not only claimed an earlier and purer descent, but adhered also with greater strictness to the rules of their profession.

The earliest authenticated mention of the Thugs is found in the following passage of Zíáu-d dín Barní's *History of Firoz Sháh* (written about 1356): "In the reign of that sultan," that is, about 1290, "some Thugs were taken in Delhi, and a man belonging to that fraternity was the means of about a thousand being captured. But not one of these did the sultan have killed. He gave orders for them to be put into boats and to be conveyed into the lower country, to the neighbourhood of Lakhnautí, where they were to be set free. The Thugs would thus have to dwell about Lakhnautí, and would not trouble the neighbourhood of Delhi any more" (Sir H. M. Elliot's *History of India*, vol. iii. p. 141). The first European travellers who speak of them without mentioning their name are Thevenot (1665) and Fryer (1673). Though instances of Thuggee had been known to the English rulers in India for many years, and sporadic efforts had been made by them towards the extinction of the gangs, it was not till Lord W. Bentinck (1828–35) took vigorous steps in this matter that the system was gradually unmasked, and finally all but stamped out. His chief agent, Captain (afterwards Sir William) Sleeman, with several competent assistants, and the co-operation of a number of native states, succeeded in completely grappling with the evil, so that up to October 1835 no fewer than 1562 Thugs had been committed, of which number 382 were hanged and 986 transported or imprisoned for life. It is true that, according to the *Thuggee and Dacoity Report for 1879*, the number of registered Punjabi and Hindustani Thugs then still amounted to 344. But all of these had already been registered as such before 1852. It may, therefore, fairly be assumed that none are alive now, and that the whole fraternity may be considered as extinct.

Full particulars concerning the system of Thuggee are given by Dr Sherwood, "On the Murderers called Phánsigárs," and J. Shakespear, "Observations regarding Bradheks and Thegs" (both treatises in vol. xiii., 1820, of the *Asiatic Researches*); [W. N. Sleeman,] *Ramaseeana, or a Vocabulary of the Language used by the Thugs, with an Introduction and Appendix*, Calcutta, 1836; the *Edinburgh Review* for Jan. 1837; [E. Thornton,] *Illustrations of the History and Practices of the Thugs*, London, 1837; Meadows Taylor, *Confessions of a Thug*, London, 1839; Major Sleeman, *Report on the Depredations committed by the Thug Gangs*, Calcutta, 1840; J. Hutton, *Popular Account of the Thugs and Dacoits*, London, 1857; Yule and Burnell, *Glossary of Anglo-Indian Colloquial Words and Phrases*, London, 1886, p. 696 *sq.* (R. R.)

THUGUT, Franz Maria von (1734–1818), foreign minister of Austria, was born of humble parentage at Linz in 1734, placed in the Government school of Oriental studies in 1752, and sent to Constantinople as an interpreter in 1757. At Constantinople he rose from post to post in the embassy, until in 1771 he became internuncius or ambassador. In 1776, after the war between Russia and Turkey, he obtained from the latter power the cession of the province of Bukowina to Austria. After thus crowning his long service in the East and gaining the confidence of Maria Theresa, he was sent by her without the knowledge of her son, the emperor Joseph, to Berlin, to avert by a peaceful settlement with Frederick the Great the threatened Bavarian war. In 1790 he was employed in the negotiations of Sistova, and his next mission was to Paris, where he entered into close relations with Mirabeau as the friend of Marie Antoinette. On the invasion of France by the allied armies in 1792, Thugut was sent to the scene of operations. It is well known that Kaunitz, the veteran minister of Austria, condemned the terms of the alliance with Prussia, as securing to Prussia the annexation of a great part of Poland, while only holding out to Austria an uncertain prospect of acquiring its equivalent in Bavaria. Thugut, a politician of the same school, viewed the new alliance with even greater hatred. After the failure of the campaign of 1792 he formed the deliberate opinion that persons around the duke of Brunswick had been bribed by the French, and that the retreat had been ordered in consequence. A few months later the anticipations of Kaunitz were realized. Prussia seized western Poland, while Austria remained as far as ever from gaining Bavaria. The emperor Francis now dismissed the ministers responsible for the Prussian alliance, and called Thugut to power. From this critical moment the alliance was doomed, and the allied commanders thwarted rather than assisted one another's operations on the eastern frontier of France. On the other hand, Thugut drew nearer to Russia, and negotiated at St Petersburg for the seizure of Venice by Austria. With England he desired to stand on a good footing; but, while Pitt's object was the overthrow of the revolutionary Government, Thugut's was simply the acquisition of territory for Austria. This discrepancy of aim led to results exasperating to the English ministry, such as the fall of Toulon, to which Thugut neglected to send the troops which he had promised. The evacuation of Belgium in 1794, usually attributed to Thugut's treachery, was, however, due to the incapacity or intrigues of others. In 1795, after the withdrawal of Prussia from the coalition, Thugut obtained financial help from England, gained from Russia a large share of Poland in the last partition, and prepared to carry on the war against France with the utmost energy. The campaign of the archduke Charles in 1796 drove the French from the east of the Rhine, and Bonaparte, who had conquered northern Italy up to Mantua, narrowly escaped destruction before this fortress. But for the genius of the French commander and the wretched character of the Austrian generals and officers, the immense efforts made by Thugut at this time would have turned the tide of the war. Defeat after defeat seemed to make no impression upon his "world-desolating obstinacy"; and, even when Bonaparte had advanced to within eighty miles of Vienna, it is stated that the empress had to throw herself at her husband's feet when in conference with his minister, in order to overcome the resistance of the latter to an armistice. The subsequent peace of Campo Formio was hotly condemned by Thugut, who tendered his resignation. Then followed the congress of Rastadt and the murder of the French envoys, long attributed, but without any real ground, to Thugut himself. War was renewed; the French were driven out of Italy by Austrian armies assisted by Suwaroff; and it was determined that the allies should conquer Switzerland, and so invade France where the frontier is most open. Thugut, now at the height of his power, and far more anxious to recover Belgium than to overthrow the republic, took the fatal step of withdrawing a great part of the Austrian forces from Switzerland at the very moment when the Russians were entering it. The result was the destruction of the Russians by Masséna and the total failure of the campaign, followed by the secession of Russia from the coalition. Still full of designs for annexation in Italy, Thugut continued the war with the help of England. On the very day when he renewed his engagements with England the news arrived of the battle of Marengo, which at one blow made an end of all that Austria had won in Italy in the preceding year. Nothing daunted, Thugut continued, during the armistice which followed, his preparation for the struggle with Moreau in the valley of the Danube; and, if he could have inspired his master with his own resolute spirit, the result of the war might have been different. But, while Thugut was actually receiving the British subsidies, the emperor, without the knowledge of his minister, surrendered the fortresses of Ulm and Ingolstadt to Moreau, in return for an extension of the armistice. Thugut's passionate indignation on learning of this miserable act is impressively described in Lord Minto's despatches from Vienna. He withdrew from office; but Lord Minto's protests compelled the emperor again to place in his hands the direction of affairs, which he held until the battle of Hohenlinden made all further resistance impossible. He was then, in deference to French influence, banished from Vienna, and never resumed office. In his retirement he was occasionally consulted, as after the battle of Wagram in 1809, when he recommended the emperor to make peace at any cost, stating that the existence of the Austrian monarchy was at stake and that the dissolution of Napoleon's empire was not far off. After the overthrow of Napoleon he returned to the capital, where he died May 29, 1818. Thugut possessed many of the qualities of a great man,—indomitable courage, calmness in danger, devotion to public interests, enormous industry; but all this was spoilt by the persistent disregard of obligations towards allies in the greedy pursuit of Austria's own aggrandizement, and by the intriguing spirit inseparable from this policy. The materials for forming a fair estimate of Thugut's conduct of affairs from 1793 to 1801 have but recently been given to the world. Of his private life next to nothing is known.

THULE was the name given by Greek and Roman geographers to a land situated to the north of Britain, which they believed to be the most northerly portion of Europe, or indeed of the known world. The first writer who mentioned the name was Pytheas of Massilia, whose statements concerning it have been already given under the heading PYTHEAS. But it is impossible for us to determine with certainty what those statements, which have only been transmitted to us at second or third hand, really were, and still more so what was their real signification. It is almost certain that Pytheas did not himself profess to have visited Thule, but had only vaguely heard of its existence, as a land of unknown extent, situated, according to the information he had received, six days' voyage to the north of Britain. This account was adopted by Eratosthenes (though rejected by Polybius and Strabo), and accordingly this unknown land became a cardinal point in the systems of many ancient geographers, as the northern limit of the known world. Nothing more was learnt concerning it until the Romans under Agricola (about 84 A.D.) accomplished the circumnavigation of the northern point of Britain, and not only visited, but according to Tacitus subdued, the Orcades or Orkney Islands. On this occasion, the historian tells us, they caught sight also of Thule,[1] which in this instance could only mean the group of the Shetland Islands. No further account of this mysterious land is found in any ancient author, except vague statements, derived from Pytheas, but mostly in an inaccurate and distorted form, concerning its position and the astronomical phenomena resulting from this cause. It is probable that what Pytheas really reported was that at the summer solstice the days were twenty-four hours in length, and conversely at the winter solstice the nights were of equal duration, a statement which would indicate the notion of its position in about 66° N. lat., or under what we now call the Arctic Circle. The skill of Pytheas as an astronomer would have been quite sufficient to lead him to the conclusion that this would be the case at some point in proceeding northwards, and the rapid changes in this respect that would be reported to him by any navigators that had really followed the shores of Britain to any considerable extent in that direction would confirm him in the correctness of his views. He had, too, a very exaggerated notion of the extent of Britain (see PYTHEAS), and hence he would be led to place an island which was six days' voyage to the north of it much nearer to the Arctic Circle than its true position.

The statement of Pytheas on this point appears to have obtained almost universal belief until the time of Marinus of Tyre and his successor Ptolemy, who were led—apparently from their knowledge that the group of islands to which the name of Thule had been applied by the Romans was really not very far distant from the Orcades—to bring down its position considerably more to the south, so that Ptolemy places the island of Thule, which he still regards as the most northerly point of Europe, in only 63° N. lat. Unfortunately this more reasonable view has been discarded by many modern writers, who have gone back to the statements of Pytheas concerning the length of the day, and have in consequence insisted upon placing Thule within the Arctic Circle, and have thus been led to identify it with Iceland. The improbability of such an hypothesis, when we consider the state of ancient navigation, is in itself a sufficient refutation, and there appears no reasonable doubt that the Thule of Pytheas, like that of the Romans and of Ptolemy, was merely an exaggerated and somewhat erroneous conception of the large group of the Shetland Islands, of which the principal, called Mainland, is in fact so predominant that the whole may well have been considered as one large island rather than a scattered group like the Orkneys. If we might trust to the accuracy of Strabo's quotation (ii. 5, p. 114), that Pytheas called Thule "the most northerly of the British Islands," this would be decisive on the point; but unfortunately the *verbal* accuracy of such references by ancient writers can seldom be relied on, and Strabo had evidently never seen Pytheas's original work.

It appears, however, to be certain that Iceland was really visited by some Irish monks long before its discovery by the Northmen, and is described under the name of Thule by a writer named Dicuil, himself an Irish monk, who wrote in the first half of the

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[1] "Dispecta est et Thule," Tac., *Agric.*, c. 10.

9th century, in such a manner as to leave no doubt that his statements really refer to that extensive but remote island. See Letronne, *Recherches sur Dicuil*, Paris, 1814.

THÜMMEL, MORITZ AUGUST VON (1738–1817), German writer in prose and verse, one of the imitators of Wieland (see vol. x. p. 541), was born May 27, 1738, in the neighbourhood of Leipsic, was educated at Rossleben and the university of Leipsic, and from 1761 till 1783 held various offices in the ducal court of Saxe-Coburg. He died at Coburg on October 26, 1817. He wrote a comic prose epic, *Wilhelmine, oder der vermählte Pedant* (1764); *Die Inoculation der Liebe* (1771), a tale in verse; *Reise in die mittäglichen Provinzen von Frankreich* (1791–1805), a romance in 10 vols.; and *Der heilige Kilian, oder das Liebespaar* (1818). An edition of his works was published at Leipsic in 8 vols. in 1854-55.

THUNBERG, CARL PETER (1743–1828), an eminent traveller, and one of the most distinguished botanists of the school of Linnæus, was born in 1743. He became a pupil of Linnæus at the university of Upsala, where he graduated in medicine in 1770. Obtaining a travelling scholarship, he visited Holland, whence he embarked on a voyage of exploration to Java, in quest of vegetable treasures. He sailed as far as the Cape of Good Hope in 1771, and three years afterwards went to Japan, remaining five years, engaged in making collections of plants, and in observing the habits, manners, and language of the people. On his return in 1779 he visited England, and made the acquaintance of Sir Joseph Banks. In 1777 he was made demonstrator of botany at Upsala, and he succeeded Linnæus as professor of botany in 1784. Thunberg published in 1784 his *Flora Japonica*; in 1788 he began to publish his travels. He completed his *Prodromus Plantarum* in 1800, in 1805 his *Icones Plantarum*, and in 1813 his *Flora Capensis* Thunberg published numerous memoirs in the *Transactions* of many Swedish and foreign scientific societies, of sixty-six of which he was an honorary member He died in 1828.

THUNDERSTORM. All the more ordinary phenomena of thunderstorms had, about 1750, been conclusively traced to electrical charges and discharges (ELECTRICITY, vol. viii. p. 6), so that they could easily be reproduced on a small scale in the laboratory To the article cited we therefore refer for their explanation. Some of the laws of relative frequency of thunderstorms, in different places at the same season or in the same place at different seasons, will be found in METEOROLOGY (vol. xvi. p. 128). A discussion of the cause of thunder, and of the circumstances which give rise to a crash, a roll, or a peal of thunder is given under ACOUSTICS (vol. i. p. 107). In what follows, therefore, the rarer phenomena of thunderstorms, and the possible sources of the atmospheric electricity, will be the chief points treated.

There can be little doubt that atmospheric electricity, at least in the great developments which characterize a thunderstorm, is due in some way to water. Before a great thunderstorm the lower air is usually at an abnormally high temperature, and fully saturated with water vapour, so that it is in a thoroughly unstable condition. Immense cloud masses, often miles in vertical thickness, which produce almost midnight darkness by day in the region of the storm, and which appear, when seen from a distance, as if boiling upwards, are always a notable feature of great thunderstorms. These are usually accompanied by torrents of rain, or by violent hail-showers. And it is commonly observed that each flash of lightning is followed, after a brief interval, by a sudden but temporary increase in the rate of rainfall. At what stage of its transformations the electrification is developed by water-substance is, as yet, only guessed at,—though it seems most reasonable to conclude that it is anterior to the formation of cloud, *i.e.*, to the condensation of vapour. And, though the idea was at one time very generally held and still has many upholders, it seems unlikely to be the direct result of evaporation. For, were it due directly either to evaporation or to condensation, it is almost impossible to doubt that proof would long since have been furnished by careful experiment, even if made on a scale so limited as that afforded by our laboratories. No trace of electrical effect has been found to attend the precipitation of moisture; and the electrical effects, sometimes considerable, which have been found associated with evaporation have always been accompanied by relatively violent physical and mechanical actions which are not observed in conjunction with atmospheric electricity. It has been suggested by some authorities that the electricity of a thunderstorm is developed during the formation of hail, by others that it is due to the molecular actions which accompany the diminution of total surface when two or more drops of water coalesce into a single one. It has been ascribed to the friction of moist against dry air, and to the dust-particles which appear to be necessary for the condensation of vapour. Again, it has been suggested that it may be a mere phenomenon of contact electricity, due to the impact of uncondensed vapour particles on particles of air. It is almost unnecessary to observe that, whatever hypothesis we adopt, some explanation must be given of two important points:—(1) What becomes of the electricity equal and opposite to that in each drop, which must be produced simultaneously with it? (2) By what means is the attraction between the drops and the recipient of the opposite charge of electricity overcome so that the drops may be enabled to part with their charge? It is to be presumed that gravity satisfies the second of these questions. As to the first, it seems to necessitate the presence of something besides water, in order that the electric separation may be commenced, and thus appears to be fatal to the capillary theory indicated above. Whatever be the true source of the charge, it is easy to see, by known properties of electricity, that even an exceedingly small charge on each vapour particle would lead to a very high potential as soon as a visible drop is formed, and that as a drop increases in size its potential is proportional to its surface. That drops of rain are often individually electrified to a very high potential is proved by the frequent occurrence of "luminous rain," when the ground is feebly lit up by the multitude of tiny sparks given out by the drops as they come near it. The flakes of falling snow, also, are often strongly electrified, so that smart sparks have been drawn from an umbrella on which the snow was falling. But the law of electric repulsion shows us at once that, as soon as the drops in a cloud are sufficiently electrified, at least the greater part of their charge must pass to the boundary of the cloud. When this occurs, the nature of the further behaviour of the charge presents no difficulty. The reason for our singularly complete ignorance of the source of atmospheric electricity seems to lie in the fact that it can only be discovered by means of experiments made on a scale very much larger than is attainable with the ordinary resources of a laboratory. The difficulties will probably be easily overcome by the first nation which will go to the expense of providing the necessary means.

Numberless other explanations of the origin of thunderstorms have been suggested; but the more reasonable of these do little more than shift the difficulty, for they begin by assuming (without any hint as to its source) an electrification of the earth as a whole, or of the lower (sometimes the upper) layers of the atmosphere. Induction, convection, &c., are then supposed to effect the rest.

Another and much less reasonable class of explanations depends upon magneto-electricity. Some of these introduce the so-called "unipolar" induction supposed to be due to the rotation of the earth, which behaves like a gigantic magnet. Of this nature is the suggestion of Edlund, which was recently crowned by the Academy of Sciences of Paris. That rapid variations in the earth's magnetic elements, such as often occur on a large scale, as in a "magnetic storm," have at least a share in the production of the aurora is a perfectly reasonable and even plausible hypothesis, long ago brought forward by Balfour Stewart. But we have yet to seek the source of these variations.

The brightness of a flash of lightning is usually much underrated. It is true that it rarely gives even at night an illumination greater than that due to moonlight. But it must be remembered that Swan has proved that the impression of a flash on the eye depends upon the duration, being nearly proportional to it, and steadily increasing for about a tenth of a second. Now the duration of a lightning-flash is (roughly speaking) only about one millionth of a second. This is proved by the fact that the most rapidly rotating bodies appear to be absolutely steady when illuminated by it. Hence, if it could be made to last for a tenth of a second, it would give near objects an illumination one hundred thousand times more brilliant than that of moonlight. It must be remembered that the flash is not a mere line, but a column, of intensely heated air, driven outwards from the track of the discharge at a rate initially far greater than that of sound.

What is called "summer lightning" or "wild-fire" is sometimes a rather puzzling phenomenon. In the majority of cases it is merely the effect of a distant thunderstorm. It is also often due to a thunderstorm in the higher strata of the atmosphere overhead,—the reason why we hear no thunder being not so much the distance from the spectator as the fact that sounds generated in rarer air lose rapidly in intensity as they are propagated into denser air. But, besides these more common forms of the phenomenon, there is certainly a form of sheet lightning which occurs, without either sound or cloud, often close to the spectator. The cause of this is not at all obvious.

But the most mysterious phenomenon is what goes by the name of "globe lightning" or "fire-ball," a phenomenon lasting sometimes for several seconds, and therefore of a totally different character from that of any other form of lightning. The fire-ball is almost incomparably less brilliant than forked lightning, because, though it lasts long enough to give the full impression of its brightness, it is rarely brighter than iron in the state which we call "red-hot." It is always spherical, often more than a foot in diameter, and appears to fall from a thunder-cloud by its own gravity, sometimes rebounding after striking the ground. It usually bursts with a bright flash and a loud explosion, occasionally discharging flashes of lightning. No experimenter has yet succeeded in producing artificially anything resembling these natural and intensely charged Leyden jars.

The term "thunderbolt," which is nowadays rarely used except by poets (and by the penny-a-liners), preserves the old notion that something solid and intensely hot passed along the track of a lightning flash and buried itself in the ground. Two distinct classes of phenomena probably gave rise to this notion. When lightning strikes the ground it often bores a hole of considerable depth, which is found to be lined in its interior with vitrified sand. This presents no difficulty. But Aerolites (*q.v.*) are often found, in the holes which they have made, still intensely hot, in consequence of their rapid passage through the air. A hasty generalization seems to have connected these two entirely independent phenomena, and thus given rise to the notion of the thunderbolt. The ancient notion that a lightning flash could occur in a clear sky is probably to be accounted for by the occasional appearance of these ultramundane visitors.

The sulphurous smell of lightning, which is vividly described in the *Odyssey*, is now known to be due to the formation of Ozone (*q.v.*).

For the precautions necessary to prevent danger from a thunderstorm, see Lightning Conductor.

A whole volume of Arago's collected works is devoted to thunderstorms, and many important observations are to be found in the writings of M. D'Abbadie and other scientific travellers. (P. G. T.)

THÚN-KHWA, or Thonegwa, a district in the Pegu division of Burmah, lying between 17° 37′ and 19° 28′ N. lat., and between 95° 53′ and 96° 53′ E. long., with an area of 5413 square miles. It is bounded on the N. by Henzada, E. by Rangoon, S. by the Bay of Bengal, and W. by Bassein district. The whole district is a large deltaic plain, divided by the numerous channels of the Irrawaddy into saucer-shaped islands, with deep depressions in the centre. The Irrawaddy traverses Thún-khwa from north to south, throwing off numerous branches until it falls into the Bay of Bengal. Geologically, Thún-khwa is composed of "older alluvial clay," differing from that of the Gangetic basin in being less rich in lime.

The population of Thún-khwa in 1881 was returned at 284,063 (males 150,131, females 133,932); Hindus numbered 723, Mohammedans 1650, Christians 6894, and Buddhists 274,237. The largest towns in the district are Yandoon and Pantanaw, with populations (1881) of 12,673 and 6174 respectively. The land is much less fertile than that of the neighbouring districts. In 1885–86 the area under cultivation was 349,259 acres, and the cultivable area 1,262,374 acres. The principal crops are rice, fruits, vegetables, and sugar-cane. The total revenue realized in the year 1885–86 amounted to £194,737, of which the land contributed £66,590. Thún-khwa was constituted a district in 1875, and its history previous to that date is identical with that of Henzada, to which administrative division it originally belonged. During the first Burmese war no resistance was offered to the British in the district as it at present exists except at the town of Donabyu. At the time of the second war Donabyu was undefended, but, after the occupation of Prome, Myat Htún, an ex-thúgyi of a small circle, succeeded in collecting a body of men and defied the British. Early in January 1853 the enemy were driven out of Donabyu, but on penetrating into the interior the British were forced to retire. In a subsequent engagement the British were driven back; but the enemy were eventually dispersed and their works captured.

THURGAU, or Thurgovia, a canton of Switzerland (ranking as seventeenth in the Confederation), takes its name from the river Thur. It is bounded on the N. by the Rhine, on the E. by the Lake of Constance (the cantonal frontier being so drawn as to leave the town of Constance to Baden), on the S. by a line running from Arbon on the lake west and south-west to Hörnli, and on the W. by a line drawn from Hörnli passing east of Winterthur and west of Frauenfeld to the Rhine, a little west of Diessenhofen and opposite Schaffhausen. It is thus shaped like a triangle, of which the Hörnli (3274 feet, the highest point in the canton) is the apex, and comprises the middle basin of the Thur. Its total area is 381·4 square miles, of which 322·6 (or 84·6 per cent.) is reckoned as "productive land," 69·8 being covered by forests, and 6·9 by vineyards. Of the "unproductive" portion no less than 50·5 square miles consists of the cantonal share of the Lake of Constance. According to the census of 1880, the population amounted to 99,552 (females being in a majority of 1000), an increase of 6252 on the census of 1870; of these, 99,026 are German-speaking. In religion the inhabitants are divided, there being 71,821 Protestants to 27,123 Roman Catholics; the canton till 1815 was in the diocese of Constance, and since 1828 has been in the reconstructed diocese of Basel, though for some time after 1873 the Government would not recognize the authority of Bishop Lachat, in consequence of his support of the dogma of infallibility at the Vatican council. The capital is Frauenfeld (5811 inhabitants), and Romanshorn (population 3647) is an important railway centre on the lake. The canton has many small villages, and the population is chiefly employed in agricultural pursuits, though cotton-spinning is rapidly increasing. The orchards are so splendid that Thurgau has been called "the garden of Helvetia." A network of well-made roads traverses it in every direction.

The Thurgau originally took in all the country, roughly speaking, between the Reuss, the Lake of Lucerne, the Rhine, and the Lake of Constance; but many smaller districts (Zürichgau, Toggenburg, Appenzell, St Gall) were gradually carved out of it, and the county was reduced to about the size of the present canton when in 1264 it passed by the gift of the last count of Kyburg to his nephew Rudolph of Hapsburg, chosen emperor in 1273. In 1415 the count, Duke Frederick of Austria (a Hapsburg), was put under the ban of the empire by the emperor Sigismund for having aided Pope John XXIII. to escape from Constance, and the county was overrun, Sigismund in 1417 mortgaging to the city of Constance the appellate jurisdiction in all civil and criminal matters ("landgericht" and "blutbann") arising within the county, which he had declared to be forfeited in consequence of Frederick's conduct. In 1460 some of the Confederates, now becoming very eager for conquests, overran and seized the county. Winterthur was saved, but in 1461 Frederick's son, Duke Sigismund, had perforce to cede the county to the Confederates. Henceforth it was ruled as a "subject district" by seven members of the League,—Bern, occupied in the west, not being admitted to a share in the government till 1712, after one of the wars of religion. It was only in 1499 that the Confederation (then consisting of ten members) obtained from Constance her supreme jurisdiction, through the mediation of the duke of Milan, but there were still forty-two minor jurisdictions belonging to various lords, spiritual and temporal, which went on till 1798 and greatly limited the power of the Confederates. Thurgau had hoped, but in vain, to be admitted in 1499 a full member of the Confederation.

At the time of the Reformation many of the inhabitants became Protestants, and bitter quarrels ensued between the Protestant and Catholic (the latter having a large majority) members of the Confederation who had rights over Thurgau, with regard to the toleration of the new doctrines in the "subject districts" such as Thurgau. By the first peace of Kappel (1529) the majority in each "commune" was to settle the religion of that "commune," but by the second (1531, after Zwingli's death) both religions were to be allowed side by side in each "commune." Thurgau thus became a "canton of parity," as it is to this day. Its rulers, however, continued to watch each other very closely, and Kilian Kesselring, one of the chief military commanders in Thurgau, was in 1633, on suspicion of having connived at the advance of the Swedes through Thurgau on Constance, seized by the Catholic cantons and severely punished. In 1798 Thurgau became free, and was one of the nineteen cantons of the Helvetic republic, being formally received (like the other "subject lands") as a full member of the Swiss Confederation in 1803 by the Act of Mediation. It was one of the very first cantons to revise, in 1830, after the July revolution in Paris, its constitution in a very liberal sense, and in 1831 proposed a revision of the federal pact of 1815. This failed, but the new federal constitutions of 1848 (of which one of the two drafters was Kern of Thurgau) and 1874 were approved by very large majorities. In 1849 the cantonal constitution was revised and the veto introduced, by which the people might reject a bill passed by the cantonal assembly. Finally, in 1869, the existing constitution was drawn up, by which the "initiative" (or right of 2500 electors to compel the cantonal assembly to take any subject into consideration) and the "obligatory *referendum*" (by which all laws passed by the cantonal assembly, and all financial resolutions involving a capital expenditure of 50,000 francs or an annual one of 10,000, must be submitted to a popular vote) were introduced. The cantonal government consists of a legislative assembly (now of ninety-seven members; one to every 250 electors) and an executive council of five members, both elected directly by the people; 5000 electors can at any time call for a popular vote on the question of the dismissal of either one or the other. Further, to show the very democratic character of the constitution, it may be added that members of both houses of the federal assembly are in Thurgau elected direct by the people. The "communes" in Thurgau are of no less than eleven or twelve varieties. The division of the lands, &c., of the old "burgher communes" between them and the new communes, consisting of all residents (with whom political power rests), was carried out (1872) in all of the 214 communes; but there are still thirty-eight guilds or corporations with special rights over certain forests, &c.

The best history of the canton is that by J. A. Pupikofer, of which a second and very much enlarged edition is now (1887) being published.

THURII, or THURIUM, a city of Magna Græcia on the Gulf of Tarentum, near the site of the older SYBARIS (*q.v.*), but farther inland. It owed its origin to an attempt made in 452 B.C. by Sybarite exiles and their descendants to repeople their old home. The new settlement was crushed by Crotona, but the Athenians lent aid to the fugitives, and in 446, or rather in 443, Pericles sent out to Thurii a mixed body of colonists from various parts of Greece, among whom were Herodotus and the orator Lysias. The pretensions of the Sybarite colonists led to dissensions and ultimately to their expulsion; peace was made with Crotona, and also, after a period of war, with Tarentum, and Thurii rose rapidly in power and drew settlers from all parts of Greece, especially from Peloponnesus, so that the tie to Athens was not always acknowledged. The oracle of Delphi determined that the city had no founder but Apollo, and in the Athenian war in Sicily Thurii was at first neutral, though it finally helped the Athenians. Thurii had a democratic constitution and good laws, and, though we hear little of its history till in 390 it received a severe defeat from the rising power of the Lucanians, many beautiful coins testify to the wealth and splendour of its days of prosperity. In the 4th century it continued to decline, and at length called in the help of the Romans against the Lucanians, and then in 282 against Tarentum. Thenceforward its position was dependent, and in the Second Punic War, after several vicissitudes, it was depeopled and plundered by Hannibal (204). In 194 a Roman colony was founded, with Latin rights, known for a time as Copiæ, but afterwards by the old name of Thurii. It continued to be a place of some importance, the situation being favourable and the region fertile, and does not seem to have been wholly abandoned till the Middle Ages. Its site, near Terranova di Sibari, is marked by considerable ruins of the Roman period (*cf.* Lenormant, in *Academy*, xvii. 73, and Barnabei, *ibid.*, xvi. 55 *sq.*).

THURINGIA (Germ. *Thüringen*), a territorial term without modern political significance, designates, strictly speaking, only that district in Upper Saxony that is bounded by the Werra, the Harz Mountains, the Saale, and the Thuringian Forest; but in common parlance it is frequently used as equivalent to the Thuringian states, *i.e.*, the group of small duchies and principalities lying between Prussia, Hesse-Nassau, Bavaria, and the kingdom of Saxony.[1] The name is derived, with great probability, from that of the Hermunduri, a branch of the great Suevic family; and the ancient Thuringians, a heathen tribe first mentioned in the 5th century by Vegetius Renatus, are believed to be the descendants of that Teutonic people. The Thuringians seem at one time to have occupied territories stretching from the Elbe not far from Hamburg to the Danube at Ratisbon; but about 531 their empire was overthrown by the united Franks and Saxons. The north part of their lands fell to the Saxons, and was known for some time as the North Thuringian gau; the district to the south of the Thuringian Forest was called Franconia after its conquerors; and the name Thuringia was restricted almost to the narrow limits to which it now properly applies. The advance of the Sorbs to the east bank of the Saale about the middle of the 7th century made the limitation still more exact. Thuringia remained under Frankish dominion, and various Frankish counts ruled in the different "gaus", into which it was divided. Christianity, if not introduced, was confirmed in this district by the British Boniface; a bishopric was founded at Erfurt; and under Charlemagne the Thuringian mark was the base of active operations against the heathen Sorbs. In 839 the title of duke of Thuringia (*ducatus Toringubæ*) appears; but that of landgrave seems to have superseded it; neither dignity implied sovereignty over the whole district. Otto the Illustrious, duke of Saxony (880), added Thuringia to his duchy, but the union was not permanent. About the beginning of the 12th century Louis the Springer, builder of the Wartburg, rose to eminence among the Thuringian nobles; and about 1130 his son, also Louis, was appointed landgrave by the emperor Lothair I. Thuringia now began to be a united land under one prince; and the landgraves, who acquired the Saxon palatinate on the fall of Henry the Lion of Saxony in 1180, rose to considerable power. The last landgrave of this line was Henry Raspe (1242–1247), brother and successor of Louis the Saint. His death was followed by a devastating war of succession between his niece Sophia, duchess of Brabant, and Henry the Illustrious, margrave of Meissen (1221–1288), whose mother Jutta was a Thuringian princess. Peace was finally established in 1263: Sophia received Hesse, and Henry took the rest of Thuringia, the general history of which thenceforth merged in that of Meissen, and later of Saxony, although it maintained its separate name. Thuringia was included in the administrative circle of Upper Saxony (see vol. xxi. p. 352, note 3). For its subsequent fate, and the rise of the present Thuringian states, see under SAXONY (vol. xxi. pp. 353 *sq.*).

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[1] The Thuringian states are Saxe-Weimar-Eisenach, Saxe-Coburg-Gotha, Saxe-Meiningen, Saxe-Altenburg, Schwarzburg-Rudolstadt, Schwarzburg-Sondershausen, and the two principalities of Reuss, all of which are separately described. Besides these, the term Thuringia also, of course, includes the various "exclaves" of Prussia, Saxony, Bavaria, and Bohemia which lie embedded among them.

The most striking natural feature of Thuringia is the Thuringian Forest (*Thüringerwald*), a range or system of hills, extending in an irregular line from the neighbourhood of Eisenach in the north-west to the Lobensteiner Kulm on the Bavarian frontier on the south-east, and forming the southern boundary of Thuringia, separating it from Franconia. On the south-east it is continued directly by the Frankenwald Mountains to the Fichtelgebirge, which is in immediate connexion with the Erzgebirge, while on the north-east it approaches the Harz Mountains, and thus takes its place in the great Sudetic chain of central Germany. The length of the Thuringian chain is 70 miles, and its breadth varies from 8 to 25 miles. It nowhere rises into peaks, and only a few of its rounded summits reach the height of 3000 feet; the successive hills melt into each other in gentle undulations, forming a continuous and easily traced comb, and only the north-west slopes are precipitous, and seamed with winding gorges. This mountain-range encloses many charming and romantic valleys and glens; the most prominent feature of its picturesque scenery is formed by the fine forests, chiefly of pines and firs, which clothe most of the hills. The north-west part of the system is the loftier and the more densely wooded, as well as the more beautiful; the highest summits here are the Grosser Beerberg (3225 feet), Schneekopf (3179), and the Inselberg (2957), all in the duchy of Gotha. The south-east part of the Thuringian Forest is the more populous and industrial; the chief summits are the Kieferle (2851 feet) at Steinheid, the Blessberg (2834 feet) near Schalkau, the Wurzelberg (2746 feet) near Oelze, and the Wetzstein (2719) near Lehesten. The crest of the Thuringian Forest, from the Werra to the Saale, is traversed by the Rennsteig or Rainsteig, a broad path of unknown antiquity, though it is believed to be referred to in a letter of Pope Gregory III. dated 738. The name means probably "frontier-path"; and the path marks in fact the boundary between Thuringia and Franconia. It may be also regarded as part of the boundary-line between North and South Germany, for dialect, customs, local names and costume are different on the two sides.

THURINGORUM LEX. See SALIC LAW.

THURLES, an ancient market-town of Ireland, in the county of Tipperary, and the seat of the Catholic archdiocese of Cashel, is pleasantly situated on the Suir, and on the Great Southern and Western Railway, 46 miles east of Limerick, 29 west from Kilkenny, and 87 south-west of Dublin. The cathedral of St Patrick is a beautiful building, erected at a cost of £45,000. The town is the seat of other important Catholic establishments, including an Ursuline convent, in which is a large boarding-school for young ladies; a Presentation convent; St Patrick's Catholic college (1829) for ecclesiastical students, where was held in 1850 the synod of Thurles, composed of all the Catholic bishops of Ireland; and an establishment of Christian Brothers, who devote themselves to the instruction of boys on the Lancastrian method. The town has a considerable agricultural and retail trade. The population was 5008 in 1871, and 4850 in 1881

Originally the town was called Durlas O'Fogarty. In the 10th century it was the scene of the defeat of the Irish by the Danes. A preceptory was founded here by the Knights Templars, who possessed themselves of a castle erected early in the 13th century. A castle was subsequently erected by James Butler, first lord palatine of Tipperary, of which till recently a tower still remained.

THURLOW, EDWARD THURLOW, BARON (1732–1806), was born at Bracon-Ash, in the county of Norfolk, in 1732. His father was a clergyman, and held successively the livings of Little Ashfield in Suffolk and of Stratton St Mary's in Norfolk. His mother Elizabeth was the daughter of Robert Smith of Ashfield. Thurlow received his early education at home. He was next placed under the care of Mr Brett at Scarning, where he remained for four years, and was then sent to the grammar school of Canterbury, where he was considered a bold refractory clever boy. In October 1748 Thurlow entered Caius College, Cambridge, and speedily justified his school reputation. The dean of the college, upon the extent and accuracy of whose classical acquirements grave suspicion rested, had directed him, as a punishment for some act of insubordination, to translate a chapter of the *Spectator* into Greek. Thurlow executed his task with care, and then gave it for revisal, not to the dean, but to the tutor of the college. When reprimanded for having thus infringed the college rules, Thurlow retorted that he had carried his exercise to one who could inform the dean whether or not he had obeyed his orders. The insult was too grave for rustication, and yet too slight to justify expulsion. Thurlow was therefore permitted to withdraw his name from the college books, and he left Cambridge without a degree (1751). He now took chambers, and began regularly to keep terms in the Inner Temple, which he had joined while still an undergraduate. He was for some time a pupil along with the poet Cowper in the office of Mr Chapman, an eminent solicitor in Lincoln's Inn. On 22d November 1754 Thurlow was called to the bar, and subsequently went on the western circuit—at first with little success But the tide turned. In the case of Luke Robinson *v.* the Earl of Winchelsea (1758) Thurlow came into collision with Sir Fletcher Norton, then the terror of solicitors and the tyrant of the bar, and put down his arrogance with dignity and success. From this time his practice increased rapidly. In December 1761 he was made a king's counsel, through the influence of the duchess of Queensberry. In January 1762 he was elected a bencher of the Inner Temple. It now became necessary for him to take his side in politics, and, after repeated oscillations, and with some hesitancy, Thurlow threw himself into the ranks of the Tory party. In May 1768 he became member for Tamworth. In 1769 the Douglas Peerage case came on for hearing in the House of Lords, and Thurlow, who had drawn the pleadings some years before (*Notes and Queries*, 3d ser., iii. 122), led for the appellant in a speech of great ability and analytic power. In March 1770, as a recognition of his defence in the previous January of the expulsion of Wilkes, Thurlow was made solicitor-general on the resignation of Dunning, and in the following year (23d January 1771), after he had enhanced his reputation with the Government by attacking the rights of juries in cases of libel (Rex *v.* Miller, 20 *State Trials*, 870–896) and the liberty of the press (16 *Parly. Hist.*, 1144), was raised to the attorney-generalship. Thurlow's public life was as factious as his youth had been daring. His violent hatred of the American colonists, and his extreme and imprudent assertion that as attorney-general he might set aside by *scire facias* as forfeited every charter in America (debate on the American Prohibitory Bill, 18 *P. H.*, 999); his speech in aggravation of punishment in the case of Horne Tooke (20 *St. Tr.*, 777–783) when he argued that the prisoner ought to be pilloried, because imprisonment was no penalty to a man of sedentary habits and a fine would be paid by seditious subscription; and his consistent opposition to all interference with the slave trade,—are characteristic of the man. In 1778 Thurlow became lord chancellor and Baron Thurlow of Ashfield (June), and took his seat in the House of Lords, where he soon acquired an almost dictatorial power. He resolutely opposed the economical and constitutional reforms proposed by Burke and Dunning. Under Rockingham he still clung to the chancellorship, while conducting himself like a leader of the opposition. To the short-lived ministry of Shelburne he gave a consistent support. Under the coalition of Fox and North (April to December 1783) the great seal was placed in commission, and Lord Loughborough was made first commissioner. But Thurlow, acting as the king's adviser, and in accordance with his wishes, harassed the new ministry, and ultimately secured the rejection of Fox's India Bill (24 *P. H.*, 226). The coalition was at once dissolved. Pitt accepted office, and Thurlow again became lord chancellor (December 23, 1783). At first he supported the Government heartily, but soon his overbearing temper asserted itself. Imprudently relying on the friendship of the king, and actuated by scarcely disguised enmity to Pitt, Thurlow passed rapidly from occasional acts of hostility to secret disaffection, and finally to open revolt. He delivered himself strongly against a bill, introduced without his privity, for the restoration to the heirs of attainted owners of estates forfeited in the Jacobite rebellion of 1745. Partly to please the king and queen, partly from dislike to Burke, and partly perhaps from a real belief in the groundlessness of the accusation, he supported Warren Hastings on every occasion "with indecorous violence." His negotiations with the Whigs during the discussion of the Regency Bill (1788–19th February 1789) went beyond the limits of mere perverse coquetry, and were designed to secure his seat on the woolsack in the event of Fox being called to power. The climax was reached in 1792, when he virulently attacked Pitt's bill "to establish a sinking fund for the redemption of the national debt," not on account of the economic objections to which it was justly liable, but on the trivial ground that it was an unconstitutional attempt to bind future parliaments. The bill was carried, but only by a narrow majority, and Pitt, feeling that co-operation with such a colleague was impossible, insisted successfully on his dismissal (June 15, 1792). The ex-chancellor, who had a few days before (June 12) been created Baron Thurlow of Thurlow, with remainder to his brothers and their male descendants, now retired into private life, and, with the exception of a futile intrigue, under the auspices of the prince of Wales, for the formation of a ministry from which Pitt and Fox should be excluded, and in which the earl of Moira should be premier and Thurlow chancellor (1797), finally abandoned the hopes of office and the dictatorship which he had so long exercised in the House of Lords. In 1795 he opposed the Treason and Sedition Bills without success. In 1801 he spoke on behalf of Horne Tooke—now his friend—when a bill was introduced to render a priest in orders ineligible for a seat in the House of Commons. His last recorded appearance in the House of Lords was on May 4, 1802. He now spent his time between his villa at Dulwich and Brighton, Bognor, Scarborough, and Bath. He died at Brighton on 12th September 1806, and was buried in the Temple church. Thurlow was never married, but left three natural daughters, for whom he made a handsome provision. The title descended to his nephew, son of the bishop of Durham.

Lord Thurlow was a master of a coarse caustic wit, which habitually in his private and too frequently in his public life displayed itself in profanity. He was a good classical scholar and made occasional translations in verse from Homer and Euripides. His judicial and his ecclesiastical patronage was wisely exercised; he was the patron of Dr Johnson and of Crabbe, and was the first to detect the great legal merits of Elden. Thurlow's personal appearance was striking. His dark complexion, harsh but regular features, severe and dignified demeanour, piercing black eyes and bushy eyebrows, doubtless contributed to his professional and political eminence and provoked the sarcasm of Fox that he *looked* wiser than any man ever *was*. Yet he was far from being an impostor. By intense though irregular application he had acquired a wide if not a profound knowledge of law. Clear-headed, self-confident, and fluent, able at once to reason temperately and to assert strongly, capable of grasping, rapidly assimilating, and forcibly reproducing minute and complicated details, he possessed all the qualities which command success. His speeches in the trial of the duchess of Kingston for bigamy (20 *S. T.*, 355–651) are singularly vigorous and effective, while his famous opening in the Douglas Peerage case and his argument for the crown in Campbell *v.* Hall (20 *S. T.*, 312–316) show that he might have rendered high service to the judicial literature of his country had he relied more upon his own industry and less upon the learning of Hargrave and Kenyon

See Lord Campbell's *Lives of the Chancellors*, vii. 153-333; Foss's *Judges of England*, viii. 374-385; *Public Characters*, 1796; *Notes and Queries*, 2d ser., iii. 283; 3d ser., iii. 122; *Reports* of his decisions by Brown, Dickens, and Vesey (Junior); Brougham's *Statesmen of the Time of George III.* (A. W. R.)

THURSO, a seaport, police burgh, and burgh of barony of Caithness, Scotland, is situated at the mouth of the Thurso, on the beautiful Thurso Bay, at the northern terminus of the Highland Railway, 21 miles north-west of Wick, and 367 north of Edinburgh by rail. The new town, regularly built with broad streets and good houses, is steadily increasing in population. In Macdonald Square, now laid out with ornamental walks, there is a statue of Sir John SINCLAIR (*q.v.*). Along the sands a promenade 300 yards in length was formed in 1882. The town-hall (1870) embraces a court-room and rooms for the free public library and the museum, which contains the geological and botanical specimens of Robert Dick, the "Thurso baker," commemorated by Samuel Smiles, as well as a large collection of northern birds. In the neighbourhood are large quarries for Caithness flags, which are cut and dressed in the town. They constitute the principal export, but the trade of the port is hindered by the inconvenience of the harbour. There is, however, communication with the south and west, and with Orkney by steamer from Scrabster pier, 3 miles to the north. To the east is Thurso Castle, the residence of the Ulbster branch of the Sinclairs. The population in 1871 was 3622 and in 1881 it was 4026.

Thurso was the centre of the Norse power on the mainland when at its height under Thorfinn (1014), and afterwards till the battle of Largs. Count Moddan, nephew of King Duncan, quartered his army for a time at Thurso, which he terms "the town of Caithness," and was plentifully supplied by spoil till surprised and slain by Thorkel in 1040. In the time of Malcolm II. Earl Erlend resided in the town. In 1633 it was created a burgh of barony, and was the seat of the sheriff courts of the county till they were removed to Wick in 1828.

THYME. The genus *Thymus* (nat. ord. *Labiatæ*) comprises a number of fragrant aromatic undershrubs, with very small leaves and whorls of small lilac flowers in the axils of the leaves or at the ends of the branches. The common garden thyme, a native of the Mediterranean region, is *Thymus vulgaris*; the wild thyme of our banks is *T. Serpyllum*. Marjoram (*Origanum*) is also closely allied. All these plants are remarkable for their essential oil, to which their fragrance is due. From this oil is produced by distillation a substance known as thymol, analogous to camphor. It is homologous with phenol or carbolic acid and may be used as a disinfectant and germicide.

TIBBUS, or TUBUS, a nomad race of North Africa, occupying the eastern section of the Sahara from about 12°, where they are conterminous with the Tuareg Berbers, to about 24° E. long., and from Fezzan southwards nearly to Lake Tchad, 25° to 15° N. lat. Their westernmost settlements are the oases of Agram, Kawar, and Jebádo, their northernmost the district of Qatrún within the Fezzan frontier, while south and south-east they merge gradually in the Negroid populations of Kanem, Bornu (Tchad basin), Wadai, and north-west Dar-Fúr. But the heart of the nation is concentrated in the central region of Tibesti or Tu, whence they take their collective name of Tib-bu or Tu-bu, *i.e.*, "people of Tibesti or Tu."[1] There are two main divisions,—the northern Teda, more or less full-blood Tibbus, and the southern Dasa, more or less mixed or Negroid Tibbus. Somewhat more distantly connected with the same family are the Baele of the eastern and south-eastern oases and the Zogháwa (Zaghwa) of Dar-Fúr, making a total population of about 190,000, distributed as follows:—

Teda (Tibesti, Qatrún, Kawar, Agram, &c.)	29,000
Dasa (Borku, parts of Kanem, Wadai, Ennedi, and Bornu)	51,000
Baele (Ennedi, Wanyanga, Guro, Wún)	20,000
Zogháwa (north Dar-Fúr)	90,000
	190,000

The Tibbus, who are not expressly mentioned under this name by any ancient or mediæval writer, are usually identified with the Garamantes of Herodotus (iv. 183), whose capital was Garama (Edrisi's Germa) in Phazania (Fezzan), and of whom Ptolemy already spoke doubtfully as Ethiopians (Negroes?): *Ὄριον δὲ καὶ αὐτῶν ἤδη μᾶλλον Αἰθιόπων* (i. 8). But Leo Africanus transfers them to the Berber connexion, whose fifth great division he deals with under the names of Gumeri (Garamantes?) and Bardæi or Bardoa, that is, the Teda of the Bardai oasis, Tibesti.[2] Lastly Barth on linguistic grounds grouped them with the Kanúri of Bornu, who are undoubtedly Negroes; and since his time (1852-53) the Tibbus have been regarded by most ethnologists as a Negro or at least a Negroid people.[3] Nachtigal, who has studied them more carefully than any modern observer, sees good reason to challenge this conclusion (*op. cit.*, ch. vii.); and, although his own inferences are somewhat vague, he supplies sufficient evidence for a solution of this difficult ethnological problem. There can be no doubt that the Teda, or true Tibbu, probably identical with the Tedamansii, a branch of the Garamantes, placed by Ptolemy south of the Samamycii in Tripolitana,[4] are physically a Hamitic, not a Negro people, closely resembling their western Tuareg neighbours. They are a pure homogeneous race, who have for ages undergone no perceptible change in their rocky homes, and who are still distinguished by the regular features, long black ringletty hair, haughty bearing, and fierce expression common to so many of the Berber and other Hamitic peoples. Mostly of middle size, they are finely proportioned in all their limbs, except the somewhat too small hands and feet, with lighter complexion than that of the southern Dasa, and no trace of the flat nose, thick tumid lips, or other marked characteristics of the true Negro. "Their women are charming while still in the bloom of youth, unrivalled amongst their sisters of North Africa for their physical beauty, pliant and graceful figures" (Keane's *Reclus*, xi. p. 429). But there has been a general displacement of the race southwards; and, while only a few still linger in the northern Qatrún and Kufara districts, large numbers have since mediæval times penetrated into the Kanem, Bornu, Wadai, and Dar-Fúr regions of central Sudan. Here they have everywhere merged with the natives, so that in the Dasa, Kanembu, Kanuri, Baele, and Zogháwa groups the Tibbu race presents all the shades of transition between the true Negro and the true Hamite that are also found to prevail between the blacks of western Sudan and the Tuareg Berbers, and between the Nubas and other eastern Sudan Negroes and the Hamitic Gallas, Somâli, and Bejas.

The same transitional stages are observed in the Tibbu forms of speech, which constitute a wide-spread linguistic family, whose most archaic and purest branch is the Tedaga of Tibesti (Nachtigal). Through the southern Dasaga the Tedaga merges in the more highly developed and more recent Kanem, Bornu (Kanuri), Ennedi (Baele), and Dar-Fúr (Zogháwa) dialects, which, owing to the absence of grammatical gender and some other structural features, are usually classed as Negro languages. But a Negro tongue could not have arisen among the Hamites of the Tibesti uplands, and the explanation of this linguistic difficulty is obviously the same as that of the physical puzzle. The Negro affinities of the southern members of the group have arisen through assimilation with the original and now partly displaced Negro idioms of central Sudan. There remains the final difficulty that Tedaga itself has absolutely nothing in common with the Berber or any other Hamitic tongue. If therefore it is neither Hamitic nor Negro, the only two stock languages recognized by Lepsius in Africa (*op. cit.*, *passim*), how is it to be placed? First of all Lepsius's hasty generalization, wholly inconsistent as it is with the conditions occurring in other parts of the continent, must be unhesitatingly rejected. Room having thus been found for other linguistic families, the Tedaga of Tibesti may be readily explained as an independent evolution from a primeval Tibbu-Berber germ, analogous to other linguistic evolutions in other isolated or inaccessible highland regions, such as the Caucasus, the Pyrenees, and the Anahuac tableland. The common germ, essentially evanescent in its nature, has long since perished, or can no longer be detected, and the Tibbu and Berber languages stand side by side as now fundamentally distinct, while the two races still remain physically one. The Tibbus are therefore a Hamitic people, who in their secluded rocky homes have had time to evolve an independent form of speech, which southwards has become largely assimilated to the Sudanese Negro dialects.

Lying on the track of the great caravan route between Fezzan and Lake Tchad, the Tibbus have always been a predatory race, levying blackmail on the convoys passing through their territory, maintaining intertribal feuds, and carrying on constant warfare with the surrounding Berber and Sudanese populations. This, combined with the severe struggle for existence in their inhospitable upland valleys, has rendered them harsh, greedy, and suspicious,—sentiments reflected in their hard features and stern expression. Till comparatively recent times all were pagans, whence the term Kufra (Kufara), "Land of the Unbeliever," applied by the Arabs to the southern oases of Tripolitana. But for two or three centuries they have been zealous Mohammedans, and some have even lately been brought within the influence of the political Senúsíya sect (see TRIPOLI, below). They are a frugal race, living mostly on goat's milk, dates, berries, durrha, and the fruit of the dûm-palm; nevertheless they are of robust constitution and remarkably agile. They are also intelligent, crossing the wilderness by a sort of instinct quite unintelligible to the stranger, and in all ordinary transactions they display surprising tact and shrewdness. The tribal organization embraces *dardai* or headmen, *maina* or nobles, and the common folk, while the unwritten law of custom rules supreme over all classes. The women, who are orderly and industrious, are well treated, and the polygamy allowed by the law is little practised. But the vendetta is still a social institution. (A. H. K.)

TIBER. See ITALY, vol. xiii. pp. 438-439.

TIBERIAS, now ṬABARÎYA, a city of Palestine, on the western shore of the Sea of Galilee or Lake of Tiberias, occupies a narrow strip of plain under a hill in a feverish but fertile situation. Recent estimates place the population at from 2000 to 3000,—about half the inhabitants being Jews, and many of the latter immigrants from Poland. The streets are indescribably filthy, and an Arab saying is that "the king of the fleas holds his court at Tiberias." The walls of the town and the castle on the north were in great part ruined by an earthquake in 1837, when half the population perished. The most interesting building is a very ancient synagogue by the lake, the lower story of which is said to have been unaffected by the earthquake. Outside the town are the plastered monuments ("whited sepulchres") of R. Akiba and Maimonides. Half an hour to the south are the famous hot baths mentioned by Pliny (*H.N.*, v. 15 [71]). Josephus calls this place Emmaus, which has suggested an identification with Hammoth-dor (Josh. xxi. 32) or Hammon (1 Chron. vi. 76 [61]), names which perhaps point to the existence of thermal springs.

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[1] Cf. Kanem-bu = people of Kanem, *bu* being the plural personal postfix answering to the Bantu prefix *ba*, *wa* (Ba-Suto, Wa-Ganda, &c.), and to the *be* of Fúl-be = Fúl people or Fulahs from Púl. In Tedaga the root *tu* means "rock"; hence Tu-bu = "rock-dwellers," as described by Herodotus and as explained in their Arab designation *Reshâdeh*, from *reshad* = rock, hill.

[2] See Vater, *Mithridates*, ii. p. 45 of Berlin ed. 1812, and Nachtigal, *Sahara und Sudan*, 1881, ii. p. 189.

[3] "Ursprunglich ein Negervolk," Lepsius, *Nubische Grammatik* (*Einleitung*), Berlin, 1880.

[4] The original inhabitants of the Kufara (Kufra) oasis in south Tripolitana were Teda, some of whom still survive in a small hamlet south of Jebel Nari. Since the beginning of the 18th century they have been replaced elsewhere in Kufara by the Zwiya Arabs from the Leshkerreh oases.

Tiberias was founded by Herod Antipas apparently not before 26 A.D.,[1] and so was quite a new place at the time of our Lord's ministry in Galilee. And, though it became the capital of Galilee, it was at first a purely Greek city, which accounts for its not appearing among the scenes of the Galilæan ministry. It joined in the war of liberty, but yielded without resistance to Vespasian, and was restored by him to its master Agrippa, on whose death in 100 it fell directly under Roman rule. The place came to be a great seat of Jews and Jewish learning: it was the residence of R. Judah, the editor of the Mishnah; and, though the schools of Palestine were ultimately overshadowed by those of Babylonia, the school of Tiberias was still famous in the time of Jerome. According to Epiphanius, the first Christian church was built by Constantine, and from this time we hear of bishops of Tiberias. The Arabs took Tiberias in 637; it was restored to Christendom by Tancred, but yielded to Saladin in 1187 after the battle of Hittin. It was again in Christian hands from 1240 to 1247. In the middle of the 18th century it was one of the fortresses of the renowned Sheikh Ẓáhir, who for many years defied the Turkish power.

TIBERIUS (42 B.C.–37 A.D.), emperor of Rome, whose full name was Tiberius Claudius Nero, was born on the Palatine Hill on 16th November 42 B.C. When he became a member of the imperial family, the court genealogists made him out to be one of the ancient patrician Claudii; but the pedigree is at some points difficult to trace. His father, who bore the same name, was an officer of Julius Cæsar, who afterwards proposed to confer honours on the assassins, then joined Mark Antony's brother in his mad attack on Octavian, took refuge with Mark Antony, and returned to Rome when the general amnesty was proclaimed in 39 B.C. Livia, the mother of Tiberius, was also of the Claudian family, out of which her father had passed by adoption into that of the Livii Drusi. Early in 38 Livia was amicably ceded to Octavian (the future Augustus), and three months after her new marriage Drusus, brother to Tiberius, was born. Livia had no children by Augustus, and therefore devoted all her remarkable gifts to the advancement of her sons. They were treated with high consideration by the emperor, yet Augustus held firmly to the hope that his throne might be filled on his death by one in whose veins ran the blood of the Octavii; and not till Tiberius was past forty did there appear any probability that he would ever rise to be emperor. He passed through the list of state offices in the usual princely fashion, beginning with the quæstorship at the age of eighteen, and attaining the consulate for the first time at twenty-nine. From the great capacity for civil business which he displayed as emperor it may be inferred that he applied himself with determination to learn the business of government.

But from 22 to 6 B.C. and again from 4 to 10 A.D. by far the greater part of Tiberius's life was spent in the camp. His first service was as legionary tribune in one of the desperate and arduous wars which led to peace in the Spanish peninsula through the decimation, or rather the extermination, of the rebellious tribes. In 20 B.C. Augustus sent Tiberius with an army to seat Tigranes of Armenia on the throne as a Roman vassal. As Tiberius approached the frontier of Armenia, he found its throne vacant through the assassination of the king, and Tigranes stepped into his place without a blow being struck. Tiberius crowned Tigranes king with his own hand. Then the Parthian monarch grew alarmed and surrendered "the spoils and the standards of three Roman armies." The senate ordered a thanksgiving such as was usually celebrated in honour of a great victory. The following year was passed by Tiberius as governor of Transalpine Gaul. In the next year (15) he was despatched to aid his brother Drusus in subjugating the Ræti and Vindelici, peoples dwelling in the mountainous region whence the Rhine, Rhone, and Danube take their rise.[2] Drusus attacked from the eastern side, while Tiberius operated from the upper waters of the Rhine, and by stern measures the mountaineers were reduced to a state of quietude, and could no longer cut communications between northern Italy and Gaul, nor prosecute their raids in both countries. In 12 B.C. Agrippa, the great general of Augustus, to whom he may be almost said to have owed his throne, and who was its chief support, died at the age of fifty-one, leaving Julia, the emperor's only child, a widow. Agrippina, daughter of Agrippa by an earlier marriage, was wife of Tiberius, and had borne him a son, Drusus, afterwards father of Germanicus. Livia with great difficulty prevailed upon Augustus to replace Agrippa by Tiberius, who was compelled to exchange Agrippina for Julia, to his bitter grief. During the year of mourning for Agrippa, which delayed his new marriage, Tiberius was occupied with a victorious campaign against the Pannonians, followed by successful expeditions in the three succeeding summers. For his victories in the Danube regions, the emperor conferred on him the distinctions which flowed from a military triumph in republican times (now first separated from the actual triumph), and he enjoyed the "ovation" or lesser form of triumphal entry into the capital. On the death of Drusus in the autumn of 9 B.C. Tiberius, whose reputation had hitherto been eclipsed by that of his brother, stepped into the position of first soldier of the empire. The army, if it did not warmly admire Tiberius, entertained a loyal confidence in a leader who, as Velleius tells us, always made the safety of his soldiers his first care. In the campaign of the year after Drusus's death Tiberius traversed all Germany between the Rhine and the Elbe, and met with slight opposition. But it would be too much to believe the statement of Velleius that "he reduced Germany almost to the position of a tributary province." He was rewarded with the full triumph, the military title of "imperator," and his second consulship, though the opposition of the powerful Sugambri had been only broken by an act of treachery, the guilt of which should perhaps be laid at the door of Augustus. In 7 B.C. there was another but insignificant campaign in Germany. Next year Augustus bestowed on his stepson the tribunician authority for five years. Tiberius was thus in the most formal manner associated with the emperor in the conduct of the government on the civil side; but Tacitus (*Ann.*, iii. 56) goes too far when he says that this promotion marked him out as the heir to the throne.

Tiberius now suddenly begged permission to retire to Rhodes and devote himself to study. He seems to have declined absolutely at the time to state his reasons for this course, but he obstinately adhered to it, in spite of the tears of Livia and the lamentations of Augustus to the senate that his son had betrayed him. If we may believe Suetonius, Tiberius determined to commit suicide by abstention from food, and Augustus only gave way when this design was all but accomplished. The departure from Italy was as secret as it could be made. Years afterwards, when Tiberius broke silence about his motives, he declared that he had retired in order to allow the young princes, Gaius and Lucius, sons of Julia, a free course. There was perhaps a portion of the truth wrapped up in this declaration. Like Agrippa, who retired to Mytilene to avoid the young Marcellus, Tiberius had clearly no taste to become the servant of the two children whom Augustus had adopted in their infancy and evidently destined to be joint emperors after his death. But it may well be believed that Tiberius, unlike Agrippa, had no burning ambition to see himself in the place destined for his stepsons; and it may have been in his eyes one of the attractions of exile that it released him from the obligation to aid in carrying out the far-reaching designs which Livia cherished for his sake. But the contemporaries of Tiberius were no doubt right in believing that the scandal of Julia's life did more than all else to render his position at Rome intolerable. His conduct to her from first to last gives a strong impression of his dignity and self-respect. When at last the emperor's eyes were opened, and he inflicted severe punishment upon his daughter, her husband, now divorced by the emperor's act, made earnest intercession for her, and did what he could to alleviate her suffering At Rhodes Tiberius lived simply, passing his time mainly in the company of Greek professors, with whom he associated on pretty equal terms. He acquired a very considerable proficiency in the studies of the day, among which must be reckoned astrology. But all his attempts at composition, whether in prose or verse, were laboured and obscure. After five years' absence from Rome, he begged for leave to return; but the boon was angrily refused, and Livia with difficulty got her son made nominally a legate of Augustus, so as in some degree to veil his disgrace. The next two years were spent in solitude and gloom. Then, on the intercession of Gaius, Augustus allowed Tiberius to come back to Rome, but on the express understanding that he was to hold aloof from all public functions,—an understanding which he thoroughly carried out.

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[1] See the discussion in Schürer, *Gesch. d. Jüd. Volkes.* ii. 127 sq.

[2] Horace, *Odes*, iv. 14.

He had scarcely returned before death removed (2 A.D.) Lucius, the younger of the two princes, and a year and a half later Gaius also died. The emperor was thus left with only one remaining male descendant, Agrippa Postumus, youngest son of Julia, and still a boy. Four months after Gaius's death Augustus adopted Agrippa and at the same time Tiberius. The emperor now indicated clearly his expectation that Tiberius would be his principal successor. The two essential ingredients in the imperial authority—the *proconsulare imperium* and the *tribunicia potestas*—were conferred on Tiberius, and not on Agrippa, who was too young to receive them. Tiberius's career as a general now began anew. In two or three safe rather than brilliant campaigns he strengthened immensely the Roman hold on Germany, and established the winter camps of the legions in the interior, away from the Rhine.

In 5 A.D. it became necessary to attack Maroboduus, who by combining peoples formerly hostile to each other had constructed a formidable power, with its centre in Bohemia, menacing the Roman acquisitions in Germany, Noricum, and Pannonia. The operations were conducted both from the Rhine and from the Danube, Tiberius being in command of the southern army. Just as the decisive engagement was about to take place, Tiberius learned that Pannonia and Dalmatia were aflame with insurrection in his rear. He was therefore forced to conclude peace on terms honourable to Maroboduus. The terror inspired in Italy by the Pannonian and Dalmatian rebellion under the able chief Bato had had no parallel since the invasion of the Cimbri and Teutones. The four serious campaigns which the war cost displayed Tiberius at his best as a general. As he was about to celebrate his well-won triumphs, the terrible catastrophe to Varus and his legions turned the rejoicing into lasting sorrow, and produced a profound change in the Roman policy towards Germany. Although Tiberius with his nephew and adopted son Germanicus made in 9 and 10 A.D. two more marches into the interior of Germany, the Romans never again attempted to bound their domain by the Elbe, but clung to the neighbourhood of the Rhine. Tiberius was thus robbed in great part of the fruit of his campaigns; but nothing can deprive him of the credit of being a chief founder of the imperial system in the lands of Europe. From the beginning of 11, when he celebrated a magnificent triumph, to the time of the emperor's death in 14 Tiberius remained almost entirely in Italy, and held rather the position of joint emperor than that of expectant heir. Agrippa Postumus had proved his incapacity beyond hope, and had been banished to a desolate island. In all probability Tiberius was not present when Augustus died, although Livia spread reports (eagerly amplified by Velleius) of an affectionate interview and a lingering farewell.

Tiberius ascended the throne at the age of fifty-six. What struck his contemporaries most was his absolute impenetrability. As was said of a very different man, the poet Gray, "he never spoke out." All his feelings, desires, passions, and ambitions were locked behind an impassable barrier, and had to be interpreted by the very uncertain light of his external acts. It is recorded of him that only once did he as commander take counsel with his officers concerning military operations, and that was when the destruction of Varus's legions had made it imperatively necessary not lightly to risk the loss of a single soldier. He was an unparalleled master of passive and silent dissimulation, and the inevitable penalty of his inscrutability was widespread dislike and suspicion. But behind his defences there lay an intellect of high power, cold, clear, and penetrating all disguises. Few have ever possessed such mental vision, and he was probably never deceived either about the weaknesses of others or about his own. For the littleness and servility of public life in regions below the court he entertained a strong contempt. It is a question whether he ever liked or was liked by a single being; but he did his duty by those with whom he was connected after a thorough though stern and unlovable fashion. As a general he commanded the full confidence of his soldiers, though he was a severe disciplinarian; yet the men of his own legions greeted his accession to the throne with a mutiny. Tiberius proved himself capable in every department of the state more by virtue of industry and application than by genius. His mind moved so slowly and he was accustomed to deliberate so long that men sometimes made the mistake of deeming him a weakling and a waverer. He was in reality one of the most tenacious of men. When he had once formed an aim he could wait patiently for years till the favourable moment enabled him to achieve it, and if compelled to yield ground he never failed to recover it in the end. The key to much of his character lies in the observation that he had in early life set before himself a certain ideal of what a Roman in high position ought to be, and to this ideal he rigidly and religiously adhered. He may in one sense be said to have acted a part throughout life, but that part had entered into and interpenetrated his whole nature. His ideal of character was pretty much that of the two Catos. He practised sternness, silence, simplicity of life, and frugality as he deemed that they had been practised by the Fabricii, the Curii, and the Fabii. That Tiberius's character was stained by vice before he became emperor no one who fairly weighs the records can believe. The persuasion entertained by many at the end of his life that he had been always a monster of wickedness, but had succeeded in concealing the fact till he became emperor, has slightly, but only slightly, discoloured the narratives we possess of his earlier years. The change which came over him in the last years of his life seems to have been due to a kind of constitutional clouding of the spirits, which made him what the elder Pliny calls him, "the gloomiest of mankind," and disposed him to brood over mysteries and superstitions. As this gloom deepened his will grew weaker, his power tended to fall into the hands of unworthy instruments, terrors closed in around his mind, and his naturally clear vision was perturbed.

The change of masters had been anticipated by the Roman world with apprehension, but it was smoothly accomplished. Tiberius was already invested with the necessary powers, and it may even be that the senate was not permitted the satisfaction of giving a formal sanction to his accession. Agrippa Postumus was put to death; but Livia may be reasonably regarded as the instigator of this crime. Livia indeed expected to share the imperial authority with her son. At first Tiberius allowed some recognition to the claim; but he soon shook himself

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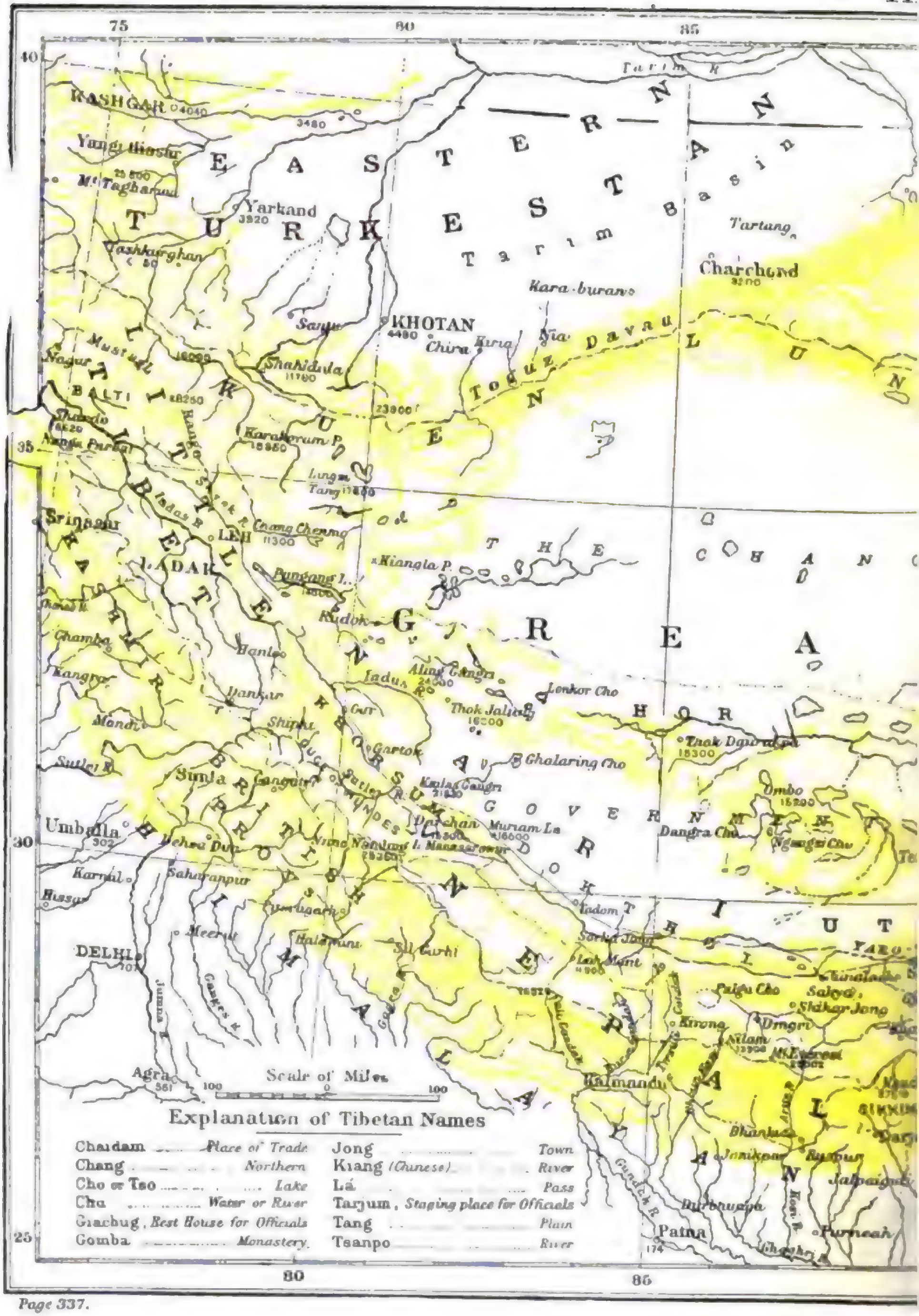
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Jumna R.
Ganges R.
Gogra R.
Palgu Cho
Sakya
Shikar Jong
Kirong
Dingri
Nilam
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BRITISH INDIA
HIMALAYA
NEPAL
SIKKIM
Agra 561
Katmandu
Scale of Miles
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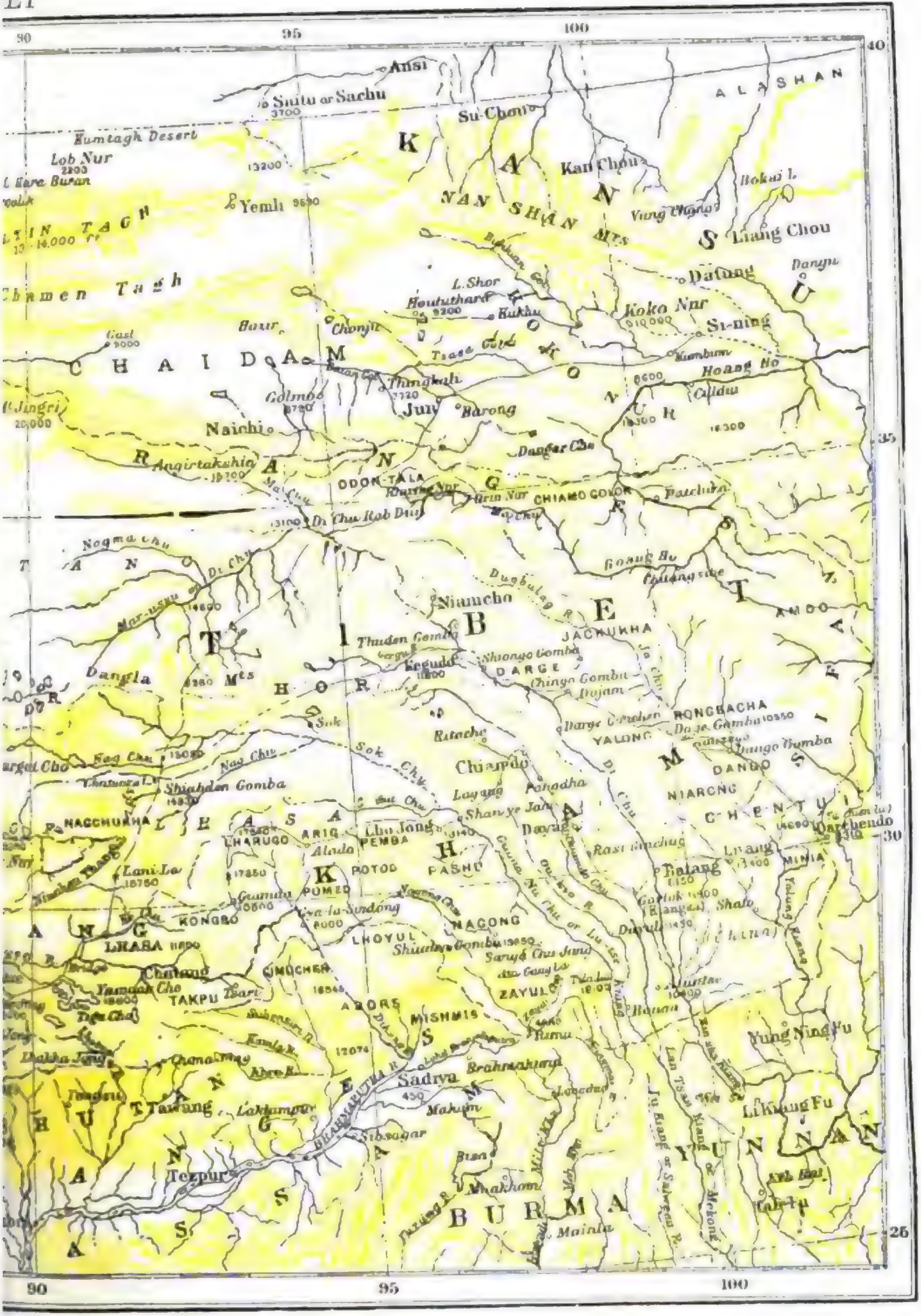
Bhanbara
Janikpur
Raypur
Jalpaiguri
Gundak R.
Kosi R.
Durbhunga
Patna 174
Purneah

Explanation of Tibetan Names

Chaidam	*Place of Trade*	Jong	*Town*
Chang	*Northern*	Kiang *(Chinese)*	*River*
Cho or Tso	*Lake*	Lá	*Pass*
Chu	*Water or River*	Tarjum, *Staging place for Officials*	
Giachug, *Rest House for Officials*		Tang	*Plain*
Gomba	*Monastery*	Tsanpo	*River*

ET

PLATE IV.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ALASHAN
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Sintu or Sachu
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Su-Chou
Kumtagh Desert
Lob Nur
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Kara Buran
13200
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N
Yemli
NAN SHAN MTS
Yung Chang
Liang Chou
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Hoututhara
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Kukhu
Datung
Danju
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Koko Nur
Si-ning
10,000
Baur
Chonju
Gasl
9000
CHAIDAM
Tsaga Gol
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K
O
Kumbum
Hoang Ho
Golmo
8720
Thingkali
Juu
Barong
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Calldu
Jingri
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R. Angirtakshia
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Ngoring Nur
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Patchuka
Ma Chu
Di Chu Rob Dui
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Keguda
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Darge Gonchen
RONGBACHA
Dege Gomba 10350
YALONG
Dango Gomba
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DANGO
Sok Chu
Nag Chu
Chiamdo
NIARONG
Shiabden Gomba
Lagong
Pangdha
CHENTU
NACGHUKHA
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Lho Jong
Shan ye Jan
Dayag
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CHARUGO
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Rasi Tinchug
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MINIA
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PASHO
Batang
Yalung
POMED
Gartok
Shato
Gya-la-Sindong
Tsangpo R.
KONGBO
NAGONG
Dupul
Chung
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G
LHABA
LHOYUL
Shiuden Gomba
Sanga Chu Jong
Chatang
Yamdok Cho
TAKPU
Tsari
GNOCHER
ZAYUL
Tsela
ABORS
MISHMIS
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Subansiri R.
Rima
Yung Ning Fu
Dhaka Jong
Kamla R.
Chona
Abor R.
E
Sadiya
Brahmaputra
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Tawang
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Lakhimpur
Makum
Lan Tsan Kiang
Ju Kiang or Salween R.
Li Kiang Fu
Tsona Jong
Sibsagar
BHUTAN
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Mainla
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free, and later became estranged from his mother and held no communication with her for years before her death. The history of Tiberius's relations with other members of his family is hardly less miserable. Perhaps with any other commander than Germanicus the dangerous mutiny of the troops on the Rhine which broke out soon after Tiberius's accession would have ended in a march of the discontented legions upon the capital. The perilous episode of Arminius caused the recall of Germanicus and his despatch to the East on an honourable but comparatively inactive mission. The pride and passion of Agrippina, the granddaughter of Augustus and wife of Germanicus, tended to open a breach between her husband and the emperor. In his Eastern command Germanicus found himself perpetually watched and even violently opposed by Piso, the governor of Syria, who was suspected to have received secret orders from Tiberius. When Germanicus died at Antioch in 19 A.D., the populace of Rome combined with Agrippina in demanding vengeance upon Piso; and the emperor was forced to disown him. The death of Germanicus was followed four years later by that of Drusus. These two princes had been firm friends, and Livilla, the wife of Drusus, was sister to Germanicus. Years afterwards it was found that Drusus had fallen a victim to the treachery of his wife Livilla, who had joined her ambition to that of the emperor's minister of state Sejanus. When Drusus died, Tiberius nominated two of Agrippina's sons as his heirs. But Sejanus had grown strong by nursing the emperor's suspicions and dislike for the household of Germanicus, and the mother and the princes were imprisoned on a charge of crime. In his memoirs of his own life Tiberius declared that he killed Sejanus because he had discovered that he entertained a mad rage against the sons of Germanicus. But the destruction of Sejanus did not save Agrippina and her two children. The third son, Gaius Cæsar (Caligula), lived to become emperor when Tiberius died in 37.

Throughout his reign Tiberius strove earnestly to do his duty to the empire at large; his guiding principle was to maintain with an almost superstitious reverence the constitutional forms which had been constructed by Augustus. Only two changes of moment were introduced. The imperial guard, hitherto only seen in the city in small detachments, was by the advice of Sejanus encamped permanently in full force close to the walls. By this measure the turbulence of the populace was kept in check. The officer in command of the guard became at once the most important of the emperor's lieutenants. The other change was the practically complete abolition of the old comitia. But the senate was treated with an almost hypocritical deference, and a pedantically precise compliance with the old republican forms was observed towards the senatorial magistrates. The care expended by Tiberius on the provinces was unremitting. His favourite maxim was that a good shepherd should shear the flock and not flay it. When he died he left the subject peoples of the empire in a condition of prosperity such as they had never known before and never knew again. Soldiers, governors, and officials of all kinds were kept in wholesome dread of vengeance if they oppressed those beneath them or encouraged irregularity of any kind. Strict economy permitted light taxation and enabled the emperor to show generosity in periods of exceptional distress. Public security both in Italy and abroad was maintained by a strong hand, and commerce was stimulated by the improvement of communications. Jurisdiction both within and without the capital was on the whole exercised with steadiness and equity, and the laws of the empire were at many points improved. The social and moral reforms of Augustus were upheld and carried further. Such risings against the emperor's authority as occurred within the Roman domain were put down with no great difficulty. The foreign or rather the frontier policy was a policy of peace, and it was pursued with considerable success. With few exceptions the duties of the Roman forces on the borders were confined to watching the peoples on the other side while they destroyed each other. On the Rhine, at least, masterly inactivity achieved tranquillity which lasted for a long period.

The disrepute which attaches to the reign of Tiberius has come mainly from three or four sources,—from the lamentable story of the imperial household, from the tales of hideous debauchery practised in deep retirement at Capreæ during the last eleven years of the emperor's life, from the tyranny which Sejanus was permitted to wield in his master's name, and from the political prosecutions and executions which Tiberius encouraged, more by silent compliance than by open incitement. The stories of immorality are recorded chiefly by Suetonius, who has evidently used a poisoned source, possibly the memoirs of the younger Agrippina, the mother of Nero. Tiberius loved to shroud himself in mystery, and such stories are probably the result of unfriendly attempts to uplift the darkness. If history ventures to doubt the blackness of Theodora, that of Tiberius grows continually lighter under the investigations of criticism. Suetonius makes the emperor's condition to have been one of mania, issuing frequently in the abandonment of all moral restraint. But in that case the authority of Tiberius, which was as firmly upheld during the years spent at Capreæ as it had been earlier, must have fallen to pieces and come to an end. With respect to Sejanus it is impossible to acquit Tiberius of blame. If he was deceived in his favourite he must have been willing to be deceived. He conferred on Sejanus a position as great as had been held by Agrippa during the reign of Augustus, and the minister was actually, and all but formally, joint emperor. Of the administrative ability of Sejanus there can be no question; but the charm and secret of his power lay in the use he made of those apprehensions of personal danger which seem never to have been absent from his master's mind. The growth of "delation," the darkest shadow that lies on the reign, was in part a consequence of the supremacy and the arts of Sejanus. Historians of Rome in ancient times remembered Tiberius chiefly as the sovereign under whose rule prosecutions for treason on slight pretexts first became rife, and the hateful race of informers was first allowed to fatten on the gains of judicial murder. Augustus had allowed considerable licence of speech and writing against himself, and had made no attempt to set up a doctrine of constructive treason. But the history of the state trials of Tiberius's reign shows conclusively that the straining of the law proceeded in the first instance from the eager flattery of the senate, was in the earlier days checked and controlled to a great extent by the emperor, and was by him acquiesced in after a time with a sort of contemptuous indifference, till he developed, under the influence of his fears, a readiness to shed blood.

The principal authorities for the reign of Tiberius are Tacitus and Suetonius. The *Annals* of Tacitus were not published till nearly eighty years after the death of Tiberius. He rarely quotes an authority by name. In all probability he drew most largely from other historians who had preceded him; to some extent he availed himself of oral tradition; and of archives and original records he made some, but comparatively little, use. In his history of Tiberius two influences were at work, in almost equal strength: on the one hand he strives continually after fairness; on the other the bias of a man steeped in senatorial traditions forbids him to attain it. Tacitus is certainly not among the historians in whom our confidence grows by repeated reading. Suetonius was a biographer rather than an historian, and the ancient biographer was even less given to exhaustive inquiry than the ancient historian; moreover Suetonius was not gifted with great critical faculty, though he told the truth so far as he could see it. His *Lives of the Twelve Cæsars* was written nearly at the time when Tacitus was composing the *Annals*, but was published a little later. Velleius Paterculus is by far the oldest authority for any part of Tiberius's life. He had been an officer under Tiberius, and he eulogizes his old general enthusiastically,—feeling it necessary, however, to do less than justice to the achievements of Germanicus. To Velleius all defenders of Tiberius have eagerly appealed. In truth it is his silence alone which affords any external aid in repelling the charges of Tacitus and Suetonius, and the fact that Velleius published his work in the lifetime of his master deprives that silence of its value. The eulogy of Sejanus which is linked with that of Tiberius must needs shake faith in the scrupulousness of the author. It is still doubtful whether Dio Cassius (whose *History* ended with the year 229) in his narrative of the reign of Tiberius is to any great extent independent of Tacitus. In recent times a considerable mass of inscriptions has added to our knowledge of the administration of this emperor. The chief account of Tiberius in English is that contained in Dean Merivale's *History of the Romans under the Empire*. Mr Beesly has written an interesting defence of him in his *Catiline, Clodius, and Tiberius*. The best recent history of this period is Hermann Schiller's *Geschichte der römischen Kaiserzeit* (Gotha, 1883). Numerous monographs relating to the reign have appeared in recent times on the Continent. The principles of the imperial administration of the provinces by Tiberius have been treated by Mommsen in the fifth volume of his *History of Rome*, translated into English under the title of *The Roman Provinces from Augustus to Diocletian*. (J. S. R.)

TIBESTI. See SAHARA, vol. xxi. p. 149. and TIBBUS.

TIBET

IV. TIBET,[1] Thibet, or Tübet, an extensive and highly elevated region in the heart of Asia, comprising tablelands ranging from 10,000 to 17,600 feet above sea-level. The Himalayan mountain ranges and the transverse ranges of upper Yun-nan constitute the southern scarp,

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[1] The name Tibet is not, as usually alleged, unknown in the country itself, though only found there in an attenuated form. The following forms are also met with—in Chinese annals *T'u-bat* (5th cent.) and

Boundaries. the Yun-ling Mountains of China the eastern scarp, and the Kuen-Lun (Kiún-Lún) ranges the northern scarp, towards Turkestan and Mongolia; on the west, where it narrows considerably, it merges into the Pamir tablelands. Its extreme length from east to west exceeds 1600 miles; its breadth from north to south ranges from 150 miles in the west to an average of 500 in central Tibet and a maximum of 700 in the east. The area of Tibet exceeds 700,000 square miles.

Much of Tibet is wholly abandoned to wild animals, and much is uncultivable and occupied only by various wandering tribes of nomads. The centres of the settled and agricultural population lie to the south, in a region named Bod-yul (meaning Bod-land) by the inhabitants, who are called Bod-pas; by the Hindus it is called Bhot, and by the Chinese Si-tsang. The greater portion of this region is governed, under the supremacy of China, by lamas and gyalpos, ecclesiastical and lay Bod-pas, the principal seat of government being at Lhása, the chief city of Bod-yul. Portions are subject to Kashmir and Nepal, and to independent chieftains, and portions are directly subject to China; but the Bod-pa ethnological element prevails more or less throughout.

European travellers.

Tibet was long a *terra incognita* to Europeans. It is difficult of access on all sides, and everywhere difficult to traverse. Its great elevation causes the climate to be rather arctic than tropical, so that there is no gradual blending of the climates and physical conditions of India and Tibet, such as would tend to promote intercourse between the inhabitants of these neighbouring regions; on the contrary, there are sharp lines of demarcation, in a mountain barrier which is scalable at only a few points and in the social aspects and conditions of life on either side. No great armies have ever crossed Tibet to invade India; even those of Jenghiz Khan took the circuitous route *via* Bokhara and Afghanistan, not the direct route from Mongolia across Tibet. Thus it was no easy matter for the early European travellers to find their way into and explore Tibet. Friar Odoric of Pordenone is supposed to have reached Lhása *circ.* 1328, travelling from Cathay; three centuries afterwards the Jesuit Antonio Andrada, travelling from India, entered Tibet on the west, in the Manasarowar Lake region, and made his way across to Tangut and north-western China; in 1661 Fathers Grueber and D'Orville travelled from Peking *via* Tangut to Lhása, and thence through Nepal to India; and during the first half of the 18th century various Capuchin friars appear to have passed freely between Delhi and Lhása, by way either of Nepal or Kashmir. The first Englishman to enter Tibet was George Bogle, in 1774, on an embassy from Warren Hastings to the tashi (teshu) lama of Shigatze. In 1811 Thomas Manning made his way from India to Lhása; he is the only Englishman who has succeeded in reaching the sacred city, and he had soon to leave it. During the 19th century Europeans have been systematically prevented from entering the country or speedily expelled if found in it. In 1844-46 the French missionaries Huc and Gabet made their way to Lhása from China, but were soon deported back again In 1866 the Abbé Desgodins travelled through portio of eastern Tibet and reached Chiamdo (in Khám), but was prevented from approaching any closer to Lhása. Last of all the Russian Colonel Prejevalsky succeeded in exploring portions of northern Tibet, but was unable to penetrate southwards into Bodland.

Maps. Geographers have long been in possession of maps of Tibet, compiled from surveys executed early in the 18th century by lamas, under instructions from the Jesuit fathers who made a survey of China for the emperor Kang-he. The lamas' maps were the basis of D'Anville's *Atlas*, published in 1733, and were employed by Klaproth in constructing his map of Asia in 1824; but they are generally very meagre, only reliable in the vicinity of the principal roads, and occasionally very misleading. They must have been compiled at best from rude estimates of distance and direction, and in some parts from mere hearsay or conjecture. They are, however, supposed to have been based on astronomical determinations of position; but this is improbable, for the latitudes of such important places as Lhása and Bátang are 30 to 60 miles in error. Our knowledge of the geography of the country is complete only for portions of western Tibet, which are subject to the maharajah of Kashmir, and have been regularly surveyed. This knowledge has been largely supplemented during the last twenty years by the work of natives of India—the so-called trans-Himalayan explorers of the Indian Survey, notably Pandits Nain Singh and Krishna (A—K)—who have been trained to carry route surveys through regions which they may, but Europeans may not, enter.

Name. *Tie-bu-te, T'u-bo-te* (11th cent.); in Mongolian, *Tübet, Toböt*; in Arabic *Tubbet*; Rabbi Benjamin (1165), *Thibet*; J. de Plano Carpini (1247), *Thabet*; Rubruquis (1253), Marco Polo (1298), *Tebet*; Ibn Batuta (1340), *Thabut*; Ibn Haukal (976), Al Biruni (1020), Odoric of Pordenone (*c.* 1328), Orazio della Penna (1730), *Tibet*. A Tibetan, arriving at Darchiendo from Lhasa, states that he comes from Teu-peu, meaning High or Upper Tibet,—Stod-Bod in contradistinction to Smad-Bod or Lower Tibet. The former expression, were it supported by any ancient authority, might be regarded as the etymological origin of "Tibet"; historical evidence, however, seems to indicate another source. The state of which Lhása is the capital is often called "Deba jung" or "land of the Debas" (*sdepa ljongs*). The title of the tepa lama is familiar. Chinese records say that the king of the country is called *diba*; and Joh. Grueber informs us that the king is styled *deva* or *teva*, and is descended from an ancient race of Tangut Tatars. The Chinese annals of the T'ang dynasty record that Fanni Tubat, the historical founder of a state in the east of Tibet in 433, gave to his dominion his surname of Tubat. This was a famous family name proper to several Tatar dynasties which ruled in the north and north-west of China, and belonged to the Sien-pi race, in the language of which *tubat* meant "a coverlet." An appended legend stated that the fifth ancestor of Liluku, the founder of the southern Liang dynasty and family and father of Fanni, derived the surname of Tubat, which became that of his family, from the fact that he was born in a coverlet while his mother Huykshe was sleeping. However worthless the legend, there is complete similarity between the name of the Tubat or Tobat Tatars and that of Tibet, and we may with considerable safety take the latter word as derived from the former, the fact being that it was and is still extensively used in the sense of "great," "chief," among the Tatar tribes. Tibet, however, is not the name by which the modern Tibetans designate themselves and their country. Bod-pa, "a man of Bod," Bod-yul, "country of Bod," are the expressions in current use; but what "Bod" means is uncertain. Hodgson has maintained that before the arrival of Indian teachers the people had no name for themselves or their country, and the present Bod comes from the Sanskrit *B'ót*—an opinion which, though inconsistent with the evidence collected about Tubat, is rather confirmed by a legendary account. According to that account, the country, which was occupied by a race of men not yet emerged from primitive barbarism, was originally called Bod-rgyal, *i.e.*, "Bod's victory." The secondary name then might be in its simple form Bod, a Buddhist appellative suggested by the Sanskrit homonyms of *-bat* or *-b'at*, part of the name brought in by the Tatar conquerors. Anyhow there is no occasion for the other etymologies suggested, such as that from Buddha, or that proposed by Schiefner (*t'ub* and *p'od*, both meaning "able," "capable"). An old name for Tibet in the native books is Gdong-mar-gyi-yul, "country of the red-faced men," so called apparently from the ancient national custom of painting the face red,—a practice which was forbidden by King Srong-btsan at the instance of his wife Wan ch'eng, a Chinese princess. Among the Mongols Tibet was simply called Barontala (the "right side"), in contradistinction to Dzontala (the "left side"), which was among them the name of Mongolia. In China, during the Yuan or Mongol dynasty, it was called Wei-sze-Tsang, in which we recognize the names of the two central provinces of DbUs (U) and Tsang. Khachi, Khache, Khaschi, Kashi, are various forms of a term which is often met with in books as applied to a part of the plateaus of Tibet, and which cannot without difficulty be identified in positive geography. We take it to be simply a revival of the old name of the Tangut or Hia kingdom, the Khashi or Khoshi of the Mongols (982-1227), on the north-east of Tibet, on the west of the Hoang-ho, whence Ho-si in Chinese history, and perhaps the origin of the name. In the 11th century Milaraspa made use of the term K'aché for Mussulman; Huc and Gabet have reported the use of the same expression in the central provinces with a similar acceptation. A popular etymology has confounded it with the words K'a-ché for K'a-chen, literally "big mouth," which is now supposed to be its meaning when applied to Mohammedans. Kashmir is also called K'a ché, from the fact that it is under Mohammedan rule, says Jaeschke; but, as this has been the case only since 1605, there is great probability that here the term is simply used as an abridged form of Kashmir. (T. DE L.)

Geographical divisions.

Tibet is commonly divided into two parts called Great and Little Tibet, the former lying between 102° and 79° E. long., the latter between 79° and 74°. Great Tibet is broadly divisible into a western region, in which there is a considerable preponderance of tableland over hill and mountain and of lake basins over river basins, and an eastern region, in which the reverse holds good and the surface of the ground is so greatly corrugated that the natives call it *rong-rtsub*, "a rough country full of ravines." In Little Tibet the Himalayas converge towards the Kuen-Lun, and the breadth of the plateau meridionally diminishes to less than a fourth of what it attains in Great Tibet. The entire region may be broadly divided into three longitudinal zones, increasing in elevation from south to north, viz., a southern zone, which contains the centres of the settled and agricultural population; a middle zone, comprising the pasture lands of the Bod-pa nomads; and a northern zone, for the most part abandoned to wild animals, but partly occupied by tribes of Turkic and Mongolian nomads. The southern and middle zones comprise Bod-land proper and are divided into four provinces, viz.,—Nári (Ngári, Ari) on the west, between 74° and 85° E. long.; Khám, otherwise Do-Khám, on the east, between 92° 30′ and 102°; and in the centre, Tsáng, adjoining Nári, and U or Us (otherwise Y or Wei), adjoining Khám; the two central provinces are commonly called U-tsáng, as one. A considerable belt of the middle zone is known as the Hor country. The middle and northern zones embrace the greater portion of the region known to Bod-pas as the Cháng-táng (Byán-táng, Ján-táng) or "Northern Plain," which, however, protrudes southwards and abuts upon the Himalayas from 80° to 85° E. long., thus interposing a nomad population between the settled populations to the east and the west. The northern zone merges on the west into the Pamir tablelands.

Table-land.

The tableland of Tibet attains its maximum elevation, 17,600 feet above sea-level, on the 79th meridian, in the Lingzi-táng plateau of the northern zone; thence there is a gradual fall east, west, and south, the plateau level on the 97th meridian being about 13,500 feet in the northern zone and 10,000 in the southern. Between the 82d and 90th meridians the northern zone is known only from the maps of the lamas' survey, which indicate a surface slightly corrugated with hills and containing numerous lakes, some of great size, but no rivers of importance.

Rivers.

The river basins in this zone apparently commence to the east of the 90th meridian and from them issue the Di-chu[1] (Chinese Kin-sha-kiang), whose headwaters unite at Di-chu Rab-dun, in 94° 30′ E. long.; the Chiamdo river or Lan-tsan-kiang; the Hoang-ho, in about 96°, which flows through the Kiaring and Orin lakes (13,500 feet above the sea and each exceeding 80 miles in circumference) and passes northwards out of Tibet through the Kuen-Lun; and the Ja-chu or Yalung-kiang, also in about 90° E. long., which flows southwards through eastern Tibet. In the middle zone a system of lakes on the 90th meridian gives birth to the Nag-chu, which becomes the Sok-chu and lower down the Giama-Nu-chu—known to the Chinese as the Lu-tse-kiang—and, trending southwards, winds round the eastern extremity of the Himalayas. In the lower zone the Indus and the Yaro-tsanpo rise on either side of the 82d meridian and flow in opposite directions parallel to the Himalayas, and then, passing through openings in those mountains twenty degrees apart in longitude, enter India on the extreme east and west. The Lohit Brahmaputra rises behind the eastern Himalayas and flows south-westwards into India. The Giama-Nu-chu, Chiamdo-chu, and Di-chu flow southwards into Burma and Yunnan, through closely contiguous valleys between a system of meridional ranges which project as spurs from the Tibetan plateau. West of 82° a single water-parting between north and south—that of the Mus-tagh and Karakoram, sometimes called the Turkic—separates Indo-Tibetan from Turko-Tibetan waters; east of that meridian there are longitudinal water-partings between the basins of the several rivers already mentioned.

Himalayan region.

The Himalayan Mountains, which constitute so considerable a portion of the southern scarp of Tibet, consist of a succession of longitudinal chains, running in general parallel to each other along the glacis of the plateau. These chains are much higher on their southern than on their northern faces, and are connected in some parts by transverse ridges, but in other parts are broken and interrupted by fissures and valleys. The principal chain is the one of high peaks covered with perpetual snow which culminates in Mont Everest, 29,000 feet above the sea. This chain may be regarded as the geographical boundary between Tibet and India. In some parts it is the water-parting; but at the several points where its continuity is broken the water-parting recedes to an inner chain on the plateau, and basins are formed between the two chains, the waters of which descend in rivers to the plains of India. The plateau is a region of plains and wide open valleys of little depth; the scarp is a region of mountains and narrow confined valleys of great depth. The narrow valleys of the scarp, being lower, are warmer and more favourably adapted for cultivation than the broad valleys of the plateau.

Cháng-táng and rong.

Higher than these last are the plains of the Cháng-táng, which are, for the most part, too high and cold for any but pastoral uses. All such tracts the inhabitants call *cháng-táng*, though the word strictly signifies "the Northern Plain"; and all tracts which contain valleys warm enough for cultivation they call *rong* (signifying a ravine or narrow valley or cleft in a hill), but more particularly the lower and warmer valleys which produce crops twice in the year; the word is also commonly employed to indicate a warm country. The alluvial beds in the valleys are composed of the débris of the surrounding rocks, laid out in horizontal deposits, which in course of time have become furrowed into gigantic ravines with a succession of narrow terraces in steps on each flank. It is on the existing lower alluvial beds and the remnants of higher beds that cultivation is carried on, in plots which are usually well watered and very fertile. The sharp needle-peaks, which are highest of all and bare of soil, but covered with perpetual snow, are met with most frequently in tracts of rong, and the rounded hills coated with grass to altitudes sometimes exceeding 16,000 feet in tracts of cháng-táng. The forest-clad mountain slopes which are occasionally met with occur chiefly in the rong. The general direction of the hill and mountain chains is east and west, but north-west and south-east in western Tibet, north-east and south-west in the province of U, and north and south in eastern Tibet. The peaks rise in many parts to between 20,000 and 25,000 feet—in the Mus-tagh range to 28,250—above the sea-level, but rarely to more than 10,000, and often to not more than a few hundred, feet above the general level of the plateaus from which they spring. The principal water-partings in some districts follow the crests of low ridges and gentle undulations which are of barely appreciable elevation above the surface of the ground.

Nar

Nári, the western province of Bodland, is divided into the sub-provinces of Ladak and Balti on the west, between 75° and 79° E. long., now a part of Kashmir; Khorsum, between 79° and 82°, conterminous with the Himalayan provinces of British India; and Mang-yul or Dokthol, between 82° and 87°, conterminous with western Nepal. The last two are under the government of Lhása. Western Nári is bounded on the south by that portion of the Himalayan chain of snow-peaks which stretches in almost a direct line north-west from the Manasarowar Lake region to the Nanga Parbat peak (26,620 feet), at first facing the plains of the Punjab, then passing north of Kashmir. The provinces appertaining to Kashmir have already been described in the article LADAK AND BALTI (*q.v.*). The Karakoram chain, although its principal pass is 18,500 feet above sea-level, nowhere rises very high above the tableland. It constitutes a portion of the water-parting between India and Turkestan, separating the Lingzi-táng plateau, the highest in all Tibet, from the broad and open valley of Chang-chenmo; it has been traced eastwards to the meridian of 82°, but no farther.

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[1] Tibetans call rivers either *tsanpo* = river or *chu* = water, the former being chiefly employed in southern Tibet, as for the great Yaro-tsanpo (Upper river) and its principal tributaries. Lakes are called *cho* or *tso*. A mountain pass is called *la*.

Khorsum.

Khorsum is mainly cháng-táng, but has some upland cultivation round the capital, Rudok, and in the Gartang valley, and lowland cultivation in the rong of the great plateau (120 miles long by 15 to 60 broad) of Guge or Hundes, the upper basin of the Sutlej. In this province lie, within the small area of a square degree, the sources of four great rivers—the Indus, the Yaro-tsanpo, the Sutlej, and the Karnali—the sacred lakes of Manasarowar and Rakas Tal, 15,300 feet above the sea and each 50 miles in circumference, and two famous mountains, Nimo Namling (25,360 feet) to the south, believed by the Tibetans to be their highest mountain, and to the north the sacred Kailas Gangri (21,830 feet), the Kantysee of the lamas' survey. From the Kailas Gangri a chain of hills stretches to the north-west, separating the upper basins of the Sutlej and the Indus; to the north of that another chain, running east and west, culminates in the Aling Gangri peaks (24,000 feet) and separates the Indus basin from the Pangong Lake (100 miles long, from 3 to 7 broad, and 14,000 feet in altitude), near which Rudok is situated. Roads pass from Ladak to Lhása through the plains of Rawang and Sarthol, the gold-fields of Thok Jalung and Thok Daurakpa, and the Hor country.

Mang-yul or Dokthol.

Mang-yul, or Dokthol, contains the upper basins of the Yaro-tsanpo—here known as the Nári-chu—and its principal affluents, the Cha-chu and the Charta-tsanpo. The province is wholly Cháng-táng and its population nomadic, the capital, Sarka Jong, being merely a good-sized village.

U-tsang.

The common border of the provinces of Nári and Tsáng falls nearly on the 87th meridian. Here the Cháng-táng recedes from the Himalayas, and its southern scarp, trending north-east, forms the upper fringe of tracts appertaining to U-tsáng that are capable of producing a single crop annually. This region constitutes the most important portion of the basin of the Yaro-tsanpo, for it contains the chief towns and monasteries of the settled Bod-pas. Cultivation commences on a slight scale where the river enters Tsáng on the west. The first town of any importance is Junglache (13,600 feet), on the right bank, with a large monastery. Thence goods may be taken down the river for some distance by boats of leather over a wooden framework, light enough to be carried back overland. Eighty-five miles lower down, also on the right bank, are the city of Shigatze or Digarchi (12,000 feet) and the great monastery of Tashilunpo (Teshu-Lumbo), the residence of the "tashi lama," one of two spiritual incarnations of equal rank, of which the other, the "dalai lama," resides at Lhása; the monastery contains 3500 lamas. Between Junglache and Shigatze the river receives the Raka-tsanpo from the cháng-táng on its left, and the Sákya-Jong-chu from that on its right. The latter descends from the Himalayan water-parting past the monastery of Sákya (13,900 feet), which is surrounded by cultivation and governed by a chief lama called the "sákya-gángma," who is held in considerable reverence as an avatar. At Shigatze the Yaro-tsanpo receives the Pena-Nyang-chu from a valley to the south-east which contains the towns of Pena-jong and Gyangtse-jong (13,000 feet), and numerous monasteries and villages, and through which passes the main road from Bhutan to Shigatze travelled by Bogle in 1774. A little lower down it receives from the left the Shiang-chu, which rises in the Ninchen-thangla range and flows past the town of Namling (12,200 feet, 200 houses), where sheep are employed as baggage animals, the country being too cold for donkeys and the roads too stony for yaks. Then at Shangpa (Jagsa) it receives from the right the Rong-chu from the famous Yamdok-tso or Scorpion Lake to the south-east. This lake is 120 miles in circumference, 13,800 feet above the sea, and is surrounded by villages and monasteries; its scorpion claws embrace a peninsula which rises above 16,000 feet, is grass-grown to its summit, and embosoms the Damo-tso, a sacred lake, 24 miles round and 500 feet above the main lake, which is expected some day to rise and destroy all animal life by a flood. Here the roads from India *via* Bhutan and from Shigatze to Lhása converge, and after crossing the Khamba-lá (15,000 feet) strike the Yaro-tsanpo at Chiak-jam-chori (= "the iron bridge at the rocky bank"). The river in its course from Shangpa down to this point is unnavigable, passing over rapids between precipitous hills; there is no road on either bank. A little below the bridge it receives from the left the Ki-chu, the river of LHÁSA (*q.v.*), the chief city of Bodland. Below the junction of the Ki-chu the Yaro-tsanpo continues its eastward course through a broad and well-peopled valley. It is crossed at Chetang by a ferry on the road from Lhása to Tawang in Bhutan *via* the Yarlung-chu valley (right bank), which is said to be the pleasantest and most populous in Tibet; fruits grow in profusion at its lower extremity and the hills are forest-clad. At Chetang the river is 350 yards broad, 20 feet deep, and 11,000 feet above the sea, and has a sluggish current. On crossing the meridian of 92° 30′ E. it passes out of the province of U into that of Khám and enters its eastern basin. After traversing the Kongbo (Khombo) district, it trends north-east for 100 miles—in general parallel with the contiguous Kongbo ranges and the distant Ninchen-thangla—and on reaching 94° turns abruptly to the south. Its course has been explored 20 miles below the bend, to Gya-la-Sindong (8000 feet), but no farther. The basin is bounded on the north and east by the continuous plateaus of Lharugo, Arig, Pemba and Lhojong, Pashu, Dainsi, and Nagong, and on the south by the inner Himalayan water-parting. Numerous tributaries join the river from both sides, but little is known of them. Those from Kongbo, Lharugo, and Arig are said to unite and join it a little above Gya-la-Sindong, and one from Nagong a little below. This last rises near the Ata-Gang-lá, a pass over the Himalayas between the Nagong plateau and the Zayul district, and is said to be on the direct road from Lhása to Zayul *via* Gya-la-Sindong; it is probably joined by the Kenpu river of the lamas' survey, which rises in the southern scarp of the Pemba-Lhojong plateau and probably flows through the Potod and Pomed districts of Khám. The independent Lhoyul country lies to the south of the Nagong-chu (lit. "black water"). The region is generally of a comparatively low elevation, is said to have much more of rong than of cháng-táng, and probably contains much more forest and luxuriant vegetation than any other part of Tibet north of the Himalayas.

The Yaro-tsanpo.

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The lower course of the Yaro-tsanpo has long been a matter of controversy between English and French geographers: the former have maintained, in accordance with information from natives of Tibet and Assam, that it enters the Assam valley and is the principal source of the Brahmaputra river, of which the Lohit Brahmaputra river is the eastern source; the latter have maintained, on the authority of Chinese geographers, that it flows into Burma and is the principal source of the Irawadi river. But now its eastern basin has been explored, and the Lohit Brahmaputra has been found to have its sources in a range bordering the Giama-Nu-chu; the Yaro-tsanpo must therefore necessarily pass into Assam, and measurements of the discharges of the principal rivers entering Assam from the north conclusively identify it with the Dihong. That river, which receives the Lohit Brahmaputra a little below Sadiya (450 feet above the sea), has been explored upwards into the Himalayas to a point within 100 miles of Gya-la-Sindong; but as yet nothing is known of the connecting channel, except that it must have a fall of about 7000 feet, or as much as the entire fall of the Yaro-tsanpo in its upper course of 900 miles.

The Tibetan basins to the south of the Yaro-tsanpo which are included between the Himalayan chains of water-parting and of high snow-peaks are the Bheri, the Kali Gandak, and the Buria Gandak, subject to Nepal; then the following, which are subject to Lhása:—(1) the Tirsuli Gandak, on the direct road from Kathmandu to Dokthol *via* Kirong (9700 feet); (2) the Bhotia Kosi, through which the road from Kathmandu to Shigatze passes *via* Nilam Jong or Kuti (13,900 feet) into (3) the Arun-Barun basin, 120 miles by 30, which embraces the Dingri Maidan and Shikar Jong plateaus and the great Chomto Dong Lake (14,700 feet); this same road, after passing Sikkim and western Bhutan, where the chain of high snow-peaks, including Kanchinjinga (27,815 feet), is the water-parting, traverses (4) the Lhobra, (5) the Cha-yul, and (6) the Mon-yul basins, which are also crossed by the road between Chetang and Tawang. East of the 93d meridian the height of the peaks of the outer Himalayan chain falls to about 15,000 feet; the inner line of water-parting recedes northwards, and with it the boundary of Lhása rule. The included basins are occupied by independent semi-savage tribes,—Miris, Abors, Mishmis, &c.; but about the 97th meridian Lhása rule again asserts itself. The mountains again rise to a great height in the Nechin-Gangra range, the easternmost Himalaya, which terminates about the 98th meridian in spurs thrown off to the north and south, parting the waters of the Lohit Brahmaputra and the Giama-Nu-chu. The southern spur bends westwards in horse-shoe fashion round the Zayul basin, and then merges into the range which separates upper Assam and eastern Bengal from Burma. Lhása rule extends over Zayul, and for a short distance down the valley of the Giama-Nu-chu, embracing some tracts which lie outside the geographical limits of Tibet, as lower Zayul, where the elevation falls below 4000 feet and the climate is so warm that criminals are sent there from Lhása as a punishment.

The Giama-Nu-chu is called by the Chinese the Lu-kiang or Lu-tse-kiang. Its course is known down to about 27° 30′ N. lat., a few marches below Bonga, on the left bank, where the Abbé Desgodins established a mission station temporarily; but nothing certain is known of its lower course. It is generally believed to be identical with the Salwin river, which the Chinese also call the Lu-kiang; but the similarity of name is not conclusive of identity, for the Lu country covers a large area, and its name may be given to a second river rising among the Ly-su and Lu-tse tribes to the south. Nothing certain is known of the Salwin above 25° N. lat.; where it is crossed on the road from Tali-fu to Bamo, it is almost certainly of too small a volume to have its sources farther off than, say, 250 miles in the southern Tibetan scarp, and not far away in the heart of Tibet. There is a considerable probability that the Giama-Nu-chu is the source of the Irawadi, and thus that Chinese geographers have been right in assigning a Tibetan origin to that river, though wrong in identifying it with the Yaro-tsanpo.

The Dayul plateau, with the lofty mountains of Kokarpo to the north near Dayul (11,450 feet) and Dokela to the south near Bonga, lies between the Giama Nu-chu and the Chiamdo or Lan-tsan-kiang; the latter river is believed to become the Mekong of Cambodia. The Ou-kio river of the Abbé Desgodins rises in an important valley between the Giama-Nu and Chiamdo rivers and, flowing past Dayul, joins the former above Bonga. Next comes the Makham plateau, between the Chiamdo and the Di-chu, of which the chief town (11,900 feet) is called Gartok by Tibetans and Kiangka by Chinese. East of the Di-chu or Kin-sha-kiang lie the plateaus of Batang, Litang, and Darchendo, which, though geographically and ethnologically Tibetan, are directly under China. The last two are separated by the Ja-chu, which is known as the Yalung in its southerly course to join the Kin-sha; the united streams flow eastwards through China as the Yang-tse-kiang or Blue river.

Western Hor country.

The western Hor country lies to the north, on the direct route between Ladak and Lhása; it is a region of extensive grassy plains and numerous lakes, some of great size, and occasional hill ranges, which, though often snow-covered, are of no great elevation above the tableland. It is inhabited by nomads—Cháng-pas of local origin and Khám-pas from the east—and occasional communities of gold-diggers and of traders in salt and borax, which are plentifully found on the margins of the lakes. Thok Daurakpa (15,300 feet), the centre of a large gold-field, is the chief settlement. Within a remarkable basin, surrounded by high hills and enclosing the great Dangra-Yum Lake and a cluster of small but well-built villages, Ombo, are lands which produce a profusion of barley at an altitude of 15,200 feet,—a unique instance of cultivation at so great a height, no other cultivation occurring within 300 miles on either side. The Tengri-nur or Nam-cho, 150 miles in circumference and 15,350 feet above the sea, lies to the north-west of Lhása; and beyond it there is said to be a still larger lake, the Chargut-cho, and numerous smaller lakes, to one or more of which the sources of the Giama-Nu-chu may perhaps be traced, though as a rule the lakes in this region have no outlet. The Ninchen-thangla range lies between the Tengri-nur and Lhása; it is considered by some writers to rival the Himalayas, but is probably not more than 300 miles long nor anywhere higher than 24,000 feet above the sea.

The Cháng-táng.

The Cháng-táng attains its greatest width (over 500 miles) on the meridian of 85°; north of Lhása it contracts to 400 miles, and is probably narrowest (140 miles) on the meridian of 97°. It is covered to a very considerable extent, probably everywhere below 16,000 feet, with a succulent grass, which forms from May to August the softest of green carpets and furnishes an abundance of green pasture. Willow and tamarisk are occasionally met with on the margins of the lakes; but as a rule there is little wood or scrub of any kind, and cultivation only in very exceptional localities, such as Ombo. Myriads of wild animals—chiefly the yak and the antelope, but also the ass and the camel—roam over the entire region, but mostly congregate in the uninhabited northern portion; their argols furnish a plentiful supply of fuel, without which it would be impossible for travellers to cross the country, as there are stretches of hundreds of miles in which no other fuel is procurable. As the Cháng-táng narrows to the east, its surface becomes corrugated with chains of low hills. Here too there is more marsh land than on the west: the Odontala plateau at the sources of the Hoang-ho river is described by Prejevalsky as one vast bog in summer, during the prevalence of the south-west monsoon from the Indian Ocean. The openings between the meridional hill ranges to the south permit the rain clouds to pass up to much higher latitudes before discharging their moisture than on the west, where they are faced by the great longitudinal ranges of the Himalayas.

The Kuen Lun range.

The Kuen-Lun has been identified, geologically, by Stoliczka, as far west as the Victoria Lake on the great Pamir, in 74° E. long.; it has been surveyed between 77° and 82°, where it rises to more than 22,000 feet, and towers above the plains of eastern Turkestan. To the east it is known for some distance as the Toguz-Davan (Eleven Passes) range; Prejevalsky observed a prominent peak (Jingri, 20,000 feet) on the 90th meridian, east of which successive portions are known as the Angirtakshia, Shuga, Namohon, Burkhan-Budha, and Dzun-mo-Lun ranges. The rivers flowing north through openings in the Kuen-Lun are generally small, with the exception of the Hoang-ho. East of the 85th meridian the Kuen-Lun constitutes the chord of an arc formed by the Altin Tagh, Nan-shan, and Koko-nur ranges, which project northwards and border the plains of the Lob-nur region and the Chinese province of Kan-suh; several hill ranges and some great plateaus—notably those of Chaidam or Tsaidam—are comprised between the arc and the chord, and the region generally is closely allied to Tibet in its physical aspects. Occasional peaks rise to considerable altitudes and are covered with perpetual snow; the plateaus form a succession of steps ascending from the plains of Gobi to the Tibetan plateau.

Commercial road from west to east. Darchiendo, called Ta-chien-lu by the Chinese, on the extreme eastern boundary of Tibet, is the principal emporium of the trade between that country and China. Thence two important roads lead to Lhása, one called the Júng-lám or "official road" (935 miles long), the other the Cháng-lám or "northern road" (890 miles). The former, which is the more direct, is the post road and that by which officials travel between Lhása and Peking; but it crosses much rugged and difficult country. The other is preferred by traders, as being less difficult and less harassed by officials, and mostly passing over plains with an abundance of pasture for their baggage animals. The former has long been known from the published travels of Huc and Gabet and the embassies from Nepal to China, and its eastern section, from Batang to Darchiendo, has been traversed by several Europeans of late years. The latter lies in regions in eastern Tibet into which no European has yet penetrated, but which were recently crossed by Pandit Krishna from north to south; they belong to the province of Khám, which appears to be split up into a number of districts, each governed by its own gyalpo or chieftain, who in some instances is subject to Lhása, in others to China, but not unfrequently is independent of both. Darchiendo itself lies in the Minia (Miniak) district, from which the Cháng-lám passes through a succession of petty districts, Tau, Dango, Dau, and Rongbacha or Horko, skirting Niarong (Gyarung?). The inhabitants of this last are said to have conquered the neighbouring districts and to have even braved the Chinese, but at last to have been won over to Lhása by bribery. Rongbacha lies in the valley of the Ja-chu and contains the large town and monastery of Kanzego (2500 houses, 2000 lamas; 10,200 feet above the sea). Beyond it lies, in the valley of the Di-chu, the district of Dar-ge (De-gue), said to be one of the richest and most populous in all Tibet, containing towns in which the best jewellery, saddlery, guns, and swords are manufactured. The Cháng-lám passes through Dar-ge up to Kegudo (11,800 feet), where it meets roads over the Cháng-táng from Chaidam on the north and the Koko-nur district in the north-east. Very little is known of the country between the Cháng-lám and the frontiers of China; it is called Sifan or "the country of the western barbarians" by the Chinese; to the north are the districts of Chiamogolok and Banakhasum, inhabited by marauding tribes, and lower down are the Amdo and Thochu districts, on the borders of tracts occupied by the Manchu tribes of Sze-chuen (China). From Kegudo the Cháng-lám trends westwards over the eastern Hor country, all cháng-táng, for 300 miles. The route has not yet been explored, but probably passes through the pasture-lands of the Sok-pas; on reaching Lake Chomora it turns southwards, then passes the monastery of Shiabden (14,930 feet), a notable resting-place for caravans, crosses the lower scarp of the Cháng-táng by the Lani pass (15,750 feet), and finally descends into the Lhása plateau.

Official road from east to west. The Jung-lám or official road from Darchiendo passes through Litang (13,400 feet; 2500 houses) and Batang (8150 feet; 2000 houses) to Gartok or Kiangka, crossing *en route* the Yalung and Kin-sha rivers; thence it proceeds up the valley of the Chiamdo-chu or Lan-tsan-kiang, and has been traversed by the Abbé Desgodins *via* Dayag (his Tchraya) to Chiamdo (his Tchamouto). He says, "To get an idea of the configuration of the ground let any one take a sheet of parchment, crumple it in his hands into many creases, and then spread it out on a table, and he will obtain a map in relief, furrowed with depressions and steep slopes and presenting very little flat surface." Chiamdo is the chief town of the province of Khám, and, being considered a point of great strategic importance, is strongly garrisoned; it has a large monastery, containing 3000 lamas. It is situated at the junction of two rivers, which are frozen in winter; but in summer the valleys are highly cultivated. Thence the Jung-lám proceeds south-west to the bridge of Shang-ye-Jam (Kia-yu-kiao) over the Giama-Nu-chu—here called the Sok river—and then ascends to Lhojong (13,140 feet)—the Lourondson of the lamas' survey—where it is joined by the road from Gartok *via* Zayul and Nagong. It then trends westwards over the plateaus already mentioned as bordering the eastern basin of the Yaro-tsanpo, passes occasional small villages, monasteries, and lakes, crosses two lofty passes—the Nub-Gang-lá (17,940 feet) and the Tola-lá (17,350 feet)—descends to the little town of Giamda (10,900 feet) in Kongbo, and, passing out of Khám into U, enters the Lhása plateau. From the capital it is continued over a distance of about 900 miles to the western limits of Khorsum, crossing the Yaro-tsanpo at the Chiak-jam-chori bridge and recrossing at Junglache, midway passing through Shigatze; it then traverses a great breadth of cháng-táng and crosses the meridional water-parting at the Muriam-lá (15,500 feet). There are twenty-five staging places called *tarjums*, from 20 to 70 miles apart, between Lhása and Rudok, with accommodation—sometimes houses, but more generally tents—for about 200 men; they are under the charge of a *jalno*, who is bound to provide yaks and other beasts of burden and horses for carrying the mails, impressing them from the nomads encamped near the tarjums. The road is generally well defined: loose stones are cleared away in the narrow defiles, and piles of stones, surmounted by flags on sticks, are erected at places on the open stretches of tableland where the track is liable to be lost.

The climate of Tibet differs greatly in different parts and at different seasons of the year. In western Tibet the frost is permanent from October to April, and the lakes and rivers down to 8000 feet are frozen every winter; at 15,000 feet the thermometer falls below the freezing-point every night; and at 20,000 feet there is probably perpetual frost in the shade. The mean monthly temperatures and ranges of temperature, embracing from six to ten years' observations at the meteorological observatory at Leh (in 34° 10′ N. lat., height 11,540 feet), are as follows in degrees Fahrenheit:—

Month.	Mean.	Range.	Month.	Mean.	Range.	Month.	Mean.	Range.	Month.	Mean.	Range.
Jan. ..	18°·0	28°·5	April	42°·0	31°·0	July	61°·1	31°·2	Oct.	41°·3	30°·5
Feb. ..	21°·0	30°·0	May	48°·6	30°·1	Aug.	59°·6	31°·3	Nov.	32°·2	26°·7
March	32°·0	28°·0	June	56°·4	31°·8	Sept.	52°·8	31°·4	Dec.	24°·8	25°·2

At Lhása (in 29° 39′ N. lat., height 11,800 feet) the mean temperatures observed by the pandits were 36° in February and March and 61° in June and July. Southern Tibet is described as being delightful in summer,—the land covered with vegetation, streams flowing in every valley, and all nature bright, sparkling, and fresh. But in winter snow and frost reign supreme; all vegetation is dried up; the lakes and rivers are frozen; the roads and footpaths are paved with ice; and cold cutting winds sweep across the surface of the land. In northern Tibet Prejevalsky found "a terrible climate" in summer at 14,000 feet: in the second half of May wintry snowstorms were not unfrequent and the frost by night reached −9° Fahr.; and in June and July there were frosts (23° Fahr.) every clear night. In the winter the cold is intense; Huc and Gabet, crossing the Di-chu river in 1846, found a great herd of yaks entombed in ice, the river having frozen whilst they were swimming across. (J. T. W.)

INDUSTRY, TRADE, AND GOVERNMENT.

The industrial arts are at a somewhat low ebb, though in metal-founding the natives display a certain amount of ability and taste. Their statues and small bells are, however, only copies of Indian models. They use the iron from their mines, which is very good, for making excellent blades for sabres and other weapons. They are very fond of precious stones, but do not know how to work them. Their chief industries are connected with wool, the great and inexhaustible staple of the country. Weaving is generally the work of women. The cloth usually employed for summer garments is the *lwa-wa*, which is dyed with madder or indigo, and sold in pieces eight or ten inches in width and about twelve yards in length. Another sort of cloth largely sold is the *chro* or *p'rug*, of a better quality of wool, finer and thicker, which is often manufactured in DbUs (U), whence it is sometimes called DbUs p'rug; it is generally dyed dark red. *T'erma* is a superior kind of thin woollen cloth, a flannel-like fabric, dyed dark red, of which there are two sorts,—*le-t'er*, made of shawl wool, and *bal-t'er*, of common wool. *Sag-lad* is for fine cloth made of fine shawl wool (*le-na*); and *snam-bu* is a woollen cloth, very coarse and loosely woven, the common sort of which is not dyed.

Every Tibetan is more or less a trader. Officers for the superintendence of trade, called *garpons*, are appointed by the king, the ministers, and the great lamaserais. The import and export traffic is carried on by caravans, which, according to the route and its difficulty, employ yaks or sheep. The two great markets are

Shigatze (or Digarchi) and Lhása, where the caravans arrive in December and January from China and Mongolia, Khám and Sze-chuen, Bhutan, Sikkim, and Nepal, Kashmir and Ladak. Of the four principal trade routes the two which start from Darchiendo have been mentioned above (p. 342). The third route, 915 miles in length, starting from Si-ning in Kan-su (China), runs along the Koko-nur to Jun, thence to Di-chu Rab-dun, crosses the *homa* or lower Dangla, and proceeds *via* Giaro and Lake Chomora to Lhása; this route, which is forbidden to the Chinese, is less frequented than the others because of the numerous bands of robbers infesting the country towards Si-ning. Much more important is the route which comes from the west, with Leh as its starting point; it runs *via* Gartok, Lake Manasarowar, Muriam pass, Tadom, and Shigatze to Lhása. Like the other caravans, the yearly one which follows this route stops several times on the way for local fairs; the districts passed through are compelled to furnish it with 300 yaks for carrying goods and to provide food for the travellers. The centres for Tibetan trade on the borders are—for Mongolia and north China, Si-ning; for Sze-chuen, Darchiendo; and in Assam, Davangiri and Udalguri, where there is a great fair twice a year in connexion with the Tawang route. Darjiling is the central mart for the Chumbi valley trade,[1] Patna for that passing through Nepal, and Leh and Kashmir in the west. From China come silks of all varieties (Buddhist prejudice not permitting the Tibetans to rear silk-worms and kill them), carpets, and hardware; from Mongolia leather, saddlery, sheep, and horses; from Khám perfume; from Sze-chuen brick tea (some six millions of pounds annually; tea in leaf is not in use in Tibet); from Tawang, Bhutan, and Sikkim rice and tobacco; from Nepal broadcloth, silk, indigo, coral, pearls, sugar, spices, and Indian manufactures; from Ladak and Kashmir saffron and Indian commodities. Silver and gold are the most important articles of export; then follow salt, wool, woollen manufactures, furs, drugs, and musk. By the Nepal and Ladak routes Tibet exports large quantities of yaks' tails, borax, gold, silver, and ponies. In 1882-83 the total exports to India amounted to £58,322 (Punjab £17,710, North-West Provinces and Oudh £40,612). The imports into Tibet reached £24,197 (£1530 from Punjab, £22,667 from North-West Provinces and Oudh). The principal exports were borax (£17,222), salt (£13,978), wool and woollen goods (£4936). The imports included grain (£13,587), cotton goods (£2875), and sugar (£2395). In 1883-84 the export of borax had increased by 12,329 maunds (about 453 tons), that of wool and woollen goods by 2244 maunds (82 tons), while the exports of salt had decreased by 572 maunds (21 tons). The whole of the increase in borax is in the trade with Kumaun, and in weight it is almost double the increase in the export of rice from that district, for which it is bartered in Tibet, the usual rate of exchange being two of borax to one of rice. The total excess of the value of exports over imports amounted to nearly two lakhs of rupees. In 1885-86 the value of the wool and woollen stuffs exported rose from £4300 to £8800. These figures, however, convey no adequate idea of the British trade with Tibet, as a large quantity of goods passes through Nepal. Russian woollen cloths, coarse and loose, of scarlet, green, blue, and violet colour, as well as hearthrugs, thickly woven and of a flowered pattern, come through Yarkand and are conveyed all over the country.

Government. Since 1720 Tibet has been a dependency of China, and as such is under the Chinese viceroy of Sze-chuen. Chinese authority is represented by two imperial delegates, one of whom is the assistant of the other. They direct exclusively the foreign and military administration of the country, leaving the civil and religious government in the hands of the Tibetans. They are appointed for terms of three years. Subordinate to these are two *daluhi* or great officers and two paymasters, residing, one of each grade, at Lhása and at Bzhikartse (Shigatze or Digarchi). Next in rank are three commanders, residing at Lhása, Digarchi, and Dingri near the Nepal frontier. Below these are three *tingpuns*, non-commissioned officers, who complete the staff of military Chinese officers in the country. The usual number of Chinese troops, all Manchu-Tatars, in Tibet does not exceed 4500 men (2000 at Lhása, 1000 at Digarchi, 1000 at Giangchi, 500 at Dingri). In matters of civil government the supreme authority belongs to the dalai lama, the *rgyal-ba rin-po-čé*, residing in the famous temple-palace of Potala (see LHASA, vol. xiv. p. 500). But he is consulted only in cases of emergency, when his decision is never questioned. His powers are transmitted to a special officer for life, nominated by the Chinese Government, who is known by several titles, such as *de-sri* or the Mongol *nomokhan*, "king of the law"; he is the *rgyal-po* or "king" as well as the prime minister of the dalai lama, and the regent when the latter is a minor. He is selected from among the four head lamas of the Chomoling, Konduling, Tangialing, and Chajoling divisions near Lhása, so-called from their chief monasteries or *dgoñpa* (vulg. *gomba*). Each of the four must be, like the dalai lama, an avatar, *i.e.*, when removed by death he must reappear in the flesh as a child, and be raised to that position. Of equal rank with the nomokhan is the deba lama of dGa-ldan, the great monastery near Lhása; he, however, is not an avatarian lama: his appointment has to be confirmed by the Chinese emperor. Next to him is the lama *guru* or chaplain of the dalai lama, the director of his conscience; he may be an avatar, but his nomination is also in the hands of the Chinese emperor, and this furnishes an interesting clue to the extent of the imperial power over the church of Tibet. The nomokhan rules with the help of five ministers: four of these—laymen—are for the financial, judicial, revenue, and home departments, and a fifth, a lama, for ecclesiastical affairs. The four provinces of Mngari-Khorsum, DbUs, gTsang (Tsáng), and Khams (Khám) are ruled each by a *bka-blon* or governor, with a proper staff of minor officers, under the authority of the nomokhan. Besides these there are several minor kings or rgyal-pos outside of the four provinces; but within these provinces there are four principalities which are under the direct government of the Chinese imperial delegates. These are (1) Dayag or Chraya and (2) Kiamdo or Chiamdo, both on the east; (3) bKra-šis-lhun-po or Tashilunpo, where resides the *pan-čen rin-po-čé* lama, who yields to none but the dalai lama in religious importance, and, though an avatar, requires also the confirmation of the Chinese emperor to his election; (4) Sakya-Kongma, south-west of the preceding. There is also a Chinese officer (*y-tsin*) in residence at Lhása who superintends several minor principalities scattered over the country. Every five years Lhása, Chiamdo, and Tashilunpo send envoys with presents to the emperor. In the east of the country is the principality of Darge or Degue, in the upper course of the Yalung-kiang, ruled by a king who recognizes the suzerainty of China, and at the same time since 1863 has managed to keep on good terms with the king of Lhása, to whom he has promised submission. On the lower course of the same river are the Chentui or Gyarung tribes, who from the conquest of Tibet were subject to China, but since 1864 have been transferred by the Chinese Government to the rule of the king of Lhása, who is now represented among them by a Tibetan resident. South of the Chentui is the principality of Dar-rtse-mdo or Darchiendo, the Ta-chien-lu (Tatsienlu) of the Chinese, the rGyala of the Tibetans, where the government, under the supervision of Chinese officers, is entrusted to a native king, called Ming-chang-se by the Chinese and rGyala rgyal-bo or king of rGyala by the Tibetans.

ETHNOLOGY.

The Tibetans, in a legend of the *Tandjur*, pretend to be the descendants of an ape, sent to the snowy kingdom (*i.e.* Tibet) by Chenresig (Spyan-ras-gzigs = Avalokitéshvara), and of a Tibetan *srinmo* (a female demon or rakshasi). They had six children, whom, as soon as they were weaned, they abandoned in a forest of fruit trees. Coming back after a few years, the father found to his great surprise that their number had increased to 500. But, as they were starving, he had recourse to his patron Chenresig, who declared that he would be the guardian of the race. So he went to Mount Tise (or Kaila the Su-Meru), and threw down a great quantity of the five kinds of grain, with which the famished apes long fed themselves. As the consequence of eating this grain the monkeys' tails and the hair on their bodies grew shorter and shorter, until they finally disappeared. The monkeys began to speak and became men, and clothed themselves with leaves. The interest of this legend, when stripped of its Buddhistic adornments, lies in the fact that belief in a monkey ancestor seems to have been common to various branches of the race. The Tang-chang and Peh-lang tribes boasted also of being descended from a monkey; they were the two great divisions of the Tang-hiang or Tangut, offsets of the same Sien-pi stock as that of the conquerors of Tibet under Fanni Tubat (see note, p. 338 above). The inhabitants of Tibet belong to the Mongoloid races. Besides the Tibetans so called, occupying the greater part of the country, especially in the south from west to east, there are Turkic tribes called Hor in the north-west, Mongol tribes called Sog (Sok) in the north-east, and several ill-defined tribes on the borders of China, who differ from the others. The Tibetan race is not thoroughly homogeneous, as may be seen from the various accounts of travellers. On the west they are described as being short, with an average stature of 5 feet 2 inches, according to the measurements of General Alexander Cunningham; in central Tibet and the east they are of middle stature, rather tall than short,—a difference resulting apparently from their intermingling with the surrounding races. As general characteristics, they are strong, slender in limb, with black eyes slightly oblique, large mouth, brown hair, no beard, a clear ruddy brownish complexion with an intelligent expression. They are a people of good natural gifts, mild in temper, true to their word, kind and simple, fond of music, dancing, and singing, but thoroughly imbued with superstition and lacking enterprise. Exception is made of the people of the eastern borders, who are described as being cheats and cowards. The most highly gifted are the inhabitants of Amdo, the region beyond Khám, having Inhabitants.

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[1] This is still in a disturbed state, the pass being closed by the Tibetans in consequence (1) of the important preparations made in 1886 for a commercial mission to Lhása by Mr Macaulay and (2) of the pressure of the Nepalese Government on that of Tibet in a recent treaty, in order that the whole trade should pass through Nepal.

Koko-nur on the north and China on the east. Taller than the Tibetans of the west, they are famed for their quick intelligence and open disposition; a large proportion of the readers and chief lamas of the great schools and the higher officials belong to this race. The nomad tribes of the north-east are known by the Chinese common appellative of Sifan ("western aliens"). They include Mongol, Tibetan, and other tribes. In the east, near the borders of China, are the numerous tribes called Gyarung or Chentui; their language has been studied by Hodgson, who has pointed out its remarkable similarity of structure to that of the Tagals in the Philippines. To the south of these are the Laka or Lolo (mainly in Sze-chuen), Liso, and Moso; the last-named have advanced to some extent into Indo-China. The Laka or Lolo are remarkable for their European white features. Their language, along with that of the Liso and Moso, &c., forms a group cognate to the Burmese. Not so far east are the Lutze or Kunung, Melam, Arru, Pagny or Djion, Telu, and Remepu, all speaking a dialect of Tibetan, mixed with foreign words, for which the name of Melam is appropriate. Savages are found, says the pandit explorer A—K, in some of the valleys of the range north of Saithang (*i.e.*, the Altin-tagh north of the Syrten plain). They have a thick and dark skin, are well built and apparently well fed. They are clad in skins, and live in caves and dens or under the shelter of overhanging rocks. Being ignorant of the use of arms in the chase, they lie in wait for their prey near springs of water or salt flats. They are remarkable for their fleetness of foot; even a horseman finds difficulty in overtaking them. Whenever they see a civilized man they run off in great alarm. They are said to know how to kindle a fire by means of a flint; and they flay the animals they kill with sharp-edged stones. This is not the only survival of the Stone Age, for in the case of some religious rites the lamas are shaved with a "lightning stone." The country is thinly peopled and large tracts in the upper plateaus and Mngari-Khorsum are quite uninhabited. In the province of Khám the population is very irregularly distributed, and the nomad character of the tribes occupying a great part of the upper country makes any estimate doubtful. The central provinces of DbUs and gTsang are the most densely peopled, and A—K puts the population of Lhása at 25,197 (7540 being lamas). The totals lately given by Chinese authorities (4,000,000) and by the Russian staff-officers (6,000,000) are probably nearer the truth than the 11,000,000 and 33,000,000 of former authorities. The Tibetans are a very social people, and all possible circumstances, especially marriages and births, are made occasions for feasting and enjoyment. The burial customs are peculiar. First the hair is plucked out from the top of the head, in order to facilitate transmigration. The corpse is not disposed of everywhere or always in the same way (lack of fuel sometimes preventing cremation), and the lamas decide whether it is to be put away by interment, by throwing into the river, by burning, or by exposure to beasts and birds of prey. The last-named mode (regarded as very honourable) has almost disappeared in the west, but is still practised in the central and eastern provinces; the body is cut in pieces and the bones broken into fragments by professional corpse butchers, and, when all the flesh has been devoured at the selected spot, called *dur krod*, to which the body had been previously carried, it is not unusual to throw the remaining fragments of the broken bones into the river; sometimes the phalanges of the fingers are preserved to be used in bead-rolls. The lamas are generally inhumed in a sitting posture, the knees being brought up to the chin and corded together as tightly as possible. In the case of the gyalpos or kahlons the body is burned in a metal vessel, the ashes being afterwards carefully collected to be made into an image of the deceased. Polyandry has been practised from the earliest times, and has been carried by the spread of the race into more genial countries, such as Bhutan. The joint husbands are usually, but not always, brothers. The arrangement seems to work smoothly, and women enjoy general consideration, according to all travellers who have spoken of the subject. The wedding ceremony takes place at the house of the bride's parents, after adequate presents have been offered by the elder brother, husband or bridegroom, and without the assistance of any priest. It consists chiefly in the engagement of the intending spouses and the placing of a piece of butter by the bride's parent on the head of the bridegroom and by his parent on that of the bride. Unless otherwise stated by the mother in each case, the elder husband is the putative father of the children, and the others are uncles. Polyandry has resulted in the assignment to the wife of a paramount position, which in the north-east and east of the country has grown among certain tribes into a real sovereignty, of which we hear from the beginnings of Chinese history, and which has left certain survivals among the Lolo and Moso tribes of the present day as well as in the late Burmese court.

Religion.

There are two religions in Tibet—Buddhism, in the shape of LAMAISM (*q.v.*), and an earlier creed, generally called the Bon religion, of which not much is known. The latter, a creed evolved from Shamanism, does not seem, from what is said in Buddhist books, to have received any regular form either in doctrine or otherwise until the introduction of Buddhism, which incited the Bonpo to seek in a better organization the means of holding their own. They borrowed much from the Buddhists, as the latter did from them,—many deities supposed to be Buddhist because of their Buddhist names being simply Bon gods. At the present day the two religions exist peaceably side by side, and the Bon creed has numerous adherents and rich convents in the central provinces of DbUs and gTsang, but few in the western and eastern provinces. The Bonpo are sometimes called the "Sect of the Black," as distinguished from the "Red" or Old and "Yellow" or Reformed Lamaists, both appellations being derived from the colour of their garments, though Bonpo have been seen in red as well as in black. They are also called Gruṅ-drúṅ-pa (see below). The establishment of the Bonpa or Bon-čos, *i.e.*, the Bon religion, is attributed to Gśen-rábs, also called Bstan-pa Gśen-rábs, *i.e.*, Gśen-rábs of the doctrine, the name under which he is worshipped in the temples of his sect, as, for instance, at Tsodam in east Tibet, not far from Bonga; his statue, which occupies the central place, represents him as squatting, with his right arm outside his red scarf, and holding in his left the vase of knowledge. In a Bon *sutra* he is said to hold in his right hand the iron hook of mercy, with which he fishes people out of the ocean of transmigration, in his left hand the seal of equality, and to wear on his head the mitra jewel. His full name is Bon gśen-rabs-gruṅ-druṅ.[1] Gśen-rábs-mi-po, or "(the) excellent human god," another name of the same personage, has been identified by some Tibetan authorities with Lao-tsze or Lao-kiun of China. This identification, however, rests only on the slender basis of an apparent affinity of sound between the *śen* of *gśen* and a common Chinese appellative for the Taoists. The genuine resemblances between Bonpa and Taoism come from the fact that both religions have drawn from similar sources, from the native rude Shamanism which is much the same in both countries, from the tantric and esoteric doctrines of India, and from Buddhist ideas. The identity is sufficient to have deceived the uncritical mind of native scholars, and the matter has not yet been carefully examined by Europeans. The eighth book of the *Grub-mthah-šel-kyi-mé-loṅ*, in twelve books, by a Tibetan lama, Chkoikyi Nyima (1674-1740), which, with three others, has been lately translated by Sarat Chandra Das (in *Jour. As. Soc. Beng.* for 1881-1882), gives some information on the rise of the Bonpa in the region of Shang-shung, identified, not with the modern region of the same name in the north-west of Lhása, but with Gugé or Ghughè and Knáor or Upper Besahr. Three stages are pointed out in the development of the Bonpa after the time of its mythical founder, who reckoned among his spiritual descendants sages of Persia, Leg-tang-mang (some names of Lao-kiun ?) of China, of Thomo, of Miniak (east Tibet), of Sumpar, and of Shang-shung. The first stage is that of the human and historical founder of the religion, a sage of the name of Shong-hon, who lived in the semi-historical time of Thi-de-tsanpo, the sixth king of Tibet (the first is said to have ruled about 415 B.C.). The second stage, dating from the 3d century B.C., is that at which Bon theories and doctrines began to exist, a beginning coincident with the arrival in the country of three Bon priests from Kashmir, Dusha, and Shang-shung. The recital down to this point gives evidence of the vagueness of the traditions preserved by the Tibetans with reference to their own beginnings, and shows that the author has striven hard to put together shreds of ancient reminiscence within a fabulous and mythical account. With the third stage we come down to historical times. It is divided into three periods,—the first dating from the arrival of an Indian pandit by way of Kashmir, who wrote some of the Bon books; the second being that of the introduction of Buddhism and the consequent persecution leading the Bonpo to multiply their sacred books, which they concealed; and the last being that of the revival of the Bonpa and the bringing forth of the hidden books subsequent to the overthrow and temporary effacement of Buddhism by gLang-dharma (908-1013). According to this source, which, however, is certainly tinged by Buddhist prejudice, it was only at the last-mentioned date that the Bonpa reached its complete organization.

Bonpa.

Eighteen principal gods and goddesses are enumerated, including the red wrathful razor spirit, the black wrathful razor spirit, the tiger god of glowing fire (the popular god universally worshipped), the messenger demon Rgyal-po, otherwise Pe(d)kar rgyal po (much dreaded and worshipped in the central provinces: he is said to be identical with the deity Kye-páng of Lhása, figured as a wooden stick or log decked with rags; see Jaeschke, *Dict.*, p. 7), the god of sound, the great demon, and the serpent demon. Information is lacking as to the specific characteristics of these gods, and it is not clear to which of them belongs the title of *kun-tu bzang-po*, frequently cited as the chief Bon god; he is reputed to have a wife Yom-ki-long-mo, the eternal female principle, and from their union have resulted all the minor gods and the whole world.

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[1] The term *gyuṅ-druṅ* (*swasti*), also applied to his followers, means the cross cramponnée, the *swastika*, similar to that of the Buddhists, from which it differs only in direction, the Bonpo manner of circumambulation round a shrine or deity being from right to left, while the Buddhist manner is from left to right.

Bonpa literature. Of the Bonpa literature the only text which has been made accessible to Western scholars is a sutra translated by A. Schiefner in *Mém. de l'Acad. de St. Pétersb.* (xxviii., No. 1) called *Gtsangma klu hbum dkar-po* ("The holy white nâga, the hundred thousand"); but Buddhist influence is so manifest in it that no correct idea of the primitive Bon religion can be derived from it. In a native account, dating from the 18th century and translated by Sarat Chandra Das, the following are enumerated—three works on philosophy and metaphysics, four meditative works, nine ritual serials, six series of epistles, and four mystic works of a late period, in all of which the title of the translated sutra is not made known. It is stated in the translation that these Bon scriptures originally consisted of wholesale plagiarisms, subsequently altered in orthography and terminology from Buddhist canonical works. The Bonpo are said to have got the counterparts of the *Kah-gyur* in general. As a correlative of the six-syllable prayer of the lamas *ŏm mani pad-me hūm* (vulgarly "om-mani pémé-on"), they have one in eight syllables, which they pronounce *ma-tri-mu-tre-sa-la-dzu*. The Bonpo are now frequently confounded with the Red Lamas or Buddhists of the Old school, who are distinguished from the Yellow or Reformed sect by their garments.

History.

History. From the 11th century B.C. the Chinese used to call by the name of Kiang the tribes (about 150 in number) of nomads and shepherds in Koko-nur and the north-east of present Tibet; but their knowledge continued to be confined to the border tribes until the sixth century of our era. In the annals of the T'ang dynasty it is said that the population of the country originated from the Bat-Kian or Fah Kiang; and, as the information collected in the first part of the notice concerning Tu-bat, afterwards Tu-ban, the modern Tu-fan, dates partly (as is proved by internal evidence) from a time anterior to the T'ang dynasty (618 A.D.), some degree of reliance may be placed on its statements. There we are told that Fanni, a scion of the southern Liang dynasty of the Tu-bat family (which flourished from 397 to 415 at Liang-chu in Kan-suh), who had submitted to the northern Liang dynasty, fled in 433 with all his people from his governorship of Lin-sung (in Kan-chu) westwards across the Yellow river, and founded beyond Tsih-shih ("heapy stones") a state amidst the Kiang tribes, with a territory extending over a thousand *li*. By his mild and just rule he was soon enabled to establish his sway over an immense territory. His original state was apparently situated along the upper course of the Yalung river, an affluent of the Kin-sha-kiang. The foregoing statements, which are most probably genuine history, are preceded in Tibetan chronicles by a mass of legends invented by the native Buddhist historians for the purpose of connecting their monarchy with India.

Through the exertions of Prinsep, Csoma de Körös, E. von Schlagintweit, and Sarat Chandra Das we possess five copies of lists of kings, forming the royal canon of Tibet from the legendary beginnings between the 5th and 2d century B.C. down to the end of the monarchy in 914. But the serious divergences which they show (except as to later times and in general outlines) make their unauthentic character plain. As the last published list is accompanied by a commentary, it is the easiest to follow, and requires only to be supplemented here and there from the other lists and from the Chinese sources. The first king, Gnya-khri btsan-po, is said to have been the fifth son of King Prasenadjit of Kosala, and was born with obliquely drawn eyes. He fled north of the Himalayas into the Bod country, where he was elected king by the twelve chiefs of the tribes of southern and central Tibet. He took up his residence in the Yarlung country south of Lhása. This Yarlung, which borrowed its name from the Yalung of the state of Fanni Tu-bat, is a river which flows into the Yaro-tsangpo. The first king and his six successors are known as the seven celestial *khri*; the next series consists of six kings known as the earthly *legs*; and they were followed by eight terrestrial *ldé*. This threefold succession is apparently an imitation or a debased form of the ancient legend of heavenly, earthly, and human rulers, which was carried into Persia and China, and from the latter country into Japan and Tibet,—the relative number of kings being altered in the last-named countries to suit local convenience and the small amount of truth which they contain. Whilst giving an Aryan descent to their first kings, the ancient Tibetans assigned to their princesses a divine origin, and called them *lhamo*, "goddess." The gynæcratic habits of the race are manifested in the names of all these kings, which were formed by a combination of those of their parents, the mother's generally preceding that of the father. The *ldé* kings were followed by four rulers simply called *btsan* ("mighty").

Then occurs a break in the lineal descent, and the king next in order (*c.* 461) may be the Tatar Fanni Tu-bat, but most probably his son and successor. His name was Lha-tho thori gnyan-btsan, otherwise Gnyan-btsan of Lha-tho thori, according to the custom usual in Tibet of calling great personages after the name of their birthplace. Lha-tho means "heaps of stones," and therefore appears to be a translation of Tsih-shih, "heapy stones," the country mentioned in connexion with the foundation of a state by Fanni Tu-bat. It was during his reign that the first Buddhist objects are reputed to have reached Tibet, probably from Nepal. Little is said of his three immediate successors. The fourth was gNam-ri srong btsan, who died in 630. During his reign the Tibetans obtained their first knowledge of arithmetic and medicine from China; the prosperity and pastoral wealth of the country were so great that "the king built his palace with cement moistened with the milk of the cow and the yak." To the same king is attributed the discovery of the inexhaustible salt mine called Chyang-gi-ts'wa (Byang-gi-ts'wa = "northern salt"), which still supplies the greater portion of Tibet. The reign of his illustrious son, Srong btsan sgam-po, opened up a new era; he introduced Buddhism and the art of writing from India, and was the founder (in 639) of Lha-ldan, afterwards Lha-sa. He was greatly helped in his proselytism by his two wives, one a Nepal princess, daughter of King Jyoti varma, the other an imperial daughter of China; afterwards, they being childless, he took two more princesses from the Ru-yong (= "left corner"?) and Mōn (general appellative for the nations between Tibet and the Indian plains) countries. As a conqueror he extended his sway from the still unsubdued Kiang tribes of the north to Ladak in the west, and in the south he carried his power through Nepal to the Indian side of the Himalayas. How far southward this dominion at first extended is not known; but in 703 Nepal and the country of the Brahmans rebelled, and the Tibetan king, the third successor of Srong btsan sgam-po, was killed while attempting to restore his power. It is rather curious that nothing is said of this Tibetan rule in India, except in the Chinese annals, where it is mentioned until the end of the monarchy in the 10th century, as extending over Bengal to the sea,—the Bay of Bengal being called the Tibetan Sea. J. R. Logan has found ethnological and linguistic evidence of this domination, which was left unnoticed in the Indian histories. Mang-srong mang btsan, the second son and successor of Srong btsan sgam-po, continuing the conquests of his father, subdued the Tukuhun Tatars around the Koko-nur in 663, and attacked the Chinese; after some adverse fortune the latter took their revenge and penetrated as far as Lhása, where they burnt the royal palace (Yumbu-lagang). Khri lde gtsug-brtan-mesag-ts'oms, the grandson of Mang-srong and second in succession from him, promoted the spread of Buddhism and obtained for his son, Jangts'a Lhapon, who was famous for the beauty of his person, the hand of the accomplished princess Kyim-shang, daughter, otherwise *kung-chu*, of the Chinese emperor Juy-tsung. But the lady arrived after the death of her betrothed, and after long hesitation became the bride of the father. She gave birth in 730 to Khri srong ldeu btsan, in the Buddhist annals the most illustrious monarch of his country, because of the strenuous efforts he made in favour of that religion during his reign of forty-six years (743-789). His son and successor Muni btsan-po, being determined to raise all his subjects to the same level, enacted that there should be no distinction between poor and rich, humble and great. He compelled the wealthy to share their riches with the indigent and helpless, and to make them their equals in respect of all the comforts and conditions of life. He repeated this experiment three times; but each time he found that they all returned to their former condition, the rich becoming still richer and the poor still poorer. The sages attributed this curious phenomenon to the good and evil acts of their former lives. Nothing of importance occurred during the following reigns, until that of Ralpachen, who won glory by his care for the translations of the Buddhist scriptures which he caused to be completed, or rewritten more accurately when required. In this reign a severe struggle took place with China, peace being concluded in 821 at Ch'ang-ngan and ratified at Lhasa the following year by the erection of bilingual tablets, which still exist. Ralpachen was assassinated by the partisans of gLang-dharma and the country fell into disorder. gLang-dharma instituted a violent persecution of Buddhism; but he was soon assassinated in his turn, and the kingdom divided into a western and an eastern part by his two sons. The partition did not, however, prevent internecine wars. The history for some time now becomes rather intricate, and requires some attention. Pal K'or tsan, the second western king, after a reign of thirteen years died leaving two sons, Thi Taši Tsegpa-pal and Thi Kyida Nyimagon. The latter went to Ngari (Mngari) and founded the capital Purang; he left three sons, of whom the eldest declared himself king of Mang-yul (the Monhuil of our maps), the second seized Purang, and the youngest, Detsud-gan, became king of the province of Shang-shung (the modern Ghughè). The revival of Buddhism began with the two sons of the last-named, the elder of whom became a monk. The younger, Khorré, inherited his father's throne, and was followed in his authority by twenty successors. Taši Tsegpa also had three sons,—Palde, Hodde, and Kyide. The descendants of the first made themselves masters of Gung-t'ang, Lugyalwa, Chyipa, Lhatse, Langlung, and Tsakor, where they severally ruled as petty chiefs. The descendants of Kyide spread themselves over the Mu, Jang, Tanag, Yarulag, and Gyaltse districts, where they also ruled as petty princes. Hodde left four sons,—Phabdose, Thide, Thich'ung, and Gnagpa. The first and fourth became masters of Tsangrong, the second took possession of Amdo and Tsongkha, the third became king of DbUs, and removed the capital to Yarlung, south of Lhása. He was followed on his throne from son to son by eleven successors. History is silent as to the fate of the eastern king, the other son of gLang-dharma, and his successors, but the geographical names of the chieftainships enumerated above make it clear that the western kingdom had extended its power to the east. Chronology is deficient for all that period. While the dynasty of Khorré in Shang-shung and that of Thich'ung in DbUs were running, another authority, destined to become the superior of both, had arisen in Tibet. Khorré left his throne to his son Lhade, who was himself succeeded by his three sons, the youngest of whom invited the celebrated Indian Buddhist, Atisha, to leave his monastery Vikrama Shila for Tibet, where he settled in the great lamaseral of Thoding in Ngari. Besides religious books and teachings, he introduced in 1026 the method of computing time by cycles of sixty years, "obtained from the Indian province of Shambala." He was the first of the several chief priests whose authority became paramount in the country. The kings of DbUs greatly patronized them, as for instance in the case of the celebrated Sakya Pandita by the seventh of these kings. Pandita, at the special request of Kuyuk, the successor of Ogdai, paid a visit to his court in 1246-48. Five years afterwards Kublai Khan conquered all the east of Tibet; and, after he had ascended the throne of China, the Mongol emperor invited to his court Phagspa Lodoi Gyaltshan, the nephew of the same Pandita. He remained twelve years with the emperor, and at his request framed for the Mongol language an alphabet imitated from the Tibetan, which, however, did not prove satisfactory, and disappeared after eighty-five years without having been very largely used. In return for his services, Kublai invested Phagspa with sovereign power over (1) Tibet proper, comprising the thirteen districts of U and Tsáng, (2) Khám, and (3) Amdo. From this time the Sakya-pa lamas became the universal rulers of Tibet, and remained so, at least nominally, under twenty-one successive lamas during seventy years (1270-1340). Their name was derived from the Sakya monastery, which was their cradle and abode, and their authority for temporal matters was exercised by specially appointed regents. When the power of the Sakya began to wane, that of the rival monasteries of Digung, Phagdub, and Tshal increased largely, and their respective influence and authority overbalanced that of the successors of Phagspa. It was at this troubled epoch that Chyang Chub Gyaltshan, better known as Phagmodu from the name of his native town, appeared on the scene. He subdued Tibet proper and Khám, for the continued possession of which he was, however, compelled to fight for several years; but he succeeded in the long run, and with the approval of the court of Peking established a dynasty which furnished twelve rulers in succession. When the Mongol dynasty of China passed away, the Mings confirmed and enlarged the dominion of the Tibetan rulers, recognizing at the same time the chief lamas of the eight principal monasteries of the country. Peace and prosperity gradually weakened the benign rule of the kings of this dynasty, and during the reign of the last but one internecine war was rife between the chiefs and nobles of U and Tsáng. This state of things, occurring just as the last rulers of the Ming dynasty of China were struggling against the encroachments of the Manchus, their future successors, favoured the interference of a Khoskot Mongol prince, Tengir To, called in the Tibetan sources king of Koko-nur. The Mongols were interested in the religion of the lamas, especially since 1576, when Altan, khakan of the Tumeds, and his cousin summoned the chief lama of the most important monastery to visit him. This lama was Sodnam rGyamtso, the third successor of Gedundub, the founder of the Tashilumbo monastery in 1447, who had been elected to the more important abbotship of Galdan near Lhása, and was thus the first of the great, afterwards dalai, lamas. The immediate successor of Gedundub, who ruled from 1475 to 1541, had appointed a special officer styled *depa* to control the civil administration of the country. To Sodnam rGyamtso the Mongol khans gave the title of Vadjra Dalai Lama in 1576, and this is the first use of the widely known title of dalai lama. During the minority of the fifth (really the third) dalai lama, when the Mongol king Tengir To, under the pretext of supporting the religion, intervened in the affairs of the country, the Pan-ch'en Lo-sang Ch'o-kyi Gyal-ts'ang lama obtained the withdrawal of the invaders by the payment of a heavy war indemnity, and then applied for help to the first Manchu emperor of China, who had just ascended the throne. This step enraged the Mongols, and caused the advance of Gushri Khan, son and successor of Tengir To, who invaded Tibet, dethroned all the petty princes, including the king of Tsáng, and, after having subjugated the whole of the country, made the fifth dalai lama supreme monarch of all Tibet, in 1645. The Chinese Government in 1653 confirmed the dalai lama in his authority, and he paid a visit to the emperor at Peking. The Mongol Khoskotes in 1706 and the Sungars in 1717 interfered again in the succession of the dalai lama, but the Chinese army finally conquered the country in 1720, and the present system of government was established. The events which have happened since that time have been recorded in the articles LHASA and LADAK.

LANGUAGE[1] AND LITERATURE.

Bod-skad is the general name of the language of Tibet, which is also occasionally called Gangs-čan-gyi skad (*i.e.* "the glaciers language"). This name is specially applied to the forms in use in DbUs-gTsang. The vernacular is called *p'ăl-skad* or common language in contradistinction to the *čos-skad* or book language. Besides the Bod-skad there are two chief dialects[2] in Great Tibet,—that of Khams, spoken in the three provinces of Mdo (Darrtsemdo), Khám, and Gong in the east, and that of Ngari-Khorsum in the west. Jaeschke arranged these dialects under three heads,—(1) western, including those of Balti and Purig, the most archaic, and of Ladak and Lahul; (2) central, including those of Spiti and of DbUs and gTsang; (3) Khams. To the same Bhot group belong the Changlo or Bhutani or Lhopa, the language of Bhutan, of which we have a grammatical notice by Robinson (1849), and the Serpa and the Takpa, of Tawang, both of which are only known through the vocabularies collected by Hodgson. The later Takpa forms the transition between the Bhot group and the Si-fan group, which includes the Miniak, Sungpan, Lifan, and Thochu dialects, spoken near the eastern borders, as well as the Horpa, spoken on a larger area west of the preceding, and much mixed with Turkic ingredients. With the exception of the Sokpa, a Mongol dialect, and of the Gyarung, a pre-Chinese dialect, the languages spoken in Tibet belong to the large linguistic family commonly called Tibeto-Burman, a division of the Kuen-lun group, which is a part of the Turano-Scythian stock.

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[1] The Capuchin friars who were settled in Lhása for a quarter of a century from 1719 studied the language; two of them, Francisco Orazio della Penna, well known from his accurate description of Tibet, and Cassian di Macerata sent home materials which were utilized by the Augustine friar Aug. Ant. Georgi of Rimini (1711-97) in his *Alphabetum Tibetanum* (Rome, 1762, 4to), a ponderous and confused compilation, which may be still referred to, but with great caution. The Tibetan characters were drawn by Della Penna, and engraved by Ant. Fontarita in 1738. In 1820 Abel Rémusat published his *Recherches sur les Langues Tartares*, a chapter of which was devoted to Tibetan. The next work of importance was a dictionary, intended for European students, which was published, with Tibetan types, at the expense of the East India Company, in 1826 at Serampur, and edited by John Marshman, from a MS. copy made by Fr. Chr. G. Schroeter, a missionary in Bengal, who had substituted English for the Italian of the original. It was the unsifted result of the labours of an unknown Italian missionary, who had been stationed either in eastern Tibet or close to the frontier in Bhutan. It was properly a collection of all the sentences he could get written by a native teacher, completed with extracts from the *Padma thangyig*, a popular series of legends about Padma Sambhava. Unfortunately the work was left unfinished, and unrevised, as there was no Tibetan scholar to correct the proofs. Though richer in words than later dictionaries, the work cannot, for these reasons, be accepted as an authority on any doubtful point. The grammatical notice, consisting of forty pages from Schroeter, prefixed to this *Dictionary of the Bhotanta, or Boutan Language*, hardly deserves mention. At Calcutta in 1834 the Hungarian Alexander Csoma de Korös (1784-1842) brought out his *Dictionary, Tibetan and English*, and his *Grammar of the Tibetan Language in English*, prepared on the western frontier, where he had resided for several years at the monasteries of Yangla and Pukdal in Zanskar, and finally at Kanum in Upper Besahr, enjoying the help of native scholars. His works are admirable so far as concerns the literary language (chiefly that of the Buddhist translations). At St Petersburg J. J. Schmidt published his *Grammatik der Tibetischen Sprache* in 1839 and his *Tibetisch-Deutsches Wörterbuch* in 1841, but neither of these works justified the great pretensions of the author, whose access to Mongolian sources had enabled him to enrich the results of his labours with a certain amount of information unknown to his predecessors. In France, P. É. Foucaux published in 1847 a translation from the *Rgya tcher rol pa*, the Tibetan version of the *Lalita Vistara*, and in 1858 a *Grammaire Thibétaine*; while Ant. Schiefner had begun at St Petersburg in 1849 his series of translations and researches. His *Tibetische Studien* (1851-68) is a valuable collection of documents and observations. In 1861 Lepsius published his paper *Ueber Chinesische und Tibetische Lautverhältnisse*; and since 1864 Léon Feer has brought out in Paris many translations of texts from Tibetan Buddhist literature. In 1849 the *Journal* of the Asiatic Society of Bengal published comparative vocabularies of spoken and written Tibetan by Bryan H. Hodgson, and grammatical notices of Tibetan (according to Csoma's grammar) and of Changlo, a Tibetan dialect, by W. Robinson. But it was at Singapore in 1852 that the general relationship of the Tibetan and the Burman, now admitted in comparative philology, was established for the first time, by J. R. Logan, in the *Journal of the Indian Archipelago*. Prof. Max Muller, in his "Letter on the Classification of the Turanian Languages" of 1853, arrived independently at a similar conclusion. In 1857 the Moravian missionaries established a station at Kyelang, district of Garza, British Lahul, in Ladak, a school, and a lithographic press, and it is to the labours of H. A. Jaeschke of this mission that we are indebted for the most valuable materials for the practical study of Tibetan. From 1860 to 1867 that scholar made several important communications, chiefly with reference to the phonetics and the dialectical pronunciation, to the academies of Berlin and St Petersburg, and in the *Journal* of the Asiatic Society of Bengal. In 1865 at Kyelang he published by lithography *A Short Practical Grammar of the Tibetan Language, with special reference to the spoken dialects*, and the following year a *Romanized Tibetan and English Dictionary*. He also published in 1871-76 at Gnadau in Prussia by the same process a Tibetan and German dictionary. Afterwards he prepared for the English Government *A Tibetan-English Dictionary, with special reference to the prevailing dialects*, in 1881. Dr H. Wenzel, one of his pupils, brought out in 1883 from his MS. a *Simplified Tibetan Grammar*. Major Th. H. Lewin with the help of a lama compiled *A Manual of Tibetan*, or rather a series of colloquial phrases, which was brought out at Calcutta in 1879. A portion of the New Testament has been translated into Tibetan. As regards native philology, the most ancient work extant is a grammar of the Tibetan tongue, by Tonmi Sambhota, the introducer of the Indian alphabet, preserved in the *Bstan-hgyur* (mdo cxxiv). This collection also contains other works of the same kind, dictionaries by later writers, translations of many Sanskrit works on grammar, vocabulary, &c., and bilingual dictionaries, Sanskrit and Tibetan. As separate publications there are several vocabularies of Chinese and Tibetan; Mongol and Tibetan; Chinese, Manchu, Mongol, Oelöt, Tibetan, and Turkish; Tibetan, Sanskrit, Manchu, Mongol, and Chinese.

[2] There are without doubt many minor *skad-lugs* or dialects which are still unknown. For instance, in the Pan-yul valley north of Lhása the inhabitants are said to speak an indistinct skad-lugs.

Grammar. The language is more consonantal than vocalic, though much softened in the central dialect. The consonants, 30 in number, which are deemed to possess an inherent sound *a*, are the following:—*ka*, *k'a*, *ga*, *nga*, *ċa*, *ċ'a*, *dja*, *nya*, *ta*, *t'a*, *da*, *na*, *pa*, *p'a*, *ba*, *ma*, *tsa*, *ts'a*, *dza*, *wa*, *zha*, *za*, *'h*, *ya*, *ra*, *la*, *sha*, *sa*, *ha*, *'a*, the so-called Sanskrit cerebrals are represented by the letters *ta*, *t'a*, *da*, *na*, *sha* turned the other way. *Ya*, when combined as second consonant with *k-*, *p-*, *m-*, is written under the first letter. *Ra*, when combined as second letter with *k-*, *t-*, *p-*, is written under the first, and when combined with another consonant as first letter over the second. The vowels are *a*, *i*, *u*, *e*, *o*, which are not distinguished as long or short in writing, though they are so in the vernaculars in the case of words altered by phonetic detrition. Agglomerations of consonants are not objectionable; and they are often met with as initials, giving the appearance of telescoped words—an appearance which historical etymology often confirms. Many of these initial consonants are silent in the softened dialects of the central provinces, or have been resolved into a simpler one of another character. The language is much ruled by laws of euphony, which have been strictly formulated by grammarians. Among the initials, five, viz., *g*, *d*, *b*, *m*, *'h*, are regarded as prefixes, and are called so for all purposes, though they belong sometimes to the stem. As a rule none of these letters can be placed before any of the same organic class. Post-positions, *pa* or *ba* and *ma*, are required by the noun (substantive or adjective) that is to be singled out; *po* or *bo* (masc.) and *mo* (fem.) are used for distinction of gender or for emphasis. The cases of nouns are indicated by suffixes, which vary their initials according to the final of the nouns. The plural is denoted when required by adding one of several words of plurality. When several words are connected in a sentence they seldom require more than one case element, and that comes last. There are personal, demonstrative, interrogative, and reflexive pronouns, as well as an indefinite article, which is also the numeral for "one." The personal pronouns are replaced by various terms of respect when speaking to or before superiors, and there are many words besides which are only employed in ceremonial language. The verb, which is properly a participle, has no element of person, and denotes the conditions of tense and mood by an external and internal inflexion, or the addition of auxiliary verbs and suffixes when the stem is not susceptible of inflexion. The conditions which approximate most closely to our present, perfect, future, and imperative are marked either by aspiration of the initial or by one of the five prefix consonants according to the rules of euphony, and the whole looks like a former system thrown into confusion and disorder by phonetic decay. As to the internal vowel, *a* or *e* in the present tends to become *o* in the imperative, the *e* changing to *a* in the past and future; *i* and *u* are less liable to change. A final *s* is also occasionally added. Only a limited number of verbs are capable of four changes; some cannot assume more than three, some two, and many only one. This deficiency is made up by the addition of auxiliaries or suffixes. There are no numeral auxiliaries or segregatives used in counting, as in many languages of eastern Asia, though words expressive of a collective or integral are often used after the tens, sometimes after a smaller number. In scientific and astrological works, the numerals, as in Sanskrit, are expressed by symbolical words. In the order of the sentence the substantive precedes the adjective and the verb stands last; the object and the adverb precede the verb, and the genitive precedes the noun on which it depends. An active or causal verb requires before it the instrumental instead of the nominative case, which goes only before a neuter or intransitive verb. The chief differences between the classical language of the Tibetan translators of the 9th century and the vernacular, as well as the language of native words, existed in vocabulary, phraseology, and grammatical structure and arose from the influence of the translated texts.

Philology. The Tibetan language, in its written and spoken forms, has a great interest for philologists, on account of its bearing on the history of the so-called monosyllabic languages of eastern Asia. Is the Tibetan a monosyllabic language passing to agglutination? or the reverse? The latter is the fact, as we shall see further on. The whole question has turned upon the elucidation of the phenomenon of the silent letters, generally prefixed, which differentiate the spelling of many words from their pronunciation, in the central dialect or current speech of Lhása. As long as the sounds of this dialect only were known, the problem could not be fully grasped. Rémusat rather dubiously suggested, while Schmidt and Schiefner maintained, that the silent letters were a device of grammarians to distinguish in writing words which were not distinguished in speech. But this convenient opinion was not sufficient for a general explanation, being supported by only a few cases. Among these are—(*a*) the addition of silent letters to foreign words in analogy with older terms of the language (*e.g.*, the Persian *tadjik* was transcribed *stagggig* or "tiger-leopard," because the foreign term left untouched would have been meaningless for Tibetan readers); (*b*) the addition for the sake of uniformity of prefixed letters to words etymologically deprived of them; (*c*) the probable addition of letters by the Buddhist teachers from India to Tibetan words in order to make them more similar to Sanskrit expressions (for instance, *rje-* for "king," written in imitation of *raja*, though the original word was *je* or *she*, as is shown by cognate languages). On the other hand, while phonetically the above explanation was not inconsistent with such cases as *rka*, d*kah*, b*kah*, bs*ka*, and *nga*, r*nga*, *ngag*, s*ngags*, l*nga*, *ngad*, and brts*e*, brdz*un*, db*yar*, &c., where the italicized letters are pronounced in full and the others are left aside, it failed to explain other cases, such as *dgra*, *mgron*, *spyod*, *spyan*, *sbrang*, *sbrul*, *bkra*, *k'ri*, *krad*, *k'rims*, *k'rus*, &c., pronounced *da*, *don*, *čod* or *čwod*, *čen*, *dang*, *deu*, *ta*, *t'i*, *tad* or *teh*, *t'im*, *tu*, &c., and many others, where the spoken forms are obviously the alteration by wear and tear of sounds originally similar to the written forms. Csoma de Körös, who was acquainted with the somewhat archaic sounds of Ladak, was able to point to only a few letters as silent. But Major Cunningham, in his book on the same country (1854), held that the Tibetan writing, when first applied to the language, was the faithful transcription of speech, and he gave as a proof that the name of the province of U, written DbUs, was the *Dabasæ* of Ptolemy. Foucaux, in his *Grammaire* (1858), quoted a fragment from a native work on grammar several centuries old, in which the pronunciation of the supposed silent letters is carefully described. Since then the problem has been disentangled; and now minor points only remain to be cleared up. Jaeschke devoted special attention to the dialectical sounds, and showed in several papers and by the comparative table prefixed to his dictionary that in the western and eastern dialects these sounds correspond more or less closely to the written forms. Thus the valuable testimony of these dialects may be added to the evidence furnished by foreign transcriptions of Tibetan words, loan words in conterminous languages, and words of common descent in kindred tongues. And the whole shows plainly that the written forms of words which are not of later remodelling are really the representatives of the pronunciation of the language as it was spoken at the time of the transcription. The concurrence of the evidence indicated above enables us to form the following outline of the evolution of Tibetan. In the 7th century there was no difference between the spoken and the written language. Soon afterwards, when the language was extended to the western valleys, the prefixed and most of the important consonants vanished from the spoken words. The *ya-tag* and *ra-tag* or *y* and *r* subscript, and the *s* after vowels and consonants, were still in force. The next change took place in the central provinces; the ra-tags were altered into cerebral dentals, and the ya-tags became *č*. Later on the superscribed letters and finals *d* and *s* disappeared, except in the east and west. It was at this stage that the language spread in Lahul and Spiti, where the superscribed letters were silent, the *d* and *g* finals were hardly heard, and *as*, *os*, *us*, were *ai*, *oi*, *ui*. The words introduced from Tibet into the border languages at that time differ greatly from those introduced at an earlier period. The other changes are more recent and restricted to the provinces of U and Tsang. The vowel sounds *ai*, *oi*, *ui*, have become *ē*, *ö*, *ü*; and *a*, *o*, *u* before the finals *d* and *n* are now *ä*, *ö*, *ü*. The *mediæ* have become aspirate tenues with a low intonation, which also marks the words having a simple initial consonant; while the former aspirates and the complex initials simplified in speech are uttered with a high tone, or, as the Tibetans say, "with a woman's voice," shrill and rapidly. An inhabitant of Lhása, for example, finds the distinction between *sh* and *zh*, or between *s* and *z*, not in the consonant, but in the tone, pronouncing *sh* and *s* with a high note and *zh* and *z* with a low one. The introduction of the important compensation of tones to balance phonetic losses had begun several centuries before, as appears from a Tibetan MS. (No. 462*b* St Petersburg) partly published by Jaeschke (*Monatsber. Akad. Berl.*, 1867). A few instances will serve to illustrate what has been said. In the bilingual inscriptions, Tibetan and Chinese, set up at Lhása in 822, and published by Bushell in 1880, we remark that the silent letters were pronounced: Tib. *spudgyal*, now *pugyal*, is rendered *suh-pot-ye* in Chinese symbols; *khri*, now *t'i*, is *kieh-li*; *hbrông* is *puh-lung*; *snyan* is *sheh-njoh* and *su-njoh*; *srong* is *su-lun*, *su-lung*, and *si-lung*. These transcriptions show by their variety that they were made from the spoken and not from the written forms, and, considering the limited capacities of Chinese orthoepy, were the nearest attempt at rendering the Tibetan sounds. *Spra* or *spreu* (a monkey), now altered into *deu* at Lhása, *teu* in Lahul, Spiti, and Tsáng, is still more recognizable in the Gyarung *shepri*, and in the following degenerated forms—*shreu* in Ladak, *sreu-go* in Khams and in cognate languages, *soba* in Limbu, *saheu* in Lepcha, *simai* in Tablung Naga, *sibeh* in Abor Miri, *shibe* in Sibsagar Miri, *sarrha* in Kol, *sara* in Kuri, &c. *Grog*-ma (ant), now altered into the spoken *t'oma*, is still *kyoma* in Bhutan, and, without the suffix, *korok* in Gyarung, *k'oro-* in Sokpa, *k'orok*, *k'alek* in Kiranti, &c. *Grang*-po (cold), spoken *t'ammo*, is still *grang*-mo in Takpa, *k'yam* in Burmese, &c. A respectful word for "head" is *u*, written *dbu*, which finds its cognates in Murmi *thobo*, Kusunda *chipi*, Sibsagar Miri *-tub*, &c. *Byu* (bird), spoken *chya*, is still *pye* in Gyarung. *Brjod* (to speak), pronounced *jod*, is cognate to the Burmese *pyauhtso*, the Garo *brot*, &c. The word for "cowries" is *'gron-* in written, *rùm-* in spoken Tibetan, and *grwa* in written Burmese; *slop* (to learn), spoken *lop*, is *slop* in Melam. "Moon" is *zlawa* in written and *dawa* in spoken language, in which *-wa* is a suffix; the word itself is *zla-*, cognate to the Mongol *ssara*, Sokpa *sara*, Gyarung *t-sile*, Vayu *cholo*, &c. The common spoken word for "head" is *go*, written *mgo*, to which the Munipuri *moko* and the Mishmi *mkura* are related. Sometimes the written forms correspond to double words which have disappeared. For instance, *gye* (eight), which is written *brgyad* and still spoken *vrgyad* in Balti in the west and Khams in the east, is *gyad* in Ladak, Lahul, and U. The same word does not appear elsewhere; but we find its two parts separately, such as Gurung *pre*, Murmi *pre*, Takeya *phre*, and Takpa *gyet*, Serpa *gye*, Garo *chet*, &c. *Rta* (horse) is reduced to *ta* in speech, but we find *ri*, *rhyi*, *roh* in Sokpa, Horpa, Thochu, Miniak, and *ta*, *tah*, *teh*, *t'ay* in Lhopa, Serpa, Murmi, Kami, Takpa, &c., both with the same meaning. Such are the various pieces of evidence obtained from an endless number of instances. The cases referred to above do not, owing to the difference of the causes, yield to any explanation of this kind. And it must be admitted that there are also many cases, some of them caused by irregularities of writing, modification of spelling by decay, and by a probable use of prefixes still unascertained, which also resist explanation, though the account just given stands good whatever solution the question of prefixes may receive in future.

Literature.

Little is known of the non-religious literature of Tibet. The most popular and widely circulated book is called *The Hundred Thousand Songs of the Venerable Milaraspa.* Their author Milaraspa (unless the work should be attributed to his disciples), often called Mila, was a Buddhist ascetic of the 11th century; according to Jaeschke, during the intervals of meditation he travelled through the southern part of middle Tibet as a mendicant friar, instructing the people by his improvisations in poetry and song, proselytizing, refuting and converting heretics, and working manifold miracles. His legends are not without wit and poetical merit. A number of poems written in an elevated and special style, dramatic works, and collections of fairy tales and fables are said to be in existence. A very extensive work, the *Djrung yg* (Sgruṅs yg), regarded as the national epic in Khám, has been partly seen by Desgodins and Baber. It is in prose; but the dialogue, interspersed with songs, is metrical, and is much more extensive than the prose framework. Religious discussions and philosophical dissertations alternate with comic episodes. It includes three divisions,—the *Djiung ling*, which describes the invasion of part of Tibet by the Djiung or Moso; the *Hor ling*, which recounts the conquest of the Hor (Turk tribes) by the Tibetans, and conveys much historical information in a tale of magic and marvel; and the *Djia ling* (Chinese division), which narrates a contest of unknown date between the Tibetans and the Chinese. This work has apparently never been published, and even the manuscripts of the three divisions cannot, says Baber, be obtained in a complete form. But every Tibetan, or at least every native of Khám, who possesses any education, is able to recite or to chant passages of great length. Another Tibetan epic, the *Gyaldrung*, praises Dagyolong, a famous warrior who subdued the savage men of Khám. Besides these poems we find allusions to a *sgrung*, referring to the Yesser Khan. Dramatic works exist, as well as translations of Galen, also of the *Ramayana* in the first vol. of the *Bstodts'ogs* of the *Bstan-ḥgyur*. For the religious literature, which is considerable, see LAMAISM.

Writing.

Writing was not introduced until the 7th century. Notched sticks (*shing-chram*) and knotted cords were in current use, but the latter contrivance is only faintly alluded to in the Tibetan records, while of the other there are numerous examples. No mention is anywhere made of a hieroglyphical writing, but on the eastern frontier the medicine-men or *tomba* of the Moso have a peculiar pictorial writing, which is known in Europe from two published MSS. (in *Journ. Roy. As. Soc.*, 1885, vol. xvii.); though apparently now confined solely to purposes of witchcraft, it perhaps contains survivals of a former extensive system superseded by the alphabetic writing introduced from India. According to tradition—a tradition of which the details are open to criticism—the alphabet was introduced from India by Tonmi Samb'ota, who was sent to India in 632 by King Srong btsan to study the Sanskrit language and Buddhist literature. Tonmi Samb'ota introduced the so-called "writing in thirty characters" (six of which do not exist in Sanskrit) in two styles,—the "thick letters" or "letters with heads," now commonly used in printed books, and the half-cursive "cornered letters," so called from their less regular heads. The former are traditionally said to have been derived from the Landza character. The Landza of Nepal, however, is certainly not the origin of the Tibetan letter, but rather an ornamental development of the parent letter. The close resemblance of the Tibetan characters "with heads" to the Gupta inscriptions of Allahabad shows them to have been derived from the monumental writing of the period; and various arguments appear to show that the other Tibetan letter came from the same Indian character in the style in which it was used in common life. The Tibetan half-cursive was further developed into the more current "headless" characters of which there are several styles. From the monumental writing of Tibet was derived, for the special use of the Mongols in the 13th century, the short-lived writing known as Bagspa, from the name of the lama who worked it out.

Bibliography.—The works of Csoma de Körös, Alex. Cunningham, Sarat Chandra Das, Desgodins, Léon Feer, Éd. Foucaux, A. A. Georgi, Bryan H. Hodgson, H. A. Jaeschke, Th. H. Lewin, Max Müller, A. Rémusat, W. Robinson, J. J. Schmidt, F. C. G. Schroeter, and A. Schiefner have been already mentioned, and those of J. W. Bushell, A. Campbell, T. W. Rhys Davids, Huc and Gabet, Koeppen, C. Markham, Pallas, Ssanang Ssetsen, Schott, Pundit Nain Singh, and others are referred to under LAMAISM, LADAK AND BALTI, and LHASA (*qq.v.*). The following also may be named: E. Colborne Baber, "Travels and Researches in Western China," in *Roy. Geogr. Soc. Suppl. Papers*, I., 1882; C. H. Desgodins, *Le Thibet d'après la correspondance des Missionaires*, Paris, 1885; Th. Duka, *Life and Works of Alexander Csoma de Körös*, London, 1885; Konrad Ganzenmüller, *Tibet*, Stuttgart, 1878; Krick, *Relation d'un Voyage au Thibet en 1852*, Paris, 1854; A. Krishna, *Explorations in Great Tibet and Mongolia*, made in 1879-82; *Report* prepared by J. B. N. Hennessey, Dehra Dun, 1884, fol.; Terrien de Lacouperie, "Beginnings of Writing in and around Tibet," in *Journ. Roy. As. Soc.*, 1885, xvii.; Id., *The Languages of China before the Chinese*, London, 1887; J. R. Logan, in *Journal of the Indian Archipelago Eastern Asia*, vol. vi., Singapore, 1852; W. Woodville Rockhill, "The Early History of Bod-yul," append. to *The Life of the Buddha*, from Tibetan sources, London, 1884; Em. von Schlagintweit, *Die Koenige von Tibet*, Munich, 1866, and *Buddhism in Tibet*, London, 1863; H. Strachey, *Physical Geography of Western Tibet*; Trotter, *Journ. Roy. Geog. Soc.*, 1877, vol. xlvii.; H. Yule, *The Book of Ser Marco Polo*, 2d ed., London, 1874.

(T. DE L.)

TIBULLUS, ALBIUS (*c.* 54-19 B.C.), was the second in the tetrad of the elegiac poets of Rome. As we learn from Ovid, he was the successor of Cornelius Gallus and the immediate predecessor of Propertius. The information which we possess about him is extremely meagre. Besides the poems themselves—that is to say, the first and second books—we have only a few references in later authors and a short *Life* of probable but not undoubted genuineness. We do not know his prænomen; and his birthplace is uncertain. It is, however, a plausible conjecture that he came from Gabii. The year of his birth has been variously assigned; but 54 B.C. may be taken as approximately correct. This would make him about twenty-five when he accompanied Messala on his Aquitanian campaign in 29, and thirty-five at his untimely death in 19. His station was that of a Roman knight; and he had inherited a very considerable estate. But, like Virgil, Horace, and Propertius, he seems to have lost the greater part of it in 41 amongst the confiscations which Antony and Octavian found expedient to satisfy the rapacity of their victorious soldiery. Tibullus, like Propertius, seems to have lost his father early. He once mentions his mother and sister; and, according to Ovid's elegy upon him, they were alive at his death.

Tibullus's chief friend and patron was M. Valerius Messala Corvinus, himself an orator and poet as well as a statesman and commander. Messala, like Mæcenas, was the centre of a literary circle in Rome; but the bond between its members was that of literature alone. They stood in no relations to the court; and the name of Augustus is never once to be found in the writings of Tibullus. It was doubtless this community of taste which gained the young poet the friendly notice of Messala, who offered him an honourable position on his private staff when he was despatched at the end of 30 by Augustus to quell the Aquitanian revolt. Tibullus distinguished himself in the campaign and was decorated for his services. But this did not rouse in him any military ardour. His tastes lay in quite other directions; and he always speaks of war with horror and dislike. At the end of the war in 29 Tibullus returned to Rome, and thenceforward his life seems to have been divided between Rome and his country estate, though his own preferences were altogether for the country life. Soon after his return he made the acquaintance of his first love, Delia. This is what he calls her in his poems; but we learn from Apuleius that her real name was Plania. Delia seems to have been a woman of middle station. It is impossible to give an exact account of the intimacy. The poems which refer to her are arranged in no chronological order. She appears now as single, now as married; but we do not hear anything either of her marriage or of her husband's death. It is clear, however, that it was the absence of her husband on military service in Cilicia which gave Tibullus the opportunity of making or renewing the acquaintance. It was not dropped when he returned, probably with Messala in 27. It was not a difficult task to deceive the simple soldier; and Delia was an apt pupil in the school of deception,—too apt, as Tibullus saw with dismay when he found that he was not the only lover. His entreaties and appeals were of no avail; and after the first book we hear no more of Delia. It was during the earlier period of this attachment and probably in the spring of 28 that, yielding to his friend's earnest and repeated requests, Tibullus left Delia to accompany Messala on a mission to Asia. He fell ill, however, and could not get farther than Corcyra. In the second book the place of Delia is taken by Nemesis, which is also a fictitious name. Nemesis (like the Cynthia of Propertius) was a courtesan of the higher class; and she had other admirers besides Tibullus. He complains bitterly of his bondage, and of her rapacity and hardheartedness. In spite of all, however, she seems to have retained her hold on him until his death. Tibullus died prematurely, probably in 19, and almost immediately after Virgil, in order, as their contemporary Domitius Marsus pathetically puts it,

"That none might sing of gentle love in elegy's sad lay,
Or gallant march of royal war on epic feet essay."

The character of Tibullus is reflected in his poems. Though not an admirable it is certainly an amiable one. He was a man of generous impulses and a gentle unselfish disposition. He was loyal to his friends to the verge of self-sacrifice, as is shown by his leaving Delia to accompany Messala to Asia, and constant to his mistresses with a constancy but ill deserved. His tenderness towards them is enhanced by a refinement and delicacy of feeling which are very rare amongst the ancients. Horace and the rest taunt the cruel fair with the retribution that is coming with the years, when they will exult over the decay of the once imperious beauty. If Tibullus refers to such a fate, he does it by way of warning and not in any petty spirit of triumph or revenge. Cruelly though he may have been treated by his love, he does not invoke curses upon her head. He goes to her little sister's grave, hung so often with his garlands and wet with his tears, and bemoans his fate to the dumb ashes there. Tibullus has no leanings to an active life: his ideal is a quiet retirement in the country with the loved one at his side. He has no ambition and not even the poet's yearning for immortality. His muse may go packing if it cannot propitiate the fair. As Tibullus loved the country life, its round of simple duties and innocent recreations, so he clung to its faiths, and in an age of crude materialism and the grossest superstition he was religious in the old Roman way. A simple, gentle, affectionate nature such as his could not fail to win esteem; and his early death caused deep regret in Rome. Tibullus was remarkable, his biographer tells us, for his good looks and the care that he bestowed upon his person. As a poet he reminds us in many respects of the English Collins His clear, finished, and yet unaffected style made him a great favourite with his countrymen and placed him, in the judgment of Quintilian, at the head of their elegiac writers. And certainly within his own range he has no Roman rival. For natural grace and tenderness, for exquisiteness of feeling and expression, he stands alone. He has far fewer faults than Propertius, and in particular he never overloads his lines with Alexandrian learning. But, for all that, his range is limited; and in power and compass of imagination, in vigour and originality of conception, in richness and variety of poetical treatment, he is much his inferior. The same differences are perceptible in the way the two poets handle their metre. Tibullus is smoother and more musical but liable to become monotonous; Propertius, with occasional harshnesses, is more vigorous and varied. It need only be added that in many of Tibullus's poems a symmetrical composition is obvious, although the symmetry must never be reduced to a fixed and unelastic scheme.

It is probable that we have lost some of the genuine poems of Tibullus. On the other hand, much has come down to us under his name which must certainly be assigned to others. Only the first and second books of the usual order, or about 1240 verses, can claim his authorship. The first book consists of poems written at various times between 30 and 26. It was probably published about 25 or 24. The second book seems to have been a posthumous publication. It is very short, containing only 428 verses, and is evidently incomplete. In both books occur poems which give evidence of internal disorder; but scholars cannot agree upon the remedies to be applied.

The third book, which contains 290 verses, is by a much inferior hand. The writer calls himself Lygdamus and the fair that he sings of Neæra. He was born in the same year as Ovid, in the consulship of Hirtius and Pansa; but there is nothing Ovidian about his work. He has very little poetical power, and his style is meagre and jejune. He has a good many reminiscences and imitations of Tibullus and Propertius; and they are not always happy. The separation of the fourth book from the third has no ancient authority. They form one in the best MSS., and are quoted as one in the anthologies of the Middle Ages. The division dates from the revival of letters, and is due to the Italian scholars of the 15th century. The fourth book consists of poems of very different quality. The first is a composition in 211 hexameters on the achievements of Messala; and very poor stuff it is. The author is unknown; but he was certainly not Tibullus. The poem itself was written in 31, the year of Messala's consulship. The next eleven poems relate to the loves of Sulpicia and Cerinthus. Sulpicia was a Roman lady of high station and the daughter of Valeria, Messala's sister. She had fallen violently in love with Cerinthus, about whom we know nothing but what the poet tells us; and he soon reciprocated her feelings. The Sulpicia elegies divide into two groups. The first comprises iv. 2-6, containing ninety-four lines, in which the theme of the attachment is worked up into four graceful poems composed for Sulpicia and Cerinthus alternately. The second, iv. 8-12 (to which seven should be added), consists of Sulpicia's own letters. They are very short, only forty lines in all; but they have a quite unique interest as being the only love poems by a Roman woman that have escaped the ravages of time. Their frank and passionate outpourings remind us of Catullus. The style and metrical handling betray the novice in poetical writing; and the Latinity is "feminine." The thirteenth poem (twenty-four lines) claims to be by Tibullus; but it is a miserable forgery. It is little more than a cento from Tibullus and Propertius. The fourteenth is a little epigram of four lines. There is nothing to determine its authorship. Last of all comes the epigram of Domitius Marsus already referred to. To sum up: the third and fourth books appear in the oldest tradition as a single book; if separated, they would contain only 290 and 373 lines respectively, as against 812 of the first book and 428 of the incomplete second; and they comprise pieces by different authors and in very different styles, none of which can be assigned to Tibullus with any certainty. The natural conclusion of this is that we have here a collection of scattered compositions relating to Messala and the members of his circle which has been added as an appendix to the genuine relics of Tibullus. When this collection was made cannot be exactly determined; but it was certainly not till after the death of Tibullus, and probably not till after Messala's. Besides the foregoing, two pieces in the collection called *Priapea* have been attributed to Tibullus; but there is very little external and no internal evidence of his authorship. The text of Tibullus is, on the whole, better preserved than that of Catullus, and still more so than that of Propertius. But it still contains many corruptions and several lacunæ, besides the disarrangements already referred to.

The value of the short *Vita Tibulli*, which is found at the end of the Ambrosian and Vatican, also of inferior, MSS., has been much discussed. E. Baehrens maintains that it is genuine, and possibly an abstract from the book of Suetonius, *De Poetis*,—a conjecture supported by the fact that even in so short a piece of writing more than one Suetonian phrase occurs (Baehr., *Tibullische Blatt.*, p. 4 *sq.*),—while Schulze (*Ztschr. f. d. Gymnasialwesen*, Berlin, xxxii. 658) regards it as a mere *rifacimento* of Horace, *Ep.*, i. 4, and various passages in Tibullus. E. Hiller (*Rhein. Mus.*, xviii. 350) thinks it genuine, but assigns it to the late classical period,—a view quite consistent with an ultimate Suetonian origin. It is as follows:—"Albius Tibullus, eques R. e Gabiis [Baehrens's ingenious conjecture for the MS. eques *regalis*, R. being the customary abbreviation for *Romanus*], insignis forma cultuque corporis observabilis, ante alios Corvinum Messalam ob ingenium [so Baehr., MSS. *originem*, others *oratorem*] dilexit, cuius et contubernalis Aquitanico bello militaribus donis donatus est. Hic multorum iudicio principem inter elegiographos optinet locum. Epistulæ quoque eius, quamquam breves, omnino utiles sunt [so the MSS.; Baehrens reads *subtiles*. The letters referred to are Sulpicia's]. Obiit adulescens, ut indicat epigramma superscriptum" (*i.e.*, the one ascribed to Domitius Marsus. These words seem to be a later addition to the *Life*).—Another moot question of some importance is whether our poet should be identified with the Albius of Horace (*Od.*, i. 33; *Epist.*, i. 4), as is done by the commentator Porphyrio (200-250

A.D.) in his *Scholia*. In the former passage Horace tells Albius to moderate his grief at the cruelty of Glycera, nor to descant in piteous elegies on her broken faith and the victory of a younger rival. It is clear that Glycera cannot be Nemesis; for it is a pseudonym, as the context shows, and Horace would, of course, have used the same pseudonym as Tibullus. If, on the other hand, Nemesis were a real name, Horace had no occasion to use a pseudonym. It is possible that Tibullus had another mistress, Glycera, of whom we know nothing further, and that the *miserabiles elegi* have perished; but this is a mere supposition. The Albius of the epistle has an estate at Pedum, where Horace conjectures he may be musing or writing. He is handsome, rich, and knows how to enjoy life. He is wise and has the gift of speech, popularity, reputation, and good health *abunde*,—an enviable list of attributes, but certainly one which does not agree very well with what we know from elsewhere of Tibullus. The theory, then, that these passages refer to Albius Tibullus must be pronounced, with Baehrens, unproven; and the *forma* of Horace's Albius must not be used, as Schulze uses it, to subvert the credit of the *insignis forma* of the *Life*.—Ovid, *Trist.*, iv. 10, 53 *sq.*, "successor fuit hic [Tibullus] tibi, Galle, Propertius illi, quartus ab his serie temporis ipse fui." In the preceding couplet he had said, "Vergilium vidi tantum nec amara Tibullo tempus amicitiæ fata dedere meæ." Ovid, who was born in 43, would be only twenty-four at Tibullus's death if it occurred in 19.—The loss of Tibullus's landed property is attested by himself (i. 1, 19 *sq.*), "Vos quoque felicis quondam, nunc pauperis agri custodes, fertis munera vestra, Lares. Tunc vitula innumeros lustrabat cæsa iuvencos; nunc agna exigui est hostia parva soli" (comp. 41, 42). Its cause is only an inference, though a very probable one. That he was allowed to retain a portion of his estate with the family mansion is clear from ii. 4, 53, "Quin etiam sedes iubeat si vendere avitas, ite sub imperium sub titulumque, Lares." Compare the passages quoted above and i. 1, 77, 78.—Messala composed epigrams (Plin., *Ep.*, v. 3) and bucolic poems (comp. the pseudo-Virgilian *Catalepton*, ii.); but he was more conspicuous as a patron than as a poet. On his circle and that of Mæcenas, see Teuffel, *Gesch. der römischen Literatur*, 4th ed., p. 431 (vol. i. p. 389 of the Eng. transl.). Other members of the circle were Messala's brother, Pedius Publicola, Æmilius Macer (probably the Macer addressed in ii. 6), Valgius Rufus, Lygdamus, Sulpicia, and others, and even Ovid to a certain extent (Ov., *Pont.*, i. 7, 28 *sq.*; *Trist.*, iv. 4, 27 *sq.*). Tibullus was Messala's *contubernalis* in the Aquitanian war (*Vita Tib.* and Tib., i. 7, 9 *sq.*, a poem composed for Messala's triumph). It should be stated that the date of the Aquitanian campaign is still undetermined. It has been assigned to 30, 29, and 28. He received *militaria dona* (*Vita*); Baehrens unkindly suggests it was for purely poetical services (*Tib. Bl.*, p. 15). Tibullus's dislike of war is always coming to the surface (*e.g.*, i. 3; i. 10), and so also his love of quiet and retirement (i. 1; ii. 1; 3, 1 *sq.*).—Apuleius (*Apol.*, 10), "accusent Tibullum . . . quod ei sit Plania in animo, Delia in versu"; this is the most probable form of the name, Delia (δῆλος) being a translation of Plania. As regards her station, it should be noticed that she was not entitled to wear the *stola*, the dress of Roman matrons (i. 6, 68). Her husband is mentioned as absent (i. 2, 67 *sq.*). She eludes the custodes placed over her (i. 2, 15, and 6, 7). Tibullus's suit was favoured by Delia's mother, of whom he speaks in very affectionate terms (i. 6, 57 *sq.*). For Tibullus's illness at Corcyra, see i. 3, 1 *sq.*, 55 *sq.* The fifth elegy was written during estrangement (*discidium*) and the sixth after the return of the husband and during Delia's double infidelity. On the difficulty of "harmonizing" the Delia elegies, see F. Leo (in Kiessling and Wilamowitz-Möllendorf's *Philol. Unters.*, ii. pp. 19-28), who is, however, too sceptical. Any other attachments that Tibullus formed (such as the supposed one for Glycera) must have fallen between the end of the Delia and the beginning of the Nemesis connexion.—Ovid, writing at the time of Tibullus's death (*Am.*, iii. 9, 31), says—"Sic Nemesis longum, sic Delia, nomen habebunt altera cura recens, altera primus amor." Nemesis is the subject of book ii. 3, 4, 6. The mention of a *lena* (ii. 6) settles her position. The connexion had lasted a year when ii. 5 was written (see ver. 109). It is worth noticing that Martial selects Nemesis as the source of Tibullus's reputation, "fama est arguti Nemesis lasciva Tibulli" (*Epigr.*, viii. 73, 7); compare xiv. 193, "ussit amatorem Nemesis lasciva Tibullum, in tota iuvit quem nihil esse domo," where, however, the second line is taken from one of the Delia elegies. Ovid, *Amores*, iii. 9, 58, "me tenuit moriens deficiente manu." The point of this can only be seen by reference to Tib., i. 1, 60, where Delia is addressed, "te teneam moriens deficiente manu."—The epigram of Domitius Marsus on his death is as follows: "Te quoque, Vergilio comitem, non æqua, Tibulle, Mors iuvenem campos misit ad Elysios, ne foret aut elegis molles qui fleret amores aut caneret forti regia bella pede."—Tibullus condemns the rough handling which the inamorata often suffered from her Roman lover, *e.g.*, i. 10, 59-60—"A! lapis est ferrumque, suam quicumque puellam verberat; e caelo deripit ille deos." The tenderness of the passage paraphrased above (ii. 6, 41) is perhaps unmatched in ancient poetry: "desino, ne dominæ luctus renoventur acerbi. Non ego sum tanti ploret ut illa semel."—His love for a rustic life and rustic worship appears throughout whole poems, as in i. 1 and ii. 1, 2. Of his poetry he says (ii. 4, 19), "Ad dominam faciles aditus per carmina quæro; ite procul, Musæ, si nihil ista valent."—Specimens of Tibullus at his best may be found in i. 1, 3, 89-94; 5, 19-36; 9, 45-68; ii. 6. Quintilian says (*Inst.*, x. 1, 93), "Elegia quoque Græcos provocamus, cuius mihi tersus atque elegans maxime videtur auctor Tibullus; sunt qui Propertium malint; Ovidius utroque lascivior sicut durior Gallus."—Ovid (*Am.*, *l.c.*) well calls him *cultus*, Martial *argutus*, "fine-toned." A short but not inadequate account of Tibullus's prosody is given by L. Mueller in his introduction to Tibullus (*Catullus, Tibullus, und Propertius*, Leipsic, 1880). Catullus and Tibullus lengthen a short vowel before *sp* and *fr*; Propertius always keeps it short in similar conjunctions, even where *s* is followed by two consonants, as in *striges*. Catullus, and in three cases Tibullus, allow a trisyllabic verb to close the pentameter. Propertius never permits himself this liberty, although in his earlier poems he has as many trisyllabic endings as Tibullus.—The chronology of the first book is discussed amongst others by Baehrens (*Tib. Bl.*, pp. 12-24). But the data do not admit in all cases of his precise determinations. Baehrens and Hiller (*Hermes*, xviii. 353) agree that the second book was posthumous. If it had been known to Ovid when he wrote his elegy on the poet's death, it seems certain that he would have quoted from it. Hiller assigns 2 B.C. as an inferior limit, by which time Ov., *Ars Am.*, iii. 3, 535 *sq.*, must have been written. Amongst the "disarranged poems" are i. 1, 4, 6 and ii. 3, 5. Proposed rearrangements of them may be found in Hiller's *Tibullus* (1885). Charisius (pp. 66 and 105) quotes part of a hexameter which is not found in the extant poems of Tibullus.

The Tibullian authorship of book iii. has long ago been surrendered by scholars. Its latest defenders have been Fuss (*De Elegg. Libro quem Lygdami esse putant*, Münster, 1867) and the English translator, J. Cranstoun. It has been suggested that *Lygdamus* (λύγδος, white marble) is a Grecizing of *Albius*, some relation of Tibullus (compare Hiller, *Hermes*, xviii. 353, n. 2); and this is possible. Gruppe's long-exploded theory that Ovid was the author has been recently revived by J. Kleeman (*De Libri III. Carminibus quæ Tibulli Nomine circumferuntur*, Strasburg, 1876). Considerable difficulty is caused by iii. 5, 15-20, which contains agreements with three passages of Ovid, *Ars Am.*, ii. 669 *sq.*; *Tr.*, iv. 10, 6: "cum cecidit fato consul uterque pari" (Lygdamus and Ovid using word for word the same expression for the year of their birth, the consulship of Hirtius and Pansa); and *Am.*, xi. 14, 23 *sq.*, which are much too close to be accidental, and in which the theory that Ovid was the imitator is excluded by the fact that the lines are much more appropriate to their surroundings in Ovid than in Lygdamus. In consequence Baehrens (*Tib. Bl.*, 40) regards the poem as written after 13 A.D., the date of the *Tristia*, while Hiller (*l.c.*, p. 359) regards the lines as a later addition by Lygdamus himself. In either case it would be published after 13. The line quoted above may have obtained proverbial currency before either of the passages was written, as the death of both consuls in one year would have impressed the Roman imagination as powerfully as the coincident deaths of Adams and Jefferson did the American. In that case no part of book iii. need be later than the Christian era. For Lygdamus's imitations of Tibullus, see Gruppe, *Die römische Elegie*, i. 112 *sq.* There are resemblances between the pseudo-Tibullus and the *Catalepton* (Baehr., *op. cit.*, p. 52).—The view of Baehrens (*Tib. Blätt.*, 49) and others that iii. and iv. originally formed one book may now be considered established, in spite of Birt's objections (*Das antike Buchwesen*, 426 *sq.*); and Hiller in his edition prints them as one. They were published some time after book ii., probably after the death of Messala (Baehrens, *op. cit.*, 43, adds, "and of his son Messalinus"). Further determination of the date is impossible. We do not know when they were added to the genuine poems of Tibullus; but it was probably before the *Life* was written.—Most scholars since Lachmann (*Kl. Schr.*, ii. 149) have condemned the "Panegyric on Messala." It is an inflated and at the same time tasteless declamation, entirely devoid of poetical merit. The language is often absurdly exaggerated, *e.g.*, 190 *sq.* The author himself seems to be conscious of his own deficiencies (1 *sq.*, 177 *sq.*). All that we know about him is that he, like so many of his contemporaries, had been reduced to poverty by the loss of his estates (181 *sq.*). The date is fixed by 121 *sq.*—Sulpicia was the daughter of Servius Sulpicius (iv. 10, 4), and she seems to have been under the tutelage of Messala (cf. 14, 5-8), her uncle by marriage (Haupt, *Hermes*, iv. 33 *sq.*). Cerinthus is a real name. He was probably a Greek (Baehr., p. 41 and note). He is not to be identified with the Cornutus addressed in Tib., ii. 2, 3. Gruppe (*op. cit.*, 27) and Teuffel (*Studien*, 367) attribute iv. 2-6 to Tibullus himself; but the style is different, and it is best to answer the question as Baehrens does (p. 46) with a *non liquet*. For Sulpicia's style and its feminine Latinity, compare Gruppe (*op. cit.*, i. 49 *sq.*).—The direct ascription of iv. 13 (verse 13—"nunc licet e caelo mittatur amica Tibullo") to Tibullus probably led to its being included in the collection. Later on, it and the epigram together caused the addition of the pseudo-Tibulliana to the genuine works. Although not suspected till recently, it is unquestionably spurious; see the examination by Postgate (*Journ. of Phil.*, ix. 280 *sq.*).—The authorship of the two *Priapea* (one an epigram and the other a longer piece in iambics) is discussed by Hiller (*Hermes*, xviii. 343-9). His conclusions are that, as regards the iambics, the theory that Tibullus was its author, though from the nature of the case it does not admit of complete disproof, rests upon the slightest of foundations, and, as regards the epigram, that the hypothesis of a Tibullian authorship is quite inadmissible.

The text of Tibullus is in a much better condition than it was in Lachmann's time, thanks to the recent discovery of new MSS. by E. Baehrens. Of these the Ambrosianus (A), of date about 1374, and the Vaticanus (V), end of the 14th or beginning of the 15th century, agree so closely that they can be referred to an original extant in the early part of the 12th or 13th century but long since lost. A third is the Guelferbytanus (G), written in Lombard characters, but on parchment of the beginning of the 1[illegible]th century. Baehrens, who attaches great importance to the original readings of this codex, considers it a faithful copy of a 10th or 11th century MS. Besides these we have a number of extracts from Tibullus in the *Florilegium Parisinum*, an anthology from various Latin writers which probably dates back to the 11th century, and which we have from two MSS. at Paris (7647 and 17903); see Meyncke, *Rhein. Mus.*, xxv. 369 *sq.* Baehrens considers that these excerpta Parisina and G are closely connected, and that their original and that of A and V were both descended from a more ancient MS., which he calls O, but which was still full of corruptions. The so-called *Excerpta Frisingensia*, preserved in an 11th-century MS. (now at Munich), but unfortunately very few in number, are extracted from a much better MS. than O. Still better was the *Fragmentum Cuiacianum*, which we know only from Scaliger's collation (in the library at Leyden), and which is to be carefully distinguished from the codex Cuiacianus, a late MS. containing Catullus, Tibullus, and Propertius, and still extant. It only contained from iii. 4, 65 to the end. The codices which Lachmann used are later than all the foregoing and full of interpolations. Baehrens's estimate of the MS. authorities for Tibullus has not been accepted in all its details. In particular his high estimate of G has been disputed by Leo, *op. cit.*, p. 8; Rothstein, *De Tibulli Codicibus*, p. 67 *sq.* (who also endeavours to raise Lachmann's MSS. to an independent position again); and others. R. Leonhard, in a careful dissertation, *De Codicibus Tibullianis Capita Tria* (Munich, 1882), agrees with Baehrens in the main, though his pedigree of the MSS. (p. 53) is more elaborate.

Editions.—The first two editions of Tibullus and the pseudo-Tibulliana are that with Catullus, Propertius, and the *Silvæ* of Statius by Vindelin de Spira (Venice, 1472) and one of Tibullus separately by Florentius de Argentina, probably printed in the same year. Compare Huschke, *Tibullus*, *Præf.*, vi. *sq.*, xxiii. *sq.* Amongst others we may mention those by Scaliger (with Catullus and Propertius, Paris, 1577, 1582, &c.), Broukhuys (Amsterdam, 1708), Vulpius (Padua, 1749), Heyne (Leipsic, 1817, 4th ed. by Wunderlich; with supplement by Dissen, 1819), Huschke (Leipsic, 1819, 2 vols.), Lachmann (Berlin, 1829, the first critical edition), Dissen (Gottingen, 1835). The most important edition with critical apparatus is that of E. Baehrens (Leipsic, 1878). The most recent edition, with critical introduction and index, is E. Hiller's (Leipsic, 1885). Recent texts are those of L. Mueller (Leipsic, 1880; also with Catullus and Propertius) and Haupt-Vahlen (Leipsic, 1885). There is no good recent commentary on Tibullus; we have to fall back on Heyne and Dissen. That by B. Fabricius (Berlin, 1881) does not even comprise all the poems. Some contributions are made to the subject in F. Leo's paper in Kiessling's and Wilamowitz-Moellendorff's *Philol. Unters.*, ii. p. 3 *sq.*, and by J. Vahlen in the *Monatsberichte* of the Berlin Academy, 1878, pp. 343-356. For fuller bibliographies, see Engelmann's *Bibliotheca Scriptorum Latinorum* (ed. Preuss, 1882) and J. E. B. Mayor's *Bibliographical Clue to Latin Literature* (1875). For the older editions, see the preface to Huschke's. There is an excellent account of Tibullus in W. S. Teuffel's *Gesch. d. römisch. Literatur* (4th ed., L. Schwabe, 1882). Those in the Eng. tr. and Pauly's *Real-Encyklopadie* are antiquated. The following translations into English verse are known,—by Dart (London, 1720), Grainger (London, 1759, 2 vols., with Latin text and notes, subsequently reprinted), Cranstoun (Edinburgh and London, 1872). *An Essay towards a New Edition of the Elegies of Tibullus, with a Translation and Notes* (London, 1792), merely contains i. 1 and 7, 29-48. Sir C. A. Elton, *Specimens of the Classic Poets* (London, 1814, vol. xii. 141-171) contains i. 1; ii. 4; iii. 2-4; 6, 33 to end; iv. 2, 3. To these should probably be added *Tibullus, with other Translations from Ovid, Horace, &c.*, by Richard Whiffin, London, 1829. Cranstoun's is the only complete version of merit; but it is far inferior to the translations by Elton, from whom Cranstoun seems sometimes to have borrowed. (J. P. P.)

TIBUR. See Tivoli.

TIC DOULOUREUX. See Neuralgia.

TICINO, or Tessin, a canton of Switzerland, ranking as eighteenth in the Confederation, consists of the upper basin of the river from which it takes its name,—the Val Leventina, with the tributary valleys of Blegno and Maggia—and farther south takes in the districts of Lugano and Mendrisio between Lakes Maggiore and Como. Its total area is 1088·2 square miles, which is exceeded by only four other Swiss cantons,—Graubünden (Grisons), Bern, Valais, and Vaud. Of this 725·8 square miles are classed as productive, including 215·3 square miles covered by forests and 33·8 by vines; of the unproductive portion 24·3 square miles are occupied by lakes (most of that of Lugano belonging to the canton) and 13·1 by glaciers. The highest points in the canton are the Basodine (10,749 feet) in the north-west and the Valrheia (11,148 feet) in the north-east corners. In 1880 the population was 130,777 (the females exceeding the males by 10,000, doubtless owing to the emigration of the latter), being an increase of 11,158 on that of 1870; the increase was particularly marked in the Val Leventina and is due to the influence of the St Gotthard Railway, which traverses the entire canton. Of this population 129,409 speak Italian; 342 of the remainder form the German-speaking hamlet of Bosco or Gurin in the Val Caverna (in north-west), a colony from the neighbouring valley of Formazza or Pommat, which is politically Italian. In religion 130,017 are Roman Catholics. Until 1859 Ticino was partly (Val Leventina, Val Blegno, and the Riviera) in the metropolitan diocese of Milan, chiefly in that of Como, and is still practically (though not legally) administered by these two bishops,—all attempts made hitherto to incorporate them with the see of Chur or to secure the erection of a special see for them having failed. The chief towns are Lugano (6129 inhabitants), Airolo (3674), Mendrisio (2749), Locarno (2645), and Bellinzona (2436). Formerly Lugano, Locarno, and Bellinzona were the capital by turns of six years each; but since 1881 the seat of government has been permanently fixed at Bellinzona. Ticino stands in a comparatively low position as regards moral, educational, agricultural, and commercial matters. It has produced a number of sculptors, painters, and architects. Many of the men migrate during the summer in search of work as picture-dealers, waiters in cafés, chimney-sweeps, and especially as masons, plasterers, labourers, and navvies. A large quantity of fruit is grown; the chief articles exported are cattle, hay, fish, chestnuts, and earthenware. In manners, customs, and general character the inhabitants strongly resemble their Italian neighbours.

The canton is made up of all the permanent conquests (with one or two trifling exceptions) made by different members of the Swiss League south of the main chain of the Alps. From an historical point of view Italian Switzerland falls into three groups:—(1) Val Leventina, conquered by Uri in 1440 (previously held from 1403 to 1426); (2) Bellinzona, the Riviera, and Val Blegno (held from 1419 to 1426), won in 1500 from the duke of Milan by men from Uri, Schwyz, and Nidwald, and confirmed by Louis XII. of France in 1503; (3) Locarno, Val Maggia, Lugano, and Mendrisio, seized in 1512 by the Confederates when fighting for the Holy League against France, ruled by the twelve members then in the League, and confirmed by Francis I. in the treaty of 1516. These districts were governed by bailiffs holding office two years and purchasing it from the members of the League; each member of group 3 sent annually an envoy, who conjointly constituted the supreme appeal in all matters. This government was very harsh and is one of the darkest pages in Swiss history. Yet only one open revolt is recorded—that of the Leventina against Uri in 1755. In 1798 the people were distracted by the Swiss and "Cisalpine republic" parties, but sided with the Swiss. On being freed from their hated masters, they were formed into two cantons of the Helvetic republic—Bellinzona (=1 and 2 above) and Lugano (=3). In 1803 all these districts were formed into one canton—Ticino—which became a full member of the Swiss Confederation. From 1810 to 1813 it was occupied by the troops of Napoleon. The roads over the Bernardino (1819-23) and the St Gotthard (1820-30) were made under the constitution of 1814. But many of the old troubles reappeared and were only done away with by the constitution of 23d July 1830, which (with subsequent modifications) prevails at the present time. A legislative assembly (112 members) chosen by direct election and an executive (5 members) chosen by the legislature are its principal features. The "optional referendum" (permitting the submission of any law to a popular vote if asked for by a certain number of citizens) was adopted in 1883. In 1848, on religious grounds and owing to fears as to customs duties, the canton voted in the minority against the Federal constitution of that year; but in 1874, though the people voted against the revised constitution, the legislature adopted it, and the canton was counted as one of the majority. Since 1830 the local history of the canton has been very disturbed owing to the fact that, though Roman Catholicism is the state religion, and all the population are Roman Catholic (the few Protestants having been expelled from Locarno in 1555), they are divided between the Radical and Ultramontane parties. Since 1876 the intervention of Federal troops (already known in 1870) has been quite common in consequence of conflicts of the local authorities *inter se*, or against the Federal assembly.

See *Der Kanton Tessin*, by Stefano Franscini (St Gall, 1835).

TICK. See Mite.

TICKELL, Thomas (1686-1740), English man of letters, the son of a clergyman, was born at Bridekirk, near Carlisle, in 1686. After a good preliminary education he went to Queen's College, Oxford, where in 1708 he took his degree, and of which college he was two years later elected fellow. He did not take orders, but by a dispensation from the crown was allowed to retain his fellowship until his marriage in 1726. As a poet Tickell displayed very mediocre qualities. His success in literature, as in life, was mainly due to the friendship and patronage of Addison, who procured for him (1717) the under-secretaryship of state, to the chagrin of Steele, who thenceforth bore Tickell no good will. During the peace negotiations with France Tickell published the *Prospect of Peace*, which was well spoken of in the *Spectator* and reached a sixth edition. In 1717 he brought out a translation of the first book of the *Iliad* contemporaneously with Pope's version. *Kensington Gardens*, his longest poem, which appeared in 1722, is inflated and pedantic, and was doomed to oblivion from its birth. Dr Johnson's criticism of it gives it its due meed of praise and blame. The most popular of Tickell's poetical writings was the ballad of "Colin and Lucy," which will bear comparison with some of the ballad poems of Wordsworth. Whether from fear of Pope's rivalry or from unbiassed choice, Tickell abandoned the translation of the *Iliad* and set about rendering the *Odyssey* and Lucan into English. In 1725 he was appointed secretary to the lords justices of Ireland,—a post which he retained until his death, which took place at Bath on 23d April 1740. Tickell rose once above the level of mediocrity, when he wrote his elegy addressed to the earl of Warwick on the death of Addison. Posterity has endorsed Dr Johnson's affirmation that this elegy is equal in sublimity and elegance to any funeral poem which had theretofore appeared, —and this notwithstanding Steele's caustic disparagement, that it was only "prose in rhyme." Tickell also contributed to the *Spectator* and the *Guardian*.

See "T. Tickell," in Johnson's *Lives of the Poets*; the *Spectator*; Anderson's *English Poets*; Ward's *English Poets*.

TICKNOR, George (1791-1871), historian of Spanish literature, was born at Boston (Mass.), on 1st August 1791. He received his early education from his father, Elisha Ticknor, who, though at that time in business, had been principal of the local Franklin public school and was the originator both of the system of free primary schools in Boston and of the first New England savings-bank. He studied at Dartmouth College from 1805 to 1807, and on leaving it was placed for nearly three years under Dr Gardiner, a pupil of Dr Parr. In the autumn of 1810 Ticknor entered the office of a leading Massachusetts lawyer, and, though his studies appear to have been literary rather than legal, he was admitted to the bar in 1813. He at once commenced practice; but a year's experiment convinced him that scholarship and letters would be more congenial to his abilities. In the spring of 1815 he set sail for England. Attractive in appearance, cultured, vivacious, and sympathetic, he had won many influential friends in America, and his introductions gave him access to most of the men then worth knowing in Europe. He spent nearly two years at Göttingen; but he also visited the chief towns on the Continent, meeting Prescott for the first time at Paris, and spending some months in Spain and Portugal, the life and literatures of which had already strong attractions for him. Returning to America in the summer of 1819, he was inducted in the August following to the Smith professorship of French and Spanish literature and to the college professorship of belles-lettres at Harvard. The history and criticism of Spanish literature was in many respects a new subject at that time even in Europe, —the Spaniards themselves having no adequate treatment of their literature as a whole, and both Bouterwek and Sismondi having worked with scanty or second-hand resources. To supply this want, therefore, he gave his most serious thought, developing in his lectures the scheme of his more permanent work. In June 1821 his father died, and in September he married Anna, daughter of Samuel Eliot, a merchant and founder of the chair of Greek literature at Harvard College. In the years following 1821 Ticknor made a vain effort to introduce measures of university reform. The death of his only son in 1834 and the subsequent failure of his wife's health led him to resign his post at Cambridge to Longfellow; and in the spring of 1835 he again went to Europe, where he remained until 1838. From that time till his death he lived chiefly at Boston. Till 1849 he published only occasional reviews and papers, such as his essays on Moore's *Anacreon*, on Milton's *Paradise Lost*, and on Thatcher's *Sermons*, in 1812; on Michael Stiefel, in 1816; on Griscom's *Tour in Europe* and on General La Fayette, in 1824; on amusements in Spain and on changes in Harvard College, in 1825; on Chateaubriand, in 1827; on Daniel Webster, in 1831; and on the best mode of teaching living languages, in 1832. His *History of Spanish Literature*, the first editions of which appeared in New York and London in 1849, was welcomed on all hands as the standard work on the subject, and was rapidly translated into Spanish and other Continental languages. Whatever its defects, it at least reduced to system and clearness a large mass of varied historical material hitherto only vaguely known; and its copious references to authorities and editions and its loving exploration of the byeways of the literature made it as valuable to scholars as its direct and unpretentious style made it popular with general readers. In many respects it was the admirable literary complement of the historical work of Prescott. Like his, the bent of Ticknor's mind was expository rather than critical; and in both cases the standards applied were of a conventional rather than of an advanced nature. As with Prescott the glow of vivid narration often hides rather than reveals the underlying problems of social and philosophic import, so with Ticknor a certain fund of graceful and genial commonplace is apt to gloss over the really vital critical issues of the subject-matter. At crucial moments in place of the keener edge of criticism one is apt to find only the paper-knife intelligence of the ordinary book-lover. The defect, however, was common to the critical schools of the time. The merits of the work in its accurate survey of comparatively untrodden ground were individual and of an exceedingly high order. Ticknor subsequently took an active part in the establishment of the Boston public library, in the interests of which he paid in 1856 another visit to Europe, and to which he left at his death his fine collection of Spanish and Portuguese works. In 1859, on the death of Prescott, he at once began to collect materials for a life of his friend, which was published in 1864. His death took place at Boston on 26th January 1871.

A *Life* of Ticknor, with his letters and journals, was edited by George S. Hillard, Boston, 1876.

TICONDEROGA, a village and township of the United States, in Essex county, New York, situated upon the stream connecting Lakes George and Champlain, and extending back upon an abrupt promontory which separates the two lakes. Two railroads enter the village,—the Delaware and Hudson and a branch of the Central Vermont. The population in 1880 was 3304.

Commanding the direct route from the St Lawrence to the Hudson, Ticonderoga was early seized by the French and fortified under the name of Fort Carillon. In July 1758 it was unsuccessfully attacked by Abercrombie. In the same month of the succeeding year it was abandoned by the French upon the approach of an English army under Amherst, who occupied it and greatly strengthened its works. At the beginning of the Revolution, in 1775, the fort was surprised and captured by Ethan Allen and a party of Vermont militia. In 1778 it was retaken by the English under Burgoyne and was held by them until the close of the war.

TIDES

I. On the Nature of Tides.

§ 1. *Definition of Tide.*

WHEN, as occasionally happens, a ship in the open sea meets a short succession of waves of very unusual magnitude, we hear of tidal waves; and the large wave caused by an earthquake is commonly so described. The use of the term "tide" in this connexion is certainly incorrect, but it has perhaps been fostered by the fact that such waves impress their records on automatic tide-gauges, as, for example, when the wave due to the volcanic outbreak at Krakatoa was thus distinctly traceable in South Africa, and perhaps even faintly at Brest. We can only adequately define a tide by reference to the cause which produces it. A tide then is a rise and fall of the water of the sea produced by the attraction of the sun and moon. A rise and fall of the sea produced by a regular alternation of day and night breezes, by regular rainfall and evaporation, or by any influence which the moon may have on the weather cannot strictly be called a tide. Such alternations may, it is true, be inextricably involved with the rise and fall of the true astronomical tide, but we shall here distinguish them as meteorological tides. These movements are the result of the action of the sun, as a radiating body, on the earth. Tides in the atmosphere would be shown by a regular rise and fall in the barometer, but such tides are undoubtedly very minute, and we shall not discuss them in this article, merely referring the reader to the *Mécanique Céleste* of Laplace, bks. i. and xiii. There are, however, very strongly marked diurnal and semi-diurnal inequalities of the barometer due to atmospheric meteorological tides. Sir William Thomson in an interesting speculation[1] shows that the interaction of these quasi-tides with the sun is that of a thermodynamic engine, whereby there is caused a minute secular acceleration of the earth's rotation. This matter is, however, beyond the scope of the present article. We shall here extend the term "tide" to denote an elastic or viscous periodic deformation of a solid or viscous globe under the action of tide-generating forces. In the technical part of the article by the term "a simple tide" we shall denote a spherical harmonic deformation of the water on the surface of the globe, or of the solid globe itself, multiplied by a simple harmonic function of the time.

§ 2. *General Description of Tidal Phenomena.*[2]

If we live by the sea or on an estuary, we see that the water rises and falls nearly twice a day; speaking more exactly, the average interval from high water to high water is about $12^h\ 25^m$, so that the average retardation from day to day is about 50^m. The times of high water are then found to bear an intimate relation with the moon's position. Thus at Ipswich high water occurs when the moon is nearly south, at London Bridge when it is south-west, and at Bristol when it is east-south-east. For a very rough determination of the time of high water it is sufficient to add the solar time of high water on the days of new and full moon (called the "establishment of the port") to the time of the moon's passage over the meridian, either visibly above or invisibly below the horizon. The interval between the moon's passage over the meridian and high water varies sensibly with the moon's age. From new moon to first quarter, and from full moon to third quarter (or rather from and to a day later than each of these phases), the interval diminishes from its average to a minimum, and then increases again to the average; and in the other two quarters it increases from the average to a maximum, and then diminishes again to the average.

Spring and neap.

The range of the rise and fall of water is also subject to great variability. On the days after new and full moon the range of tide is at its maximum, and on the day after the first and third quarter at its minimum. The maximum is called "spring tide" and the minimum "neap tide," and the range of spring tide is usually between two and three times as great as that of neap tide. At many ports, however, especially non-European ones, two successive high waters are of unequal heights, and the law of variability of the difference is somewhat complex; a statement of that law will be easier when we come to consider tidal theories. In considering any tide we find, especially in estuaries, that the interval from high to low water is longer than that from low to high water, and the difference between the intervals is greater at spring than at neap.

River tides.

Distinction of rise and fall from flood and ebb.

In a river the current continues to run up stream for some considerable time after high water is attained and to run down similarly after low water. Much confusion has been occasioned by the indiscriminate use of the term "tide" to denote a tidal current and a rise of water, and it has often been incorrectly inferred that high water must have been attained at the moment of cessation of the upward current. The distinction between "rising and falling" and "flowing and ebbing" must be carefully maintained in rivers, whilst it vanishes at the seaboard. If we examine the progress of the tide-wave up a river, we find that high water occurs at the sea earlier than higher up. If, for instance, on a certain day it is high water at Margate at noon, it is high water at Gravesend at a quarter past two, and at London Bridge a few minutes before three. The interval from low to high water diminishes also as we go up the river; and at some distance up certain rivers—as, for example, the Severn—the rising water spreads over the flat sands in a roaring surf and travels up the river almost like a wall of water. This kind of sudden rise is called a "bore."[3] In other cases where the difference between the periods of rising and falling is considerable, there are, in each high water, two or three rises and falls. A double high water exists at Southampton.

Augmentation of height in estuaries.

When an estuary contracts considerably, the range of tide becomes largely magnified as it narrows; for example, at the entrance of the Bristol Channel the range of spring tides is about 18 feet, and at Chepstow about 50 feet. This augmentation of the height of the tide-wave is due to the concentration of the energy of motion of a large mass of water into a narrow space. At oceanic ports the tidal phenomena are much less marked, the range of tide being usually only 2 or 3 feet, and the interval from high to low water sensibly equal to that from low to high water. The changes from spring to neap tide and the relation of the time of high water to the moon's transit remain, however, the same as in the case of the river tides.

Land-locked seas.

In long and narrow seas, such as the English Channel, the tide in mid-channel follows the same law as at a station near the mouth of a river, rising and falling in equal times; the current runs in the direction analogous to up stream for three hours before and after high water, and down stream for the same period before and after low water. But near the sides of channels and near the mouths of bays the changes of the currents are very complex; and near the headlands separating two bays there is usually at certain times a very swift current, termed a "race."

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[1] Société de Physique, September 1881, or *Proc. Roy. Soc. of Edinburgh*, 1881-82, p. 396.

[2] Founded on Airy's "Tides and Waves," in *Ency. Metrop.*

[3] See a series of papers bearing on this kind of wave by Sir W. Thomson, in *Phil. Mag.*, 1886-87.

In inland seas, such as the Mediterranean, the tides are nearly insensible except at the ends of long bays. Thus at Malta the tides are not noticed by the ordinary observer, whilst at Venice they are conspicuous.

Wind.

The effect of a strong wind on the height of tide is generally supposed to be very marked, especially in estuaries. In the case of an exceptional gale, when the wind veered round appropriately, Airy states[1] that the water has been known to depart from its predicted height at London by as much as 5 feet. The effect of wind will certainly be different at each port. The discrepancy of opinion on this subject appears to be great,—so much so that we hear of some observers concluding that the effect of the wind is insensible.

Atmospheric pressure.

Variations in barometric pressure also cause departures from the predicted height of water, high barometer corresponding to decrease of height of water. Roughly speaking, an inch of the mercury column will correspond to something less than a foot of water, but the effect seems to vary much at different ports.[2]

§ 3. *General Explanation of the Cause of Tides.*

Tide-generating forces.

The moon attracts every particle of the earth and ocean, and by the law of gravitation the force acting on any particle is directed towards the moon's centre, and is jointly proportional to the masses of the particle and of the moon, and inversely proportional to the square of the distance between the particle and the moon's centre. If we imagine the earth and ocean subdivided into a number of small portions or particles of equal mass, then the average, both as to direction and intensity, of the forces acting on these particles is equal to the force acting on that particle which is at the earth's centre. For there is symmetry about the line joining the centres of the two bodies, and, if we divide the earth into two portions by an ideal spherical surface passing through the earth's centre and having its centre at the moon, the portion remote from the moon is a little larger than the portion towards the moon, but the nearer portion is under the action of forces which are a little stronger than those acting on the further portion, and the resultant of the weaker forces on the larger portion is exactly equal to the resultant of the stronger forces on the smaller. If every particle of the earth and ocean were being urged by equal and parallel forces, there would be no cause for relative motion between the ocean and the earth. Hence it is the departure of the force acting on any particle from the average which constitutes the tide-generating force. Now it is obvious that on the side of the earth towards the moon the departure from the average is a small force directed towards the moon; and on the side of the earth away from the moon the departure is a small force directed away from the moon. Also these two departures are very nearly equal to one another, that on the near side being so little greater than that on the other that we may neglect the excess. All round the sides of the earth along a great circle perpendicular to the line joining the moon and earth, the departure is a force directed inwards towards the earth's centre. Thus we see that the tidal forces tend to pull the water towards and away from the moon, and to depress the water at right angles to that direction. If we could neglect the rotations of the bodies, and could consider the system as at rest, we should find that the water was in equilibrium when elongated into a prolate ellipsoid with its long axis directed towards and away from the moon.

Theory of equatorial canal on earth.

But it must not be assumed that this would be the case when there is motion. For, suppose that the ocean consisted of a canal round the equator, and that an earthquake or any other cause were to generate a great wave in the canal, this wave would travel along it with a velocity dependent on the depth. If the canal were about 13 miles deep, the velocity of the wave would be about 1000 miles an hour, and with depth about equal to the depth of our seas the velocity of the wave would be about half as great. We may conceive the moon's tide-generating force as making a wave in the canal and continually outstripping the wave it generates, for the moon travels along the equator at the rate of about 1000 miles an hour, and the sea is less than 13 miles deep. The resultant oscillation of the ocean must therefore be the summation of a series of partial waves generated at each instant by the moon and always falling behind her, and the aggregate wave, being the same at each instant, must travel 1000 miles an hour so as to keep up with the moon.

Now it is a general law of frictionless oscillation that, if a slowly varying periodic force acts on a system which would oscillate quickly if left to itself, the maximum excursion on one side of the equilibrium position occurs simultaneously with the maximum force in the direction of the excursion; but, if a quickly varying periodic force acts on a system which would oscillate slowly if left to itself, the maximum excursion on one side of the equilibrium position occurs simultaneously with the maximum force in the direction opposite to that of the excursion. An example of the first is a ball hanging by a short string, which we push slowly to and fro; the ball will never quit contact with the hand, and will agree with its excursions. If, however, the ball is hanging by a long string we can play at battledore and shuttlecock with it, and it always meets our blows. The latter is the analogue of the tides, for a free wave in our shallow canal goes slowly, whilst the moon's tide-generating action goes quickly.

Tides inverted.

Hence, when the system is left to settle into steady oscillation, it is low water under and opposite to the moon, whilst the forces are such as to make it high water at those times.

If we consider the moon as revolving round the earth, the water assumes nearly the shape of an oblate spheroid with the minor axis pointed to the moon. The rotation of the earth in the actual case introduces a complexity which it is not easy to unravel by general reasoning. We can see, however, that if water moves from a lower to a higher latitude it arrives at the higher latitude with more velocity from west to east than is appropriate to its latitude, and it will move accordingly on the earth's surface. Following out this conception, we see that an oscillation of the water to and fro between south and north must be accompanied by an eddy. Laplace's solution of the difficult problem involved in working out this idea will be given below.

The conclusion at which we have arrived about the tides of an equatorial canal is probably more nearly true of the tides of a globe partially covered with land than if we were to suppose the ocean at each moment to assume the prolate figure of equilibrium. In fact, observation shows that it is more nearly low water than high water when the moon is on the meridian. If we consider how the oscillation of the water would appear to an observer carried round with the earth, we see that he will have low water twice in the lunar day, somewhere about the time when the moon is on the meridian, either above or below the horizon, and high water half way between the low waters.

Sun's influence.

If the sun be now introduced, we have another similar tide of about half the height, and this depends on solar time, giving low water somewhere about noon and midnight. The superposition of the two, modified by friction and by the interference of land, gives the actually observed aggregate tide, and it is clear that about new and full moon we must have spring tides and at quarter moons neap tides, and that (the sum of the lunar and solar tide-generating forces being about three times their difference) the range of spring tide will be about three times that of neap tide.

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[1] Airy, "Tides and Waves."

[2] Airy, *op. cit.*, §§ 572-573.

Diurnal tide.

So far we have supposed the luminaries to move on the equator; now let us consider the case where the moon is not on the equator. It is clear in this case that at any place the moon's zenith distance at the upper transit is different from her nadir distance at the lower transit. But the tide-generating force is greater the smaller the zenith or nadir distance, and therefore the forces are different at successive transits. This was not the case when the moon was deemed to move on the equator. Thus there is a tendency for two successive lunar tides to be of unequal heights, and the resulting inequality of height is called a "diurnal tide." This tendency vanishes when the moon is on the equator; and, as this occurs each fortnight, the lunar diurnal tide is evanescent once a fortnight. Similarly in summer and winter the successive solar tides are generally of unequal height, whilst in spring and autumn this difference is inconspicuous.

vanescent in case of niform epth.

One of the most remarkable conclusions of Laplace's theory of the tides, on a globe covered with ocean to a uniform depth, is that the diurnal tide is everywhere non-existent. But this hypothesis differs much from the reality, and in fact at some ports the diurnal tide is so large that during two portions of each lunation there is only one great high water and one great low water in each twenty-four hours, whilst in other parts of the lunation the usual semi-diurnal tide is observed.

§ 4. *Historical Sketch.*[1]

In 1687 Newton laid the foundation for all that has since been added to the theory of the tides when he brought his grand generalization of universal gravitation to bear on the subject.

epler.

Kepler had indeed at an earlier date recognized the tendency of the water of the ocean to move towards the centres of the sun and moon, but he was unable to submit his theory to calculation. Galileo expresses his regret that so acute a man as Kepler should have produced a theory which appeared to him to reintroduce the occult qualities of the ancient philosophers. His own explanation referred the phenomenon to the rotation and orbital motion of the earth, and he considered that it afforded a principal proof of the Copernican system.

ewton.

In the 19th corollary of the 66th proposition of book i. of the *Principia*, Newton introduces the conception of a canal circling the earth, and he considers the influence of a satellite on the water in the canal. He remarks that the movement of each molecule of fluid must be accelerated in the conjunction and opposition of the satellite with the molecule, and retarded in the quadratures, so that the fluid must undergo a tidal oscillation. It is, however, in propositions 26 and 27 of book iii. that he first determines the tidal force due to the sun and moon. The sea is here supposed to cover the whole earth, and to assume at each instant a figure of equilibrium, and the tide-generating bodies are supposed to move in the equator. Considering only the action of the sun, he assumes that the figure is an ellipsoid of revolution with its major axis directed towards the sun, and he determines the ellipticity of such an ellipsoid. High solar tide then occurs at noon and midnight, and low tide at sunrise and sunset. The action of the moon produces a similar ellipsoid, but of greater ellipticity. The superposition of these ellipsoids gives the principal variations of tide. He then proceeds to consider the influence of latitude on the height of tide, and to discuss other peculiarities of the phenomenon. Observation shows, however, that spring tides occur a day and a half after syzygies, and Newton falsely attributed this to the fact that the oscillations would last for some time if the attractions of the two bodies were to cease.

"Astres fictifs."

The Newtonian hypothesis, although it fails in the form which he gave to it, may still be made to represent the tides, if the lunar and solar ellipsoids have their major axes always directed towards a fictitious moon and sun, which are respectively at constant distances from the true bodies; these distances are such that the syzygies of the fictitious planets occur about a day or a day and a half later than the true syzygies. In fact, the actual tides may be supposed to be generated directly by the action of the real sun and moon, and the wave may be imagined to take a day and a half to arrive at the port of observation. This period has accordingly been called "the age of the tide." In what precedes the planets have been supposed to move in the equator; but the theory of the two ellipsoids cannot be reconciled with the truth when they move in orbits inclined to the equator. At equatorial ports the theory of the ellipsoids would at spring tides give morning and evening high waters of nearly equal height, whatever the declinations of the bodies. But at a port in any other latitude these high waters would be of very different heights, and at Brest, for example, when the declinations of the bodies are equal to the obliquity of the elliptic, the evening tide would be eight times as great as the morning tide. Now observation shows that at this port the two tides are nearly equal to one another, and that their greatest difference is not a thirtieth of their sum.

Age of tide.

Newton here also offered an erroneous explanation of the phenomenon. In fact, we shall see that by Laplace's dynamical theory the diurnal tide is evanescent when the ocean is of uniform depth over the earth. At many non-European ports, however, the diurnal tide is very important, and thus as an actual means of prediction the dynamical theory, where the ocean is treated as of uniform depth, may be hardly better than the equilibrium theory.

D. Bernoulli and others.

In 1738 the Academy of Sciences of Paris offered, as a subject for a prize, the theory of the tides. The authors of four essays received prizes, viz., Daniel Bernoulli, Euler, Maclaurin, and Cavalleri. The first three adopted not only the theory of gravitation but also Newton's method of the superposition of the two ellipsoids. Bernoulli's essay contained an extended development of the conception of the two ellipsoids, and, under the name of the equilibrium theory, it is commonly associated with his name. Laplace gives an account and critique of the essays of Bernoulli and Euler in the *Mécanique Céleste*. The essay of Maclaurin presented little that was new in tidal theory, but is notable as containing those theorems concerning the attraction of ellipsoids which we now know by his name. In 1746 D'Alembert wrote a paper in which he treated the tides of the atmosphere; but this work, like Maclaurin's, is chiefly remarkable for the importance of collateral points.

Laplace.

The theory of the tidal movements of an ocean was therefore, as Laplace remarks, almost untouched when in 1774 he first undertook the subject. In the *Mécanique Céleste* he gives an interesting account of the manner in which he was led to attack the problem. We shall give below the investigation of the tides of an ocean covering the whole earth; the theory is substantially Laplace's, although presented in a somewhat different form. This theory, although very wide, is far from representing the tides of our ports. Observation shows, in fact, that the irregular distribution of land and water and the variable depth of the ocean produce an irregularity in the oscillations of the sea of such complexity that the rigorous solution of the problem is altogether beyond the power of analysis. Laplace, however, rested his discussion of tidal observation on this principle—*The state of oscillation of a system of bodies in which the primitive conditions of move-*

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[1] Founded on Laplace, *Mécanique Céleste*, bk. xiii. chap. i.

Principle of forced oscillations. *ment have disappeared through friction is coperiodic with the forces acting on the system.* Hence, if the sea is solicited by a periodic force expressed as a coefficient multiplied by the cosine of an angle which increases proportionately with the time, there results a partial tide, also expressed by the cosine of an angle which increases at the same rate; but the phase of the angle and the coefficient of the cosine in the expression for the height may be very different from those occurring in the corresponding term of the equilibrium theory. The coefficients and the constants or epochs of the angles in the expressions for the tide are only derivable from observation. The action of the sun and moon is expressible in a converging series of similar cosines; whence there arise as many partial tides, which by the principle of superposition may be added together to give the total tide at any port. In order to unite the several constants of the partial tides Laplace considers each tide as being produced by a fictitious satellite moving uniformly on the equator. Sir W. Thomson and others have followed Laplace in this conception; but in the present article we shall not do so. The difference of treatment is in reality only a matter of phraseology, and the proper motion of each one of Laplace's *astres fictifs* is at once derivable from the *argument* (or angle under the sign of cosine), which we shall here associate with the partial tides.

Lubbock, Whewell, and Airy. Subsequently to Laplace the most important workers in this field were Sir John Lubbock (senior), Whewell, and Airy. The work of Lubbock and Whewell (see § 34 below) is chiefly remarkable for the coordination and analysis of enormous masses of data at various ports, and the construction of trustworthy tide-tables and of cotidal maps. Airy contributed an important review of the whole tidal theory. He also studied profoundly the theory of waves in canals, and explained the effects of frictional resistances on the progress of tidal and other waves. Of other authors whose work is of great importance we shall speak below.

Amongst all the grand work which has been bestowed on this difficult subject, Newton, notwithstanding his errors, stands out first, and next to him we must rank Laplace. However original any future contribution to the science of the tides may be, it would seem as though it must perforce be based on the work of these two.

Bibliography. A complete list of works bearing on the *theory* of the tides, from the time of Newton down to 1881, is contained in vol. ii. of the *Bibliographie de l'Astronomie* by Houzeau and Lancaster (Brussels, 1882). This list does not contain papers on the tides of particular ports, and we are not aware of the existence of any catalogue of works on practical observation, reduction of observations, prediction, and tidal instruments. References are, however, given below to several works on these points.

II. TIDE-GENERATING FORCES.

§ 5. *Investigation of Tide-generating Potential and Forces.*

Tide-generating forces. We have already given a general explanation of the nature of tide-generating forces; we now proceed to a rigorous investigation.

If a planet is attended by a single satellite, the motion of any body relatively to the planet's surface is found by the process described as reducing the planet's centre to rest. The planet's centre will be at rest if every body in the system has impressed on it a velocity equal and opposite to that of the planet's centre; and this is accomplished by impressing on every body an acceleration equal and opposite to that of the planet's centre.

Let M, m be the masses of the planet and the satellite; r the radius vector of the satellite, measured from the planet's centre; ρ the radius vector, measured from the same point, of the particle whose motion we wish to determine; and z the angle between r and ρ. The satellite moves in an elliptic orbit about the planet, and the acceleration relatively to the planet's centre of the satellite is $(M+m)/r^2$ towards the planet along the radius vector r. Now the centre of inertia of the planet and satellite remains fixed in space, and the centre of the planet describes an orbit round that centre of inertia similar to that described by the satellite round the planet, but with linear dimensions reduced in the proportion of m to $M+m$. Hence the acceleration of the planet's centre is m/r^2 towards the centre of inertia of the two bodies. Thus, in order to reduce the planet's centre to rest, we apply to every particle of the system an acceleration m/r^2 parallel to r, and directed from satellite to planet.

Now take a set of rectangular axes fixed in the planet, and let M_1r, M_2r, M_3r be the coordinates of the satellite referred thereto; and let $\xi\rho$, $\eta\rho$, $\zeta\rho$ be the coordinates of the particle P whose radius is ρ. Then the component accelerations for reducing the planet's centre to rest are $-mM_1/r^2$, $-mM_2/r^2$, $-mM_3/r^2$; and since these are the differential coefficients with respect to $\rho\xi$, $\rho\eta$, $\rho\zeta$ of the function

$$-\frac{m\rho}{r^2}(M_1\xi+M_2\eta+M_3\zeta),$$

and since $\cos z=M_1\xi+M_2\eta+M_3\zeta$, it follows that the potential of the forces by which the planet's centre is to be reduced to rest is

$$-\frac{m\rho}{r^2}\cos z.$$

Now let us consider the other forces acting on the particle. The planet is spheroidal, and therefore does not attract equally in all directions; but in this investigation we may make abstraction of the ellipticity of the planet and of the ellipticity of the ocean due to the planetary rotation. This, which we set aside, is considered in the theories of gravity and of the figures of planets. Outside of its body, then, the planet contributes forces of which the potential is M/ρ. Next the direct attraction of the satellite contributes forces of which the potential is the mass of the satellite divided by the distance between the point P and the satellite; this is—

$$\frac{m}{\sqrt{\{r^2+\rho^2-2r\rho\cos z\}}}.$$

To determine the forces from this potential we regard ρ and z as the variables for differentiation, and we may add to this potential any constant we please. As we are seeking to find the forces which urge P relatively to M, we add such a constant as will make the whole potential at the planet's centre zero, and thus we take as the potential of the forces due to the attraction of the satellite—

$$\frac{m}{\sqrt{\{r^2+\rho^2-2r\rho\cos z\}}}-\frac{m}{r}.$$

It is obvious that r is very large compared with ρ, and we may therefore expand this in powers of ρ/r. This expansion gives us

$$\frac{m}{r}\left\{\frac{\rho}{r}P_1+\frac{\rho^2}{r^2}P_2+\frac{\rho^3}{r^3}P_3+\&c.\right\},$$

where $P_1=\cos z$, $P_2=\frac{3}{2}\cos^2 z-\frac{1}{2}$, $P_3=\frac{5}{2}\cos^3 z-\frac{3}{2}\cos z$, &c. The reader familiar with spherical harmonic analysis of course recognizes the Legendre's functions; but the result for a few terms, which is all that is necessary, is easily obtainable by simple algebra.

Now, collecting together the various contributions to the potential, and noticing that $\frac{m}{r}\cdot\frac{\rho}{r}P_1=\frac{m\rho}{r^2}\cos z$, and is therefore equal and opposite to the potential by which the planet's centre was reduced to rest, we have as the potential of the forces acting on a particle whose coordinates are $\rho\xi$, $\rho\eta$, $\rho\zeta$

$$\frac{M}{\rho}+\frac{m\rho^2}{r^3}\left(\tfrac{3}{2}\cos^2 z-\tfrac{1}{2}\right)+\frac{m\rho^3}{r^4}\left(\tfrac{5}{2}\cos^3 z-\tfrac{3}{2}\cos z\right)+\ \ldots\ldots(1).$$

The first term of (1) is the potential of gravity, and the terms of the series, of which two only are written, constitute the tide-generating potential. In all practical applications this series converges so rapidly that the first term is amply sufficient, and thus we shall generally denote

$$V=\frac{3m}{2r^3}\rho^2\left(\cos^2 z-\tfrac{1}{3}\right)\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

as the tide-generating potential.

In many mathematical works the tide-generating force is presented as being due to an artificial statical system, which produces nearly the same force as the dynamical system considered above. This statical system is as follows. Stopping all the rotations, we divide the satellite into two equal parts, and place them diametrically opposite to one another in the orbit. Then it is clear that, instead of the term

$$\frac{m}{\sqrt{\{r^2+\rho^2-2r\rho\cos z\}}}-\frac{m}{r},$$

we have

$$\frac{\frac{1}{2}m}{\sqrt{\{r^2+\rho^2-2r\rho\cos z\}}}+\frac{\frac{1}{2}m}{\sqrt{\{r^2+\rho^2+2r\rho\cos z\}}}-\frac{m}{r}.$$

And this reduces to

$$\frac{m}{r^3}\rho^2P_2+\frac{m}{r^5}\rho^4P_4+\ldots$$

The first term is the same as before; hence the statical system produces approximately the same tide-generating force as the true system. The "moon" and "anti-moon," however, produce rigorously the same force on each side of the planet, whereas the true system only satisfies this condition approximately.[1]

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[1] The reader may refer to Thomson and Tait's *Natural Philosophy* (1883), part ii. §§ 798-821, for further considerations on this and analogous subjects, together with some interesting examples.

§ 6. *Form of Equilibrium.*

Let us consider the shape assumed by a layer of fluid of density σ, lying on a globe of mass M, when acted on by disturbing forces whose potential is

$$V=\frac{3m}{2r^3}\rho^2(\cos^2 z-\tfrac{1}{3})\ \ldots\ldots\ldots\ldots(3).$$

Suppose the layer to be very thin, and that the mean radius of the layer is a, and let the equation to the boundary of the fluid be

$$\rho=a[1+\epsilon(\cos^2 z-\tfrac{1}{3})]\ \ldots\ldots\ldots\ldots(4).$$

We assume this form, because the theory of harmonic analysis tells us that the departure from sphericity must be represented by a function of the form $\cos^2 z-\frac{1}{3}$. That theory also gives us as the potential of a layer of matter of depth $a\epsilon(\cos^2 z-\frac{1}{3})$, and density σ, at an external point the value

$$\tfrac{4}{5}\pi\sigma a^2\left(\frac{a}{\rho}\right)^3\epsilon(\cos^2 z-\tfrac{1}{3}).$$

Hence the whole potential, outside of and up to the fluid layer, is

$$\frac{M}{\rho}+\frac{3m}{2r^3}\rho^2(\cos^2 z-\tfrac{1}{3})+\tfrac{4}{5}\pi\sigma a^3\left(\frac{a}{\rho}\right)^3\epsilon(\cos^2 z-\tfrac{1}{3})\ \ldots\ldots(5).$$

The first term of (5) is the potential of the globe, the second that of the disturbing force, and the third the potential due to departure from sphericity.

Now the fluid must stand in a level surface; hence, if we equate this potential to a constant, we must get back to the equation (4), which was assumed to be that of the surface. In other words, if we put $\rho=a[1+\epsilon(\cos^2 z-\frac{1}{3})]$ in (5), the result must be constant, provided the departure from sphericity is small. In effecting the substitution for ρ, we may put $\rho=a$ in the small terms, but in the first term of (5) we put

$$\frac{M}{\rho}=\frac{M}{a}\{1-\epsilon(\cos^2 z-\tfrac{1}{3})\}.$$

The whole potential (5) can only be constant if, after this substitution, the coefficient of $\cos^2 z-\frac{1}{3}$ vanishes. Thus we must have

$$-\frac{M}{a}\epsilon+\frac{3ma^2}{2r^3}+\tfrac{4}{5}\pi\sigma a^2\epsilon=0.$$

But if δ be the mean density of the planet $M=\frac{4}{3}\pi a^3\delta$, and gravity $g=M/a^2$. Then we easily find that

$$\epsilon=\frac{3ma}{2gr^3}\,\frac{1}{1-\frac{3}{5}\sigma/\delta}\ \ldots\ldots\ldots\ldots(6).$$

Form of equilibrium.

Thus the equation to the surface is

$$r=a\left\{1+\frac{3ma}{2gr^3}\,\frac{1}{1-\frac{3}{5}\sigma/\delta}(\cos^2 z-\tfrac{1}{3})\right\}\ \ldots\ldots\ldots\ldots(7).$$

If σ be small compared with δ, the coefficient is $3ma/2gr^3$; thus we see that $1/(1-\frac{3}{5}\sigma/\delta)$ is the coefficient by which the mutual attraction of the fluid augments the deformation of the fluid under the action of the disturbing force. If the density of the fluid be the same as that of the sphere, the augmenting factor becomes $\frac{5}{2}$, and we have $\epsilon=\frac{15}{4}ma/gr^3$, which gives the form of equilibrium of a fluid sphere under the action of these forces. Since $\frac{3m}{2r^3}=\frac{g}{a}\left(1-\frac{3\sigma}{5\delta}\right)\epsilon$, it follows that, when the form of equilibrium is $\rho=a[1+\epsilon(\cos^2 z-\frac{1}{3})]$, the potential of the forces is

$$V=\frac{g}{a}\left(1-\frac{3\sigma}{5\delta}\right)\epsilon\rho^2(\cos^2 z-\tfrac{1}{3})\ \ldots\ldots\ldots\ldots(8).$$

More generally, if we neglect the attraction of the fluid on itself, so that σ/δ is treated as small, and if $\rho=a(1+s)$ be the equation to the surface of the fluid, where s is a function of latitude and longitude, then the potential of the forces under which this is an equilibrium form is

$$V=\frac{g\rho^2}{a}s\ \ldots\ldots\ldots\ldots(9).$$

Tide-generating force specified by equilibrium form.

It thus appears that we may specify any tide-generating forces by means of the figure of equilibrium which the fluid would assume under them, and in the theory of the tides it has been found practically convenient to specify the forces in this way.

By means of the principle of "forced vibrations" referred to in the historical sketch, we shall pass from the equilibrium form to the actual oscillations of the sea.

§ 7. *Development of Tide-generating Potential in Terms of Hour-Angle and Declination.*

Development of tide-generating potential.

We now proceed to develop the tide-generating potential, and shall of course implicitly (§ 6) determine the equation to the equilibrium figure.

We have already seen that, if z be the moon's zenith distance at the point P on the earth's surface, whose coordinates referred to A, B, C, axes fixed in the earth, are $a\xi$, $a\eta$, $a\zeta$, then

$$\cos z=\xi M_1+\eta M_2+\zeta M_3,$$

where M_1, M_2, M_3 are the moon's direction cosines referred to the same axes. Then with this value of $\cos z$—

$$\cos^2 z-\tfrac{1}{3}=2\xi\eta M_1M_2+2\frac{\xi^2-\eta^2}{2}\cdot\frac{M_1^2-M_2^2}{2}+2\eta\zeta M_2M_3+2\xi\zeta M_1M_3$$
$$+\frac{3}{2}\,\frac{\xi^2+\eta^2-2\zeta^2}{3}\,\frac{M_1^2+M_2^2-2M_3^2}{3}\ \ldots\ldots\ldots\ldots(10).$$

The axis of C is taken as the polar axis, and AB is the equatorial plane, so that the functions of ξ, η, ζ are functions of the latitude and longitude of the point P, at which we wish to find the potential.

The functions of M_1, M_2, M_3 depend on the moon's position, and we shall have occasion to develop them in two different ways,—first in terms of her hour-angle and declination, and secondly (§ 23) in terms of her longitude and the elements of the orbit.

Now let A be on the equator in the meridian of P, and B 90° east of A on the equator. Then, if M be the moon, the inclination of the plane MC to the plane CA is the moon's easterly local hour-angle. Let h = local hour-angle of moon and δ = moon's declination: we have

$$M_1=\cos\delta\cos h,\quad M_2=\cos\delta\sin h,\quad M_3=\sin\delta,$$

whence

$$2M_1M_2=\cos^2\delta\sin 2h,\quad M_1^2-M_2^2=\cos^2\delta\cos 2h,$$
$$2M_2M_3=2\sin\delta\cos\delta\sin\lambda,\quad 2M_1M_3=2\sin\delta\cos\delta\cos h,$$
$$\frac{M_1^2+M_2^2-2M_3^2}{3}=\tfrac{1}{3}-\sin^2\delta.$$

Also, if λ be the latitude of P,

$$\xi=\cos\lambda,\quad\eta=0,\quad\zeta=\sin\lambda,$$

and

$$\xi\eta=0,\ \frac{\xi^2-\eta^2}{2}=\tfrac{1}{2}\cos^2\lambda,\ \xi\zeta=\tfrac{1}{2}\sin 2\lambda,\ \xi\eta=0,$$
$$\tfrac{1}{3}(\xi^2+\eta^2-2\zeta^2)=\tfrac{1}{3}-\sin^2\lambda.$$

Hence (10) becomes

$$\cos^2 z-\tfrac{1}{3}=\tfrac{1}{2}\cos^2\lambda\cos^2\delta\cos 2h+\sin 2\lambda\sin\delta\cos\delta\cos h$$
$$+\tfrac{3}{2}(\tfrac{1}{3}-\sin^2\delta)(\tfrac{1}{3}-\sin^2\lambda)\ \ldots\ldots\ldots\ldots(11).$$

The angle h, as defined at present, is the eastward local hour-angle, and therefore diminishes with the time. As, however, this function does not change sign with h, it will be more convenient to regard it as the westward local hour-angle. Also, if h_0 be the Greenwich westward hour-angle at the moment under consideration, and l be the west longitude of the place of observation P, we have

$$h=h_0-l\ \ldots\ldots\ldots\ldots(12).$$

Hence we have at the point P, whose radius vector is a,

$$V=\frac{3ma^2}{2r^3}\{\tfrac{1}{2}\cos^2\lambda\cos^2\delta\cos 2(h_0-l)+\sin 2\lambda\sin\delta\cos\delta\cos(h_0-l)$$
$$+\tfrac{3}{2}(\tfrac{1}{3}-\sin^2\delta)(\tfrac{1}{3}-\sin^2\lambda)\}\ \ldots\ldots\ldots\ldots(13).$$

Potential developed in hour-angle and declination.

The tide-generating forces are found by the rates of variation of V for latitude and longitude, and also for radius a, if we care to find the radial disturbing force.

§ 8. *Evaluation of Tide-generating Forces, and Lunar Deflexion of Gravity.*

The westward component of the tide-generating force at the earth's surface, where $\rho=a$, is $dV/a\cos\lambda dl$, and the northward component is $dV/ad\lambda$; the change of apparent level is the ratio of these to gravity g. Therefore, differentiating (13), changing signs, and writing $\frac{3m}{2M}\left(\frac{a}{r}\right)^3$ for $\frac{3ma}{2gr^3}$, we have component change of level southward

$$=\frac{3m}{4M}\left(\frac{a}{r}\right)^3\{\sin 2\lambda\cos^2\delta\cos 2(h_0-l)-2\cos 2\lambda\sin 2\delta\cos(h_0-l)$$
$$+\sin 2\lambda(1-3\sin^2\delta)\};$$

Lunar deflexion of gravity.

component change of level westward

$$=\frac{3m}{2M}\left(\frac{a}{r}\right)^3\{\cos\lambda\cos^2\delta\sin 2(h_0-l)$$
$$+\sin\lambda\sin 2\delta\sin(h_0-l)\}\ \ldots\ldots\ldots\ldots(14).$$

The westward component is made up of two periodic terms, one going through its variations twice and the other once a day. The southward component has also two similar terms; but it has a third term, which does not oscillate about a zero value. If Δ be a declination such that the mean value of $\sin^2\delta$ is equal to $\sin^2\Delta$, then, to determine the southward component so that it shall be a truly periodic function, we must subtract from the above $\sin 2\lambda(1-3\sin^2\Delta)$, and the last term then becomes

$$3\sin 2\lambda(\sin^2\Delta-\sin^2\delta).$$

In the case of the moon, Δ varies a little according to the position of the moon's node, but its mean value is about 16° 31′.

The constant portion of the southward component of force has its effect in causing a constant heaping up of the water at the equator; or, in other words, the moon's attraction has the effect of causing a small permanent ellipticity of the earth's mean figure. This augmentation of ellipticity is of course very small, but it is necessary to mention it in order that the meaning to be attributed to lunar deflexion of gravity may be clearly defined.

If we consider the motion of a pendulum-bob during any one day, we see that, in consequence of the semi-diurnal changes of level, it twice describes an ellipse with major axis east and west, with ratio of axes equal to the sine of the latitude, and with linear dimensions proportional to $\cos^2\delta$, and it once describes an ellipse whose north and south axis is proportional to $\sin 2\delta\cos 2\lambda$ and whose east and west axis is proportional to $\sin 2\delta \sin\lambda$. Obviously the latter is circular in latitude 30°. When the moon is on the equator, the maximum deflexion occurs when the moon's local hour-angle is 45°, and is then equal to

$$\frac{3m}{2M}\left(\frac{a}{r}\right)^3\cos\lambda.$$

At Cambridge in latitude 52° 43′ this angle is 0″·0216.

An attempt, made by George and Horace Darwin,[1] to measure the lunar deflexion of a pendulum failed on account of incessant variability of level occurring in the supports of the pendulum and arising from unknown terrestrial changes. The work done, therefore, was of no avail for the purposes for which it was instituted, but remained as a contribution to an interesting subject now beginning to be studied, viz., the small changes which are always taking place on the upper strata of the earth.

§ 9. *Correction to Equilibrium Theory for Continents.*

Effect of land in equilibrium theory.

In the equilibrium theory as worked out by Newton and Bernoulli it is assumed that the figure of the ocean is at each instant one of equilibrium under the action of gravity and of the tide-generating forces. Sir W. Thomson has, however, reasserted[2] a point which was known to Bernoulli, but has since been overlooked, namely, that this law of rise and fall of water cannot, when portions of the globe are continents, be satisfied by a constant volume of water in the ocean. The law would still hold if water were appropriately supplied to and exhausted from the ocean; and, if in any configuration of the tide-generating body we imagine water to be instantaneously so supplied or exhausted, the level will everywhere rise or fall by the same height. Now the amount of that rise or fall depends on the position of the tide-generating body with reference to the continents, and is different for each such position. Conversely, when the volume of the ocean remains constant, we have to correct Bernoulli's simple equilibrium theory by an amount which is constant all over the globe at any instant, but which changes in time. Thomson's solution of this problem has since been reduced to a form which is easier to grasp intelligently than in the shape in which he gave it, and the results have also been reduced to numbers.[3] It appears that there are four points on the earth's surface at which in the corrected theory the semi-diurnal tide is evanescent, and four others where it is doubled. A similar statement holds for the diurnal tide. As to the tides of long period, there are two parallels of latitude of evanescent and two of doubled tide.

Now in Bernoulli's theory the semi-diurnal tide vanishes at the poles, the diurnal tide at the poles and the equator, and the tides of long period in latitudes 35° 16′ north and south. The numerical solution of the corrected theory shows that the points and lines of doubling and evanescence in every case fall close to the points and lines where in the uncorrected theory there is evanescence. When in passing from the uncorrected to the corrected theory we speak of a doubled tide, the tide doubled may be itself *nil*, so that the result may still be *nil*. The conclusion, therefore, is that Thomson's correction, although theoretically interesting, is practically so small that it may be left out of consideration.

III. DYNAMICAL THEORY OF TIDES.

§ 10. *Historical Explanation.*

Dynamical theory.

The problem of tidal oscillation is essentially a dynamical one. Even when the ocean is taken as covering the whole earth, it presents formidable difficulties, and this is the only case in which it has been hitherto solved.[4] Laplace gives the solution in bks. i. and iv. of the *Mécanique Céleste*; but his work is unnecessarily complicated by the inappropriate introduction of spherical harmonic analysis, and it is generally admitted that his investigation is difficult. Airy, in his "Tides and Waves" (in *Ency. Metrop.*) presents the solution free from that complication, but he has made a criticism of Laplace's method which we believe to be wrong. Sir W. Thomson has written some interesting papers (in *Phil. Mag.*, 1875) in justification of Laplace, and on these we base the following paragraphs. This portion of the article is given more fully than others, because there exists no complete presentment of the theory free from objections of some kind.

§ 11. *Equations of Motion.*

Equations of motion.

Let r, θ, ϕ be the radius vector, co-latitude, and east longitude of a point with reference to an origin, a polar axis, and a zero-meridian rotating with a uniform angular velocity n from west to east. Then, if R, H, Ξ be the radial, co-latitudinal, and longitudinal accelerations of the point, we have

$$\left.\begin{aligned} R&=\frac{d^2r}{dt^2}-r\left(\frac{d\theta}{dt}\right)^2-r\sin^2\theta\left(\frac{d\phi}{dt}+n\right)^2\\ \Xi&=\frac{1}{r}\frac{d}{dt}\left(r^2\frac{d\theta}{dt}\right)-r\sin\theta\cos\theta\left(\frac{d\phi}{dt}+n\right)^2\\ H&=\frac{1}{r\sin\theta}\frac{d}{dt}\left[r^2\sin^2\theta\left(\frac{d\phi}{dt}+n\right)\right]\end{aligned}\right\}\text{.......(15).}$$

Now suppose that the point never moves far from a zero position and that its displacements ξ, $\eta\sin\theta$ co-latitudinally and longitudinally are very large compared with its radial displacement ρ, and that the velocities are so small that their squares and products are negligible compared with n^2r^2; then we have

$$\frac{dr}{dt}=\frac{d\rho}{dt}, \text{ a very small quantity;}$$

$$r\sin\theta\frac{d\phi}{dt}=\frac{d}{dt}(\eta\sin\theta),$$

$$r\frac{d\theta}{dt}=\frac{d\xi}{dt}.$$

Hence (15) is approximately

$$\left.\begin{aligned} R&=-n^2r\sin^2\theta\\ \Xi&=\frac{d^2\xi}{dt^2}-2n\sin\theta\cos\theta\frac{d\eta}{dt}\\ H&=\sin\theta\frac{d^2\eta}{dt^2}+2n\cos\theta\frac{d\xi}{dt}\end{aligned}\right\}\text{.................. (16)}$$

Component accelerations.

With regard to the first equation of (16), we observe that the time has disappeared, and that R has exactly the same form as if the system were rendered statical by introducing a potential $\frac{1}{2}n^2r^2\sin^2\theta$ and annulling the rotation of the axes. Since inertia plays no sensible part radially, it follows that, if we apply these expressions to the formation of equations of motion for the ocean, the radial motion need not be considered. We are left, therefore, with only the last two equations of (16).

Component forces.

We now have to consider the forces by which an element of the ocean is urged in the direction of co-latitude and longitude. These forces are those due to the external disturbing forces and to the pressure of the surrounding fluid, the attraction of the fluid on itself being supposed negligible. We have seen in (9) that, if fluid on a sphere of radius a be under the action of disturbing forces whose potential is Ur^2, and if $r=a+\mathfrak{h}$ be the equation to the surface, then must $g\mathfrak{h}=Ua^2$. Hence, if ϵ be the equilibrium height of tide, the potential of the disturbing force is $g\epsilon r^2/a^2$. But, if the elevation be $\mathfrak{h}$, the potential under which it would be in equilibrium is $g\mathfrak{h}r^2/a^2$. Therefore, if $\mathfrak{h}$ be the elevation of the tide in our dynamical problem, the forces due to hydrostatic pressure on an element of the ocean are the same as would be caused by a potential $-g\mathfrak{h}r^2/a^2$. Hence it follows that the whole forces on the element are those due to a potential $-g(\mathfrak{h}-\epsilon)r^2/a^2$. Therefore from (16) we see that the equations of motion are

$$\left.\begin{aligned} \frac{d^2\xi}{dt^2}-2n\sin\theta\cos\theta\frac{d\eta}{dt}&=-\frac{g}{a}\frac{d}{d\theta}(\mathfrak{h}-\epsilon)\\ \sin\theta\frac{d^2\eta}{dt^2}+2n\cos\theta\frac{d\xi}{dt}&=-\frac{g}{a\sin\theta}\frac{d}{d\phi}(\mathfrak{h}-\epsilon)\end{aligned}\right\}\text{.....(17).}$$

Equations motion

It remains to find the equation of continuity. This may be deduced geometrically from the consideration that the volume of an element of the fluid remains constant; but a shorter way is to derive it from the equation of continuity as it occurs in ordinary hydrodynamical investigations. If V be a velocity potential, the equation of continuity for incompressible fluid is

$$\delta r\frac{d}{dr}\left(r^2\frac{dV}{dr}\sin\theta\,\delta\theta\,\delta\phi\right)+\delta\theta\frac{d}{d\theta}\left(r\sin\theta\frac{dV}{rd\theta}\delta r\,\delta\phi\right)$$
$$+\delta\phi\frac{d}{d\phi}\left(r\frac{1}{r\sin\theta}\frac{dV}{d\phi}\delta r\,\delta\theta\right)=0.$$

The element referred to in this equation is defined by r, θ, ϕ, $r+\delta r$, $\theta+\delta\theta$, $\phi+\delta\phi$. The co-latitudinal and longitudinal velocities are the same for all the elementary prism defined by θ, ϕ, $\theta+\delta\theta$, $\phi+\delta\phi$, and the sea bottom. Then $\frac{dV}{rd\theta}=\frac{d\xi}{dt}$, $\frac{dV}{r\sin\theta d\phi}=\sin\theta\frac{d\eta}{dt}$; and, since the radial velocity is $d\mathfrak{h}/dt$ at the surface of the ocean, where $r=a+\gamma$, and is zero at the sea bottom, where $r=a$, we have $\frac{dV}{dr}=\frac{r-a}{\gamma}\frac{d\mathfrak{h}}{dt}$. Hence, integrating with respect to from $r=a+\gamma$ to $r=a$, and again with respect to t from the time t to the time when $\mathfrak{h}$, ξ, η all vanish, and treating γ and $\mathfrak{h}$ as small compared with a, we have

$$\mathfrak{h}a\sin\theta+\frac{d}{d\theta}(\gamma\xi\sin\theta)+\frac{d}{d\phi}(\gamma\eta\sin\theta)=0\text{.........(18).}$$

Equation conti ity.

This is the equation of continuity, and, together with (17), it forms the system which must be integrated in the general problem of the tides. The difficulties in the way of a solution are so great that none has hitherto been found, except on the supposition that γ, the depth of the ocean, is only a function of latitude. In this case (18) becomes

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[1] *Reports to the British Assoc.*, 1881 (York) and 1882 (Southampton).

[2] Thomson and Tait, *Nat. Phil.*, § 807.

[3] Darwin and Turner, *Proc. Roy. Soc.*, 1886.

[4] Sir W. Thomson's paper "On the Gravitational Oscillations of Rotating Water," in *Phil. Mag.*, August 1880, bears on the same subject. It is the only attempt which has hitherto been made to consider the effects of the earth's rotation on the oscillations of land-locked seas.

$$\mathfrak{h}a+\frac{1}{\sin\theta}\frac{d}{d\theta}(\gamma\xi\sin\theta)+\gamma\frac{d\eta}{d\phi}=0 \text{ ....(19).}$$

§ 12. *Adaptation to Forced Oscillations.*

Since we may suppose that the free oscillations are annulled by friction, the solution required is that corresponding to forced oscillations. Now we have seen from (13) that $\mathfrak{e}$ (which is proportional to V) has terms of three kinds, the first depending on twice the moon's (or sun's) hour-angle, the second on the hour-angle, and the third independent thereof. The coefficients of the first and second terms vary slowly, and the whole of the third varies slowly. Hence $\mathfrak{e}$ has a semi-diurnal, a diurnal, and a long period term. We shall see later that these terms may be expanded in a series of approximately semi-diurnal, diurnal, and slowly varying terms, each of which is a strictly harmonic function of the time. Thus we may assume for $\mathfrak{e}$ a form $\mathrm{e}\cos(2nft+k\phi+\alpha)$, where f and k are numbers, and where e is only a function of co-latitude and of the elements of the orbit of the disturbing body. According to the usual method of treating oscillating systems, we may therefore make the following assumption for the form of solution

$$\left.\begin{aligned}\mathfrak{e}&=\mathrm{e}\cos(2nft+k\phi+\alpha)\\ \mathfrak{h}&=\mathrm{h}\cos(2nft+k\phi+\alpha)\\ \xi&=\mathrm{x}\cos(2nft+k\phi+\alpha)\\ \eta&=\mathrm{y}\sin(2nft+k\phi+\alpha)\end{aligned}\right\}\text{ ...(20),}$$

where e, h, x, y are functions of co-latitude θ only. Substituting these values in (19), we have

$$\frac{1}{\sin\theta}\frac{d}{d\theta}(\gamma\mathrm{x}\sin\theta)+k\gamma\mathrm{y}+\mathrm{h}a=0 \text{ ....(21).}$$

Then, if we write u for h − e, and put $m=n^2a/g$, substitution from (20) in (17) leads at once to

$$\left.\begin{aligned}\mathrm{x}f^2+\mathrm{y}f\sin\theta\cos\theta&=\frac{1}{4m}\frac{d\mathrm{u}}{d\theta}\\ \mathrm{y}f^2\sin\theta+\mathrm{x}f\cos\theta&=-\frac{k}{4m}\frac{\mathrm{u}}{\sin\theta}\end{aligned}\right\}\text{............(22).}$$

Solving (22) for x and y, we have

$$\left.\begin{aligned}\mathrm{x}(f^2-\cos^2\theta)&=\frac{1}{4m}\left(\frac{d\mathrm{u}}{d\theta}+\frac{k}{f}\mathrm{u}\frac{\cos\theta}{\sin\theta}\right)\\ \mathrm{y}\sin\theta(f^2-\cos^2\theta)&=\frac{-1}{4m}\left(\frac{\cos\theta}{f}\frac{d\mathrm{u}}{d\theta}+\frac{k\mathrm{u}}{\sin\theta}\right)\end{aligned}\right\}\text{ ...(23).}$$

Then substituting from (23) in (21), we have

$$\frac{1}{\sin\theta}\frac{d}{d\theta}\left[\frac{\gamma\left(\sin\theta\frac{d\mathrm{u}}{d\theta}+\frac{k}{f}\mathrm{u}\cos\theta\right)}{f^2-\cos^2\theta}\right]-k\gamma\frac{\frac{\cos\theta}{f}\frac{d\mathrm{u}}{d\theta}+\frac{k\mathrm{u}}{\sin\theta}}{\sin\theta(f^2-\cos^2\theta)}$$
$$+4ma(\mathrm{u}+\mathrm{e})=0\text{ ....(24).}$$

This is Laplace's equation for tidal oscillations in an ocean whose depth is only a function of latitude. When u is found from this equation, its value substituted in (23) will give x and y.

§ 13. *Preparation for Solution.*

The ocean which is considered in this case is not like that on the earth's surface, and therefore it does not seem desirable to pursue the integration of (24) except in certain typical cases.

In (13) we have the expansion of the disturbing potential and implicitly of the disturbing forces in three terms, the first of which is variable in half a day, the second in a day, and the third in half the period of revolution of the tide-raising body. Forestalling the results of chapter iv.—each of these terms may be expressed as the sum of a series of strictly harmonic functions of the time; the first set of these have all approximately semi-diurnal periods, the second approximately diurnal periods, and the third vary slowly in dependence on the periodic time of the tide-generating body. The first set involve twice the terrestrial longitude, the second the longitude, and the third set are independent of the longitude of the place of observation. From these statements compared with (13) we see that in the semi-diurnal terms f is approximately unity, $k=2$, and $\mathfrak{e}=\mathrm{E}\sin^2\theta$; in the diurnal terms f is approximately $\frac{1}{2}$, $k=1$, and $\mathfrak{e}=\mathrm{E}\sin\theta\cos\theta$; in the terms of long period f is a small fraction (for the fortnightly tide about $\frac{1}{27}$), $k=0$, $\mathfrak{e}=\mathrm{E}(\frac{1}{3}-\cos^2\theta)$. The departure from exactness in the relation $f=1$ for the semi-diurnal, and $f=\frac{1}{2}$ for the diurnal terms is generally (except for certain critical depths of ocean) not such as to greatly change the nature of the results from those obtained when $f=1$ and $\frac{1}{2}$ rigorously. Hence the integration of (24) will be pursued on these three hypotheses, giving Laplace's three kinds of oscillation. The hypothesis which will be made with regard to γ is that $\gamma=l(1-q\cos^2\theta)$, and in the case of the semi-diurnal tides we shall be compelled by mathematical difficulties to suppose q to be either unity or zero. The tides of zonal seas may be worked out, and more complex laws of depth may be assumed; but for the discussion of such cases the reader is referred to Thomson's papers in *Phil. Mag.*, 1875.

There might be reason to conjecture that the form of u would be similar to that of e, and this is in fact the case for the diurnal tides for any value of q and for the semi-diurnal tides when q is unity.

Preliminary transformations.

Before proceeding further it will be convenient to exhibit two purely analytical transformations of the first two terms of (24) which hold true for certain values of k and f, and when u has such a form as that suggested. If we put $k=1$, $f=\frac{1}{2}$, $\gamma=l(1-q\cos^2\theta)$, then, if $v=A\sin\theta\cos\theta$, it will be found on substitution that

$$\frac{1}{\sin\theta}\frac{d}{d\theta}\frac{\gamma\left(\sin\theta\frac{dv}{d\theta}+2v\cos\theta\right)}{\frac{1}{4}-\cos^2\theta}-\gamma\frac{2\cot\theta\frac{dv}{d\theta}+\frac{v}{\sin^2\theta}}{\frac{1}{4}-\cos^2\theta}=-8lqv\text{ ...(25).}$$

Again, if we put $k=2$, $f=1$, $q=1$, $\gamma=l(1-\cos^2\theta)=l\sin^2\theta$, and if $v=A\sin^2\theta$,

$$\frac{1}{\sin\theta}\frac{d}{d\theta}\frac{\gamma\left(\sin\theta\frac{dv}{d\theta}+2v\cos\theta\right)}{1-\cos^2\theta}-2\gamma\frac{\cot\theta\frac{dv}{d\theta}+\frac{2v}{\sin^2\theta}}{1-\cos^2\theta}=-8lv\text{ ...(26).}$$

Another general property of (24) is derived from the supposition that u is expressed in a series proceeding by powers of l; thus

$$\mathrm{u}=v_0+v_1\frac{l}{a}+v_2\frac{l^2}{a^2}+\dots\text{ ....(27).}$$

Let v_0, v_1, v_2, &c., be so chosen that, when u is substituted in (24), the coefficient of each power of l vanishes independently; then the term independent of l obviously gives $v_0=-\mathrm{e}$, and the connexion between successive v's is

$$\frac{1}{\sin\theta}\frac{d}{d\theta}\left[\frac{\gamma\left(\sin\theta\frac{dv_m}{d\theta}+\frac{k}{f}v_m\cos\theta\right)}{f^2-\cos^2\theta}\right]-k\gamma\frac{\left(\frac{\cos\theta}{f}\frac{dv_m}{d\theta}+\frac{kv_m}{\sin\theta}\right)}{\sin\theta(f^2-\cos^2\theta)}$$
$$+4mlv_{m+1}=0\text{ ....(28).}$$

We shall suppose below that u is expansible in the form (27), and shall use (28) in conjunction with (25) or (26) for finding the successive values of the v's.

§ 14. *Diurnal Tide.*

Diurnal tide.

Let us first consider the diurnal tides. We have $\mathrm{e}=\mathrm{E}\sin\theta\cos\theta$, $k=1$, and $f=\frac{1}{2}$; then $v_0=-\mathrm{E}\sin\theta\cos\theta$. Hence by (28) and (25)

$$-8lqv_0+4mlv_1=0\text{ ....(29),}$$

and therefore $v_1=\frac{2q}{m}v_0$. Applying the same theorem a second time, $v_2=(2q/m)v_1$, and so on; therefore $\mathrm{u}=v_0[1+2lq/ma+(2lq/ma)^2+\dots]$

$$=\frac{v_0}{1-2lq/ma}=-\frac{\mathrm{e}}{1-2lq/ma}\text{ ....(30).}$$

But $\mathrm{u}=\mathrm{h}-\mathrm{e}$; hence $\mathrm{h}=-\frac{2lq/ma}{1-2lq/ma}\mathrm{e}$ ....(31).

It appears, therefore, that the tide is "inverted," giving low water where the equilibrium tide gives high water. If $q=0$, so that the ocean is of uniform depth, the tide vanishes.

§ 15. *Semi-Diurnal Tide, with Variable Depth.*

Semi-diurnal tide.

Next let us consider the semi-diurnal tide in the case where $q=1$, so that $\gamma=l\sin^2\theta$. Then $\mathrm{e}=\mathrm{E}\sin^2\theta$, $k=2$, $f=1$; also $v_0=-\mathrm{e}=-\mathrm{E}\sin^2\theta$. Hence by (28) and (26) $-8lv_0+4mlv_1=0$, whence $v_1=2/mv_0$. Applying the same theorem a second time, $v_2=(2/m)^2v_0$, and so on; therefore $\mathrm{u}=v_0[1+2l/ma+(2l/ma)^2+\dots]$

$$=\frac{v_0}{1-2l/ma}=-\frac{\mathrm{e}}{1-2l/ma}.$$

Hence $\mathrm{h}=\mathrm{u}+\mathrm{e}=-\frac{2l/ma}{1-2l/ma}\mathrm{e}$ ....(32).

If $2l/ma=\frac{1}{2}$, the height of tide is equal to the equilibrium height; but it is inverted, giving low water where the equilibrium theory gives high water. In the case of the earth $m=1/289$, and therefore this relation is satisfied if $l=a/1156$. Hence in a sea 3000 fathoms deep at the equator, and shallowing to the poles, we have inverted semi-diurnal tides of the equilibrium height.

§ 16. *Semi-Diurnal Tide, with Uniform Depth.*

The method of development used above, where we proceed by powers of the depth of the ocean, is not applicable where the depth is uniform, because it leads to a divergent series. We have therefore to resume equation (24). In the case of the semi-diurnal tides we have for the depth $\gamma=l$ (a constant by hypothesis), $k=2$, $f=1$ approximately, and $\mathrm{e}=\mathrm{E}\sin^2\theta$. Now for brevity let $\beta=4ma/l$, $\nu=\sin\theta$, so that $\mathrm{e}=\mathrm{E}\nu^2$. Then we find that on development (24) becomes

$$\nu^2(1-\nu^2)\frac{d^2\mathrm{u}}{d\nu^2}-\nu\frac{d\mathrm{u}}{d\nu}-(8-2\nu^2-\beta\nu^4)\mathrm{u}=-\beta\mathrm{E}\nu^6\text{ ......(33).}$$

Let us now assume as the solution of this equation

$$\mathrm{u}=(K_2-\mathrm{E})\nu^2+K_4\nu^4+K_6\nu^6+\dots+K_{2i}\nu^{2i}+\dots\text{ ......(34).}$$

Substituting from (34) in (33), and equating to zero the coefficients of the successive powers of ν, we find $K_2=E$, K_4 apparently indeterminate, and

$$2i(2i+6)K_{2i+4}-2i(2i+3)K_{2i+2}+\beta K_{2i}=0\text{ ......(35).}$$

Since $K_0=0$, this equation of condition may be held to apply for all positive integral values of i, beginning with $i=0$. It is obvious that K_6 is determinable in terms of K_4 and K_2, K_8 in terms of K

and K_6, &c., so that all the K's are to be found in terms of K_2, which is known, and of K_4, which is apparently indeterminate.

The condition for the convergency of the series (34) for u and for the series $du/d\nu$ is that K_{2i+2}/K_{2i} shall tend to a limit less than unity. The equation (35) may be written

$$\frac{K_{2i+4}}{K_{2i+2}}=\frac{2i+3}{2i+6}-\frac{\beta}{2i(2i+6)}\frac{K_{2i}}{K_{2i+2}}\text{..............(36).}$$

Now K_{2i+2}/K_{2i} tends to be either infinitely small or not infinitely small. If it be not infinitely small in the limit, the second term on the right of (36) becomes evanescent when i is very great, and we have in the limit when i is very large—

$$\frac{K_{2i+4}\nu^{2i+4}}{K_{2i+2}\nu^{2i+2}}=\frac{2i+3}{2i+6}\nu^2=\left[1-\frac{3}{2(i+3)}\right]\nu^2=\left[1-\frac{3}{2i}\right]\nu^2.$$

But the ratio of successive terms of $\sqrt{(1-\nu^2)}$ tends to become $(1-\tfrac{3}{2}/i)\nu^2$. Hence, if K_{2i+2}/K_{2i} does not tend to become infinitely small, $\mathrm{u}=\mathrm{A}+\mathrm{B}\sqrt{1-\nu^2}$, where A and B are finite for all values of ν. Again, under the same circumstances we have in the limit when i is very large—

$$\frac{(2i+4)K_{2i+4}\nu^{2i+3}}{(2i+2)K_{2i+2}\nu^{2i+1}}=\frac{2i+4}{2i+2}\cdot\frac{2i+3}{2i+6}\nu^2=\left(1+\frac{1}{i+1}\right)\left(1-\frac{3}{2(i+3)}\right)\nu^2$$
$$=(1-1/2i)\nu^2.$$

But the ratio of successive terms of $(1-\nu^2)^{-\frac{1}{2}}$ tends to $(1-\tfrac{1}{2}/i)\nu^2$. Hence, if K_{2i+2}/K_{2i} does not tend to become infinitely small, $d\mathrm{u}/d\nu=\mathrm{C}+\mathrm{D}(1-\nu^2)^{-\frac{1}{2}}$, where C and D are finite for all values of ν.

Now $$\frac{d\mathrm{u}}{d\theta}=\frac{d\mathrm{u}}{d\nu}\sqrt{1-\nu^2}=\mathrm{C}\sqrt{1-\nu^2}+\mathrm{D}.$$

Therefore at the equator, where $\nu=1$, $d\mathrm{u}/d\theta=\mathrm{D}$, a finite quantity. Hence the hypothesis that K_{2i+2}/K_{2i} tends to be not infinitely small leads to the conclusion that u and $d\mathrm{u}/d\theta$ are finite at the equator. But on account of the symmetry of the system the co-latitudinal displacement ξ must vanish at the equator, and therefore x also. By (23), when $f=1$, $k=2$, $\nu=\sin\theta$,

$$\nu^2\mathrm{x}=\frac{1}{4m}\left(\frac{d\mathrm{u}}{d\theta}+2\mathrm{u}\cos\theta\right).$$

But we have just seen that this hypothesis makes u finite when $\nu=1$ or $\theta=90°$, and therefore at the equator

$$\mathrm{x}=\frac{1}{4m}\frac{d\mathrm{u}}{d\theta},\text{ a finite quantity.}$$

Now symmetry necessitates a vanishing value of $d\mathrm{u}/d\theta$ at the equator. Thus the hypothesis that K_{2i+2}/K_{2i} tends to be not infinitely small is negatived, and we conclude that, on account of the symmetry of the motion, it is infinitely small for infinitely great values of i. This being established, let us write (36) in the form

$$\frac{K_{2i+2}}{K_{2i}}=\frac{\frac{1}{2}\beta}{2i^2+3i-(2i^2+6i)K_{2i+4}/K_{2i+2}}\text{ ....(36a).}$$

Method of continued fraction. Hence by repeated application of (36a) we have

$$\frac{K_{2i+2}}{K_{2i}}=\frac{\frac{1}{2}\beta}{2i^2+3i-}\frac{(i^2+3i)\beta}{2(i+1)^2+3(i+1)-}\frac{[(i+1)^2+3(i+1)]\beta}{2(i+2)^2+3(i+2)-\&c.}\text{ (37).}$$

And we know that this is a continuous approximation to K_{2i+2}/K_{2i}, which must hold in order that the latitudinal velocity may vanish at the equator. Writing $N_i=K_{2i+2}/K_{2i}$, all the N's may be computed from the continued fraction (37). Then

$$K_2=\mathrm{E},\ K_4/\mathrm{E}=N_1,\ K_6/\mathrm{E}=N_1N_2,\ K_8/\mathrm{E}=N_1N_2N_3,\ \&c.$$

We cannot compute K_6 from K_4, K_8 from K_6, and so on; for, if we do, then, short of infinite accuracy in the numerical values, we shall be gradually led to successive values of the K's which tend to equality.[1]

This process was followed by Laplace without explanation. It was attacked by Airy in his "Tides and Waves" (in *Ency. Metrop.*) and by Ferrel in his *Tidal Researches* (U.S. Coast Survey, 1873), but was justified by Sir W. Thomson in the *Phil. Mag.* (1875, p. 230). The investigation given here is substantially Thomson's.

Solutions. Laplace gives numerical solutions for three different depths of the sea, $\frac{1}{2890}$, $\frac{1}{722\frac{1}{2}}$, $\frac{1}{361\frac{1}{4}}$ of the earth's radius. Since $m=\frac{1}{289}$, these correspond respectively to the cases of $\beta=40$, 10, 5, and the solutions are

$$\begin{aligned}\beta=40,\ \mathrm{h}=\mathrm{E}\{&\nu^2+20{\cdot}1862\nu^4+10{\cdot}1164\nu^6-13{\cdot}1047\nu^8-15{\cdot}4488\nu^{10}\\&-7{\cdot}4581\nu^{12}-2{\cdot}1975\nu^{14}-0{\cdot}4501\nu^{16}-0{\cdot}0687\nu^{18}\\&-0{\cdot}0082\nu^{20}-0{\cdot}0008\nu^{22}-0{\cdot}0001\nu^{24}\ldots\}\\ \beta=10,\ \mathrm{h}=\mathrm{E}\{&\nu^2+6{\cdot}1960\nu^4+3{\cdot}2474\nu^6+0{\cdot}7238\nu^8+0{\cdot}0919\nu^{10}\\&+0{\cdot}0076\nu^{12}+0{\cdot}0004\nu^{14}\ldots\}\\ \beta=5,\ \mathrm{h}=\mathrm{E}\{&\nu^2+0{\cdot}7504\nu^4+0{\cdot}1566\nu^6+0{\cdot}0157\nu^8+0{\cdot}0009\nu^{10}+\ldots\}\end{aligned}$$

Since h vanishes when $\nu=0$, there is no rise and fall of water at the poles. When $\nu=1$ at the equator, we find

$$\begin{aligned}\beta&=40,\ \mathrm{h}=-7{\cdot}434\,\mathrm{E}\\ \beta&=10,\ \mathrm{h}=11{\cdot}267\,\mathrm{E}\\ \beta&=5,\ \mathrm{h}=1{\cdot}924\,\mathrm{E}.\end{aligned}$$

The negative sign in the first case shows that the tide is inverted at the equator, giving low water when the disturbing body is on the meridian. Near the pole, however, that is, for small values of ν, the tides are direct. In latitude 18° (approximately) there is a nodal line of evanescent semi-diurnal tide. In the second and third cases the tides are everywhere direct, increasing in magnitude from pole to equator. As β diminishes the tides tend to assume their equilibrium value, because all the terms, save the first, become evanescent. When $\beta=1$ (depth $\frac{1}{72}$ of radius) the tide at the equator still exceeds its equilibrium value by 11 per cent. As β diminishes from 40 to 10 the nodal line of evanescent tide contracts round the pole, and when it is infinitely small the tides are infinitely great. The particular value of β for which this occurs is that where the free oscillation of the ocean has the same period as the forced oscillation. The values chosen by Laplace were not well adapted for the illustration of the results, because in the cases of $\beta=40$ and $\beta=10$ the depth of the ocean is not much different from that value which would give infinite semi-diurnal tide. For values of β greater than 40 we should find other nodal lines dividing the sphere into regions of direct and inverted tides. We refer the reader to Sir W. Thomson's papers for further details on this interesting point.

§ 17. *Tides of Long Period; Laplace's Argument from Friction.*

Laplace's argument from friction unsound. In treating these oscillations Laplace remarks that a very small amount of friction will be sufficient to cause the surface of the ocean to assume at each instant its form of equilibrium, and he adduces in proof of his conclusion the considerations given below. The friction here contemplated is such that the integral effect is represented by a retarding force proportional to the velocity of the water relatively to the bottom. Although proportionality to the square of the velocity would probably be nearer to the truth, yet Laplace's hypothesis suffices for the present discussion.

In oscillations of this class the water moves for half a period north, and then for half a period south. In oscillating systems, where the resistances are proportional to the velocities, it is usual to specify the resistance by a modulus of decay, namely, that period in which a velocity is reduced to ϵ^{-1} of its initial value by friction. Now the friction contemplated by Laplace is such that the modulus of decay is short compared with the semi-period of oscillation. The quickest of the important tides of long period is the fortnightly (see chapter iv.); hence, for the applicability of Laplace's conclusion, the modulus of decay must be short compared with a week. Now it seems practically certain that the friction of the bed of the ocean would not materially affect the velocity of a slow ocean current in a day or two. Hence we cannot accept Laplace's discussion as satisfactory. However this may be, we now give what is substantially his argument.

Let us write ϵ for the reciprocal of the modulus of decay. Then the frictional forces introduced on the left-hand side of (17) are $+\epsilon d\xi/dt$ in the first and $\sin\theta\,\epsilon d\eta/dt$ in the second. Laplace's hypothesis with regard to the magnitude of the frictional forces enables us to neglect the terms $d^2\xi/dt^2$ and $\sin\theta\,d^2\eta/dt^2$ compared with the frictional forces. Then, if we observe that in oscillations of this class the motion is entirely latitudinal, equations (17) and (19) become

$$\left.\begin{aligned}&\epsilon\frac{d\xi}{dt}-2n\sin\theta\cos\theta\frac{d\eta}{dt}=-\frac{g}{a}\frac{d}{d\theta}(\mathfrak{h}-\mathfrak{e})\\&\sin\theta\,\epsilon\frac{d\eta}{dt}+2n\cos\theta\frac{d\xi}{dt}=0\\&\mathfrak{h}a\sin\theta+\frac{d}{d\theta}(\gamma\xi\sin\theta)=0\end{aligned}\right\}\text{......(38).}$$

From the first two of these we easily obtain

$$\left(\epsilon+\frac{4n^2}{\epsilon}\cos^2\theta\right)\frac{d\xi}{dt}=-\frac{g}{a}\frac{d}{d\theta}(\mathfrak{h}-\mathfrak{e})\text{ ....(39).}$$

As a first approximation we treat $d\xi/dt$ as zero, and obtain $\mathfrak{h}=\mathfrak{e}$, or the height of water satisfies the equilibrium theory. In these tides (see chap. iv.) $\mathfrak{e}=\mathfrak{E}(\tfrac{1}{3}-\cos^2\theta)\cos it$, so that from the third equation of (38) we can obtain a first approximation to ξ; then, substituting in (39), we obtain on integration a second approximation to $\mathfrak{h}$. Laplace, however, considers as adequate the first approximation, which is simply the conclusion of the equilibrium theory.

§ 18. *Tides of Long Period in an Ocean of Uniform Depth.*

Tides of long period without friction. As it seems certain that these tides do not satisfy even approximately the equilibrium law, we now proceed to find the solution where there is no friction. In the case of these tides $k=0$, f a small fraction, and $\mathrm{e}=\mathrm{E}(\tfrac{1}{3}-\cos^2\theta)$. The equation (24) then becomes

$$\frac{1}{\sin\theta}\frac{d}{d\theta}\left(\frac{\gamma\sin\theta\frac{d\mathrm{u}}{d\theta}}{f^2-\cos^2\theta}\right)+4ma(\mathrm{u}+\mathrm{e})=0;$$

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[1] Thomson calls this a dissipation of accuracy. It may be illustrated thus. Consider the equation $s^2-3s+2=0$, which may be written either $s=\tfrac{2}{3}+\tfrac{1}{3}s^2$ or $s=3-2/s$. Now let $s_{n+1}=\tfrac{2}{3}+\tfrac{1}{3}s^2_n$, and suppose we start with any value s_0, less than unity, and compute $s_1, s_2\ldots s_n$. Then, starting with s_n in the equation $s_{n-1}=3-2/s_n$, if we work backwards, we ought to come to the original value s_0. In fact, however, we shall only do so if there is infinite accuracy in all the numerical values. For, start with $s_0=\tfrac{1}{2}$, then $s_1={\cdot}75$, $s_2={\cdot}8542$, $s_3={\cdot}9099$, $s_4={\cdot}9527$, $s_5={\cdot}9693$; and the values go on approximating to 1, which is a root of the equation. Next start backwards with $s_5={\cdot}97$, and we find $s_4={\cdot}938$, $s_3={\cdot}868$, $s_2={\cdot}696$, $s_1={\cdot}127$, $s_0=-12{\cdot}75$, $s_{-1}=3{\cdot}157$, $s_{-2}=2{\cdot}367$, $s_{-3}=2{\cdot}155$, $s_{-4}=2{\cdot}072$; and the values go on approximating to 2, the other root of the equation.

or, writing μ for $\cos\theta$ and $e = E(\frac{1}{3} - \mu^2)$,

$$\frac{d}{d\mu}\left(\gamma\frac{1-\mu^2}{\mu^2-f^2}\frac{du}{d\mu}\right) = 4ma(u+e) \quad\ldots\ldots\ldots\ldots\ldots(40).$$

We shall confine the investigation to the case where $\gamma = l$, a constant, and where the sea covers the whole surface of the globe. The symmetry of the motion in this case demands that u when expanded in a series of powers of μ shall only involve even powers. Let us assume, therefore, that

$$\frac{1}{\mu^2-f^2}\frac{du}{d\mu} = B_1\mu + B_3\mu^3 + \ldots + B_{2i+1}\mu^{2i+1} + \ldots \quad\ldots\ldots(41).$$

Then
$$\frac{1-\mu^2}{\mu^2-f^2}\frac{du}{d\mu} = B_1\mu + (B_3 - B_1)\mu^3 + \ldots + (B_{2i+1} - B_{2i-1})\mu^{2i+1} + \ldots$$

$$\frac{d}{d\mu}\left(\frac{1-\mu^2}{\mu^2-f^2}\frac{du}{d\mu}\right) = B_1 + 3(B_3 - B_1)\mu^2 + \ldots + (2i+1)(B_{2i+1} - B_{2i-1})\mu^{2i} + \ldots \quad\ldots\ldots(42).$$

Again,

$$\frac{du}{d\mu} = -f^2B_1\mu + (B_1 - f^2B_3)\mu^3 + \ldots + (B_{2i-1} - f^2B_{2i+1})\mu^{2i+1} + \ldots\ldots(43),$$

$$u = C - \tfrac{1}{2}f^2B_1\mu^2 + \tfrac{1}{4}(B_1 - f^2B_3)\mu^4 + \ldots + \frac{1}{2i}(B_{2i-3} - f^2B_{2i-1})\mu^{2i} + \quad(44),$$

where C is a constant. Then, writing β for $4ma/l$, as in the case of the semi-diurnal tide, substituting from (42), (43), and (44) in (40), and equating to zero the successive coefficients of the powers of μ, we find

$$\left.\begin{aligned} C &= -\tfrac{1}{3}E + B_1/\beta \\ B_3 - B_1\left(1 - \frac{1}{2.3}f^2\beta\right) + \tfrac{1}{3}\beta E &= 0 \\ &\cdots\cdots\cdots\cdots \\ B_{2i+1} - B_{2i-1}\left(1 - \frac{1}{2i(2i+1)}f^2\beta\right) - \frac{\beta}{2i(2i+1)}B_{2i-3} &= 0 \end{aligned}\right\}(45).$$

Thus the constant C and B_3, B_5, &c., are all expressible in terms of B_1, and B_1 is apparently indeterminate. We may remark that, if

$$-\frac{\beta}{2.3}B_{-1} = \tfrac{1}{3}\beta E, \text{ or } B_{-1} = -2E,$$

the equation of condition (45) may be held to apply for all values of i, from one to infinity. Let us write (45) in the form

$$\frac{B_{2i+1}}{B_{2i-1}} = 1 - \frac{1}{2i(2i+1)}f^2\beta + \frac{\beta}{2i(2i+1)}\frac{B_{2i-3}}{B_{2i-1}} \quad\ldots\ldots\ldots(46).$$

When i is large B_{2i+1}/B_{2i-1} either tends to become infinitely small or it does not do so. Let us suppose that it does not tend to become infinitely small. Then it is obvious that the successive B's tend to become equal to one another, and so also do the values of $(B_{2i-3} - f^2B_{2i-1})/2i$ and the coefficients of $du/d\mu$. Hence we have $du/d\mu = L + M/(1-\mu^2)$, for all values of μ, where L and M are finite. Hence this hypothesis gives infinite velocity to the fluid at the pole, where $\mu = 1$. But with a water-covered globe this infinite velocity is impossible, and therefore the hypothesis is negatived, and B_{2i+1}/B_{2i-1} must tend to become infinitely small. This being established, let us write (46) in the form

Method of continued fraction.

$$\frac{B_{2i-1}}{B_{2i-3}} = \frac{-\dfrac{\beta}{2i(2i+1)}}{1 - \dfrac{f^2\beta}{2i(2i+1)} - \dfrac{B_{2i+1}}{B_{2i-1}}} \quad\ldots\ldots\ldots\ldots\ldots(47).$$

By repeated applications of (47), we have in the form of a continued fraction

$$\frac{B_{2i-1}}{B_{2i-3}} = \frac{-\dfrac{\beta}{2i(2i+1)}}{1 - \dfrac{f^2\beta}{2i(2i+1)} + \dfrac{\dfrac{\beta}{(2i+2)(2i+3)}}{1 - \dfrac{f^2\beta}{(2i+2)(2i+3)} + \dfrac{\dfrac{\beta}{(2i+4)(2i+5)}}{1 - \dfrac{f^2\beta}{(2i+4)(2i+5)} + \&c.}}} \quad(48).$$

And we know that this is a continuous approximation, which must hold in order to satisfy the condition that the water covers the whole globe. Let us denote this continued fraction by $-N_i$. Then, if we remember that $B_{-1} = -2E$, we have

$$B_1 = 2EN_1,\ B_3/B_1 = -N_2,\ B_5/B_3 = -N_3,\ B_7/B_5 = -N_4,\ \&c.,$$

so that

$$B_3 = -2EN_1N_2,\ B_5 = 2EN_1N_2N_3,\ B_7 = -2EN_1N_2N_3N_4,\ \&c.,$$

and
$$C = -\tfrac{1}{3}E + 2EN_1/\beta.$$

Then $h = u + e$

$$\begin{aligned} &= C + \tfrac{1}{3}E - (E + \tfrac{1}{2}f^2B_1)\mu^2 + \tfrac{1}{4}(B_1 - f^2B_3)\mu^4 + \tfrac{1}{6}(B_3 - f^2B_5)\mu^6 + \ldots \\ &= E\{2N_1/\beta - (1 + f^2N_1)\mu^2 + \tfrac{1}{2}N_1(1 + f^2N_2)\mu^4 \\ &\qquad - \tfrac{1}{3}N_1N_2(1 + f^2N_3)\mu^6 + \ldots\} \quad\ldots\ldots\ldots\ldots\ldots(49). \end{aligned}$$

Now we find that, when $\beta = 40$, which makes the depth of the sea 3000 fathoms or $\frac{1}{1160}$ of the radius of the earth, and with $f = \cdot0365012$, which is the value for the fortnightly tide (see chap. iv.),

$$N_1 = 3\cdot040692,\ N_2 = 1\cdot20137,\ N_3 = \cdot66744,\ N_4 = \cdot42819,\ N_5 = \cdot29819,$$
$$N_6 = \cdot21950,\ N_7 = \cdot16814,\ N_8 = \cdot13287,\ N_9 = \cdot107,\ N_{10} = \cdot1.$$

These values give

$$2N_1/\beta = \cdot15203,\ 1 + f^2N_1 = 1\cdot0041,\ \tfrac{1}{2}N_1(1 + f^2N_2) = 1\cdot5228,$$
$$\tfrac{1}{3}N_1N_2(1 + f^2N_3) = 1\cdot2187,\ \tfrac{1}{4}N_1N_2N_3(1 + f^2N_4) = \cdot60988,$$
$$\tfrac{1}{5}N_1\ldots N_4(1 + f^2N_5) = \cdot20888,\ \tfrac{1}{6}N_1\ldots N_5(1 + f^2N_6) = \cdot05190,$$
$$\tfrac{1}{7}N_1\ldots N_6(1 + f^2N_7) = \cdot00976,\ \tfrac{1}{8}N_1\ldots N_7(1 + f^2N_8) = \cdot0014,$$
$$\tfrac{1}{9}N_1\ldots N_8(1 + f^2N_9) = \cdot00017.$$

So that

Solutions.

$$h/e = \{\cdot1520 - 1\cdot0041\mu^2 + 1\cdot5228\mu^4 - 1\cdot2187\mu^6 + \cdot6099\mu^8 - \cdot2089\mu^{10} + \cdot0519\mu^{12} - \cdot0098\mu^{14} + \cdot0014\mu^{16} - \cdot0002\mu^{18}\} \div (\tfrac{1}{3} - \mu^2) \quad(50).$$

$$\left.\begin{aligned} &\text{At the pole, where } \mu = 1,\ h = -E \times \cdot1037 = e \times \cdot1556 \\ &\text{and at the equator, where } \mu = 0,\ h = +E \times \cdot1520 = e \times \cdot4561 \end{aligned}\right\}(51).$$

Now let us take a second case, where $\beta = 10$, which was also one of those solved for the case of the semi-diurnal tide by Laplace, and we find

$$h/E = \cdot2363 - 1\cdot0016\mu^2 + \cdot5910\mu^4 - \cdot1627\mu^6 + \cdot0258\mu^8 - \cdot0026\mu^{10} + \cdot0002\mu^{12}.$$

At the pole, where $\mu = 1$, we find $h = -E \times \cdot3137 = e \times \cdot471$, and at the equator $h = +E \times \cdot2363 = e \times \cdot709$. With a deeper ocean we should soon arrive at the equilibrium value for the tide, for N_1, N_2, &c., become very small, and $2N_1/\beta$ becomes equal to $\frac{1}{3}$. In this case, with such oceans as those with which we have to deal, the tides of long period are considerably smaller than the equilibrium value.

§ 19. *Stability of the Ocean.*

Stability of the ocean.

Imagine a globe of density δ, surrounded by a spherical layer of water of density σ. Then, still maintaining the spherical figure, and with water still covering the nucleus, let the layer be displaced sideways. The force on any part of the water distant r' from the centre of the water and r from the centre of the nucleus is $\frac{4}{3}\pi\sigma r'$ towards the centre of the fluid sphere and $\frac{4}{3}\pi(\delta - \sigma)r$ towards the centre of the nucleus. If δ be greater than σ there is a force tending to carry the water from places where it is deeper to places where it is shallower; and therefore the equilibrium, thus arbitrarily disturbed, is stable. If, however, δ is less than σ (or the nucleus lighter than water) the force is such that it tends to carry the water from where it is shallower to where it is deeper, and therefore the equilibrium of a layer of fluid distributed over a nucleus lighter than itself is unstable. As Sir William Thomson has remarked,[1] if the nucleus is lighter than the ocean, it will float in the ocean with part of its surface dry. Suppose, again, that the fluid layer be disturbed, so that its equation is $r = a(1 + s_i)$, where s_i is a surface harmonic of degree i; then the potential due to this deformation is $\frac{4\pi\sigma}{2i+1}\frac{a^{i+3}}{r^{i+1}}s_i$, and the whole potential is

Stabilities of various orders.

$$\frac{4\pi\delta a^3}{3r} + \frac{4\pi\sigma}{2i+1}\frac{a^{i+3}}{r^{i+1}}s_i.$$

If, therefore, $\sigma/(2i+1)$ is greater than $\frac{1}{3}\delta$, the potential of the forces due to deformation is greater than that due to the nucleus. But we have seen that a deformation tends to increase itself by mutual attraction, and therefore the forces are such as to increase the deformation. If, therefore, $\sigma = \frac{1}{3}(2i+1)\delta$, all the deformations up to the ith are unstable, but the $i+1$th is stable.[2] If, however, σ be less than δ, then all the deformations of any order are such that there are positive forces of restitution. For our present purpose it suffices that this equilibrium is stable when the fluid is lighter than the nucleus.

§ 20. *Precession and Nutation.*

Precession and nutation.

Suppose we have a planet covered with a shallow ocean, and that the ocean is set into oscillation. Then, if there are no external disturbing forces, so that the oscillations are "free," not "forced," the resultant moment of momentum of the planet and ocean remains constant. And, since each particle of the ocean executes periodic oscillations about a mean position, it follows that the oscillation of the ocean imparts to the solid earth oscillations such that the resultant moment of momentum of the whole system remains constant. But the mass of the ocean being very small compared with that of the planet, the component angular velocities of the planet necessary to counterbalance the moment of momentum of the oscillations of the sea are very small compared with the component angular velocities of the sea, and therefore the disturbance of planetary rotation due to oceanic reaction is negligible. If now an external disturbing force, such as that of the moon, acts on the system, the resultant moment of momentum of sea and earth is unaffected by the interaction between them, and the processional and nutational couples are the same as if sea and earth were rigidly connected together. Therefore the additions to these couples on account of tidal oscillation are the couples due to the attraction of the moon on the excess or deficiency of water above or below mean sea-level. The tidal oscillations are very small in height compared with the equatorial protuberance of the earth, and the density of water is $\frac{4}{11}$ths of that of surface rock; hence the additional couples are very small compared with the couples due to the moon's action on the

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[1] Thomson and Tait, *Nat. Phil.*, § 816.

[2] Compare an important paper by Poincaré in *Acta Math.* (1885), 7; 3, 4.

Corrections to precession and nutation insensible.

solid equatorial protuberance. Therefore precession and nutation take place sensibly as though the sea were congealed in its mean position. If the ocean be regarded as frictionless, the principles of energy show us that these insensible additional couples must be periodic in time, and thus the corrections to nutation must consist of semi-diurnal, diurnal, and fortnightly nutations of absolutely insensible magnitude. We shall have much to say below on the results of the introduction of friction into the conception of tidal oscillations as a branch of speculative astronomy.

§ 21. *Some Phenomena of Tides in Rivers.*

Tides in rivers.

In § 2 we have given a description of some of the phenomena of the tide-wave in rivers. As a considerable part of our practical knowledge of tides is derived from observations in estuaries and rivers, we give an investigation of two of the most important features of the tide-wave in these cases. It must be premised that when the profile of a wave does not present the simple harmonic form it is convenient to analyse its shape into a series of partial waves superposed on a fundamental wave; and generally the principle of harmonic analysis is adopted, in which the actual wave is regarded as the sum of a number of simple harmonic waves.

The tide-wave in a river is a "long" wave in which the vertical motion of the water is very small compared with the horizontal, the river very shallow compared with the wave-length, and the water which is at any moment in a vertical plane always remains so throughout the oscillation.

Suppose that the water is contained in a straight and shallow canal of uniform depth; then take an origin of coordinates at the bottom, with the x axis horizontal in the direction of the canal, and the y axis vertical; let h be the undisturbed depth of water; let $h+\eta$ be the ordinate of the surface corresponding to that fluid whose undisturbed abscissa is x and disturbed abscissa $x+\xi$; and let g be gravity. The equations of motion and continuity[1] are

$$\left.\begin{aligned}\frac{d^2\xi}{dt^2}&=gh\frac{d^2\xi/dx^2}{(1+d\xi/dx)^3}\\ \eta&=\frac{-h\,d\xi/dx}{1+d\xi/dx}\end{aligned}\right\}\text{....................(52).}$$

For brevity we shall write $v^2=gh$ and $u=vt-x$. Since for "long" waves $d\xi/dx$ is small, the equations (52) become approximately

$$\left.\begin{aligned}\frac{d^2\xi}{dt^2}&=v^2\frac{d^2\xi}{dx^2}\left(1-3\frac{d\xi}{dx}\right)\\ \frac{\eta}{h}&=-\frac{d\xi}{dx}+\left(\frac{d\xi}{dx}\right)^2\end{aligned}\right\}\text{....................(53).}$$

For finding a first approximation we neglect the second term on the right of each of (53). The solution is obviously

$$\left.\begin{aligned}\xi&=a\cos m(vt-x)=a\cos mu\\ \eta&=-mah\sin mu\end{aligned}\right\}\text{................(54).}$$

(54) gives the height of the water whose undisturbed abscissa is x, and since ξ is small this is approximately the height at the point on the bank whose abscissa is x. But now suppose that at the origin (the mouth of the river) the canal communicates with a basin in which there is a forced oscillation of water-level given by

$$\eta=H\sin nt\text{............................(55).}$$

This represents the oceanic tide, and n is that which we call below (§ 23) the speed of the tide. Then obviously $m=n/v$, so that at any point x up the river

$$\eta=H\sin n\left(t-\frac{x}{\sqrt{gh}}\right)\text{ ....(56).}$$

(56) gives the first approximation to the forced tide-wave, and it is clear that any number of oscillations may be propagated independently up the river with the velocity $\sqrt{gh}$ due to the depth of the river. In passing to the second approximation we must separate the investigation into two branches.

Over tides.

(i.) *Over-Tides* (see § 24).—We now suppose that the tide at the river mouth is simply (55). On substituting the approximate values (54) in (53) our equations become

$$\left.\begin{aligned}\frac{d^2\xi}{dt^2}&=v^2\frac{d^2\xi}{dx^2}+\tfrac{3}{2}v^2a^2m^3\sin 2mu\\ \frac{\eta}{h}&=-\frac{d\xi}{dx}+\tfrac{1}{2}m^2a^2-\tfrac{1}{2}m^2a^2\cos 2mu\end{aligned}\right\}\text{............(57).}$$

We have now to assume an appropriate form for the solution of (57), such as

$$\xi=a\cos mu+Ax\cos 2mu+B\sin 2mu\text{ ....(58).}$$

We have here in effect assumed that the second and third terms of (58) are small compared with the first. It is clear, however, that at a distance from the origin the term in A will become large. This difficulty may be eluded by taking the canal of finite length, and supposing that, where the canal debouches into a second basin, a second appropriate forced oscillation is maintained. The length of the canal remains arbitrary, save that the second term of (58) shall still be small compared with the first. On substituting from (58) in (57) we have B indeterminate and $A=-\tfrac{3}{8}a^2m^3$; hence

$$\eta/h=\tfrac{1}{2}m^2a^2-ma\sin mu+\tfrac{3}{4}m^3a^2x\sin 2mu+(2mB-\tfrac{1}{2}m^2a^2)\cos 2mu\text{ (59).}$$

This gives the elevation of the water whose undisturbed abscissa is x, that is to say, at the point whose abscissa along the bank is $X=x+\xi$. If we put $x=X-\xi$ in the largest term of (59), and treat ξ as small, and put $x=X$ in the small terms, (59) becomes

$$\begin{aligned}\eta/h=-ma\sin m(vt-X)&+\tfrac{3}{4}m^3a^2X\sin 2m(vt-X)\\ &+(2mB-\tfrac{1}{2}m^2a^2)\cos 2m(vt-X).\end{aligned}$$

But at the origin (55) holds true, therefore $B=\frac{1}{4}ma^2$, $-mah=H$, and $mv=n$. Thus the solution is

$$\eta=H\sin n\left(t-\frac{X}{\sqrt{gh}}\right)+\frac{3H^2n}{4h\sqrt{gh}}X\sin 2n\left(t-\frac{X}{\sqrt{gh}}\right)\text{ (60).}$$

Solution giving over-tide.

From (60) we can see what the proper forced oscillation at the further end of the canal must be; but this matter has no present interest. The first term of (60) being called the fundamental, the second gives what is called the first over-tide; and by further approximation we can get the second, third, &c. The over-tide travels up the river at the same rate as the fundamental, but it has double frequency or "speed," and the ratio of its amplitude to that of the fundamental is $\frac{3H}{4h}\,\frac{nX}{\sqrt{gh}}$.

As a numerical example, let the range of tide at the river mouth be 20 feet and the depth of river 50 feet. The "speed" of the semi-diurnal tide is about 1/1·9 radians per hour; $\sqrt{gh}=27$ miles per hour; hence $\frac{3H}{4h}\,\frac{nX}{\sqrt{gh}}=\frac{1}{342}X$. Therefore 34 miles up the river the over-tide is $\frac{1}{10}$th of the fundamental and has a range of 2 feet. If the river shallows very gradually, the formula will still hold, and we see that the height of over-tide varies as $(\text{depth})^{-\frac{7}{4}}$.

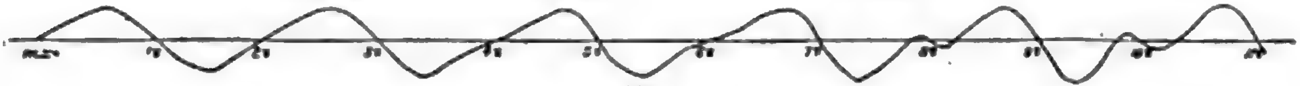

Fig. 1

Fig. 1[2] read from left to right exhibits the progressive change of shape. The steepness of the advancing crest shows that it is a shorter time from low to high water than *vice versa*. The law of the ebb and flow of currents mentioned in § 2 may also be easily determined from the above investigation. We leave the reader to determine the effect of friction, which is given by inserting a term $-\mu d\xi/dt$ on the right-hand side of (57).

Interference of waves in shallow water.

(ii.) *Compound Tides* (see § 24).—We shall now consider the mutual influence of two waves of different periods travelling up the river together. In the first approximation they are quite independent, and we may assume

$$\xi=a\cos m(vt-x)+b\cos[n(vt-x)+\epsilon]\text{ ....(61).}$$

In proceeding to the second approximation, we only take notice of those terms which result from the interaction of the two, and omit all others, writing for the sake of brevity

$$\begin{aligned}\{m-n\}&=(m-n)(vt-x)-\epsilon,\\ \{m+n\}&=(m+n)(vt-x)+\epsilon.\end{aligned}$$

With the value of ξ assumed in (61), we find, on substituting in (53) and only retaining terms depending on mutual influence, that the equations for the second approximation are

$$\left.\begin{aligned}\frac{d^2\xi}{dt^2}&=v^2\frac{d^2\xi}{dx^2}+\tfrac{3}{2}v^2abmn[(m+n)\sin\{m+n\}-(m-n)\sin\{m-n\}]\\ \eta/h&=-abmn[\cos\{m+n\}-\cos\{m-n\}]-d\xi/dx\end{aligned}\right\}\text{(62.)}$$

Now let us assume as the solution

$$\left.\begin{aligned}\xi=a\cos m(vt-x)&+Ax\cos\{m+n\}+B\sin\{m+n\}\\ +b\cos[n(vt-x)+\epsilon]&+Cx\cos\{m-n\}+D\sin\{m-n\}\end{aligned}\right\}\text{...(63);}$$

and let us elude the difficulty about the increasing magnitude of the second term in the same way as before. Substituting in the equation of motion, we have for all time,

$$\begin{aligned}&2(m+n)A\sin\{m+n\}+2(m-n)C\sin\{m-n\}\\ &+\tfrac{3}{2}abmn[(m+n)\sin\{m+n\}-(m-n)\sin\{m-n\}]=0.\end{aligned}$$

This gives $A=-\tfrac{3}{4}abmn$ and $C=+\tfrac{3}{4}abmn$. B and D remain arbitrary as before, and will be dropped, because they are to be determined by the condition that at the origin the terms of $d\xi/dx$ in $\cos\{m+n\}$, $\cos\{m-n\}$ are to vanish, whence

$$\begin{aligned}\eta/h=&-am\sin m(vt-x)-bn\sin[n(vt-x)+\epsilon]\\ &+\tfrac{3}{4}abmn[(m+n)x\sin\{m+n\}-(m-n)x\sin\{m-n\}]\\ &+\text{terms in }\cos\{m+n\}\text{ and }\cos\{m-n\}.\end{aligned}$$

Then we pass from x to X as in the last section, and make the terms in $\cos\{m+n\}$ and $\cos\{m-n\}$ vanish by proper values of B and D, and we have

$$\begin{aligned}\eta=amh\sin m(vt-X)&-bnh\sin[n(vt-x)+\epsilon]\\ &+\tfrac{3}{4}abmnX[(m+n)\sin\{m+n\}-(m-n)\sin\{m-n\}]\text{ (64).}\end{aligned}$$

Now at the river's mouth, where $x=0$, suppose that the oceanic tide is represented by $\eta=H_1\sin n_1t+H_2\sin(n_2t+\epsilon)$.

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[1] See, for example, Lamb's *Hydrodynamics*, chap. vii.

[2] From Airy, "Tides and Waves."

Then $$-am=H_1/h\,,\quad -bn=H_2/h,\quad habmn=H_1H_2/h,$$
$$mv=n_2\,,\quad nv=n_3\,,\quad v=\sqrt{gh}\,,\quad m\pm n=\frac{n_1\pm n_2}{\sqrt{gh}}\,,$$
so that (64) becomes
$$\eta=H_1\sin n_1\left(t-\frac{X}{\sqrt{gh}}\right)+H_2\sin\left[n_2\left(t-\frac{X}{\sqrt{gh}}\right)+\epsilon\right]$$
$$+\frac{3H_1H_2}{4h}\frac{n_1+n_2}{\sqrt{gh}}X\sin\left[(n_1+n_2)\left(t-\frac{X}{\sqrt{gh}}\right)+\epsilon\right]$$
$$-\frac{3H_1H_2}{4h}\frac{n_1-n_2}{\sqrt{gh}}X\sin\left[(n_1-n_2)\left(t-\frac{X}{\sqrt{gh}}\right)-\epsilon\right]\ldots\ (65).$$
As a numerical example, suppose at the mouth of a river 50 feet deep that the solar semi-diurnal tide has a range $2H_1=4$ feet, and the lunar $2H_2=12$ feet; then $n_1+n_2=$ [illegible] radians per hour, $n_1-n_2=\frac{1}{57}$ radians per hour, and as before $\sqrt{gh}=27$ miles per hour. With these figures $$\frac{3H_1H_2}{4h}\frac{n_1+n_2}{\sqrt{gh}}X=\frac{1}{170}X.$$
Thus 15 miles up the river the quater-diurnal tide (in § 24 below, called MS) has a semi-range of an inch. But the luni-solar fortnightly tide (called MSf in § 24) would have a semi-range of $\frac{1}{57}$th of an inch. Where the two interacting tides are of nearly equal speed, the summation compound tide is very large compared with the differential tide. As before, when the river shallows gradually this formula will still hold.

It is interesting to note the kind of effect produced by these compound tides. When the primary tides are in the same phase
$$n_1t=n_2t+\epsilon.$$
Then $$(n_1+n_2)\left(t-\frac{X}{\sqrt{gh}}\right)+\epsilon=2n_1t-(n_1+n_2)\frac{X}{\sqrt{gh}}\,;$$
$$(n_1-n_2)\left(t-\frac{X}{\sqrt{gh}}\right)-\epsilon=\quad -(n_1-n_2)\frac{X}{\sqrt{gh}}\,;$$
and
$$\eta=(H_1+H_2)\sin n_1\left(t-\frac{X}{\sqrt{gh}}\right)+\frac{3H_1H_2}{4h}\frac{n_1+n_2}{\sqrt{gh}}\sin\left[2n_1t-(n_1+n_2)\frac{X}{\sqrt{gh}}\right]$$
$$-\frac{3H_1H_2}{4h}\frac{n_1-n_2}{\sqrt{gh}}\,\sin\,\frac{(n_1-n_2)}{\sqrt{gh}}X.$$
Hence the front slope of the tide-wave is steeper at spring than at neap tide, and the compound tide shows itself in the form of an augmentation of the first over-tide; and the converse statements hold of neap tide. Also mean-water mark is lower and higher alternately up the river at spring tide, and higher and lower alternately at neap tide, by a small amount which depends on the differential tide. With the river which we were considering, the alternation would be so long that it would in actuality be either all lower or all higher.

IV. THE HARMONIC ANALYSIS.

§ 22. *Methods of applying Theory to Practice.*

The comparison between tidal observations and tidal theories, and the formation of tables predicting the tidal oscillations of the sea, have been carried out in two different ways, which may be called the "synthetic" and the "analytic."

The semi-diurnal rise and fall of tide with the weekly alternation of spring and neap would naturally suggest to the investigator to make his formula conform to the apparent simplicity of the phenomenon. He would seek to represent the height of water by either one or two periodic functions with a variable amplitude; such a representation is the aim of the synthetic method. That method has been followed by all the great investigators of the past,—Newton, Bernoulli, Maclaurin, Laplace, Lubbock, Whewell, Airy. Since at European ports the two tides which follow one another on any one day are nearly equal, or, in other words, there is scarcely a sensible diurnal tide, these investigators bestowed comparatively little attention to the diurnal tides. If these are neglected, the synthetic method is simple, for a single function suffices to represent the tide. In non-European ports, however, the diurnal tide is sometimes so large as to mask the semi-diurnal, and to make only a single instead of a double high water in twenty-four hours. To represent this diurnal tide in the synthetic method we are compelled to introduce at least one more function. There should also be a third function representing the tides of long period; but until the last few years these tides have scarcely been considered, and therefore we shall have little to say of them in explaining the synthetic method. The expression for the tide-generating forces due to either sun or moon consists of three terms, involving the declinations and hour-angles of the planet. One of these terms for each goes through its period approximately twice a day, a second once a day, and the third varies slowly (§ 7). The mathematical basis of the synthetic method consists of a synthesis of the mathematical formulæ. The semi-diurnal term for the moon is fused with that for the sun, and the same process is carried out for the diurnal and slowly varying terms. A mass of tidal observation at a place where the diurnal tide is small, even if, as in all the older observations, it consists merely of heights and times of high and low water, soon shows that the fusion of two simple harmonic or periodic functions is insufficient to represent the state of tide; and the height and time of high water are found to need corrections for the variations of declination, of motion in right ascension, and of the parallaxes of both bodies.

But when continuous tide-gauges were set up far more extended data than those of the older observations became accessible to the investigator, and more and more corrections were found to be expedient to adapt the formulæ to the facts. A systematic method of utilizing all the data became also a desideratum. This state of matters led Sir W. Thomson to suggest the analytic method.[1] It is true that the dynamical foundations of that method have always lain below the surface of the synthetic method, and have constantly been appealed to for the theoretical determination of corrections; nevertheless, we must regard the explicit adoption of the analytic method as a great advance. In this method we conceive the tidal forces or potential due to each disturbing body to be developed into a series of terms each consisting of a constant (determined by the elements of the planet's orbit and the obliquity of the ecliptic) multiplied by a simple harmonic function of the time. Thus in place of the terms of the synthetic method for the three classes of tides we have an indefinitely long series of terms for each of the three classes. The loss of simplicity in the expression for the forces is far more than counterbalanced by the gain of facility for the discussion of the oscillations of the water. This facility arises from the great dynamical principle of forced oscillations, which we have explained in the historical sketch. Applying this principle, we see that each individual term of the harmonic development of the tide-generating forces corresponds to an oscillation of the sea of the same period, but the amplitude and phase of that oscillation must depend on a network of causes of almost inextricable complication. The analytic method, then, represents the tide at any port by a series of simple harmonic terms whose period is determined from theoretical considerations, but whose amplitude and phase are found from observation. Fortunately the series representing the tidal forces converges with sufficient rapidity to permit us to consider only a moderate number of harmonic terms in the series.

Analytic method.

Now it seems likely that the corrections which have been applied in the use of the synthetic method might have been clothed in a more satisfactory and succinct mathematical form had investigators first carried out the harmonic development. In this article we shall therefore invert history and come back on the synthetic method from the analytic, and shall show how the formulæ of correction stated in harmonic language may be made comparable with them in synthetic language. One explanation is expedient before proceeding with the harmonic development. There are certain terms in the tide-generating forces of the moon, depending on the longitude of the moon's nodes, which complete their revolution in 18·6 years. Now it has been found practically convenient, in the application of the harmonic method, to follow the synthetic plan to the extent of classifying together terms whose speed differs only in consequence of the movement of the moon's node, and at the same time to conceive that there is a small variability in the intensity of the generating forces.

Fusion of terms affected by motion of the moon's node.

§ 23. *Development of Equilibrium Theory of Tides in Terms of the Elements of the Orbits.*

Within the limits at our disposal we cannot do more than indicate the processes to be followed in this development.

Equilibrium theory; elements or orbits introduced.

We have already seen in (3) that the expression for the moon's tide-generating potential is
$$V=\frac{3m}{2r^3}\rho^2(\cos^2 z-\tfrac{1}{3}),$$
and in (10) that
$$\cos^2 z-\tfrac{1}{3}=2\xi\eta M_1M_2+2\frac{\xi^2-\eta^2}{2}\cdot\frac{M_1^2-M_2^2}{2}+2\eta\zeta M_2M_3+2\xi\zeta M_1M_3$$
$$+\frac{3}{2}\frac{\xi^2+\eta^2-2\zeta^2}{3}\cdot\frac{M_1^2+M_2^2-2M_3^2}{3},$$
where M_1, M_2, M_3 are the direction cosines of the moon referred to axes fixed in the earth. We require to find the functions M_1M_2, $\tfrac{1}{2}(M_1^2-M_2^2)$, &c., of the moon's direction cosines.[2] Let A, B, C (fig. 2) be the axes fixed in the earth, C being the north pole and AB the equator; let X, Y, Z be a second set of axes, XY being the plane of the moon's orbit; M the projection of the moon in her orbit; $I=$ ZC, the obliquity of the lunar orbit to the equator; $\chi=$ AX $=$ BCY; $l=$ MX, the

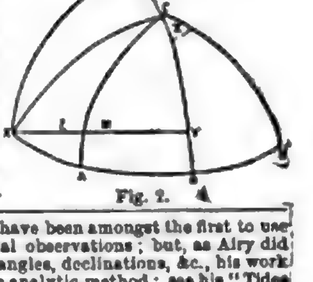

Fig. 2.

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[1] Airy, and after him Chazallon, appear to have been amongst the first to use a kind of harmonic analysis for reducing tidal observations; but, as Airy did not emancipate himself from the use of hour-angles, declinations, &c., his work can hardly be considered as an example of the analytic method; see his "Tides and Waves," and Hatt's *Phénomène des Marées*, Paris, 1885.

[2] For further details of the analysis of this section, see the *Report* "On Harmonic Analysis, &c.," for 1883 to the British Association (Southport).

Moon's longitude and obliquity of orbit introduced.

moon's longitude in her orbit measured from X, the intersection of the equator with the lunar orbit, hereafter called the "intersection." Then

$$\left.\begin{aligned} M_1 &= \cos l \cos\chi + \sin l \sin\chi \cos I \\ M_2 &= -\cos l \sin\chi + \sin l \cos\chi \cos I \\ M_3 &= \sin l \sin I \end{aligned}\right\} \quad \text{.........(66).}$$

Writing for brevity $p = \cos\tfrac{1}{2}I$, $q = \sin\tfrac{1}{2}I$ ....(67), we find that

$$\left.\begin{aligned} M_1^2 - M_2^2 &= p^4\cos 2(\chi - l) + 2p^2q^2\cos 2\chi + q^4\cos 2(\chi + l) \\ -2M_1M_2 &= \text{the same with sines in place of cosines} \\ M_2M_3 &= -p^3q\cos(\chi - 2l) + pq(p^2 - q^2)\cos\chi + pq^3\cos(\chi + 2l) \\ M_1M_3 &= \text{the same with sines in place of cosines} \\ \tfrac{1}{3} - M_3^2 &= \tfrac{1}{3}(p^4 - 4p^2q^2 + q^4) + 2p^2q^2\cos 2l \end{aligned}\right\} \text{(68).}$$

Moon's distance and eccentricity introduced.

These are the required functions of M_1, M_2, M_3.

Now let c be the moon's mean distance, e the eccentricity of the moon's orbit, and let

$$\tau = \frac{3}{2}\frac{m}{c^3} \quad \text{..........................(69).}$$

Then, putting

$$X = \left[\frac{c(1-e^2)}{r}\right]^{\frac{3}{2}} M_1,\ Y = \left[\frac{c(1-e^2)}{r}\right]^{\frac{3}{2}} M_2,\ Z = \left[\frac{c(1-e^2)}{r}\right]^{\frac{3}{2}} M_3 \quad \text{(70),}$$

we have

$$V \div \frac{\tau}{(1-e^2)^3}\rho^2 = 2\xi\eta XY + 2\frac{\xi^2-\eta^2}{2}\frac{X^2-Y^2}{2} + 2\eta\zeta YZ + 2\xi\zeta XZ$$
$$+ \frac{3}{2}\frac{\xi^2+\eta^2-2\zeta^2}{3}\,\frac{X^2+Y^2-2Z^2}{3} \quad \text{.........(71).}$$

Corresponding to the definition of a simple tide given in § 1, the expression for each term of the tide-generating potential should consist of a solid spherical harmonic, multiplied by a simple time-harmonic. In (71) $\rho^2\xi\eta$, $\rho^2(\xi^2-\eta^2)$, &c., are solid spherical harmonics, and in order to complete the expression for V it is necessary to develop the five functions of X, Y, Z in a series of simple time-harmonics. But (71) may be simplified in such a way that the five functions are reduced to three. The axes fixed in the earth may be taken, as in § 7, to have their extremities as follows:—the axis C the north pole, the axis B 90° E. of A on the equator, and the axis A on the equator in the meridian of the place of observation. Thus, if λ be the latitude of that place, we have

$$\xi = \cos\lambda,\ \eta = 0,\ \zeta = \sin\lambda.$$

Tide-generating potential.

Then, writing a for the earth's radius at the place of observation, (71) becomes

$$V = \frac{\tau a^2}{(1-e^2)^3}\left[\tfrac{1}{2}\cos^2\lambda(X^2-Y^2) + \sin 2\lambda\,XZ\right.$$
$$\left.+ \tfrac{3}{2}(\tfrac{1}{3} - \sin^2\lambda)\tfrac{1}{3}(X^2+Y^2-2Z^2)\right] \quad \text{......(71a).}$$

The process of developing the three functions of X, Y, Z consists in the introduction of the formulæ of elliptic motion into (66) and (70), the subsequent development of the X-Y-Z functions in a series of trigonometrical terms, and the rejection of terms which appear numerically to be negligible. The terms depending on the principal lunar inequalities—evection and variation—are also introduced. Finally, the three X-Y-Z functions are obtained as a series of simple time-harmonics, with the arguments of the sines and cosines linear functions of the earth's rotation, the moon's mean motion, and the longitude of the moon's perigee. The next step is to pass, according to the principle of forced oscillations, from the potential to the height of tide generated by the forces corresponding to that potential. The X-Y-Z functions being simple time-harmonics, the principle of forced vibrations allows us to conclude that the forces corresponding to V in (71a) will generate oscillations in the ocean of the same periods and types as the terms in V, but of unknown amplitudes and phases. Now let $\mathfrak{X}^2 - \mathfrak{Y}^2$, $\mathfrak{X}\mathfrak{Z}$, $\tfrac{1}{3}(\mathfrak{X}^2 + \mathfrak{Y}^2 - 2\mathfrak{Z}^2)$ be three functions having respectively similar forms to those of

$$\frac{X^2-Y^2}{(1-e^2)^3},\ \frac{XZ}{(1-e^2)^3},\ \text{and}\ \frac{1}{3}\frac{(X^2+Y^2-2Z^2)}{(1-e^2)^3},$$

Height of tide at any port.

but differing from them in that the argument of each of the simple time-harmonics has some angle subtracted from it, and that the term is multiplied by a numerical factor. Then, if g be gravity and h the height of tide at the place of observation, we must have

$$\mathrm{h} = \frac{\tau a^2}{g}\left[\tfrac{1}{2}\cos^2\lambda(\mathfrak{X}^2-\mathfrak{Y}^2) + \sin 2\lambda\,\mathfrak{X}\mathfrak{Z} + \tfrac{3}{2}(\tfrac{1}{3}-\sin^2\lambda)\tfrac{1}{3}(\mathfrak{X}^2+\mathfrak{Y}^2-2\mathfrak{Z}^2)\right] \quad \text{(72).}$$

The factor $\tau a^2/g$ may be more conveniently written $\frac{3m}{2M}\left(\frac{a}{c}\right)^3 a$, where M is the earth's mass. It has been so chosen that, if the equilibrium theory of tides were fulfilled, with water covering the whole earth, the numerical factors in the $\mathfrak{X}$-$\mathfrak{Y}$-$\mathfrak{Z}$ functions would be each unity and the alterations of phase would be zero.

Definition of high tide of tide of long period.

The terms in $\tfrac{1}{3}(\mathfrak{X}^2+\mathfrak{Y}^2-2\mathfrak{Z}^2)$ require special consideration. The function of the latitude being $\tfrac{1}{3} - \sin^2\lambda$, it follows that, when in the northern hemisphere it is high water north of a certain critical latitude, it is low water on the opposite side of that parallel; and the same is true of the southern hemisphere. It is best to adopt a uniform system for the whole earth, and to regard high tide and high water as consentaneous in the equatorial belt, and of opposite meanings outside of the critical latitudes. We here conceive the function always to be written $\tfrac{1}{3} - \sin^2\lambda$, so that outside of the critical latitudes high tide is low water. We may in continuing the development write the $\mathfrak{X}$-$\mathfrak{Y}$-$\mathfrak{Z}$ functions in the form appropriate to the equilibrium theory, with water covering the whole earth; for the actual case it is only then necessary to multiply by the reducing factor, and to subtract the phase alteration κ. As these are unknown constants for each place, they would only occur in the development as symbols of quantities to be deduced from observation. It will be understood, therefore, that in the following schedules the "argument" is that part of the argument which is derived from theory, the true complete argument being the "argument" − κ, where κ is derived from observation.

Up to this point we have supposed the moon's longitude and the earth's position to be measured from the intersection; but in order to pass to the ordinary astronomical formulæ we must measure the longitude and the earth's position from the vernal equinox. Hence we determine the longitude and right ascension of the intersection in terms of the longitude of the moon's node and the inclination of the lunar orbit, and introduce them into our formulæ for the $\mathfrak{X}$-$\mathfrak{Y}$-$\mathfrak{Z}$ functions. The expressions for the functions corresponding to solar tides may be written down by symmetry, and in this case the intersection is actually the vernal equinox.

Explanation of schedules below.

The final result of the process sketched is to obtain a series of terms each of which is a function of the elements of the moon's or sun's orbit, and a function of the terrestrial latitude of the place of observation, multiplied by the cosine of an angle which increases uniformly with the time. We shall now write down the result in the form of a schedule; but we must first state the notation employed:—e, e_1 = eccentricities of lunar and solar orbits; I, ω = obliquities of equator to lunar orbit and ecliptic; p, p_1 = longitudes of lunar and solar perigees; ϖ, ϖ_1 = hourly increments of p, p_1; s, h = moon's and sun's mean longitudes; σ, η = hourly increments of s, h; t = local mean solar time reduced to angle; $\gamma - \eta$ = 15° per hour; λ = latitude of place of observation; ξ, ν = longitude in lunar orbit, and R.A. of the intersection; N = longitude of moon's node; i = inclination of lunar orbit.

Speed defined.

The speed of any tide is defined as the rate of increase of its argument, and is expressible, therefore, as a linear function of γ, η, σ, ϖ; for we may neglect ϖ_1 as being very small.

The following schedules, then, give h the height of tide. The arrangement is as follows. First, there is a universal coefficient $\frac{3m}{2M}\left(\frac{a}{c}\right)^3 a$, which multiplies every term of all the schedules. Secondly, there are general coefficients, one for each schedule, viz., $\cos^2\lambda$ for the semi-diurnal terms, $\sin 2\lambda$ for the diurnal, and $\tfrac{1}{2} - \tfrac{3}{2}\sin^2\lambda$ for the terms of long period. In each schedule the third column, headed "coefficient," gives the functions of I and e (and in two cases also of p). In the fourth column is given the mean semi-range of the corresponding term in numbers, which is approximately the value of the coefficient in the first column when $I = \omega$; but we pass over the explanation of the mode of computing the values. The fifth column contains arguments, linear functions of t, h, s, p, ν, ξ. In [A, i.] $2t + 2(h - \nu)$ and in [A, ii.] $t + (h - \nu)$ are common to all the arguments. The arguments are grouped in a manner convenient for subsequent computation. Lastly, the sixth is a column of speeds, being the hourly increase of the arguments in the preceding column, estimated in degrees per hour. It has been found practically convenient to denote each of these partial tides by an initial letter, arbitrarily chosen. In the first column we give a descriptive name for the tide, and in the second the arbitrarily chosen initial. In some cases no initial has been chosen, and here we indicate the tide by the analytical expression for its speed, or hourly increase of argument.

The schedule for the solar tides is drawn up in precisely the same manner, the only difference being that the coefficients are absolute constants. The eccentricity of the solar orbit is so small that the elliptic tides may be omitted, except the larger elliptic semi-diurnal tide. In order that the comparison of the importance of the solar tides with the lunar may be complete, the same universal coefficient $\frac{3m}{2M}\left(\frac{a}{c}\right)^3 a$ is retained, and the special coefficient for each term is made to involve the factor $\frac{\tau_1}{\tau}$. Here $\tau_1 = \frac{3}{2}\frac{m_1}{c_1^3}$, m_1 being the sun's mass. With

$$\frac{M}{m} = 81{\cdot}5,\quad \frac{\tau_1}{\tau} = {\cdot}46035 = \frac{1}{2{\cdot}17226}.$$

Mode of reading schedule explai-

To write down any term, take the universal coefficient, the general coefficient for the class of tides, the special coefficient, and multiply by the cosine of the argument. The result, taken with the positive sign, is a term in the equilibrium tide, with water covering the whole earth. The transition to the actual case by the introduction of a factor and a delay of phase (to be derived from observation) has been already explained. The sum of all the terms is the complete expression for the height of tide h.

Schedule of Lunar Tides.

[A, i.]—Universal Coefficient $= \frac{3}{2}\frac{m}{M}\left(\frac{a}{c}\right)^3 a$.

Semi-diurnal Tides ; General Coefficient $= \cos^2\lambda$.

Descriptive Name.	Initial.	Coefficient.	Mean Value of Coefficient.	Argument $2t+2(h-\nu)$	Speed in Degrees per m. s. Hour.
Principal lunar.	M_2	$\frac{1}{2}(1-\frac{5}{2}e^2)\cos^4\frac{1}{2}I$	·45426	$-2(s-\xi)$	28°·9841042
Luni-solar (lunar portion).	K_2	$\frac{1}{2}(1-\frac{3}{2}e^2)\frac{1}{2}\sin^2 I$	·03929	·	30°·0821372
Larger elliptic.	N	$\frac{1}{2}\cdot\frac{7}{2}e\cos^4\frac{1}{2}I$	·08796	$-2(s-\xi)-(s-p)$	28°·4397296
Smaller elliptic.[1]	L	$\frac{1}{2}\cdot\frac{1}{2}e\cos^4\frac{1}{2}I\times\{1-12\tan^2\frac{I}{2}\cos(2p-2\xi)\}^{\frac{1}{2}}$	·01257	$-2(s-\xi)+(s-p)-R+\pi$ where $\tan R=\frac{6\sin 2(p-\xi)}{\cot^2\frac{1}{2}I-6\cos 2(p-\xi)}$	29°·5284789
Elliptic, second order.	2N	$\frac{1}{2}\cdot\frac{17}{4}e^2\cos^4\frac{1}{2}I$	·01173	$-2(s-\xi)-2(s-p)$	27°·8953548
Larger evectional.[2]	ν	$\frac{1}{2}\cdot\frac{15}{8}me\cos^4\frac{1}{2}I$	·01654[3] ·01706	$-2(s-\xi)+(s-p)+2h-2s$	28°·5125830
Smaller evectional	λ	$\frac{1}{2}\cdot\frac{1}{4}me\cos^4\frac{1}{2}I$	·00176[3] ·00330	$-2(s-\xi)-(s-p)-2h+2s+\pi$	29°·4556254
Variational.[4]	μ	$\frac{1}{2}\cdot\frac{33}{16}m^2\cos^4\frac{1}{2}I$	[illegible][3] ·01094	$-2(s-\xi)+2h-2s$	27°·9682084

[A, ii.]—Diurnal Tides ; General Coefficient $= \sin 2\lambda$.

Descriptive Name	Initial.	Coefficient.	Mean Value of Coefficient.	Argument $t+(h-\nu)$.	Speed in Degrees per m. s. Hour.
Lunar diurnal.	O	$(1-\frac{5}{2}e^2)\frac{1}{2}\sin I\cos^2\frac{1}{2}I$	·18856	$-2(s-\xi)+\frac{1}{2}\pi$	13°·9430356
$\gamma+2\sigma$.	OO	$(1-\frac{5}{2}e^2)\frac{1}{2}\sin I\sin^2\frac{1}{2}I$	·00812	$+2(s-\xi)-\frac{1}{2}\pi$	16°·1391016
Luni-solar (lunar portion).	K_1	$(1+\frac{3}{2}e^2)\frac{1}{2}\sin I\cos I$	·18115	$-\frac{1}{2}\pi$	15°·0410686
Larger elliptic.	Q	$\frac{7}{2}e\cdot\frac{1}{2}\sin I\cos^2\frac{1}{2}I$	·03651	$-2(s-\xi)-(s-p)+\frac{1}{2}\pi$	13°·3986609
Smaller elliptic.[6]	M_1	$e\cdot\frac{1}{2}\sin I\cos^2\frac{1}{2}I\times\sqrt{\{\frac{1}{4}+\frac{9}{4}\cos 2(p-\xi)\}}$	[illegible] ·01649	$-(s-\xi)+Q-\frac{1}{2}\pi$ where $\tan Q=\frac{1}{2}\tan(p-\xi)$	14°·4920521
$\gamma+\sigma-\varpi$.	J	$\frac{3}{2}e\cdot\frac{1}{2}\sin I\cos I$	·01485	$+(s-p)-\frac{1}{2}\pi$	15°·5854433
Elliptic, second order.	$\gamma-4\sigma+2\varpi$	$\frac{17}{4}e^2\cdot\frac{1}{2}\sin I\cos^2\frac{1}{2}I$	·00157	$-2(s-\xi)-2(s-p)+\frac{1}{2}\pi$	12°·8542862
Evectional	$\gamma-3\sigma-\varpi+2\eta$	$\frac{15}{8}me\cdot\frac{1}{2}\sin I\cos^2\frac{1}{2}I$	·00512[7] ·00708	$-2(s-\xi)+(s-p)-2h+2s+\frac{1}{2}\pi$	13°·4715144

[A, iii.]—Long Period Tides ; General Coefficient $\frac{1}{2}-\frac{3}{2}\sin^2\lambda$.

Descriptive Name.	Initial.	Coefficient.	Mean Value of Coefficient.	Argument.	Speed in Degrees per m. s. Hour.
Change of mean level.		$(1+\frac{3}{2}e^2)(\frac{1}{2}-\frac{3}{4}\sin^2 I)$	·50221[8]	Of variable part is N, the long. of node	19°·34 per annum
Monthly.	Mm	$3e\cdot\frac{1}{2}(1-\frac{3}{2}\sin^2 I)$	·08256	$s-p$	0°·5443747
Evectional monthly.	$\sigma-2\eta+\varpi$	$\frac{15}{8}me\cdot\frac{1}{2}(1-\frac{3}{2}\sin^2 I)$	[illegible][9] [illegible]	$-(s-p)+2s-2h$	0°·4715211
Luni-solar fortnightly.[10]	MSf	$3m^2\frac{1}{2}(1-\frac{3}{2}\sin^2 I)$	[illegible][9] [illegible]	$2(s-h)$	1°·0158958
Fortnightly.	Mf	$(1-\frac{5}{2}e^2)\frac{1}{2}\sin^2 I$	·07827	$2(s-\xi)$	1°·0980330
Ter-mensual.	$3\sigma-\varpi$	$\frac{7}{2}e\frac{1}{2}\sin^2 I$	·01116	$(s-p)+2(s-\xi)$	1°·6424077

[B.]—*Schedule of Solar Tides.*

Solar Tides ; Universal Coefficient $= \frac{3}{2}\frac{M}{m}\left(\frac{a}{c}\right)^3 a$.

Descriptive Name.	Initial.	Coefficient.	Value of Coefficient.	Argument.	Speed in Degrees per m. s. Hour.
[i.]—Semi-diurnal Tides ; General Coefficient $= \cos^2\lambda$.					
Principal solar	S_2	$\frac{\tau}{\tau}(1-\frac{5}{2}e_1^2)\frac{1}{2}\cos^4\frac{1}{2}\omega$	·21137	$2t$	30°·0000000
Luni-solar (solar portion).	K_2	$\frac{\tau}{\tau}(1+\frac{3}{2}e_1^2)\frac{1}{2}\sin^2\omega$	·01823	$2t+2h$	30°·0821373
Larger elliptic.	T	$\frac{\tau}{\tau}\frac{1}{2}\frac{7}{2}e_1\cos^4\frac{1}{2}\omega$	·01243	$2t-(h-p_1)$	29°·9589333
[ii.]—Diurnal Tides ; General Coefficient $= \sin 2\lambda$.					
Solar diurnal.	P	$-\frac{\tau}{\tau}(1-\frac{5}{2}e_1^2)\frac{1}{2}\sin\omega\cos^2\frac{1}{2}\omega$	·08775	$t-2h+\frac{1}{2}\pi$	14°·9589314
Luni-solar (solar portion).	K_1	$\frac{\tau}{\tau}(1+\frac{3}{2}e_1^2)\frac{1}{2}\sin\omega\cos\omega$	·08407	$t-\frac{1}{2}\pi$	15°·0410686
[iii.]—Long Period Tides ; General Coefficient $= \frac{1}{2}-\frac{3}{2}\sin^2\lambda$.					
Semi-annual.	Ssa	$\frac{\tau}{\tau}(1-\frac{5}{2}e_1^2)\frac{1}{2}\sin^2\omega$	·03643	$2h$	0°·0821373

Scale of importance of tides. From the fourth columns we see that the coefficients in descending order of magnitude are M_2, K_1 (both combined), S_2, O, K_1 (lunar), N, P, K_1 (solar), K_2 (both combined), K_2 (lunar), Mf, Q, Mm, K_2 (solar), Ssa, ν, M_1, J, L, T, 2N, μ, OO, $3\sigma-\varpi$, $\gamma-3\sigma-\varpi+2\eta$, $\gamma-4\sigma+2\varpi$, $\sigma-2\eta+\varpi$, $2(\sigma-\eta)$, λ.

The tides depending on the fourth power of the moon's parallax arise from the potential $V = \frac{M}{\rho^4}r^3(\frac{5}{2}\cos^3 z-\frac{3}{2}\cos z)$. They give rise to a small diurnal tide M_1, and to a small ter-diurnal tide M_3 ; but we shall not give the analytical development.

§ 24. *Meteorological Tides, Over-Tides, and Compound Tides.*

Meteorological tides. All tides whose period is an exact multiple or submultiple of a mean solar day, or of a tropical year, are affected by meteorological conditions. Thus all the tides of the principal solar astronomical series S, with speeds $\gamma-\eta$, $2(\gamma-\eta)$, $3(\gamma-\eta)$, &c., are subject to more or less meteorological perturbation. An annual inequality in the diurnal meteorological tide S_1 will also give rise to a tide $\gamma-2\eta$, and this will be fused with and indistinguishable from the astronomical P ; it will also give rise to a tide with speed γ, which will be indistinguishable from the astronomical part of K_1. Similarly the astronomical tide K_2 may be perturbed by a semi-annual inequality in the semi-diurnal astronomical tide of speed $2(\gamma-\eta)$. Although the diurnal elliptic tide S_1 or $\gamma-\eta$ and the semi-annual and annual tides of speeds 2η and η are all probably quite insensible as arising from astronomical causes, yet they have been found of sufficient importance to be considered. The annual and semi-annual tides are of enormous importance in some rivers, representing in fact the yearly flooding in the rainy season. In the reduction of these tides the arguments of the S series are t, $2t$, $3t$, &c., and of the annual, semi-annual, ter-annual tides h, $2h$, $3h$. As far as can be foreseen, the magnitudes of these tides are constant from year to year.

Over-tides. We have in § 21 considered the dynamical theory of over-tides. The only tides of this kind in which it has hitherto been thought necessary to represent the change of form in shallow water belong to the principal lunar and principal solar series. Thus, besides the fundamental astronomical tides M_2 and S_2, the over-tides M_4, M_6, M_8, and S_4, S_6 have been deduced by harmonic analysis. The height of the fundamental tide M_2 varies from year to year, according to the variation in the obliquity of the lunar orbit, and this variability is represented by the coefficient $\cos^4\frac{1}{2}I$. It is probable that the variability of M_4, M_6, M_8 will be represented by the square, cube, and fourth power of that coefficient, and theory (§ 21) indicates that we should make the argument of the over-tide a multiple of the argument of the fundamental, with a constant subtracted.

Compound tides. Compound tides have been also considered dynamically in § 21. By combining the speeds of the important tides, it will be found that there is in many cases a compound tide which has itself a speed identical with that of an astronomical or meteorological tide. We thus find that the tides O, K_1, Mm, P, M_2, Mf, Q, M_1, L are liable to perturbation in shallow water. If either or both the component tides are of lunar origin, the height of the compound tide will change from year to year, and will probably vary proportionally to the product of the coefficients of the component tides. For the purpose of properly reducing the numerical value of the compound tides, we require not merely the speed, but also the argument. The following schedule gives the accepted initials, argument, and speed of the principal compound tides. The coefficients are the products of those of the two tides to be compounded.

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[1] Fused with $2\gamma-\sigma+\varpi$.

[2] m is the ratio of the moon's mean motion to the sun's.

[3] In these three entries the lower number gives the value when the coefficients of the evection and variation have their full values as derived from lunar theory.

[4] Indicated by 2MS as a compound tide (see below, § 24).

[5] A fusion of $\gamma-\sigma\pm\varpi$, of which the latter is the tide named.

[6] The upper number is the mean value of the coefficient of the tide $\gamma-\sigma-\varpi$, the lower applies to the tide M_1, compounded from the tides $\gamma-\sigma-\varpi$ and $\gamma-\sigma+\varpi$.

[7] The lower number gives the value when the coefficients in the evection have their full value as derived from lunar theory.

[8] The mean value of this coefficient is $\frac{1}{2}(1-\frac{3}{2}e^2)(1-\frac{3}{2}\sin^2 i)(1-\frac{3}{2}\sin^2\omega)=\cdot 25$, and the variable part is approximately $-(1+\frac{3}{2}e^2)\sin i\cos i\sin\omega\cos\omega\cos N = -\cdot 0328\cos N$.

[9] The lower of these two numbers gives the value when the coefficients in the evection and variation have their full values as derived from lunar theory.

[10] Indicated by MSf as a compound tide.

[C.]—*Schedule of Compound Tides.*

Initials.	Arguments combined.	Speed.	Speed in Degrees per m.s. Hour.
MK	M_2+K_1 M_4-O	$3\gamma-2\sigma$	44°·0251728
MS	M_2+S_2	$4\gamma-2\sigma-2\eta$	58°·9841042
MSf	S_2-M_2	$2\sigma-2\eta$	1°·0158958
2MK	M_2+O M_4-K_1	$3\gamma-4\sigma$	42°·9271898
..	S_2+K_1	$3\gamma-2\eta$	45°·0410686
MN	M_2+N	$4\gamma-5\sigma+\varpi$	57°·4238338
..	S_2+O	$3\gamma-2\sigma-2\eta$	43°·9430356
..	S_2-O	$\gamma+2\sigma-2\eta$	16°·0569644
2SM	S_4-M_2	$2\gamma+2\sigma-4\eta$	31°·0158958
..	M_2+S_4	$6\gamma-2\sigma-4\eta$	88°·9841042
2MS	M_4-S_2	$2\gamma-4\sigma+2\eta$	27°·9682084
..	M_4+S_2	$6\gamma-4\sigma-2\eta$	87°·9682084

§ 25. *On the Form of Presentation of Results of Tidal Observations.*

Immediate result of harmonic analysis.

Supposing n to be the speed of any tide in degrees per mean solar hour, and t to be mean solar time elapsing since 0^h of the first day of (say) a year of continuous observation, then the immediate result of harmonic analysis is to obtain A and B, two heights (estimated in feet and tenths) such that the height of this tide at the time t is given by $A \cos nt + B \sin nt$. If we put $R=\sqrt{(A^2+B^2)}$ and $\tan \zeta = B/A$, then the tide is represented by

$$R \cos (nt-\zeta).$$

In this form R is the semi-range of the tide in British feet, and ζ is an angle such that ζ/n is the time elapsing after 0^h of the first day until it is high water of this particular tide. It is obvious that ζ may have any value from 0° to 360°, and that the results of the analysis of successive years of observation will not be comparable with one another when presented in this form.

Final form: tidal constants.

But let us suppose that the results of the analysis are presented in a number of terms of the form

$$fH \cos (V+u-\kappa),$$

where V is a linear function of the moon's and sun's mean longitudes, the mean longitude of the moon's and sun's perigees, and the local mean solar time at the place of observation, reduced to angle at 15° per hour. V increases uniformly with the time, and its rate of increase per mean solar hour is the n of the first method, and is called the speed of the tide. It is supposed that u stands for a certain function of the longitude of the node of the lunar orbit at an epoch half a year later than 0^h of the first day. Strictly speaking, u should be taken as the same function of the longitude of the moon's node, varying as the node moves; but, as the variation is but small in the course of a year, u may be treated as a constant and put equal to an average value for the year, which average value is taken as the true value of u at exactly mid year. Together $V+u$ constitute that function which has been tabulated as the "argument" in the schedules of § 23. Since $V+u$ are together the whole argument according to the equilibrium theory of tides, with sea covering the whole earth, it follows that κ/n is the lagging of the tide which arises from kinetic action, friction of the water, imperfect elasticity of the earth, and the distribution of land. It is supposed that H is the mean value in British feet of the semi-range of the particular tide in question; f is a numerical factor of augmentation or diminution, due to the variability of the obliquity of the lunar orbit. The value of f is the ratio of the "coefficient" in the third column of the preceding schedules to the mean value of the same term. For example, for all the solar tides f is unity, and for the principal lunar tide M_2 it is equal to $\cos^4 \frac{1}{2}I \div \cos^4 \frac{1}{2}\omega \cos^4 \frac{1}{2}i$; for the mean value of this term has a coefficient $\cos^4 \frac{1}{2}\omega \cos^4 \frac{1}{2}i$. It is obvious, then, that, if the tidal observations are consistent from year to year, H and κ should come out the same from each year's reductions. It is only when the results are presented in such a form as this that it will be possible to judge whether the harmonic analysis is yielding satisfactory results. This mode of giving the tidal results is also essential for the use of a tide-predicting machine (see § 38).

We must now show how to determine H and κ from R and ζ. It is clear that $H = R/f$, and the determination of f from the schedules depends on the evaluation of the mean value of each of the terms in the schedules, into which we shall not enter. If V_0 be the value of V at 0^h of the first day, then clearly

$$-\zeta = V_0 + u - \kappa,$$

so that

$$\kappa = \zeta + V_0 + u.$$

Thus the rule for the determination of κ is: *Add to the value of* ζ *the value of the argument at* 0^h *of the first day.*

Tidal constants.

The results of harmonic analysis are usually tabulated by giving H, κ under the initial letter of each tide; the results are thus comparable from year to year.[1] For the purpose of using the tide-predicting machine the process of determining H and κ from R and ζ has simply to be reversed, with the difference that the instant of time to which to refer the argument is 0^h of the first day of the new year, and we must take note of the different value of u and f for the new year. Tables[2] have been computed for f and u for all longitudes of the moon's node and for each kind of tide, and the mean longitudes of moon, sun, and lunar perigee may be extracted from any ephemeris. Thus when the mean semi-range H and retardation κ of any tide are known its height may be computed for any instant. The sum of the heights for all the principal tides of course gives the actual height of water.

§ 26. *Numerical Harmonic Analysis for Tides of Short Period.*

Treatment of tide curves.

The tide-gauge (described below, § 36) furnishes us with a continuous graphical record of the height of the water above some known datum mark for every instant of time. The first operation performed on the tidal record is the measurement in feet and decimals of the height of water above the datum at every mean solar hour. The period chosen for analysis is about one year and the first measurement corresponds to noon.

If T be the period of any one of the diurnal tides, or the double period of any one of the semi-diurnal tides, it approximates more or less nearly to 24 m.s. hours, and, if we divide it into twenty-four equal parts, we may speak of each as a T-hour. We shall for brevity refer to mean solar time as S-time. Suppose, now, that we have two clocks, each marked with 360°, or 24 hours, and that the hand of the first, or S-clock, goes round once in 24 S-hours, and that of the second, or T-clock, goes round once in twenty-four T-hours, and suppose that the two clocks are started at 0° or 0^h at noon of the initial day. For the sake of distinctness, let us imagine that a T-hour is longer than an S-hour, so that the T-clock goes slower than the S-clock. The measurements of the tide curve give us the height of water exactly at each S-hour; and it is required from these data to determine the height of water at each T-hour. For this end we are, in fact, instructed to count T-time, but are only allowed to do so by reference to S-time, and, moreover, the time is always to be specified as an integral number of hours. Commencing with 0^h of the first day, we begin counting 0, 1, 2, &c., as the T-hand comes up to its hour-marks. But, as the S-hand gains on the T-hand, there will come a time when, the T-hand being exactly at the p hour-mark, the S-hand is nearly as far as $p+\frac{1}{2}$. When, however, the T-hand has advanced to the $p+1$ hour-mark, the S-hand will be a little beyond $p+1+\frac{1}{2}$,—that is to say, a little less than half an hour before $p+2$. Counting, then, in T-time by reference to S-time, we jump from p to $p+2$. The counting will go on continuously for a number of hours nearly equal to $2p$, and then another number will be dropped, and so on throughout the whole year. If it had been the T-hand which went faster than the S-hand, it is obvious that one number would be repeated at two successive hours instead of one being dropped. We may describe each such process as a "change."

Method of analysis.

Now, if we have a sheet marked for entry of heights of water according to T-hours from results measured at S-hours, we must enter the S-measurements continuously up to p, and we then come to a change; dropping one of the S-series, we go on again continuously until another change, when another is dropped; and so on. Since a change occurs at the time when a T-hour falls almost exactly half-way between two S-hours, it will be more accurate at a change to insert the two S-entries which fall on each side of the truth. If this be done the whole of the S-series of measurements is entered on the T-sheet. Similarly, if it be the T-hand which goes faster than the S-hand, we may leave a gap in the T-series instead of duplicating an entry. For the analysis of the T-tide there is therefore prepared a sheet arranged in rows and columns; each row corresponds to one T-day, and the columns are marked $0^h, 1^h, \ldots 23^h$; the 0's may be called T-noons. A dot is put in each space for entry, and where there is a change two dots are put if there is to be a double entry, and a bar if there is to be no entry.[3] The numbers entered in each column are summed; the results are then divided, each by the proper divisor for its column, and thus the mean value for that column is obtained. In this way 24 numbers are found which give the mean height of water at each of the 24 special hours. It is obvious that if this process were continued over a very long time we should in the end extract the tide under analysis from amongst all the others; but, as the process only extends over about a year, the elimination of the others is not quite complete. The elimination of the effects of the other tides may be improved by choosing the period for analysis not exactly equal to one year.

Let us now return to our general notation, and consider the 24 mean values, each pertaining to the 24 T-hours. We suppose that all the tides except the T-tide are adequately eliminated, and, in fact, a computation of the necessary corrections for the absence of complete elimination, which is given in the *Tidal Report* to the British Association in 1872, shows that this is the case. It is

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[1] See, for example, a collection of results by Baird and Darwin, *Proc. Roy. Soc.*, No. 230, 1885.

[2] *Report on Harmonic Analysis to Brit. Assoc.*, 1883, and more extended table in Baird's *Manual of Tidal Observation*, London, 1887.

[3] A sample page is given in the *Report* to the Brit. Assoc., 1883.

Necessity for augmenting factors.

obvious that any one of the 24 values does not give the true height of the T-tide at that T-hour, but gives the average height of the water, as due to the T-tide, estimated over half a T-hour before and half a T-hour after that hour. A consideration of this point shows that certain augmenting factors, differing slightly from unity, must be applied. In the reduction of the S-series of tides, the numbers treated are the actual heights of the water exactly at the S-hours, and therefore no augmenting factor is requisite.

We must now explain how the harmonic analysis, which the use of these factors presupposes, is carried out.

If t denotes T-time expressed in T-hours, and n is 15°, we express the height h, as given by the averaging process above explained, by the formula

$$\mathrm{h} = A_0 + A_1 \cos nt + B_1 \sin nt + A_2 \cos 2nt + B_2 \sin 2nt + \ldots,$$

where t is 0, 1, 2, ... 23. Then, if Σ denotes summation of the series of 24 terms found by attributing to t its 24 values, it is obvious that

Analysis.

$$A_0 = \tfrac{1}{24}\Sigma \mathrm{h}\ ;\ A_1 = \tfrac{1}{12}\Sigma \mathrm{h}\cos nt\ ;\ B_1 = \tfrac{1}{12}\Sigma \mathrm{h}\sin nt\ ;$$
$$A_2 = \tfrac{1}{12}\Sigma \mathrm{h}\cos 2nt\ ;\ B_2 = \tfrac{1}{12}\Sigma \mathrm{h}\sin 2nt\ ;\ \&c., \&c.$$

Since n is 15° and t is an integer, it follows that all the cosines and sines involved in these series are equal to one of the following, viz., 0, ±sin 15°, ±sin 30°, ±sin 45°, ±sin 60°. ±sin 75°, ±1. It is found convenient to denote these sines by $0, \pm S_1, \pm S_2, \pm S_3, \pm S_4, \pm S_5, \pm 1$. The multiplication of the 24 h's by the various S's and the subsequent additions may be arranged in a very neat tabular form, like that given in a *Report* to the British Association in 1883. The A's and B's having been thus deduced, we have $R = \sqrt{(A^2 + B^2)}$. R must then be multiplied by the augmenting factor. We thus have the augmented R. Next the angle whose tangent is B/A gives ζ. The addition to ζ of the appropriate $V_0 + u$ gives κ, and the multiplication of R by the appropriate $1/f$ gives H. The reduction is then complete. An actual numerical example of harmonic analysis is given in the *Admiralty Scientific Manual* (1886) in the article "Tides"; but the process there employed is slightly different from the above, because the series of observations is supposed to be a short one.

§ 27. *Harmonic Analysis for Tides of Long Period.*

Tides of long period.

For the purpose of determining the tides of long period we have to eliminate the oscillations of water-level arising from the tides of short period. As the quickest of these tides has a period of many days, the height of mean water at one instant for each day gives sufficient data. Thus there will in a year's observations be 365 heights to be submitted to harmonic analysis. To find the daily mean for any day we take the arithmetic mean of 24 consecutive hourly values, beginning with the height at noon. This height will then apply to the middle instant of the period from 0^h to 23^h,—that is to say, to $11^h\ 30^m$ at night. The formation of a daily mean does not obliterate the tidal oscillations of short period, because none of the tides, except those of the principal solar series, have commensurable periods in mean solar time. A small correction, or "clearance of the daily mean," has therefore to be applied for all the important tides of short period, except for the solar tides. Passing by this clearance, we next take the 365 daily means, and find their mean value. This gives the mean height of water for the year. We next subtract the mean height from each of the 365 values, and find 365 quantities $\delta \mathrm{h}$, giving the daily height of water above the mean height. These quantities are to be the subject of the harmonic analysis, and the tides chosen for evaluation are those which have been denoted above as Mm, Mf, MSf, Sa, Ssa.

Harmonically analysed.

Let

$$\left.\begin{aligned} \delta \mathrm{h} = {} & A\cos(\sigma - \varpi)t + B\sin(\sigma - \varpi)t \\ & + C\cos 2\sigma t \qquad + D\sin 2\sigma t \\ & + C'\cos 2(\sigma - \eta)t + D'\sin 2(\sigma - \eta)t \\ & + E\cos \eta t \qquad + F\sin \eta t \\ & + G\cos 2\eta t \qquad + H\sin 2\eta t \end{aligned}\right\} \ldots\ldots\ldots\ldots(73),$$

where t is time measured from the first $11^h\ 30^m$. If we multiply the 365 δh's by 365 values of $\cos(\sigma - \varpi)t$ and effect the summation, the coefficients of B, C, D, &c., are very small, and that of A is nearly 182½. Similarly, multiplying by $\sin(\sigma - \varpi)t$, $\cos 2\sigma t$, &c., we obtain 10 equations for A, B, C, &c., in each of which one coefficient is nearly 182½ and the rest small. These equations are easily solved by successive approximation. In this way A, B, C, &c., are found, and afterwards the clearance to which we have alluded is applied. Finally the cleared A, B, C, &c., are treated exactly as were the components of the tides of short period. Special forms and tables have been prepared for facilitating these operations.

V. SYNTHETIC METHOD.

§ 28. *On the Method and Notation.*

Synthetic method.

The general nature of the synthetic method has been already explained; we now propose to develop the expressions for the tide from the result as expressed in the harmonic notation. If it should be desired to make a comparison of the results of tidal observation as expressed in the synthetic method with those of the harmonic method, or the converse, or to compute a tide-table from the harmonic constants by reference to the moon's transits and from the declinations and parallaxes of sun and moon, the analytical expressions of the following sections are necessary.

In chapter iv. the mean semi-range and angle of retardation or lag of any one of the tides have been denoted by H and κ. We shall here, however, require to introduce several of the H's and κ's into the same expression, and they must therefore be distinguished from one another. This may in general be conveniently done by writing as a subscript letter the initial of the corresponding tide; for example H_m, κ_m, will be taken to denote the H and κ of the principal lunar tide M_2. This notation does not suit the K_2 and K_1 tides, and we shall therefore write H'', κ'' for the semi-diurnal K_2, and H', κ' for the diurnal K_1 tide. These two tides proceed according to sidereal time and arise from the sun and moon jointly, and a synthesis of the two parts of each is effected in the harmonic method, although that synthesis is not explained in chapter iv. The ratio of the solar to the lunar part of the total K_2 tide is ·46407; hence ·683 H'' is the lunar portion of the total K_2. There will be no occasion to separate the two portions of K_1, and we shall retain the synthesis which is effected in the harmonic method.

§ 29. *Semi-Diurnal Tides.*

Mean longitude and elements replaced by hour-angle, declination, and parallax.

The process adopted is to replace the mean longitudes and elements of the orbit in each term of the harmonic development of the schedules of § 23 by hour-angles, declinations, and parallaxes.

At the time t (mean solar time of port reduced to angle) let α, δ, ψ be ☽'s R.A., declination, and hour-angle, and l ☽'s longitude measured from the "intersection." These and other symbols when written with subscript accent are to apply to the sun. Then ν being the R.A. of the intersection, we have from the right-angled spherical triangle of which the sides are l, δ, $\alpha - \nu$ the relations

$$\tan(\alpha - \nu) = \cos I \tan l, \quad \sin \delta = \sin I \sin l \ \ldots\ldots\ldots(74).$$

Now $s - \xi$ is the ☽'s mean longitude measured from the intersection and $s - p$ is the mean anomaly; hence approximately

$$l = s - \xi + 2e\sin(s - p) \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots(75).$$

From (74) and (75) we have approximately

$$\alpha = s + (\nu - \xi) + 2e\sin(s - p) - \tan^2 \tfrac{1}{2}I \sin 2(s - \xi).$$

Now, h being the $\odot$'s mean longitude, $t + h$ is the sidereal hour-angle, and

$$\psi = t + h - \alpha.$$

Hence

$$t + h - s - (\nu - \xi) = \psi + 2e\sin(s - p) - \tan^2 \tfrac{1}{2}I \sin 2(s - \xi) \quad (76).$$

Again, if we put

$$\cos^2\Delta = 1 - \tfrac{3}{2}\sin^2 I \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots(77),$$

we have approximately from (74) and (75)

$$\left.\begin{aligned} & \frac{\cos^2\delta - \cos^2\Delta}{\sin^2\Delta} = \cos 2(s - \xi) \\ \text{whence}\quad & \frac{\sin\delta\cos\delta}{\sigma\sin^2\Delta}\frac{d\delta}{dt} = \sin 2(s - \xi) \end{aligned}\right\} \ldots\ldots\ldots\ldots\ldots(78).$$

Obviously Δ is such a declination that $\sin^2\Delta$ is the mean value of $\sin^2\delta$ during a lunar month. Again, if P be the ratio of the ☽'s parallax to her mean parallax, the equation to the ellipse described

$$\left.\begin{aligned} \text{gives}\quad & \frac{1}{e}(P - 1) = \cos(s - p) \\ \text{whence}\quad & -\frac{1}{e(\sigma - \varpi)}\frac{dP}{dt} = \sin(s - p) \end{aligned}\right\} \ldots\ldots\ldots\ldots\ldots(79).$$

Now it appears in schedule A of § 23 that the arguments of all the lunar semi-diurnal tides are of the form $2(t + h - \nu) \pm 2(s - \xi)$ or $\pm(s - p)$. It is clear, therefore, that the cosines of such angles may by the relations (76), (78), (79) be expressed in terms of hour-angles, declinations, and parallaxes. Also by means of (77) we may introduce Δ in place of I in the coefficients of each term. An approximate formula for Δ is $16°{\cdot}51 + 8°{\cdot}44 \cos N - 0°{\cdot}19 \cos 2N$. In the *Report to the British Association* for 1885, the details of the processes indicated are given.

Age of declinational and parallactic corrections.

Before giving the formula it must be remarked that the result is expressed more succinctly by the introduction of the symbol δ' to denote the ☽'s declination at a time earlier than that of observation by an interval which may be called the "age of the declinational inequality," and is computed from the formula $\tan(\kappa'' - \kappa_m)/2\sigma$ or $52^h{\cdot}2 \tan(\kappa'' - \kappa_m)$. Similarly, it is convenient to introduce P' to denote the value of P at a time earlier than that of observation by the "age of the parallactic inequality," to be computed from $\tan(\kappa_m - \kappa_n)/(\sigma - \varpi)$ or $105^h{\cdot}3 \tan(\kappa_m - \kappa_n)$. These two "ages" probably do not differ in general much from a third period, computed from $(\kappa_s - \kappa_m)/2(\sigma - \eta)$, which is called the "age of the tide."

The similar series of transformations when applied to the solar tides leads to simpler results, because $\Delta_{,}$ is a constant, being 16°·33, and the "ages" may be treated as zero; besides the terms depending on $d\delta_{,}/dt$ and $dP_{,}/dt$ are negligible. If now we denote by h_2 the height of water with reference to mean water-mark, in so far as the height is affected by the harmonic tides M_2, S_2, K_2, N, L, T, R,[1] the harmonic expression is transformed into

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[1] R is the smaller solar elliptic tide bearing the same relation to T that L does to N amongst the lunar tides. It was omitted as unimportant in schedule [B, I.] of § 23.

Total semi-diurnal tide.

$$\begin{aligned}h_2 = {} & \frac{\cos^2\Delta}{\cos^2\Delta_{,}} H_m \cos(2\psi - \kappa_m) + H_s \cos(2\psi_{,} - \kappa_s)\\ & + \frac{\cos^2\delta - \cos^2\Delta}{\sin^2\Delta_{,}} \cdot 683\, H'' \cos(2\psi - \kappa'')\\ & + \frac{\cos^2\delta_{,} - \cos^2\Delta}{\sin^2\Delta_{,}} \cdot 317\, H'' \cos(2\psi_{,} - \kappa'')\\ & - \frac{\sin\delta\cos\delta}{\sigma\sin^2\Delta_{,}}\frac{d\delta}{dt}\left[\frac{\cdot 683\, H''}{\cos(\kappa'' - \kappa_m)} - H_m \tan^2\Delta_{,}\right]\sin(2\psi - \kappa_m)\\ & + \frac{\cos^2\Delta}{\cos^2\Delta_{,}}(P' - 1)\frac{H_n\cos\kappa_n - H_l\cos\kappa_l}{e\cos\epsilon}\cos(2\psi - \epsilon)\\ & + (P_{,} - 1)\frac{H_t - H_r}{e_{,}}\cos(2\psi_{,} - \kappa_s)\\ & + \frac{\cos^2\Delta}{e\cos^2\Delta_{,}}\frac{dP/dt}{(\sigma - \varpi)}\left[4H_m e - \frac{H_n}{\cos(\kappa_m - \kappa_n)} - \frac{H_l}{\cos \kappa_l - \kappa_m)}\right]\sin(2\psi - \kappa_m) \quad (80),\end{aligned}$$

where ϵ is an auxiliary angle defined by

$$\tan\epsilon = \frac{H_n \sin\kappa_n - H_l \sin\kappa_l}{H_n\cos\kappa_n - H_l\cos\kappa_l} \quad \text{.....................(81).}$$

The first two terms are the principal tides, and the physical origin of the remaining small terms is indicated by their involving δ', $\delta_{,}$, $d\delta/dt$, P, $P_{,}$, dP/dt. The terms in $d\delta/dt$ and dP/dt are generally smaller than the others.

The approximation may easily be carried further. But the above is in some respects a closer approximation than the expression from which it is derived, since the hour-angles, declinations, and parallaxes necessarily involve all the lunar and solar inequalities.

§ 30. *Syntheses of Solar and of Lunar Portions of the Semi-Diurnal Tide.*

Commencement of synthesis.

Let us write

$$\begin{aligned}M = {} & \frac{\cos^2\Delta}{\cos^2\Delta_{,}} \cdot H_m + \frac{\cos^2\delta' - \cos^2\Delta}{\sin^2\Delta_{,}} \cdot 683\, H'' \cos(\kappa'' - \kappa_m)\\ & + \frac{\cos^2\Delta}{\cos^2\Delta_{,}}(P - 1)\frac{H_n\cos\kappa_n - H_l\cos\kappa_l}{e\cos\epsilon}\cos(\epsilon - \kappa_m);\\ 2\mu = {} & \kappa_m + \frac{\cos^2\delta' - \cos^2\Delta}{\sin^2\Delta} \cdot 683\, H'' \sin(\kappa'' - \kappa_m)\\ & + \frac{\cos^2\Delta}{\cos^2\Delta_{,}}(P' - 1)\frac{H_n\cos\kappa_n - H_l\cos\kappa_l}{e\cos\epsilon}\sin(\epsilon - \kappa_m)\\ & - \frac{\sin\delta\cos\delta}{\sigma\sin^2\Delta_{,}}\frac{d\delta}{dt}\left[\frac{\cdot 683\, H''}{\cos(\kappa'' - \kappa_m)} - H_m\tan^2\Delta_{,}\right]\\ & + \frac{\cos^2\Delta}{e\cos^2\Delta_{,}}\frac{dP/dt}{\sigma - \varpi}\left[4H_m e - \frac{H_n}{\cos(\kappa_m - \kappa_n)} - \frac{H_l}{\cos(\kappa_l - \kappa_m)}\right];\\ M_{,} = {} & H_s + \frac{\cos^2\delta_{,} - \cos^2\Delta}{\sin^2\Delta_{,}} \cdot 317\, H'' + (P_{,} - 1)\frac{H_t - H_r}{e_{,}};\\ 2\mu_{,} = {} & \kappa_s \quad \text{...(82).}\end{aligned}$$

Since observation and theory agree in showing that κ'' is generally very nearly equal to κ_s, we are justified in substituting κ_s for κ'' in the small solar declinational term of (80) involving ·317 H''. Then, using (82) in (80),

One solar and one lunar term.

$$h_2 = M\cos 2(\psi - \mu) + M_{,}\cos 2(\psi_{,} - \mu_{,}) \quad \text{............(83).}$$

If the equilibrium theory of tides were true, each H would be proportional to the corresponding term in the harmonically developed potential. This proportionality holds nearly between tides of almost the same speed; hence, using the expressions in the column of coefficients in schedule [B, i.], § 23 (with the additional tide R there omitted, but having a coefficient $(\tau_{,}/r)^{\frac{1}{2}} \cdot \frac{1}{2}e_{,} \cos^4\frac{1}{2}\omega$, found by symmetry with the lunar tide L), and introducing $\Delta_{,}$ in place of ω in the solar tides, we may assume the truth of the proportion

$$\frac{\cos^2\Delta_{,}}{\sin^2\Delta_{,}} \cdot 317\, H'' = \frac{1}{3}\frac{H_t - H_r}{e_{,}} = H_s.$$

With this assumption, $M_{,}$ reduces to

$$M_{,} = \frac{\cos^2\delta_{,}}{\cos^2\Delta_{,}}H_s + 3(P_{,} - 1)H_s = \frac{\cos^2\delta_{,}}{\cos^2\Delta_{,}}H_s\{1 + 3(P_{,} - 1)\}.$$

Hence $M_{,} = P_{,}^3 \dfrac{\cos^2\delta_{,}}{\cos^2\Delta_{,}}H_s$ ....(84).

This is the law which we should have derived directly from the equilibrium theory, with the hypothesis that all solar semi-diurnal tides suffer nearly equal retardation. Save for meteorological influences, this must certainly be true.

A similar synthesis of M cannot be carried out, because the considerable diversity of speed amongst the lunar tides makes a similar appeal to the equilibrium theory incorrect. It may be seen, however, that it would be more correct to write $\cos^2\delta'$ instead of $\cos^2\Delta$ in the coefficient of the parallactic terms in M and 2μ.

The three terms of M in (82) give the height of lunar tide with its declinational and parallactic corrections, and similarly the formula for μ in (82) gives its value and corrections.

If now τ denotes the mean solar time elapsing since the moon's upper transit and γ the angular velocity of the earth's rotation, it is clear that the moon's hour-angle

$$\psi = (\gamma - d\alpha/dt)\tau;$$

and, since $M\cos 2(\psi - \mu)$ is a maximum when $\psi = \mu$ or differs from μ by 180°, it follows that $\mu/(\gamma - d\alpha/dt)$ is the "interval" from the moon's upper or lower transit to high water of the lunar tide. Since τ is necessarily less than 12^h, we may during the interval from transit to high water take as an approximation $d\alpha/dt = \sigma$, the moon's mean motion.[1] Hence that interval is $\mu/(\gamma - \sigma)$, or $\frac{2}{29}\mu$ hours nearly, when μ is expressed in degrees. Thus (82) for μ gives by its first term the mean interval for the lunar tide, and by the subsequent terms the declinational and parallactic corrections.

Approximate formula.

We have said that the synthesis of M cannot be carried out as in the case of $M_{,}$, but the partial synthesis below will give fairly good results. The proposed formula is

$$\begin{aligned}M & = P_{,}^3\frac{\cos^2\Delta}{\cos^2\Delta_{,}}H_m + \frac{\cos^2\delta' - \cos^2\Delta}{\sin^2\Delta_{,}} \cdot 683\, H''\cos(\kappa'' - \kappa_m);\\ 2\mu & = \kappa_m + \frac{\cos^2\delta' - \cos^2\Delta}{\sin^2\Delta_{,}} \cdot 683\, H''\sin(\kappa'' - \kappa_m);\\ M_{,} & = P_{,}^3\frac{\cos^2\delta_{,}}{\cos^2\Delta_{,}}H_s;\\ 2\mu_{,} & = \kappa_s \quad \text{.. ....(85).}\end{aligned}$$

These formulæ have been used in the example of the computation of a tide-table given in the *Admiralty Scientific Manual* (1886).

§ 31. *Synthesis of Lunar and Solar Semi-Diurnal Tides.*

Let A be the excess of ☽'s over ⊙'s R.A., so that

$$\left.\begin{aligned}A & = \alpha - \alpha_{,},\\ \psi_{,} & = \psi + A,\\ \text{and}\quad h_2 & = M\cos 2(\psi - \mu) + M_{,}\cos 2(\psi + A - \mu_{,})\end{aligned}\right\} \text{......(86).}$$

Synthesis to obtain single term.

The synthesis is then completed by writing

$$\begin{aligned}H\cos 2(\mu - \phi) & = M + M_{,}\cos 2(A - \mu_{,} + \mu),\\ H\sin 2(\mu - \phi) & = \phantom{M +{}} M_{,}\sin 2(A - \mu_{,} + \mu),\end{aligned}$$

so that

$$h_2 = H\cos 2(\psi - \phi) \quad \text{......................(87).}$$

Then H is the height of the total semi-diurnal tide and $\phi/(\gamma - d\alpha/dt)$ or $\phi/(\gamma - \sigma)$ or $\frac{2}{29}\phi$, when ϕ is given in degrees, is the "interval" from the moon's transit to high water.

The formulæ for H and ϕ may be written

$$\left.\begin{aligned}H & = \sqrt{\{M^2 + M_{,}^2 + 2MM_{,}\cos 2(A - \mu_{,} + \mu)\}}\\ \tan 2(\mu - \phi) & = \frac{M_{,}\sin 2(A - \mu_{,} + \mu)}{M + M_{,}\cos 2(A - \mu_{,} + \mu)}\end{aligned}\right\} \text{......(88).}$$

They may be reduced to a form adapted for logarithmic calculation.

Fortnightly inequality.

Since A goes through its period in a lunation, it follows that H and ϕ have inequalities with a period of half a lunation. These are called the "fortnightly or semi-menstrual inequalities" in the height and interval.

Age of tide.

Spring tide obviously occurs when $A = \mu_{,} - \mu$. Since the mean value of A is $s - h$ (the difference of the mean longitudes), and since the mean values of μ and $\mu_{,}$ are $\frac{1}{2}\kappa_m$, $\frac{1}{2}\kappa_s$, it follows that the mean value of the period elapsing after full moon and change of moon up to spring tide is $(\kappa_s - \kappa_m)/2(\sigma - \eta)$. The association of spring tide with full and change is obvious, and a fiction has been adopted by which it is held that spring tide is generated in those configurations of the moon and sun, but takes some time to reach the port of observation. Accordingly $(\kappa_s - \kappa_m)/2(\sigma - \eta)$ has been called the "age of the tide." The average age is about 36 hours as far as observations have yet been made. The age of the tide appears not in general to differ very much from the ages of the declinational and parallactic inequalities.

In computing a tide-table it is found practically convenient not to use A, which is the difference of R.A.'s at the unknown time of high water, but to refer the tide to A_0, the difference of R.A.'s at the time of the moon's transit. It is clear that A_0 is the apparent time of the moon's transit reduced to angle at 15° per hour. We have already remarked that $\phi/(\gamma - d\alpha/dt)$ is the interval from transit to high water, and hence at high water

$$A = A_0 + \frac{d\alpha/dt - d\alpha_{,}/dt}{\gamma - d\alpha/dt}\phi \quad \text{..................(89).}$$

Reference to moon's transit.

As an approximation we may attribute to all the quantities in the second term their mean values, and we then have

$$A = A_0 + \frac{\sigma - \eta}{\gamma - \sigma}\mu$$

and

$$A - \mu_{,} + \mu = A_0 - \mu_{,} + \frac{\gamma - \eta}{\gamma - \sigma}\mu = A_0 - \mu_{,} + \frac{30}{29}\mu \quad \text{......(90).}$$

This approximate formula (90) may be used in computing from (88) the fortnightly inequality in the "height" and "interval."

In this investigation we have supposed that the declinational and parallactic corrections are applied to the lunar and solar tides before their synthesis; but it is obvious that the process might be reversed, and that we may form a table of the fortnightly inequality, based on mean values H_m and H_s, and afterwards apply corrections. This is the process usually adopted, but it is less exact. The labour of computing the fortnightly inequality, especially by graphical methods, is not great, and the plan here suggested seems preferable.

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[1] The tide has been referred by Lubbock and others to an earlier transit, and not to the one immediately preceding the time under consideration. In this case we cannot admit with great accuracy that $d\alpha/dt = \sigma$, since the interval may be 30 or 40 hours.

§ 32. *Diurnal Tides.*

These tides have not been usually treated with completeness in the synthetic method. In the tide-tables of the British Admiralty we find that the tides at some ports are "affected by diurnal inequality"; such a statement may be interpreted as meaning that the tides are not to be predicted by the information given in the so-called tide-table. The diurnal tides are indeed complex, and do not lend themselves easily to a complete synthesis. In the harmonic notation the three important tides are K_1, O, P, and the lunar portion of K_1 is nearly equal to O in height, whilst the solar portion is nearly equal to P. A complete synthesis may be carried out on the lines adopted in treating the semi-diurnal tides, but the advantage of the plan is lost in consequence of large oscillations of the amplitude through the value zero, so that the tide is often represented by a negative quantity multiplied by a circular function. It is best, then, only to attempt a partial synthesis, and to admit the existence of two diurnal tides.

We see from schedules [A, ii.] and [B, i.], § 23, that the principal diurnal tides are those lettered O, P, K_1. Of these K_1 occurs both for the moon and the sun. The synthesis of the two parts of K_1 is effected without difficulty, and the result is a formula for the total K_1 tide like that in [A, ii.], but with the ν which occurs in the argument replaced by a different angle denoted as ν'. If, then, we write

$$\left.\begin{aligned} V_0 &= t + h - 2s - \nu + 2\xi + \tfrac{1}{2}\pi \\ V' &= t + h - \nu' - \tfrac{1}{2}\pi \end{aligned}\right\} \ldots\ldots\ldots\ldots\ldots(91),$$

the three tides O, K_1, P are written as follows:—

$$\begin{aligned} O &= f_0 H_0 \cos(V_0 - \kappa_0), \\ K_1 &= f' H' \cos(V' - \kappa'), \\ P &= -H_p \cos[V' - \kappa' - (2h - \nu') + \kappa' - \kappa_p)] \end{aligned} \quad \ldots\ldots(92).$$

The last two tides have very nearly the same speed, so that we may assume $\kappa' = \kappa_p$, and that H_p has the same ratio to H' as in the equilibrium theory. Now, in schedules [A, ii.], [B, ii.], § 23, the coefficient of K_1, viz., H' (the sum of the lunar and solar parts), is ·26522, and the coefficient of P, viz., H_p, is ·08775, so that $H' = 3·023\,H_p$, or say $= 3H_p$. Hence we have

$$\begin{aligned} K_1 + P = H'[f' - \tfrac{1}{3}\cos(2h - \nu')]\cos(V' - \kappa') \\ - H'\tfrac{1}{3}\sin(2h - \nu')\sin(V' - \kappa'). \end{aligned}$$

If, therefore, we put

$$\left.\begin{aligned} R'\cos\psi &= H'[f' - \tfrac{1}{3}\cos(2h - \nu')] \\ R'\sin\psi &= \tfrac{1}{3}H'\sin(2h - \nu') \end{aligned}\right\} \ldots\ldots\ldots(93),$$

$$K_1 + P = R'\cos(V' + \psi - \kappa').$$

It is clear that ψ and R' have a semi-annual inequality, and therefore for several weeks together R' and ψ may be treated as constant.

Now suppose that we compute V_0 and V' at the epoch—that is, at the initial noon of the period during which we wish to predict the tides—and with these values put

$$\zeta_0 = \kappa_0 - V_0 \text{ at epoch}, \quad \zeta' = \kappa' - V' \text{ at epoch} - \psi.$$

Then the speed of V_0 is $\gamma - 2\sigma$, or 13°·94303 per hour, or 360° − 25°·3673 per day; and the speed of V' is γ, or 15°·0410686 per hour, or 360°·9856 per day. Hence, if t be the mean solar time on the $(n+1)$th day since the initial moment or epoch,

$$\begin{aligned} V_0 - \kappa_0 &= 360°n + 13°{\cdot}943\ t - \zeta_0 - 25°{\cdot}367n, \\ V' + \psi - \kappa' &= 360°n + 15°{\cdot}041\ t - \zeta' + 0°{\cdot}986n. \end{aligned}$$

Therefore the diurnal tides at time t of the $(n+1)$th day are given by

$$\left.\begin{aligned} O &= f_0 H_0 \cos[13°{\cdot}943t - \zeta_0 - 25°{\cdot}367n] \\ K_1 + P &= R'\cos[15°{\cdot}041\ t - \zeta' + 0°{\cdot}986n] \end{aligned}\right\} \ldots\ldots(94).$$

If we substitute for t the time of high or low water as computed simply from the semi-diurnal tide, it is clear that the sum of these two expressions will give the diurnal correction for height of tide at high or low water, provided the diurnal tides are not very large. If we consider the maximum of a function

$$A\cos 2(t - \alpha) + B\cos n(t - \beta),$$

where B is small compared with A and n is nearly unity, we see that the time of maximum is given approximately by $t = \alpha$, with a correction δt determined from

$$-2A\sin(2\delta t) - nB\sin n(\alpha - \beta) = 0;$$

or

$$\delta t = -\frac{180°}{\pi} \cdot \frac{nB}{4A}\sin n(\alpha - \beta).$$

In this way we find that the corrections to the time of high water from O and $K_1 + P$ are

$$\left.\begin{aligned} \delta t_0 &= -0^h{\cdot}988\left(1 - \frac{\sigma}{\gamma - \sigma}\right)\frac{f_0 H_0}{H}\sin[13°{\cdot}943t - \zeta_0 - 25°{\cdot}367n] \\ \delta t' &= -0^h{\cdot}988\left(1 + \frac{\sigma}{\gamma - \sigma}\right)\frac{R'}{H}\sin[15°{\cdot}041t - \zeta' + 0°{\cdot}986n] \end{aligned}\right\} (95),$$

H denoting the height and t the time of high water as computed from the semi-diurnal tide. If t next denotes the time of low water the same corrections with opposite sign give the corrections for low water.

If the diurnal tides are large a second approximation will be necessary. These formulæ have been used in computing a tide-table in the example given in the *Admiralty Scientific Manual* (1886).

§ 33. *Explanation of Tidal Terms in common use; Datum Levels.*

Tidal terms explained.

The mean height at spring tide between high and low water is called the *spring rise*, and is equal to $2(H_m + H_s)$. The height between mean high-water mark of neap tide and mean low-water mark at spring tide is called the *neap rise*, and is equal to $2H_m$. The mean height at neap tide between high and low water is called the *neap range*; this is equal to $2(H_m - H_s)$. Neap range is usually about one-third of spring range. The mean period between full or change of moon and spring tide is called the *age of the tide*; this is equal to $(\kappa_s - \kappa_m)/2(\sigma - \eta)$, or, if $\kappa_s - \kappa_m$ be expressed in degrees, $0^h{\cdot}984 \times (\kappa_s - \kappa_m)$; $\kappa_s - \kappa_m$ is commonly about 36°, and the age about 36^h. The period elapsing from the moon's upper or lower transit until it is high water is called the *interval* or the *lunitidal interval*. The interval at full moon or change of moon is called the *establishment of the port* or the *vulgar establishment*. The interval at spring tide is called the *corrected* or *mean establishment*.

The mean establishment may be found from the vulgar establishment by means of the spring and neap rise and the age of the tide, as follows.

Let α be the age of the tide reduced to angle at the rate of 1°·016 to the hour. Then the mean establishment in hours is equal to the vulgar establishment in hours, diminished by a period expressed in hours numerically equal to $\frac{1}{15}$ of the angle whose tangent is $H_s \sin\alpha/(H_m + H_s\cos\alpha)$, expressed in degrees. Also H_s/H_m is equal to the ratio of the excess of spring rise over neap rise to neap rise.

The French have called a quantity which appears to be identical with $H_m + H_s$, or half the spring rise, the unit of height, and then define the height of any other tide by a tidal coefficient.[1]

Admiralty datum.

The practice of the British Admiralty is to refer their soundings and tide-tables to "mean low-water mark of ordinary spring tides." This datum is found by taking the mean of the low-water marks of such observations at spring tide as are available, or, if the observations are very extensive, by excluding from the mean such spring tides as appear to be abnormal, owing to the largeness of the moon's parallax at the time or any other cause. The Admiralty datum is not, then, susceptible of exact scientific definition; but, when it has once been fixed with reference to a bench mark ashore, it is expedient to adhere to it, by whatever process it was first fixed.

Indian datum.

It is now proposed to adopt for any new Indian tidal stations a low-water datum for the tide-table to be called "Indian low-water mark,"[2] and to be defined as $H_m + H_s + H' + H_0$ below mean-water level. Although such a datum is not chosen from any precise scientific considerations, it is susceptible of exact definition, is low enough to exclude almost all negative entries from the table (a *sine quâ non* for a good datum), and will differ but little from the Admiralty datum, however that may be determined. A valuable list of datum levels is given by Mr J. Shoolbred in a *Report* to the British Association in 1879.

§ 34. *On the Reduction of Observations of High and Low Water.*[3]

Observations of H.W. and L.W.

A continuous register of the tide or observation at fixed intervals of time, such as each hour, is certainly the best; but for the adequate use of such a record some plan analogous to harmonic analysis is necessary. Observations of high and low water only have, at least until recently, been more usual. Some care has to be taken with respect to these observations, for about high and low water an irregularity in the rise and fall becomes very noticeable, especially if the place of observation is badly chosen.[4] Observations should therefore be taken every five or ten minutes for half an hour or an hour, embracing the time of high and low water. The time and height of high and low water should then be found by plotting down a curve of heights, and by taking as the true tide-curve a line which presents a sweeping curvature and smoothes away the minor irregularities. A similar but less elaborate process would render hourly observations more perfect. In the reduction the immediate object is to connect the times and heights of high and low water with the moon's transits by means of the establishment, age, and fortnightly inequality in the interval and height. The reference of the tide to the establishment is not, however, scientifically desirable, and it is better to determine the mean establishment, which is the mean interval from the moon's transit to high water at spring tide, and the age of the tide, which is the mean period from full moon and change of moon to spring tide.

Graphical treatment.

For these purposes the observations may be conveniently treated graphically.[5] An equally divided horizontal scale is taken to represent the twelve hours of the clock of civil time, regulated to the time of the port, or—more accurately—arranged always to show

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[1] See Hatt, *Phénomène des Marées*, p. 151, Paris, 1885.

[2] See Prefaces to *Indian Official Tide-Tables for 1887*.

[3] Founded on Whewell's article "Tides", in *Admiralty Sc. Manual* (ed. 1841), and on Airy's "Tides and Waves," in *Ency. Metrop.*

[4] Waves with a period of from five to twenty minutes are very common, and appear to be analogous to the "seiches" of Geneva and other lakes. See Forel, *Bulletin Soc. Vaud. Sci. Nat.*, 1873, 1875, 1877, and 1879; *Ann. Chimie et Physique*, vol. ix., 1876; *Comptes Rendus*, 1879; *Arch. Sci., Ph., et Nat.*, *Geneva*, 1885; also Airy, "On the Tides of Malta," *Phil. Trans.*, 1878, part i.

[5] For a numerical treatment, see *Directions for Reducing Tidal Observations*, by Commander Burdwood, R.N., London, 1876.

Graphical determination of establishment, &c.

apparent time by being fast or slow by the equation of time; this time-scale represents the time-of-clock of the moon's transit, either upper or lower. The scale is perhaps most conveniently arranged in the order V, VI, . . ., XII, I . . . IIII. Then each interval of time from transit to high water is set off as an ordinate above the corresponding time-of-clock of the moon's transit. A sweeping curve is drawn nearly through the tops of the ordinates, so as to cut off minor irregularities. Next along the same ordinates are set off lengths corresponding to the height of water at each high water. A second similar figure may be made for the interval and height at low water.[1] In the curve of high-water intervals the ordinate corresponding to XII is the establishment, since it gives the time of high water at full moon and change of moon. That ordinate of high-water intervals which is coincident with the greatest ordinate of high-water heights gives the mean establishment. Since the moon's transit falls about fifty minutes later on each day, in setting off a fortnight's observations there will be about five days for each four times-of-clock of the upper transit. Hence in these figures we may regard each division of the time-scale I to II, II to III, &c., as representing twenty-five hours instead of one hour Then the distance from the greatest ordinate of high-water heights to XII is called the age of the tide. From these two figures the times and heights of high and low water may in general be predicted with fair approximation. We find the time-of-clock of the moon's upper or lower transit on the day, correct by the equation of time, read off the corresponding heights of high and low water from the figures, and the intervals being also read off are added to the time of the moon's transit and give the times of high and low water. At all ports there is, however, an irregularity of heights and intervals between successive tides, and in consequence of this the curves present more or less of a zigzag appearance. Where the zigzag is perceptible to the eye, the curves must be smoothed by drawing them so as to bisect the zigzags, because these diurnal inequalities will not present themselves similarly in the future. When, as in some equatorial ports, the diurnal tides are large, this method of tidal prediction fails.

Graphical prediction.

Methods of Laplace, Lubbock, Whewell.

This method of working out observations of high and low water was not the earliest. In the *Mécanique Céleste*, bks. i and v., Laplace treats a large mass of tidal observations by dividing them into classes depending on the configurations of the tide-generating bodies. Thus he separates the two syzygial tides at full moon and change of moon and divides them into equinoctial and solstitial tides. He takes into consideration the tides of several days embracing these configurations. He goes through the tides at quadratures on the same general plan. The effects of declination and parallax and the diurnal inequalities are similarly treated. Lubbock (*Phil Trans.*, 1831 *sq.*) improved the method of Laplace by taking into account all the observed tides, and not merely those appertaining to certain configurations. He divided the observations into a number of classes. First, the tides are separated into parcels, one for each month; then each parcel is sorted according to the hour of the moon's transit. Another classification is made according to declination; another according to parallax; and a last for the diurnal inequalities. This plan was followed in treating the tides of London, Brest, St Helena, Plymouth, Portsmouth, and Sheerness. Whewell (*Phil. Trans.*, 1834 *sq.*) did much to reduce Lubbock's results to a mathematical form, and made a highly important advance by the introduction of graphical methods by means of curves. The method explained above is due to him. Airy remarks of Whewell's papers that they appear to be "the best specimens of reduction of new observations that we have ever seen."

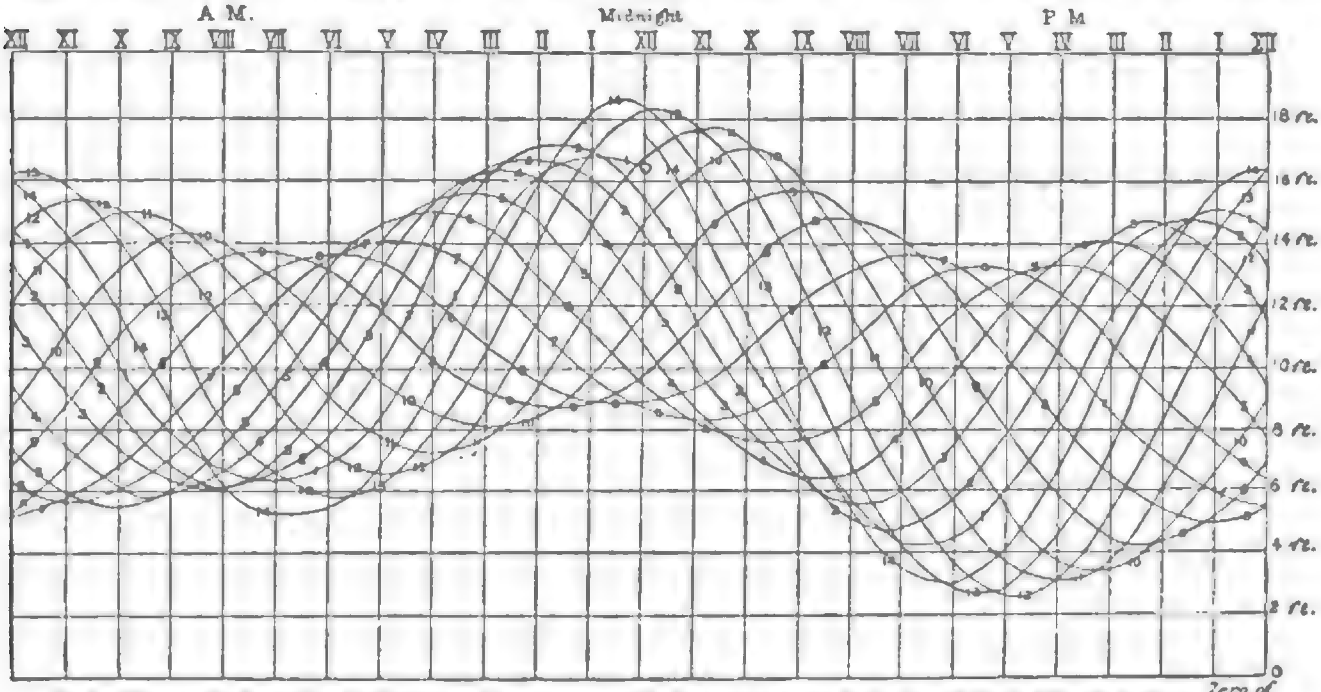

FIG. 3.—Tide-curve for Bombay from the beginning of the civil year 1884 to the midnight ending Jan. 14, 1884, or from 12^h Dec. 31 1883, to 12^h Jan. 14, 1884, astronomical time.

VI. TIDAL INSTRUMENTS AND TIDAL PREDICTION.

§ 35. *General Remarks.*

Observation and prediction.

Practical tidal work is divisible into the three stages of observation, reduction of observations, and prediction.

The simplest observation is that of the height of water on a graduated staff fixed in the sea, with such allowance as is possible made for wave-motion. It is far better, however, to sink a tube into the sea, into which the water penetrates through small holes. The wave-motion is thus annulled. In this calm water there lies a float, to which is attached a cord passing over a pulley and counterpoised at the end. The motion of the counterpoise against a scale is observed. In either case the observations may be made every hour, which is preferable, or the times and heights of high and low water may be noted. We have explained in § 34 the methods of reducing the latter kind of observation. Although more appropriate for rough observations, this method is susceptible of great accuracy when carefully used. It has been largely superseded by the harmonic method, but is still adhered to by the British Admiralty. In more careful observations than those of which we are speaking the tidal record is automatic and continuous; the reduction may be, and probably at some future time will be, mechanical; and the prediction is so already. We shall therefore devote some space to general descriptions of the three classes of instrument. The harmonic reductions are at present (1887) actually done numerically, and in chapter iv we have indicated the nature of the arithmetical processes.

§ 36. *The Tide-Gauge.*

Tide-gauge.

The site for the erection of a tide-gauge depends on local circumstances. It should be placed so as to present a fair representation of the tidal oscillations of the surrounding area. A tank is generally provided, communicating by a channel with the sea at about 10 feet (more or less according to the prevalent surf) below the lowest low-water mark. In many cases on open coasts and frequently in estuaries the tank may be dispensed with. At any rate we suppose that water is provided rising and falling with the tide, without much wave-motion. The nature of the installation depends entirely on the circumstances of the case. A vertical pipe is fixed in the water in such a way as to admit it only through holes small enough to annul wave motion and large enough to make no sensible retardation of its rise and fall in the pipe. The diameter of the pipe differs greatly in different instruments: sometimes that which we have described as the tank serves as the pipe, and sometimes the pipe alone dips into the sea. A cylindrical float, usually a hollow metallic box or a block of green-heart wood, hangs and floats in the pipe, and is of such density as just to sink without support. In Sir W. Thomson's gauge the float hangs by a fine platinum wire, in Newman's (used in India) by a metallic ribbon. In the latter a chain hangs at the bottom of the float of such weight that, whether the water be high or low, there is the same upward force on the float. It is necessary that the pull on the float should be constant, otherwise a systematic error is introduced between rising and falling water. The suspension wire is wrapped round a wheel, and imparts to it rotation proportional to the rise and fall of tide. By a simple gearing this wheel drives another, by which the range is reduced to any convenient extent. A fine wire wound on the final wheel of the train drags a pencil or pen up and down or to and fro proportionately to the tidal oscillations. The pencil is lightly pressed against a drum, which is driven by clockwork so as to make one revolution per day. The pen leaves its trace or tide-curve on paper wrapped round the drum. Generally, however, the paper is fixed to the drum, and the record of a fortnight may be taken without change of paper. An example of a tide-curve for Apollo Bunder, Bombay, from 1st to 15th January 1884, is shown in fig. 3. Sometimes the paper is in a long band, which the drum picks off from one coil and delivers on to another. The contact of the pen must be such that the work done in dragging it over the paper is small, otherwise a varying tension is thrown on to the float wire. Hence, if the friction is considerable, the float must be large.

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[1] An example of this kind of curve for the high-water heights for Bombay, drawn automatically by a tide-gauge, would be shown by joining all the high waters together (as in fig. 3) by a continuous curve; and a similar curve may be constructed for the low waters. In this case, however, the hours of the clock are repeated twice over, so that the morning and evening tides occur in different halves of the figure, and the hours are not hours of the moon's transit, but the actual times of high water. It is obvious that the separation of the morning and evening tides prevents the occurrence of the zigzags referred to.

The conditions necessary for a good tide-gauge appear to be better satisfied by Sir W. Thomson's than by any other; but, as his instrument is recent, other forms have been much more extensively used, and have worked well. The peculiarity of Thomson's tide-gauge is that, by giving the drum an inclination to the vertical, the pressure of the pen on the paper and on its guides is very delicately regulated to the minimum necessary for effecting the purpose. In other gauges the drum has been either vertical or horizontal, and the amount of friction has necessarily been considerably greater.[1]

§ 37. *The Harmonic Analyser.*

If a function H be expressed as a series of harmonic terms, and if one pair of these terms be A $\cos nt$ + B $\sin nt$, then, if T be a multiple of the complete period $2\pi/n$, we have

$$A=\frac{2}{T}\int_0^T H\cos nt\,dt,\quad B=\frac{2}{T}\int_0^T H\sin nt\,dt.$$

Thus a machine which will effect these integrations will give A and B. Such a machine has been invented by Prof. James Thomson and perfected by Sir W. Thomson. In fig. 4 let TT′ be a circular table, capable of rotation about the inclined shaft s. Let S be a sphere touching the table anywhere along its horizontal diameter. Let C be a cylinder, of somewhat smaller diameter than the sphere, capable of rotation about a horizontal axis parallel to the table, and touching the sphere so that CS is parallel to TT′. Suppose that the point of contact of the sphere with the table is distant x from the centre of the table, and nearer to us than the shaft; then, when the shaft s and the table TT′ turn in such a direction that T rises from the paper and T′ goes below it, the sphere will turn in the direction of its arrow. If the radius of the sphere is a, and that of the cylinder b, then, when the table turns through a small angle $\delta\theta$, the sphere turns through $x\delta\theta/a$ and the cylinder through $x\delta\theta/b$. This angle vanishes if S touches the table at the centre, and is reversed if the sphere be moved across to the other side of the centre. Also whilst the table is turning the sphere may be rolled backwards and forwards without rubbing, and thus transmits motion from the table to the cylinder without slipping. Now suppose the turning of the table is so constrained that $\delta\theta = k\cos\psi d\psi$, whilst x is constrained to be equal to the arbitrarily varying quantity H. Then the total angle turned through by the cylinder, as the machine runs, is proportional to $\int H\cos\psi d\psi$. If we impart to the table a simple harmonic oscillatory motion, with a period proportional to the lunar half-day, whilst the sphere moves, relatively to the centre of the table, proportionately to the tide-heights on the same time-scale, then, at the end of a sufficient number of lunar days, we shall find that the total angle turned through by the cylinder is proportional to either the A or B component of the lunar semi-diurnal tide. An index, which points to a dial, may be fixed to the cylinder, so that the required result may be read off.

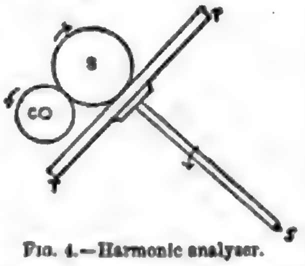

Fig. 4.—Harmonic analyser.

In the harmonic analyser the tide-curve diagram is wrapped on a drum, which is turned by one hand, whilst with the other a pointer is guided to follow the tide-curve. As the drum turns proportionately to mean solar time, appropriate gearing causes two tables to execute harmonic oscillations in phases at right angles, with lunar semi-diurnal period. At the same time a fork attached to the pointer guides the two spheres so that their distances from the centres of their tables are equal to the tide-height in the diagram. The indexes attached to the two cylinders give the two components of the lunar semi-diurnal tide, and the approximation improves the longer the tide-curve which is passed through the machine. Corresponding to each of the principal lunar and solar tides there are a pair of tables, spheres with guiding forks, and cylinders similarly geared, and there is another sphere and another table, which last always turns the same way and at the same rate as the drum, from which the mean height of water is determined. Such an instrument has been constructed under the supervision of Sir W. Thomson, but has not yet been put into practical use, so that we cannot say how it will compete with the arithmetical harmonic analysis. A similar, but less complex machine for the analysis of meteorological observations is in constant use in the Meteorological Office in London, and is found to work well.[2]

§ 38. *The Tide-Predicting Instrument.*

Tide-predicting instrument.

The first suggestion for instrumental prediction of tides was given, we believe, by Sir W. Thomson in 1872, and the instruments since made have been founded on the principles which he then laid down. Mr Edward Roberts bore a very important part in the first practical realization of such a machine, and a tide-predicter was constructed by Légé for the Indian Government under his direction. Thomson's is the only instrument in Europe as yet in regular practical use for navigational purposes. It requires much skill and care in manipulation, and it has been ably worked by Mr Roberts for the production of the Indian tide-tables ever since its completion. We refer the reader to Sir W. Thomson's paper on "Tidal Instruments," in *Inst. C.E.*, vol. lxv., and to the subsequent discussion, for a full account of the several instruments, and for details of the share borne by the various persons concerned in the realization of the idea.

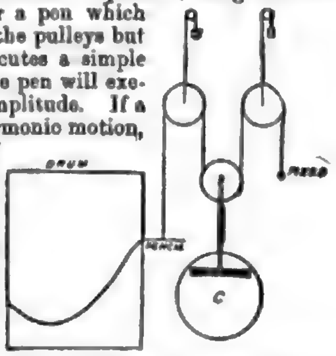

Fig. 5.—Tide-predicting instrument.

Fig. 5 illustrates diagrammatically the nature of the instrument. A cord passes over and under a succession of pulleys, being fixed at one end and having at the other a pen which touches a revolving drum. If all the pulleys but one be fixed, and if that one executes a simple harmonic motion up and down, the pen will execute the same motion with half amplitude. If a second pulley be now given an harmonic motion, the pen takes it up also with half amplitude. The same is true if all the pulleys are in harmonic motion. Thus the pen sums them all up, and leaves a trace on the revolving drum. When the drum and pulleys are so geared that the angular motion of the drum is proportional to mean solar time, whilst the harmonic motions of the pulleys correspond in range and phase to all the important lunar and solar tides, the trace on the drum is a tide-curve, from which a tide-table may be constructed. The harmonic motion of the pulley is given by an arrangement indicated only in the case of the lower pulley in the figure. The pulley frame has attached to its vertical portion a horizontal slot, in which slides a pin fixed to a wheel. Suppose that whilst the drum turns through 15° the wheel turns through 28°·984. Now a lunar day is 24·842 mean solar hours; hence as the drum turns through 15° × 24·842 the wheel turns through 24·842 × 28°·984 or 720°. Thus, if the drum turns with an angular velocity proportional to solar time, the wheel turns with twice the angular velocity proportional to lunar time, and the pulley geared to the wheel executes lunar semi-diurnal harmonic oscillations. When the throw of the pin and its angular position on its wheel are adjusted so as to correspond with the range and phase of the observed lunar semi-diurnal tide, the oscillation of the pulley remains rigorously accurate for that tide for all future time, if the gearing be rigorously accurate, and with all needful accuracy for some ten years of tide with gearing as practically constructed. The upper pulleys have to be carefully counterpoised as indicated. It has not been found that any appreciable disturbance is caused by the inertia of the moving parts, even when the speed of working is high. The predicter of the India Office takes about four hours to run off a year's tides, but greater speed seems attainable by modification in the gearing. The Indian instrument, in the store department at Lambeth, has pulleys for the following tides (see chap. iv.):—M_2, M_4, M_6, K_1, S_1, S_2, O, N, P, K_2, Q, ν, J, L, λ, 2MS, 2SM, MS, Ssa, Sa.

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[1] For further details concerning the establishment of tide-gauges, see Major Braid's *Manual of Tidal Observation*, London, 1887, and Sir W. Thomson, "On Tidal Instruments," in *Inst. Civ. Eng.*, vol. lxv. p. 10.

[2] For further details, see Appendixes iii., iv., v., to Thomson and Tait's *Nat. Phil.*, 1879, vol. i., part i.; James Thomson, *Proc. Roy. Soc.*, vol. xxiv., 1876, p. 262, and (Sir W. Thomson) pp. 269, 271; Sir W. Thomson, *Proc. Inst. C.E.*, vol. lxv.

Tides on Indian instrument.

§ 39. *Numerical Harmonic Analysis and Prediction.*

In chapter iv. we have discussed the application of the numerical harmonic method to a long series of hourly observations. An actual numerical example of this analysis, with modifications to render it applicable to a short series, such as a fortnight, is given in the *Admiralty Scientific Manual*, 1886, where also an example of the numerical and graphical prediction of the tides may be found. The formulæ used are those given in chapter v.

VII. PROGRESS OF THE TIDE-WAVE OVER THE SEA, AND THE TIDES OF THE BRITISH SEAS.

§ 40. *Meaning of Cotidal Lines.*

Sufficient tidal data would of course give the state of the tide at every part of the world at the same instant of time, and if we were to follow the successive changes we should be able to picture mentally the motion of the wave over the ocean and the successive changes in its height. The data are, however, as yet very incomplete and only a rough scheme is possible. A map purporting to give the progress of the tide-wave is called a map of cotidal lines. For a perfect representation three series of maps would be required, one for the semi-diurnal tides, a second for the diurnal tides, and a third for the tides of long period. Each class of map would then show the progress of the wave for each configuration of the tide-generators. But as yet the only cotidal maps made are those for the mean semi-diurnal tide, and only for the configuration of new and full moon. The knowledge of the tides is not very accurate throughout the world, and therefore in the maps which we give it is assumed that the same interval elapses at all places between new and full moon and spring tide.

At spring tide, as we have seen in (87) and (88),

$$h_2 = (M + M_{\prime}) \cos 2 (\psi - \mu),$$

since $A - \mu$, becomes then equal to $-\mu$. As a rough approximation spring tide occurs when the moon's transit is at one o'clock at night or in the day. We only assume, however, that it occurs simultaneously everywhere. Now let τ be the Greenwich mean time of high water, and l the E. long. in hours of the place of observation, then, the local time of high water being the time of the moon's transit plus the interval, and local time being Greenwich time plus E. long., we have

$$\tau = \mu/(\gamma - \sigma) - l = \tfrac{2}{29}\mu - l + 1^h,$$

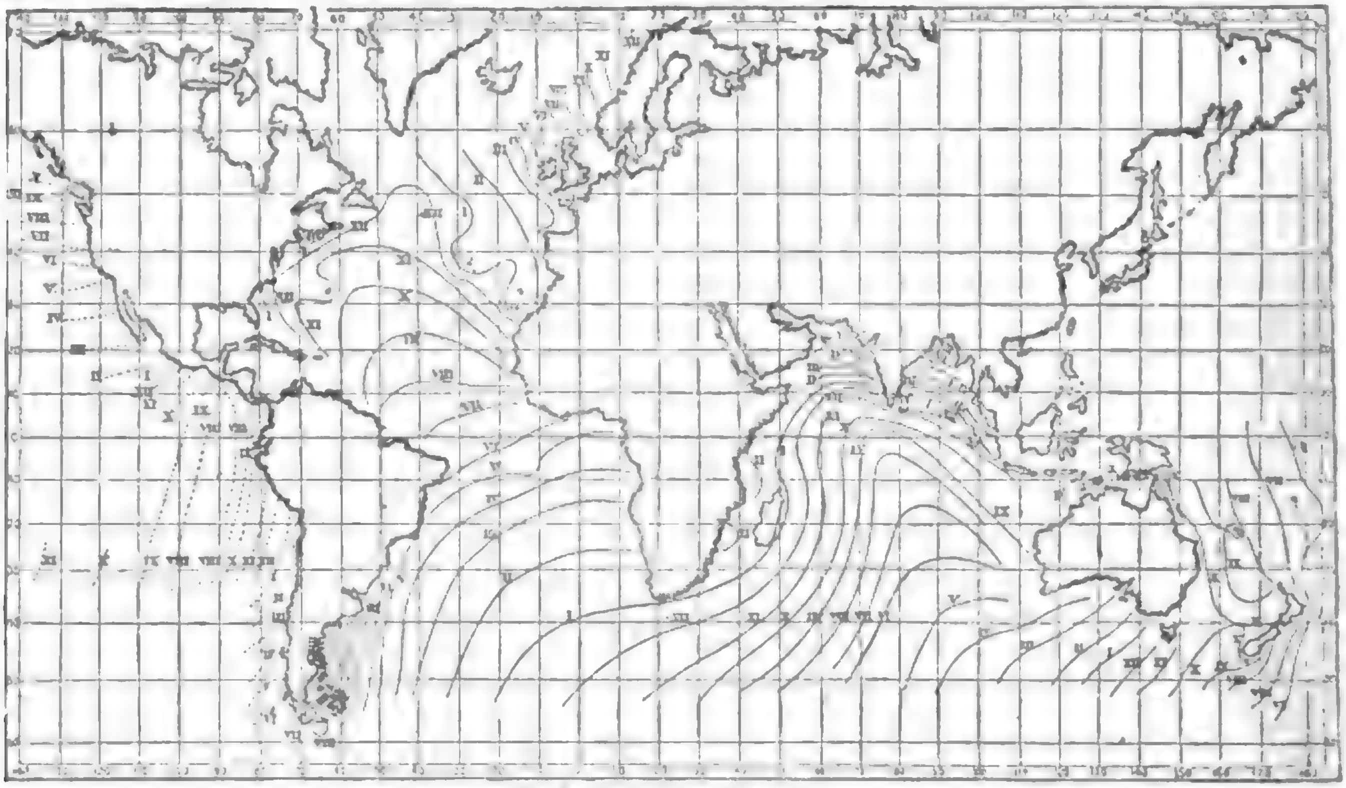

FIG. 6.—Cotidal lines of the world.

where μ is in degrees. Therefore, if we draw over the ocean a succession of lines defined by equidistant integral values of the Greenwich time of high water, and if we neglect the separation of the moon from the sun in longitude in twelve hours, the successive lines will give the motion of the semi-diurnal tide-wave in one hour.

§ 41. *Cotidal Lines of the World.*

No recent revisal of cotidal lines has been made with the aid of the great mass of tidal data which is now being accumulated, and we therefore reproduce (fig 6) the chart of the world prepared by Sir George Airy for his article on "Tides and Waves." The parts of the world for which data are wanting are omitted. The Roman numerals upon the cotidal lines denote the hour in Greenwich time of high water on the day of new or full moon. Airy remarks (§§ 575-584) that the cotidal lines of the North Atlantic are accurately drawn, that those of the South Atlantic are doubtful, and in the Pacific east of New Zealand are almost conjectural. The embodiment of recent observations in a cotidal chart would necessitate some modification of these statements.

Lines crowded near land.

When a free wave runs into shallow water it travels with less velocity and its height is increased. This is observable in the flexure and crowding of the cotidal lines near continents and oceanic islands, as, for example, about the Azores, the Bermudas, and the coast of South America. The velocity of the tide-wave gives good information as to the depth of the sea. In the North Sea it appears to travel at about 45 miles an hour, which corresponds to a depth of 140 feet, and we know that the depth along the deeper channel is greater and along the sides less than this. In the Atlantic the wave passes over 90° of latitude, from the southern to the northern one o'clock line, in twelve hours, that is at the rate of 520 miles an hour. If the Atlantic tide could be considered as a free wave generated by the Pacific tide, this velocity would correspond to a depth of 18,000 feet. Airy considers, however, that the Atlantic forms too large a basin to permit the neglect of the direct tidal action, and thinks that the tides of this ocean derive extremely little of their character from the Pacific.

"There is another consideration," he says, "which must not be left out of sight. It is that, supposing the cotidal lines to be accurately what they profess to be—namely, the lines connecting all the points at which high water is simultaneous—they may, nevertheless, with a compound series of tide-waves, not at all represent the ridge of the tide-wave which actually runs over the ocean. Thus an eye at a great distance, capable of observing the swells of the tide-waves, might see one huge longitudinal ridge extending from the mouth of the Amazon to the sea beyond Iceland, making high water at one time from Cape de Verde to the North Cape, and at another time from Florida to Greenland, and another ridge transversal to the former, travelling from the coast of Guiana to the northern sea; and the cotidal lines which we have traced may depend simply on the combination of these waves. It does not appear likely that we can ever ascertain whether it is so or not; but it is certainly possible that the original waves may have these or similar forms;

and if so it is vain for us to attempt entirely to explain the tides of the Atlantic."

He sums up the discussion of the chart by saying:—

"Upon the whole, therefore, we are driven to the conclusion that we cannot at all explain the cause of the form of the cotidal lines in the ocean, so far as they have been traced with any probability. And, supposing us to know with tolerable certainty those corresponding to the semi-diurnal tide, we cannot at all predict those which should hold for the diurnal tide."

§ 42. *Cotidal Lines of the British Seas.*

Fig. 7 shows the cotidal lines in the seas surrounding the British Islands. Here the lines refer to full moon and change of moon and not to spring tide. The small figures along different parts of the coast denote the extreme range of the tide in yards. This figure is from the same source as the preceding one, and we again reproduce a portion of Airy's remarks.

"The tides in the English Channel claim notice as having been the subject of careful examination by many persons, English and French. It appears that in the upper part of the Channel the water flows up the Channel nearly three hours after high water and runs down nearly three hours after low water (this continuance of the current after high water, if it last three hours, is called by sailors *tide-and-half-tide*; if it last one hour and a half, it is called *tide-and-quarter-tide*). On the English side of the Channel, especially opposite the entrance of bays, the directions of the currents turn in twelve hours in the same direction as the hands of a watch; on the French side they turn in the opposite direction. This is entirely in conformity with theory. The same laws are recognized as holding in the British [Bristol?] Channel, and in the German or North Sea near the Scotch and English coasts.

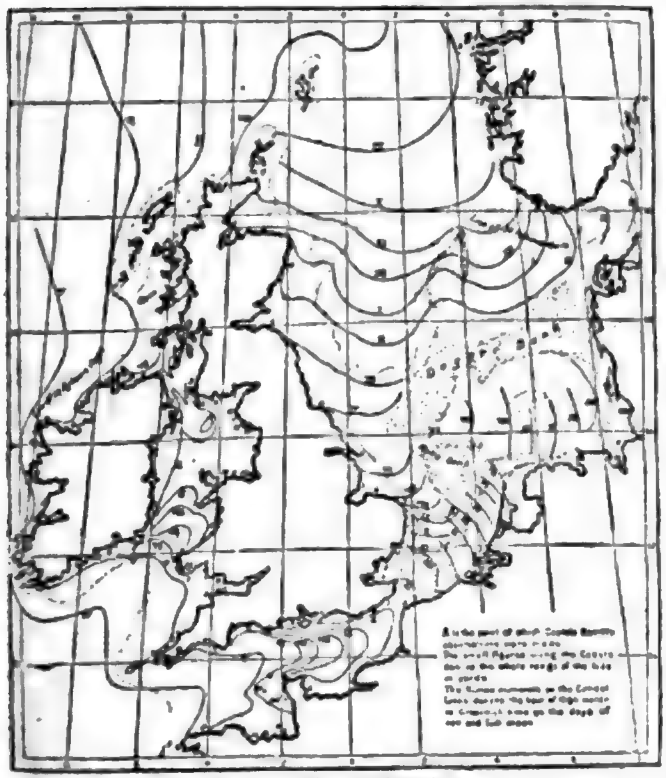

FIG. 7.—Cotidal lines of British seas.

"With regard to the Irish Channel we have only to remark that there is a very great difference in the height of the tide on the different sides, the tide on the east side being considerably the greater. They are also greater in the northern part (north of Wicklow on one side, and of Bardsey Island on the other side) than in the southern part. Between Wexford and Wicklow they are very small.

"The tides of the German Sea present a very remarkable peculiarity. Along the eastern coast of England, as far as the mouth of the Thames, the tide-wave, coming from the Atlantic round the Orkney Islands, flows towards the south. Thus, on a certain day, it is high water in the Murray [Moray] Firth at eleven o'clock, at Berwick at two o'clock, at Flamborough Head at five o'clock, and so on to the entrance of the Thames. But on the Belgian and Dutch coasts immediately opposite, the tide-wave flows from the south towards the north. Thus, on the day that we have supposed, it will be high water off the Thames at eleven o'clock (the tide having travelled in twelve hours from the Murray Firth) and at Calais nearly at the same time; but at Ostend it will be at twelve, off The Hague at two, off the Helder at six, and so on.

"We believe that a complete explanation may be found in the arrangement of the great shoals of the North Sea. It must be remarked that (except within a very small distance of Norway) the North Sea is considerably deeper on the English side than on the German side; so much so that the tide-wave coming from the north runs into a deep bay of deep water, bounded on the west side by the Scotch and English coasts as far as Newcastle, and on the east side by the great Dogger Bank. As far as the latitude of Hull, the English side is still the deep one; and, though a species of channel through the shoal there allows an opening to the east, yet immediately on the south of it is the Wells Bank, which again contracts the deep channel to the English side. After this (that is, in the latitude of Yarmouth) the deep channel expands equally to both sides. It seems reasonable to conclude from this that the great set of north tide is on the English side of the North Sea, both between the Dogger Bank and England and between the Wells Bank and England (a branch stream of tide having been given off to the east between these two banks), and that any passage of tide-wave over these banks may be neglected. Now this view is supported in a remarkable degree by the tidal observations on two dangerous shoals called the Ower and Leman, lying between Cromer and the Wells Bank, but nearer to the latter. It appears that on these shoals the direction of the tide-current revolves in the same manner as the hands of a watch, proving conclusively that the Ower and Leman are on the left hand of the main stream of tide (supposing the face turned in the direction in which the tide proceeds), or are on its eastern border, and therefore that the central stream is still nearer to the coast of Norfolk. From a point not far south of this we may suppose the tide to diverge in a fan-shaped form over the uniformly deep Belgian Sea. Along the English coast the wave will flow to the south; but it will reach the whole of the Belgian and Dutch coast at the same instant; and, if this tide alone existed, we doubt not that the time of high water would be sensibly the same along the whole of that coast.

"But there is another tide of great magnitude, namely, that which comes from the English Channel through the Straits of Dover. This also diverges, we conceive, in a fan form, affecting the whole Belgian Sea: the western part turns into the estuary of the Thames; the eastern part runs along the Dutch coast, producing at successive times high water (even as combined with the North Sea tide) along successive points of that coast from Calais towards the Helder. And this we believe to be the complete explanation of the apparently opposite tide-currents. The branch tide of the North Sea running between the Dogger Bank and the Wells Bank will assist in propagating the tide along the German coast from the Helder towards the mouth of the Elbe. We have gone into some detail in this explanation for the purpose of showing the importance of considering the form of the bottom in explanations of specific tides.

"A set of observations has been made by Captain Hewett (at the point A, fig. 7) on the depth and motion of the water at a strictly definite point a few miles south of the Wells Bank, near the middle of the Belgian Sea. The result was that the change of elevation of the surface was insensible, but that there was a considerable stream of tide alternately north-east and south-west (magnetic). The point in question corresponds pretty well to the intersection of the cotidal lines of nine o'clock of the North Sea tide and three o'clock of the English Channel tide (ordinary establishment), and these tides would therefore wholly or partially destroy each other as regards elevation. As regards the compound tide-stream, the greatest positive current from one tide will be combined with the greatest negative current of the other, and this will produce a stream whose direction agrees well with observation. At 8^h on the day of new moon, the North Sea tide would be running north (magnetic), and the English Channel tide would be running east, and therefore the compound current would be running north-east; at 9^h it would be running south-west. Both currents, and consequently the compound current, would cease at about 0^h, 6^h, &c., on the day of new moon; and, as the observations were made rather more than a day before new moon, the slack water would occur an hour or more before noon. The whole of this agrees well with the observations."

VIII. TIDAL DEFORMATION OF THE SOLID EARTH.

§ 43. *Elastic Tides.*

Elastic tides.

The tide-generating potential varies as the square of the distance from the earth's centre, and the corresponding forces act at every point throughout its mass. No solid matter possesses the property of absolute rigidity, and we must therefore admit the probable existence of tidal elastic deformation of the solid earth. The problem of finding the state of strain of an elastic sphere under given stresses was first solved by Lamé;[1] he made, however, but few physical deductions from his solution. An independent solution was found by Sir W. Thomson,[2] who drew some interesting conclusions concerning the earth.

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[1] *Théorie Math. de l'Élasticité*, 1866, p. 213.

[2] Thomson and Tait, *Nat. Phil.*, §§ 732-737 and 833-842, or *Phil. Trans.*, pt. ii., 1863, p. 583.

His problem, in as far as it is now material, is as follows. Let a sphere, of radius a and density w, be made of elastic material whose bulk and rigidity moduli are k and n, and let it be subjected to forces due to a potential wr^2S_2 per unit volume, where S_2 is a surface spherical harmonic of the second order. Then it is required to find the strain of the sphere. We refer the reader to the original sources for the methods of solution applicable to spherical shells and to solid spheres. In order to write Thomson's solution we put r, λ, l for radius vector, latitude, and longitude, and ρ, μ, ν for the corresponding displacements. Then the solution is as follows:—

$$\left.\begin{aligned}\rho&=\frac{w}{(19k+\frac{4}{3}n)n}[(8a^2-3r^2)k+\tfrac{4}{3}a^2n]rS_2\\ \mu&=\frac{w}{2(19k+\frac{4}{3}n)n}[(8a^2-5r^2)k+\tfrac{4}{3}(a^2-r^2)n]r\frac{dS_2}{d\lambda}\\ \nu&=\frac{w}{2(19k+\frac{4}{3}n)n}[(8a^2-5r^2)k+\tfrac{4}{3}(a^2-r^2)n]\frac{r}{\cos\lambda}\frac{dS_2}{dl}\end{aligned}\right\}\quad(96).$$

For either tidal or rotational stresses

$$S_2=\tau(\sin^2\lambda-\tfrac{1}{3}),$$

in the case of tides $\tau=\frac{3}{2}m/c^3$, m and c being the moon's mass and distance, and in the case of rotation $\tau=-\frac{1}{2}\omega^2$, ω being the angular velocity about the polar axis. The equation to the surface is found by putting $r=a+\rho$, where in the expression for ρ we put $r=a$. Hence from (96) the form of surface is given by

$$a\left\{1+\frac{15wa^2}{19n}\left[1+\frac{\frac{8}{57}n/k}{1+\frac{4}{57}n/k}\right]\tau(\sin^2\lambda-\tfrac{1}{3})\right\}\quad\text{...(97).}$$

In most solids the bulk modulus is considerably larger than the rigidity modulus, and in this discussion it is sufficient to neglect n compared with k. With this approximation, the ellipticity e of the surface becomes

$$e=\frac{5wa^2}{19n}\tau\quad\text{.............................. (98).}$$

Now suppose the sphere to be endued with the power of gravitation, and write

$$\mathfrak{r}=\frac{19n}{5wa^2},\ \mathfrak{g}=\frac{2}{5}\frac{g}{a}\text{..........................(99),}$$

where g is gravity at the surface of the globe. Then, if there were no elasticity, the ellipticity would be given by $e=\tau/\mathfrak{g}$, and without gravitation by $e=\tau/\mathfrak{r}$. And it may be proved in several ways that, gravity and elasticity co-operating,

$$e=\frac{\tau}{\mathfrak{r}+\mathfrak{g}}=\frac{\tau}{\mathfrak{g}}\cdot\frac{1}{1+\mathfrak{r}/\mathfrak{g}}\quad\text{..................(100).}$$

If n be the rigidity of steel, and if the globe have the size and mean density of the earth, $\mathfrak{r}/\mathfrak{g}=2$, and with the rigidity of glass $\mathfrak{r}/\mathfrak{g}=\frac{2}{3}$. Hence the ellipticity of an earth of steel under tide-generating force would be $\frac{1}{3}$ of that of a fluid earth, and the similar fraction for glass would be $\frac{3}{5}$. If an ocean be superposed on the globe, then, if the globe rises and falls with the tide as though it were fluid, there will obviously be no tide visible to an observer carried up and down with the solid; and with any degree of rigidity the visible tide will be the excess of the fluid tide above the solid tide. Hence on an earth with rigidity of steel the oceanic tides would be reduced to $\frac{2}{3}$, and with rigidity of glass to $\frac{2}{5}$ of the tides on a rigid earth.

§ 44. *Rigidity of the Earth.*

Rigidity of the earth.

Although the computation of oceanic tides is as yet impossible, it cannot be admitted that perfect rigidity in the earth would augment the tides in the proportion of 5 to 2, although they might perhaps be augmented in the proportion 4 to 3. Thus Thomson concludes that the earth's mass must have an effective rigidity at least as great as that of steel. If it were true, as was held until recently, that the earth is a fluid ball coated with a crust, that crust must be of fabulous rigidity to resist the tidal surgings of subjacent fluid. Hence we are led to the conclusion that far the larger portion of the earth's mass, if not all of it, is a solid of great rigidity. Up to the present time the argument by which the tides of long period were proved to have approximately their equilibrium height has generally been accepted without much doubt, but we have (§ 17) shown good cause for rejecting Laplace's argument, at least for a fortnightly tide. It appeared formerly that, from numerical data as to the heights of the tides of long period, we should be able to compute the actual effective rigidity of the earth's mass. But from § 18 we see that, although these tides remain incalculable, yet with such oceans as ours the tides of long period must conform much more nearly to the equilibrium laws than do the tides of short period. Thus a comparison of the observed heights of the tides of long period with the equilibrium law still remains of interest, although the evaluation of the earth's rigidity appears with present data unattainable. Acting on the old belief, Mr G. H. Darwin has compared the lunar fortnightly and monthly tides, as observed for thirty-three years at various Indian and European ports, with the equilibrium theory, and has found that the tide-heights were about two-thirds of the equilibrium height.[1] From this the conclusion was drawn that the effective rigidity of the earth was as great as that of steel. Whilst, then, this precise comparison with the rigidity of steel falls to the ground, the investigation remains as an important confirmation of Thomson's conclusion as to the great effective rigidity of the earth. When extensive and accurate knowledge of the tides has been attained, the attempted evaluation of the rigidity may conceivably be possible, because there is a minute tide with a period of 18·6 years (§ 23, schedule [A, iii.]) of which Laplace's argument must hold good. Great accuracy will, however, be necessary, because the height of the tide at the equator only amounts to one-third of an inch, and a preliminary inquiry seems to show that there are other relatively considerable variations of sea-level arising from unexplained causes.[2]

Attempt to evalue rigidity by tides of long period.

Sir W. Thomson's solution of the strain of an elastic sphere has been also used to determine what degree of strength the materials of the earth must have in order that the great continental plateaus and mountains may not sink in.[3] In another investigation it has been shown that local elastic yielding on the coast-lines of continents may produce an augmentation of apparent tide in certain places on account of the flexure of the upper strata, when a great weight of water is added and subtracted from the adjacent oceanic area at high and low tide.[4] There is reason to believe that such flexure has actually been observed by a delicate form of level on the coast of the Bay of Biscay.[5]

§ 45. *Viscous and Elastico-Viscous Tides.*

It might be supposed that the earth is composed of a viscous fluid of great stiffness, or that it possesses an elasticity which breaks down under continued stress. Both these hypotheses have been considered, and the results are confirmatory of the conclusion that the earth is made of very stiff material.[6] These problems appear to have been worthy of attack, although the existence of measurable oceanic tides of long period negatives the adoption of the hypothesis of true viscosity, at least under stresses comparable with tide-generating forces.

If a sphere of radius a, density w, viscosity modulus v, be under the action of forces due to a potential per unit volume $wr^2S_2\cos nt$, so that n is the speed of the tide, the solution of the problem shows that the tide of the sphere is expressed by

$$\frac{aS_2}{\mathfrak{g}}\cos\epsilon\cos(nt-\epsilon)\text{...... ....(101),}$$

where $\tan\epsilon=n\dfrac{\mathfrak{r}}{\mathfrak{g}}$, $\mathfrak{r}=\dfrac{19v}{5wa^2}$, $\mathfrak{g}=\frac{2}{5}\dfrac{g}{a}$.

Thus the tides of the viscous globe are to the equilibrium tides of a fluid globe as $\cos\epsilon$ to unity, and there is a retardation ϵ/n of the time of high tide after the passage of the tide-generator over the meridian. Further, by arguments similar to that applied in the case of elastic tides, it is found that oceanic tides are reduced by the yielding in the proportion of $\sin\epsilon$ to unity, and that there is an apparent acceleration of the time of high water by $(\frac{1}{4}\pi-\epsilon)/n$. It appears by numerical calculation that, in order that the oceanic semi-diurnal tide may have a value equal to two-thirds of the full amount on a rigid globe, the stiffness of the globe must be about twenty thousand times as great as that of pitch at freezing temperature, when it is hard and brittle. We must here pass by the results of the hypothesis of an elasticity degrading under the influence of continued stress.

IX. TIDAL FRICTION.

§ 46. *General Explanation.*

The investigation of the tides of a viscous sphere has led us to the consideration of a frictionally retarded tide. The effects of tidal friction are of such general interest that we give a sketch of the principal results without the aid of mathematical symbols. In fig. 8 the paper is supposed to be the plane of the orbit of a satellite M revolving in the direction of the arrow about the planet C, which rotates in the direction of the arrow about an axis perpendicular to the paper. The rotation of the planet is supposed to be more rapid than that of the satellite, so that the day is shorter than the month. Let us suppose that the planet is either entirely fluid, or has an ocean of such depth that it is high water under or nearly under the satellite. When there is no friction, with the satellite at m, the planet is elongated into the ellipsoidal shape shown, cutting the mean sphere, which is dotted. But, when there is friction in the fluid motion, the tide is retarded, and high tide occurs after the satellite has passed the meridian. Then, if we keep the same figure to represent the tidal elongation, the satellite must be at M, instead of at m. If we number the four quadrants as shown, the satellite must be in quadrant 1. The protuberance P is nearer to the satellite than P′, and the deficiency Q is further away than the deficiency

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[1] Thomson and Tait, *Nat. Phil.*, vol. i. pt. ii., 1883, § 847 *sq.*

[2] Darwin, "On 19-yearly Tide at Karachi," in *Brit. Assoc. Report*, 1886.

[3] G. H. Darwin, *Phil. Trans.*, pt. i., 1882, p. 187, with correction, *Proc. Roy. Soc.*, 1885.

[4] Id., *Brit. Assoc. Rep.*, 1882, or *Phil. Mag.*, 1882.

[5] D'Abbadie, *Annales Soc. Sc. de Bruxelles*, 1881, or quotation by Darwin, *loc. cit.*

[6] G. H. Darwin, *Phil. Trans.*, pt. i., 1879, p. 1; see also Lamb, "On the Oscillations of a Viscous Spheroid," *Proc. Lond. Math. Soc.*, Nov. 1881, p. 51.

Q. Hence the resultant action of the planet on the satellite must be in some such direction as MN. The action of the satellite on the planet is equal and opposite, and the force in NM, not being through the planet's centre, must produce a retarding couple on the planet's rotation, the magnitude of which depends on the length of the arm CN. This tidal frictional couple varies as the height of the tide, and also depends on the satellite's distance; its intensity in fact varies as the square of the tide-generating force, and therefore as the inverse sixth power of the satellite's distance. Thus tidal friction must retard the planetary rotation. Let us now consider its effect on the satellite. If the force acting on M be resolved along and perpendicular to the direction CM, the perpendicular component tends to accelerate the satellite's velocity. It alone would carry the satellite further from C than it would be dragged back by the central force towards C. The satellite would describe a spiral, the coils of which would be very nearly circular and very nearly coincident. If now we resolve the central component force along CM tangentially and perpendicular to the spiral, the tangential component tends to retard the velocity of the satellite, whereas the disturbing force, already considered, tends to accelerate it. With the gravitational law of force between the two bodies the retardation must prevail over the acceleration.[1] The moment of momentum of the whole system remains unchanged, and that of the planetary rotation diminishes, so that the orbital moment of momentum must increase; now orbital moment of momentum increases with increasing distance and diminishing linear and angular velocity of the satellite. The action of tidal friction may appear somewhat paradoxical, but it is the exact converse of the acceleration of the linear and angular velocity and the diminution of distance of a satellite moving through a resisting medium. The latter result is generally more familiar than the action of tidal friction, and it may help the reader to realize the result in the present case. Tidal friction then diminishes planetary rotation, increases the satellite's distance, and diminishes the orbital angular velocity. The comparative rate of diminution of the two angular velocities is generally very different. If the satellite be close to the planet the rate of increase of the satellite's periodic time or month is large compared with the rate of increase of the period of planetary rotation or day; but if the satellite is far off the converse is true. Hence, if the satellite starts very near the planet, with the month a little longer than the day, as the satellite recedes the month soon increases, so that it contains many days. The number of days in the month attains a maximum and then diminishes. Finally the two angular velocities subside to a second identity, the day and month being identical and both very long.

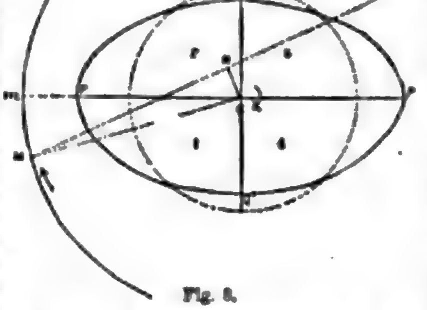

Fig. 8.

We have supposed that the ocean is of such depth that the tides are direct; if, however, they are inverted, with low water under or nearly under the satellite, friction, instead of retarding, accelerates the tide; and it would be easy by drawing another figure to see that the whole of the above conclusions hold equally true with inverted tides.

§ 47. *Exact Investigation of the Secular Effects of Tidal Friction.*

The general conclusions of the last section are of such wide interest that we proceed to a rigorous discussion of the principal effects of tidal friction in the elementary case of the circular orbit. In order, however, to abridge the investigation we shall only consider the case when the planetary rotation is more rapid than the satellite's orbital motion.

Suppose an attractive particle or satellite of mass m to be moving in a circular orbit, with an angular velocity Ω, round a planet of mass M, and suppose the planet to be rotating about an axis perpendicular to the plane of the orbit, with an angular velocity n; suppose, also, the mass of the planet to be partially or wholly imperfectly elastic or viscous, or that there are oceans on the surface of the planet; then the attraction of the satellite must produce a relative motion in the parts of the planet, and that motion must be subject to friction, or, in other words, there must be frictional tides of some sort or other. The system must accordingly be losing energy by friction, and its configuration must change in such a way that its whole energy diminishes. Such a system does not differ much from those of actual planets and satellites, and, therefore, the results deduced in this hypothetical case must agree pretty closely with the actual course of evolution, provided that time enough has been and will be given for such changes. Let C be the moment of inertia of the planet about its axis of rotation, r the distance of the satellite from the centre of the planet, h the resultant moment of momentum of the whole system, e the whole energy, both kinetic and potential, of the system. It is assumed that the figure of the planet and the distribution of its internal density are such that the attraction of the satellite causes no couple about any axis perpendicular to that of rotation. A special system of units of mass, length, and time will now be adopted such that the analytical results are reduced to their simplest forms. Let the unit of mass be $Mm/(M+m)$. Let the unit of length γ be such a distance that the moment of inertia of the planet about its axis of rotation may be equal to the moment of inertia of the planet and satellite, treated as particles, about their centre of inertia, when distant γ apart from one another. This condition gives

$$M\left(\frac{m\gamma}{M+m}\right)^2+m\left(\frac{M\gamma}{M+m}\right)^2=C;$$

whence

$$\gamma=\left\{\frac{C(M+m)}{Mm}\right\}^{\frac{1}{2}}.$$

Let the unit of time τ be the time in which the satellite revolves through 57°·3 about the planet, when the satellite's radius vector is equal to γ. In this case $1/\tau$ is the satellite's orbital angular velocity, and by the law of periodic times we have

$$\tau^{-2}\gamma^3=\mu(M+m),$$

where μ is the attraction between unit masses at unit distance. Then by substitution for γ

$$\tau=\left\{\frac{C^3(M+m)}{\mu^2(Mm)^3}\right\}^{\frac{1}{4}}.$$

Special units.

This system of units will be found to make the three following functions each equal to unity, viz., $\mu^{\frac{1}{2}}Mm(M+m)^{-\frac{1}{2}}$, μMm, and C. The units are in fact derived from the consideration that these functions are each to be unity. In the case of the earth and moon, if we take the moon's mass as $\frac{1}{82}$nd of the earth's and the earth's moment of inertia as $\frac{1}{3}Ma^2$ (as is very nearly the case), it may easily be shown that the unit of mass is $\frac{1}{83}$ of the earth's mass, the unit of length 5·26 earth's radii or 33,506 kilomètres (20,807 miles), and the unit of time 2 hrs. 41 minutes. In these units the present angular velocity of the earth's diurnal rotation is expressed by ·7044, and the moon's present radius vector by 11·454.

Moment of momentum.

The two bodies being supposed to revolve in circles about their common centre of inertia with an angular velocity Ω, the moment of momentum of orbital motion is

$$M\left(\frac{mr}{M+m}\right)^2\Omega+M\left(\frac{Mr}{M+m}\right)^2\Omega=\frac{Mm}{M+m}r^2\Omega.$$

Then, by the law of periodic times in a circular orbit,

$$\Omega^2r^3=\mu(M+m);$$

whence

$$\Omega r^2=\mu^{\frac{1}{2}}(M+m)^{\frac{1}{2}}r^{\frac{1}{2}}.$$

The moment of momentum of orbital motion

$$=\mu^{\frac{1}{2}}Mm(M+m)^{-\frac{1}{2}}r^{\frac{1}{2}},$$

and in the special units this is equal to $r^{\frac{1}{2}}$. The moment of momentum of the planet's rotation is Cn, and $C=1$ in the special units. Therefore

$$h=n+r^{\frac{1}{2}} \quad\ldots\ldots\ldots \quad (102).$$

Since the moon's present radius vector is 11·454, it follows that the orbital momentum of the moon is 3·384. Adding to this the rotational momentum of the earth, which is ·704, we obtain 4·088 for the total moment of momentum of the moon and earth. The ratio of the orbital to the rotational momentum is 4·80, so that the total moment of momentum of the system would, but for the obliquity of the ecliptic, be 5·80 times that of the earth's rotation. Again, the kinetic energy of orbital motion is

$$\tfrac{1}{2}M\left(\frac{mr}{M+m}\right)\Omega^2+\tfrac{1}{2}m\left(\frac{Mr}{M+m}\right)^2\Omega^2=\tfrac{1}{2}\frac{Mm}{M+m}r^2\Omega^2=\tfrac{1}{2}\frac{\mu Mm}{r}.$$

The kinetic energy of the planet's rotation is $\frac{1}{2}Cn^2$. The potential energy of the system is $-\mu Mm/r$. Adding the three energies together, and transforming into the special units, we have

$$2e=n^2-1/r \quad\ldots\ldots\ldots\ldots\ldots \quad (103).$$

Now let $x=r^{\frac{1}{2}}$, $y=n$, $Y=2e$.

It will be noticed that x, the moment of momentum of orbital motion, is equal to the square root of the satellite's distance from the planet. Then equations (102) and (103) become

$$h=y+x \quad\ldots\ldots\ldots\ldots\ldots\ldots \quad (104).$$

$$Y=y^2-1/x^2=(h-x)^2-1/x^2 \quad\ldots\ldots\ldots\ldots \quad (105).$$

(104) is the equation of conservation of moment of momentum, or, shortly, the equation of momentum; (105) is the equation of energy.

Maximum and minimum energy.

Now consider a system started with given positive moment of momentum h; and we have all sorts of ways in which it may be started. If the two rotations be of opposite kinds, it is clear that we may start the system with any amount of energy however great, but the true maxima and minima of energy compatible with the given moment of momentum are supplied by $dY/dx=0$,

or

$$x-h+1/x^3=0,$$

that is to say,

$$x^4-hx^3+1=0 \quad\ldots\ldots\ldots\ldots\ldots \quad (106).$$

We shall presently see that this quartic has either two real roots

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[1] This way of presenting the action of tidal friction is due to Professor Stokes.

No relative motion between satellite and planet when energy maximum or minimum.

and two imaginary, or all imaginary roots. The quartic may be derived from quite a different consideration, viz., by finding the condition under which the satellite may move round the planet so that the planet shall always show the same face to the satellite,—in fact, so that they move as parts of one rigid body. The condition is simply that the satellite's orbital angular velocity $\Omega = n$, the planet's angular velocity of rotation, or $y = 1/x^3$, since $n = y$ and $r^{\frac{1}{2}} = \Omega^{-\frac{1}{3}} = x$. By substituting this value of y in the equation of momentum (104), we get as before $x^4 - \lambda x^3 + 1 = 0$

At present we have only obtained one result, viz., that, if with given moment of momentum it is possible to set the satellite and planet moving as a rigid body, it is possible to do so in two ways, and one of these ways requires a maximum amount of energy and the other a minimum; from this it is clear that one must be a rapid rotation with the satellite near the planet and the other a slow one with the satellite remote from the planet. In the three equations

Equations of momentum, energy, and no relative motion.

$$\lambda = y + x \quad\text{..............................}(107),$$
$$Y = (\lambda - x)^2 - 1/x^2 \quad\text{......................}(108),$$
$$x^3 y = 1 \quad\text{....................................}(109),$$

(107) is the equation of momentum, (108) that of energy, and (109) may be called the equation of rigidity, since it indicates that the two bodies move as though parts of one rigid body. To illustrate these equations geometrically, we may take as abscissa x, which is the moment of momentum of orbital motion, so that the axis of x may be called the axis of orbital momentum. Also, for equations (107) and (109) we may take as ordinate y, which is the moment of momentum of the planet's rotation, so that the axis of y may be called the axis of rotational momentum. For (108) we may take as ordinate Y, which is twice the energy of the system, so that the axis of Y may be called the axis of energy. Then, as it will be convenient to exhibit all three curves in the same figure, with a parallel axis of x, we must have the axis of energy identical with that of rotational momentum. It will not be necessary to consider the case where the resultant moment of momentum λ is negative, because this would only be equivalent to reversing all the rotations; λ is therefore to be taken as essentially positive. Then the line of momentum whose equation is (107) is a straight line inclined at 45° to either axis, having positive intercepts on both axes. The curve of rigidity whose equation is (109) is clearly of the same nature as a rectangular hyperbola, but it has a much more rapid rate of approach to the axis of orbital momentum than to that of rotational momentum. The intersections (if any) of the curve of rigidity with the line of momentum have abscissæ which are the two roots of the quartic $x^4 - \lambda x^3 + 1 = 0$. The quartic has, therefore, two real roots or all imaginary roots. Then, since $x = \sqrt{r}$, the intersection which is more remote from the origin indicates a configuration where the satellite is remote from the planet; the other gives the configuration where the satellite is closer to the planet. We have already learnt that these two correspond respectively to minimum and maximum energy. When x is very large, the equation to the curve of energy is $Y = (\lambda - x)^2$, which is the equation to a parabola with a vertical axis parallel to Y and distant λ from the origin, so that the axis of the parabola passes through the intersection of the line of momentum with the axis of orbital momentum. When x is very small, the equation becomes $Y = -1/x^2$. Hence the axis of Y is asymptotic on both sides to the curve of energy. Then, if the line of momentum intersects the curve of rigidity, the curve of energy has a maximum vertically underneath the point of intersection nearer the origin and a minimum underneath the point more remote. But, if there are no intersections, it has no maximum or minimum.

Graphical illustration.

Fig. 9 shows these curves when drawn to scale for the case of the earth and moon, that is to say, with $\lambda = 4$. The points a and b, which are the maximum and minimum of the curve of energy, are supposed to be on the same ordinates as A and B, the intersections of the curve of rigidity with the line of momentum. The intersection of the line of momentum with the axis of orbital momentum is denoted by D, but in a figure of this size it necessarily remains indistinguishable from B. As the zero of energy is quite arbitrary, the origin for the energy curve is displaced downwards, and this prevents the two curves from crossing one another in a confusing manner. On account of the limitation imposed we neglect the case where the quartic has no real roots. Every point of the line of momentum gives by its abscissa and ordinate the square root of the satellite's distance and the rotation of the planet, and the ordinate of the energy curve gives the energy corresponding to each distance of the satellite. Part of the figure has no physical meaning, for it is impossible for the satellite to move round the planet at a distance less than the sum of the radii of the planet and satellite. For example, the moon's diameter being about 2200 miles, and the earth's about 8000, the moon's distance cannot be less than 5100 miles. Accordingly a strip is marked off and shaded on each side of the vertical axis within which the figure has no physical meaning. The point P indicates the present configuration of the earth and moon. The curve of rigidity $x^3y = 1$ is the same for all values of λ, and by moving the line of momentum parallel to itself nearer to or further from the origin, we may represent all possible moments of momentum of the whole system. The smallest amount of moment of momentum with which it is possible to set the system moving as a rigid body, with centrifugal force enough to balance the mutual attraction, is when the line of momentum touches the curve of rigidity. The condition for this is clearly that the equation $x^4 - \lambda x^3 + 1 = 0$ should have equal roots. If it has equal roots, each root must be $\frac{3}{4}\lambda$, and therefore

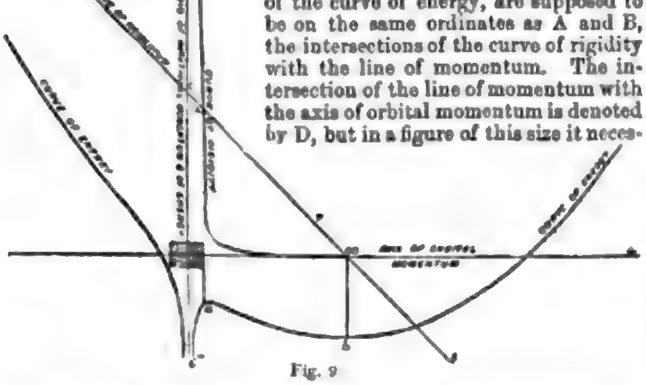

Fig. 9

Least momentum for which no relative motion possible.

$$(\tfrac{3}{4}\lambda)^4 - \lambda(\tfrac{3}{4}\lambda)^3 + 1 = 0,$$

whence $\lambda^4 = 4^4/3^3$ or $\lambda = 4/3^{\frac{3}{4}} = 1{\cdot}75$. The actual value of λ for the moon and earth is about 4; hence, if the moon-earth system were started with less than $\frac{7}{16}$ of its actual moment of momentum, it would not be possible for the two bodies to move so that the earth should always show the same face to the moon. Again, if we travel along the line of momentum, there must be some point for which yx^3 is a maximum, and since $yx^3 = n/\Omega$ there must be some point for which the number of planetary rotations is greatest during one revolution of the satellite; or, shortly, there must be some configuration for which there is a maximum number of days in the month. Now yx^3 is equal to $x^3(\lambda - x)$, and this is a maximum when $x = \frac{3}{4}\lambda$ and the maximum number of days in the month is $(\frac{3}{4}\lambda)^3(\lambda - \frac{3}{4}\lambda)$ or $3^3\lambda^4/4^4$; if λ is equal to 4, as is nearly the case for the earth and moon, this becomes 27. Hence it follows that we now have very nearly the maximum number of days in the month. A more accurate investigation in a paper on the "Precession of a Viscous Spheroid" in *Phil. Trans.*, part i., 1879, showed that, taking account of solar tidal friction and of the obliquity to the ecliptic, the maximum number of days is about 29, and that we have already passed through the phase of maximum.

Maximum number of days in month.

We will now consider the physical meaning of the figure. It is assumed that the resultant moment of momentum of the whole system corresponds to a positive rotation. Now imagine two points with the same abscissa, one on the momentum line and the other on the energy curve, and suppose the one on the energy curve to guide that on the momentum line. Then, since we are supposing frictional tides to be raised on the planet, the energy must degrade, and however the two points are set initially the point on the energy curve must always slide down a slope, carrying with it the other point. Looking at the figure, we see that there are four slopes in the energy curve, two running down to the planet and two down to the minimum. There are therefore four ways in which the system may degrade, according to the way it was started; but we shall only consider one, that corresponding to the portion AB*ba* of the figure. For the part of the line of momentum AB the month is longer than the day, and this is the case with all known satellites except the nearer one of Mars. Now, if a satellite be placed in the condition A—that is to say, moving rapidly round a planet which always shows the same face to the satellite—the condition is clearly dynamically unstable, for the least disturbance will determine whether the system shall degrade down the slopes *ac* or *ab*—that is to say, whether it falls into or recedes from the planet. If the equilibrium breaks down by the satellite receding, the recession will go on until the system has reached the state corresponding to B. It is clear that, if the intersection of the edge of the shaded strip with the line of momentum be identical with the point A, which indicates that the satellite is just touching the planet, then the two bodies are in effect parts of a single body in an unstable configuration. If, therefore, the moon was originally part of the earth, we should expect to find this identity. Now in fig. 9, drawn to scale to represent the earth and moon, there is so close an approach between the edge of the shaded band and the intersection of the line of momentum and curve of rigidity that it would be scarcely possible to distinguish them. Hence, there seems a probability that the two bodies once formed parts of a single one, which broke up in consequence of some kind of instability. This view is confirmed by the more detailed consideration of the case in the paper on the "Precession of a Viscous Spheroid," already referred to, and subsequent papers, in the *Philosophical Transactions* of the Royal Society.[1]

Discussion of figure.

History of satellite as energy degrades.

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[1] For further consideration of this subject see a series of papers by Mr G. H. Darwin, in *Proceed.* and *Trans.* of the Royal Society from 1878 to 1881, and Appendix G (b) to part ii. vol. i. of Thomson and Tait's *Nat. Phil.*, 1883.

§ 48. *Amount of Tidal Retardation of Earth's Rotation.*

Accelera- tion of moon's motion due to tidal friction.

With respect to the actual amount of retardation of the earth's rotation, we quote the following from Thomson and Tait's *Nat. Phil.* (1883), § 830.[1]

"In observational astronomy the earth's rotation serves as a time-keeper, and thus a retardation of terrestrial rotation will appear astronomically as an acceleration of the motion of the heavenly bodies. It is only in the case of the moon's motion that such an apparent acceleration can be possibly detected. Now, as Laplace first pointed out, there must be a slow variation in the moon's mean motion arising from the secular changes in the eccentricity of the earth's orbit around the sun. At the present time, and for several thousand years in the future, the variation in the moon's motion is and will be an acceleration. Laplace's theoretical calculation of the amount of that acceleration appeared to agree well with the results which were in his day accepted as representing the facts of observation. But in 1853 Adams showed that Laplace's reasoning was at fault, and that the numerical results of Damoiseau's and Plana's theories with reference to it consequently require to be sensibly altered. Hansen's theory of the secular acceleration is vitiated by an error of principle similar to that which affects the theories of Damoiseau and Plana; but, the mathematical process which he followed being different from theirs, he arrived at somewhat different results. From the erroneous theory Hansen found the value of 12″·18 for the coefficient of the term in the moon's mean longitude depending on the square of the time, the unit of time being a century · in a later computation given in his *Darlegung* he found the coefficient to be 12″·56.[2]

"In 1859 Adams communicated to Delaunay his final result, namely, that the coefficient of this term appears from a correctly conducted investigation to be 5″·7, so that at the end of a century the moon is 5″·7 before the position it would have had at the same time if its mean angular velocity had remained the same as at the beginning of the century. Delaunay verified this result, and added some further small terms which increased the coefficient from 5″·7 to 6″·1.

Various esti- mates of amount.

"Now, according to Airy, Hansen's value of the 'advance' represents very well the circumstances of the eclipses of Agathocles, Larissa, and Thales, but is if anything too small. Newcomb, on the other hand, is inclined from an elaborate discussion of the ancient eclipses to believe Hansen's value to be too large, and gives two competing values, viz., 8″·4 and 10″·9.[3]

"In any case it follows that the value of the advance as theoretically deduced from all the causes, known up to the present time to be operative, is smaller than that which agrees with observation. In what follows 12″ is taken as the observational value of the advance, and 6″ as the explained part of this phenomenon. About the beginning of 1866 Delaunay suggested that the true explanation of the discrepancy might be a retardation of the earth's rotation by tidal friction. Using this hypothesis, and allowing for the consequent retardation of the moon's mean motion by tidal reaction,

Numeri- cal result as to earth's rotation.

Adams, in an estimate which he has communicated to us, founded on the rough assumption that the parts of the earth's retardation due to solar and lunar tides are as the squares of the respective tide-generating forces, finds 22 sec. as the error by which the earth, regarded as a time-keeper, would in a century get behind a perfect clock rated at the beginning of the century. Thus at the end of a century a meridian of the earth is 330″ behind the position in which it would have been if the earth had continued to rotate with the same angular velocity which it had at the beginning of the century. . . .

"Whatever be the value of the retardation of the earth's rotation it is necessarily the result of several causes, of which tidal friction is almost certainly preponderant. If we accept Adams's estimate as applicable to the outcome of the various concurring causes, then, if the rate of retardation giving the integral effect were uniform, the earth as a time-keeper would be going slower by ·22 of a second per year in the middle, and by ·44 of a second per year at the end, than at the beginning of the century. The latter is $\frac{1}{71{\cdot}7\times10^{6}}$ of the present angular velocity; and, if the rate of retardation had been uniform during ten million centuries past, the earth must have been rotating faster by about one-seventh than at present, and the centrifugal force must have been greater in the proportion of 817² to 717² or of 67 to 51. If the consolidation took place then or earlier, the ellipticity of the upper layers must have been $\frac{1}{230}$ instead of about $\frac{1}{300}$, as it is at present. It must necessarily remain uncertain whether the earth would from time to time adjust itself completely to a figure of equilibrium adapted to the rotation. But it is clear that a want of complete adjustment would leave traces in a preponderance of land in equatorial regions. The existence of large continents and the great effective rigidity of the earth's mass render it improbable that the adjustments, if any, to the appropriate figure of equilibrium would be complete. The fact then that the continents are arranged along meridians rather than in an equatorial belt affords some degree of proof that the consolidation of the earth took place at a time when the diurnal rotation differed but little from its present value. It is probable, therefore, that the date of consolidation is considerably more recent than a thousand million years ago. It is proper, however, to add that Adams lays but little stress on the actual numerical values which have been used in this computation, and is of opinion that the amount of tidal retardation of the earth's rotation is quite uncertain."

Thomson's argument as to age of consolidation of earth.

Great uncertainty in preceding numbers.

§ 49. *Effects of Tidal Friction on the Elements of the Moon's Orbit and on the Earth's Rotation.*

Effects of tidal friction.

It would be impossible within the limits of the present article to discuss completely the effects of tidal friction; we therefore confine ourselves to certain general considerations which throw light on the nature of those effects. We have in the preceding sections supposed that the planet's axis is perpendicular to the orbit of the satellite, and that the latter is circular; we shall now suppose the orbit to be oblique to the equator and eccentric, and shall also consider some of the effects of the solar perturbation of the moon-earth system. For the sake of brevity the planet will be called the earth, and the satellite the moon. The complete investigation was carried out on the hypothesis that the planet was a viscous spheroid, because this was the only theory of frictionally resisted tides which had been worked out. Although the results would be practically the same for any system of frictionally resisted tides, we shall speak below of the planet or earth as a viscous body.[4]

Obliquity of the ecliptic increases.

We shall show that if the tidal retardation be small the obliquity of the ecliptic increases, the earth's rotation is retarded, and the moon's distance and periodic time are increased. Fig 10 represents the earth as seen from above the south pole, so that S is the pole and the outer circle the equator. The earth's rotation is in the direction of the curved arrow at S. The half of the inner circle which is drawn with a full line is a semi-small-circle of south latitude, and the dotted semicircle is a semi-small-circle in the same north latitude. Generally dotted lines indicate parts of the figure which are below the plane of the paper. It will make the explanation somewhat simpler if we suppose the tides to be raised by a moon and anti-moon diametrically opposite to one another. Let M and M′ be the projections of the moon and anti-moon on to the terrestrial sphere. If the fluid in which the tides are raised were perfectly frictionless,[5] or if the earth were a perfect fluid or perfectly elastic, the apices of the tidal spheroid would be at M and M′. If, however, there is internal friction, due to any sort of viscosity, the tides will lag, and we may suppose the tidal apices to be at T and T′. Now suppose the tidal protuberances to be replaced by two equal heavy particles at T and T′, which are instantaneously rigidly connected with the earth. Then the attraction of the moon on T is greater than on T′, and that of the anti-moon on T′ is greater than on T. The resultant of these forces is clearly a pair of forces acting on the earth in the direction TM, T′M′. These forces clearly cause a couple about the axis in the equator, which lies in the same meridian as the moon and anti-moon. The direction of the couple is shown by the curved arrows at L, L′. If the effects of this couple be compounded with the existing rotation of the earth according to the principle of the gyroscope, the south pole S tends to approach M and the north pole to approach M′. Hence, supposing the moon to move in the ecliptic, the inclination of the earth's axis to the ecliptic diminishes, or the obliquity increases. Next the forces TM, T′M′ clearly produce, as in the simpler case considered above, a couple about the earth's polar axis, which tends to retard the diurnal rotation.

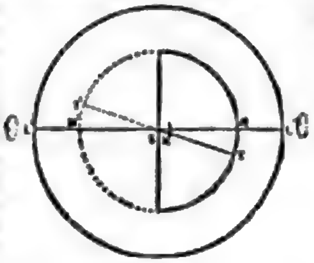

Fig. 10.

This general explanation remains a fair representation of the state of the case so long as the different harmonic constituents of the aggregate tide-wave do not suffer very different amounts of retardation; and this is the case so long as the viscosity is not great. The rigorous result for a viscous planet shows that in general the obliquity will increase, and it appears that, with small viscosity of the planet, if the period of the satellite be longer than two periods of rotation of the planet, the obliquity increases, and *vice versa*. Hence zero obliquity is only dynamically stable when the period of the satellite is less than two periods of the planet's rotation.

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[1] See also G. H. Darwin's *Address to Sect. A*, Brit. Assoc. meeting, 1886.

[2] "It appears not unusual for physical astronomers to use an abbreviated phraseology, for specifying accelerations, which needs explanation. Thus, when they speak of the secular acceleration being, *e.g.*, '12″·56 in a century,' they mean by 'acceleration' what is more properly 'the effect of the acceleration on the moon's mean longitude.' The correct unabbreviated statement is 'the acceleration is 25″·12 per century per century.' Thus Hansen's result is that in each century the mean motion of the moon is augmented by an angular velocity of 25″·12 per century, so that at the end of a century the mean longitude is greater by ½ of 25″·12 than it would have been had the moon's mean motion remained the same as it was at the beginning of the century. Considering how absurd it would be to speak of a falling body as experiencing an acceleration of 16 feet in a second, or of 64 feet in two seconds, and how false and inconvenient it is to speak of a watch being 20 seconds fast when it is 20 seconds in advance of where it ought to be, we venture to suggest that, to attain clearness and correctness without sacrifice of brevity, 'advance' be substituted for 'acceleration' in the ordinary astronomical phraseology."

Researches on the Motion of the Moon, Washington, 1878.

[4] These explanations, together with other remarks, are to be found in the abstracts of Mr G. H. Darwin's memoirs in *Proc. Roy. Soc.*, 1878 to 1881.

[5] We here suppose the tides not to be inverted. If they are inverted the conclusion is precisely the same.

Inclination of plane of orbit generally decreases. Suppose the motions of the planet and of its solitary satellite to be referred to the invariable plane of the system. The axis of resultant moment of momentum is normal to this plane, and the component rotations are that of the planet about its axis of figure and the orbital motion of the planet and satellite round their common centre of inertia; the axis of this latter rotation is clearly the normal to the satellite's orbit. Hence the normal to the orbit, the axis of resultant moment of momentum, and the planet's axis of rotation must always lie in one plane. From this it follows that the orbit and the planet's equator must necessarily have a common node on the invariable plane. If either of the component rotations alters in amount or direction, a corresponding change must take place in the other, such as will keep the resultant moment of momentum constant in direction and magnitude. It has been shown that the effect of tidal friction is to increase the distance of the satellite from the planet, and to transfer moment of momentum from that of planetary rotation to that of orbital motion. If, then, the direction of the planet's axis of rotation does not change, it follows that the normal to the lunar orbit must approach the axis of resultant moment of momentum. By drawing a series of parallelograms on the same diameter and keeping one side constant in direction, this may be easily seen to be true. This is equivalent to saying that the inclination of the satellite's orbit will decrease. But this decrease of inclination does not always necessarily take place, for the previous investigations show that another effect of tidal friction may be to increase the obliquity of the planet's equator to the invariable plane, or, in other words, to increase the inclination of the planet's axis to the axis of resultant moment of momentum. Now, if a parallelogram be drawn with a constant diameter, it is seen that by increasing the inclination of one of the sides to the diameter (and even decreasing its length) the inclination of the other side to the diameter may also be increased. The most favourable case for such a change is when the side whose inclination is increased is nearly as long as the diameter. From this it follows that the inclination of the satellite's orbit to the invariable plane may increase, and that it is most likely to increase, when the moment of momentum of planetary rotation is large compared with that of the orbital motion. The analytical solution of the problem agrees with these results, for it shows that if the viscosity of the planet be small the inclination of the orbit always diminishes, but if the viscosity be large, and if the satellite moves with a short periodic time (as estimated in rotations of the planet), the inclination of the orbit will increase. These results convey some idea of the physical causes which may have given rise to the present inclination of the lunar orbit to the ecliptic. For the analytical investigation shows that the inclination of the lunar orbit to a certain plane, which replaces the invariable plane when the solar attraction is introduced, was initially small, that it then increased to a maximum, and that it finally diminished and is still diminishing.

But the laws above referred to would, by themselves, afford a very unsatisfactory explanation of the inclination of the lunar orbit, because the sun's attraction is a matter of much importance. It has been found that, if the viscosity of the planet be small, the inclination of the orbit of the solitary satellite to the invariable plane will always diminish; but, when solar influence is introduced, the corresponding statement is not true with regard to the inclination of the lunar orbit to the proper plane, for during one part of the moon's history the inclination to the proper plane would have increased even if the viscosity of the earth had been small.

Eccentricity of orbit generally increases. Consider a satellite revolving about a planet in an elliptic orbit, with a periodic time which is long compared with the period of rotation of the planet; and suppose that frictional tides are raised on the planet. The major axis of the tidal spheroid always points in advance of the satellite, and exercises on it a force which tends to accelerate its linear velocity. When the satellite is in perigee the tides are higher, and this disturbing force is greater than when the satellite is in apogee. The disturbing force may therefore be represented as a constant force, always tending to accelerate the motion of the satellite, and as a periodic force which accelerates in perigee and retards in apogee. The constant force causes a secular increase of the satellite's mean distance and a retardation of its mean motion. The accelerating force in perigee causes the satellite to swing out further than it would otherwise have done, so that when it comes round to apogee it is more remote from the planet. The retarding force in apogee acts exactly inversely, and diminishes the perigean distance. Thus, the apogean distance increases and the perigean distance diminishes, or, in other words, the eccentricity of the orbit increases. **But it may decrease.** Now consider another case, and suppose the satellite's periodic time to be identical with that of the planet's rotation. Then, when the satellite is in perigee, it is moving faster than the planet rotates, and when in apogee it is moving slower; hence at apogee the tides lag, and at perigee they are accelerated. Now the lagging apogean tides give rise to an accelerating force on the satellite, and increase the perigean distance, whilst the accelerated perigean tides give rise to a retarding force, and decrease the apogean distance. Hence in this case the eccentricity of the orbit will diminish. It follows from these two results that there must be some intermediate periodic time of the satellite for which the eccentricity does not tend to vary.

But the preceding general explanation is in reality somewhat less satisfactory than it seems, because it does not make clear the existence of certain antagonistic influences, to which, however, we shall not refer. The rigorous result, for a viscous planet, shows that in general the eccentricity of the orbit will increase; but, if the obliquity of the planet's equator be nearly 90°, or if the viscosity be so great as to approach perfect rigidity, or if the periodic time of the satellite (measured in rotations of the planet) be short, the eccentricity will slowly diminish. When the viscosity is small the law of variation of eccentricity is very simple: if eleven periods of the satellite occupy a longer time than eighteen rotations of the planet, the eccentricity increases, and *vice versa*. Hence in the case of small viscosity a circular orbit is only dynamically stable if the eleven periods are shorter than the eighteen rotations.

X. COSMOGONIC SPECULATIONS FOUNDED ON TIDAL FRICTION.

§ 50. *History of the Earth and Moon.*

We shall not attempt to discuss the mathematical methods by which the complete history of a planet, attended by one or more satellites, is to be traced. The laws indicated in the preceding sections show that there is such a problem, and that it may be solved, and we refer to Mr Darwin's papers for details (*Phil. Trans.*, 1879-81). It may be interesting, however, to give the various results of the investigation in the form of a sketch of the possible evolution of the earth and moon, followed by remarks on the other planetary systems and on the solar system as a whole.

Conjectural genesis of moon from earth. We begin with a planet not very much more than 8000 miles in diameter, and probably partly solid, partly fluid, and partly gaseous. It is rotating about an axis inclined at about 11° or 12° to the normal to the ecliptic, with a period of from two to four hours, and is revolving about the sun with a period not much shorter than our present year. The rapidity of the planet's rotation causes so great a compression of its figure that it cannot continue to exist in an ellipsoidal form with stability; or else it is so nearly unstable that complete instability is induced by the solar tides. The planet then separates into two masses, the larger being the earth and the smaller the moon. It is not attempted to define the mode of separation, or to say whether the moon was initially a chain of meteorites. At any rate it must be assumed that the smaller mass became more or less conglomerated and finally fused into a spheroid, perhaps in consequence of impacts between its constituent meteorites, which were once part of the primeval planet. Up to this point the history is largely speculative, for the conditions of instability of a rotating mass of fluid have not yet been fully investigated. **Earth and moon subject of investigation.** We now have the earth and moon nearly in contact with one another, and rotating nearly as though they were parts of one rigid body.[1] This is the system which was the subject of dynamical investigation. As the two masses are not rigid, the attraction of each distorts the other; and, if they do not move rigorously with the same periodic time, each raises a tide in the other. Also the sun raises tides in both. In consequence of the frictional resistance to these tidal motions, such a system is dynamically unstable. If the moon had moved orbitally a little faster than the earth rotated, she must have fallen back into the earth; thus the existence of the moon compels us to believe that the equilibrium broke down by the moon revolving orbitally a little slower than the earth rotates. In consequence of the tidal friction the periodic times both of the moon (or the month) and of the earth's rotation (or the day) increase; but the month increases in length at a much greater rate than the day. At some early stage in the history of the system the moon was conglomerated into a spheroidal form, and acquired a rotation about an axis nearly parallel to that of the earth.

The moon. The axial rotation of the moon is retarded by the attraction of the earth on the tides raised in the moon, and this retardation takes place at a far greater rate than the similar retardation of the earth's rotation. As soon as the moon rotates round her axis with twice the angular velocity with which she revolves in her orbit, the position of her axis of rotation (parallel with the earth's axis) becomes dynamically unstable. The obliquity of the lunar equator to the plane of the orbit increases, attains a maximum, and then diminishes. Meanwhile the lunar axial rotation is being reduced towards identity with the orbital motion. Finally, her equator is nearly coincident with the plane of the orbit, and the attraction of the earth on a tide, which degenerates into a permanent ellipticity of the lunar equator, causes her always to show the same face to the earth.

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[1] See criticisms by Mr Nolan, *Genesis of Moon*, Melbourne, 1885; also *Nature*, 16th February 1886.

The earth and lunar orbit. All this must have taken place early in the history of the earth, to which we now return. As the month increases in length the lunar orbit becomes eccentric, and the eccentricity reaches a maximum when the month occupies about a rotation and a half of the earth. The maximum of eccentricity is probably not large. After this the eccentricity diminishes. The plane of the lunar orbit is at first practically identical with the earth's equator, but as the moon recedes from the earth the sun's attraction begins to make itself felt. We must therefore introduce the conception of two ideal planes (here called the proper planes), to which the motion of the earth and moon must be referred. The lunar proper plane is at first inclined at a very small angle to the earth's proper plane, and the orbit and equator coincide with their respective proper planes. As soon as the earth rotates with twice the angular velocity with which the moon revolves in her orbit, a new instability sets in. The month is then about twelve of our present hours, and the day about six such hours in length. The inclinations of the lunar orbit and of the equator to their respective proper planes increase. That of the lunar orbit to its proper plane increases to a maximum of 6° or 7°, and ever after diminishes, that of the equator to its proper plane increases to a maximum of about 2° 45′, and ever after diminishes. The maximum inclination of the lunar orbit to its proper plane takes place when the day is a little less than nine of our present hours, and the month a little less than six of our present days. The maximum inclination of the equator to its proper plane takes place earlier than this. Whilst these changes have been going on the proper planes have been themselves changing in their positions relatively to one another and to the ecliptic. At first they were nearly coincident with one another and with the earth's equator, but they then open out, and the inclination of the lunar proper plane to the ecliptic continually diminishes, whilst that of the terrestrial proper plane continually increases. At some stage the earth became more rigid, and oceans were formed, so that oceanic tidal friction probably came to play a more important part than bodily tidal friction. If this be the case, the eccentricity of the orbit, after passing through a stationary phase, begins to increase again. We have now traced the system to a state in which the day and month are increasing, but at unequal rates, the inclination of the lunar proper plane to the ecliptic and of the orbit to the proper plane are diminishing, the inclination of the terrestrial proper plane to the ecliptic is increasing and of the equator to its proper plane is diminishing, and the eccentricity of the orbit is increasing. No new phase now supervenes and at length we have the system in its present configuration. The minimum time in which the changes from first to last can have taken place is 54,000,000 years.

Distortion of plastic planet. There are other collateral results which must arise from a supposed primitive viscosity or plasticity of the earth's mass. For during this course of evolution the earth's mass must have suffered a screwing motion, so that the polar regions have travelled a little from west to east relatively to the equator. This affords a possible explanation of the north and south trend of our great continents. Also a large amount of heat has been generated by friction deep down in the earth; and some very small part of the observed increase of temperature in underground borings may be attributable to this cause. The preceding history might vary a little in detail according to the degree of viscosity which we attribute to the earth's mass, and according as oceanic tidal friction is or is not, now and in the more recent past, a more powerful cause of change than bodily tidal friction. The argument reposes on the imperfect rigidity of solids and on the internal friction of semi-solids and fluids; these are *veræ causæ*. Thus changes of the kind here discussed must be going on, and must have gone on in the past.

The theory postulates sufficient lapse of time. And for this history of the earth and moon to be true throughout, it is only necessary to postulate a sufficient lapse of time, and that there is not enough matter diffused through space to materially resist the motions of the moon and earth in perhaps 200,000,000 years. It seems hardly too much to say that, granting these two postulates, and the existence of a primeval planet, such as that above described, a system would necessarily be developed which would bear a strong resemblance to our own. A theory, reposing on *veræ causæ*, which brings into quantitative correlation the lengths of the present day and month, the obliquity of the ecliptic, and the inclination and eccentricity of the lunar orbit should have claims to acceptance.

§ 51. *The Other Planetary Subsystems.*

Other planetary subsystems. If this has been the evolution of the earth and moon, a similar process must have been going on elsewhere. So far we have only considered a single satellite and the sun, but the theory may of course be extended, with modifications, to planets attended by several satellites. We will now, therefore, consider some of the other members of the solar system. A large planet has much more energy of rotation to be destroyed, and moment of momentum to be redistributed, than a small one, and therefore a large planet ought to proceed in its evolution more slowly than a small one. Therefore we ought to find the larger planets less advanced than the smaller ones. The masses of such of the planets as have satellites are, in terms of the earth's mass, as follows:—Mars = $\frac{1}{9}$; Jupiter = 340; Saturn = 100; Uranus = 17; Neptune = 20.

Mars. Mars should therefore be furthest advanced in its evolution, and it is here alone in the whole system that we find a satellite moving orbitally faster than the planet rotates. This will also be the ultimate fate of our moon, because, after its orbital motion has been reduced to identity with that of the earth's rotation, solar tidal friction will further reduce the earth's angular velocity; the tidal reaction on the moon will then be reversed, and the moon's orbital velocity will increase and her distance from the earth diminish. But, since the moon's mass is very large, she must recede to an enormous distance from the earth before this reversal takes place. Now the satellites of Mars are very small, and therefore they need only recede a very short distance from the planet before the reversal of tidal reaction. The periodic time of the satellite Deimos is $30^{h}\ 18^{m}$, and, as the period of rotation of Mars is $24^{h}\ 37^{m}$, Deimos must be still receding from Mars, but very slowly. The periodic time of the satellite Phobos is $7^{h}\ 39^{m}$; therefore it must be approaching Mars. It does not seem likely that it has ever been remote from the planet.[1] The eccentricities of the orbits of both satellites are small: that of Deimos is ·0057 and that of Phobos ·0066. If the viscosity of the planet be small, or if oceanic tidal friction be the principal cause of change, both eccentricities are diminishing; but, if the viscosity be large, both are increasing. As we have no means of knowing whether the eccentricities are increasing or diminishing, the larger eccentricity of the orbit of Phobos cannot be a fact of much importance either for or against the present views. But it must be admitted that it is a slightly unfavourable indication. The position of the proper plane of a satellite is determined by the periodic time of the satellite, the oblateness of the planet, and the sun's distance. The inclination of the orbit of a satellite to the proper plane is not determined by anything in the system. Hence it is only the inclination of the orbit which can afford any argument for or against the theory. The proper planes of both satellites are necessarily nearly coincident with the equator of the planet; but it is in accordance with the theory that the inclinations of the orbits to their respective proper planes should be small. Any change in the obliquity of the equator of Mars to the plane of his orbit must be entirely due to solar tides. The present obliquity is about 30°, and this points also to an advanced stage of evolution, at least if the axis of the planet was primitively at all nearly perpendicular to the ecliptic.

Jupiter. We now come to the system of Jupiter. This enormous planet is still rotating in about ten hours; its axis is nearly perpendicular to the ecliptic; and three of its satellites revolve in seven days or less, whilst the fourth has a period of $16^{d}\ 16^{h}$. This system is obviously far less advanced than our own. The inclinations of the proper planes to Jupiter's equator are necessarily small, but the inclinations of the orbits to the proper planes appear to be very interesting from a theoretical point of view. They are in the case of the first satellite 0° 0′ 0″, in the case of the second 0° 27′ 50″, in that of the third 0° 12′ 20″, and in that of the fourth 0° 14′ 58″. We have shown above that the orbit of a satellite is first coincident with its proper plane, and that the inclination afterwards rises to a maximum and finally declines. If then we may assume, as seems reasonable, that the satellites are in stages of evolution corresponding to their distances from the planet, these inclinations accord well with the theory. The eccentricities of the orbits of the two inner satellites are insensible, those of the outer two small. This does not tell strongly either for or against the theory, because the history of the eccentricity depends considerably on the nature of the friction to which the tides are subject. Yet it on the whole agrees with the theory that the eccentricity should be greater in the more remote satellites. It appears that the satellites of Jupiter always present the same face to the planet, just as does our moon. This was to be expected.

Saturn. The case of Saturn is not altogether so favourable to the theory. The extremely rapid rotation, the ring, and the short periodic time of the inner satellites point to an early stage of development; whilst the longer periodic time of the three outer satellites and the high obliquity of the equator indicate a later stage. Perhaps both views may be more or less correct, for successive shedding of satellites would impart a modern appearance to the system. It has probably been previously remarked that the Saturnian system bears a strong analogy to the solar system, Titan being analogous to Jupiter, Hyperion and Iapetus to Uranus and Neptune, and the inner satellites to the inner planets. Thus anything which aids us in forming a theory of the one system will throw light on the other. The details of the Saturnian system seem to be more or less favourable to the theory. The proper planes of the orbits (except that of Iapetus) are nearly in the plane of the ring, and the inclinations of all the orbits thereto appear not to be large. As the result of a careful series of observations made at Washington in 1873, Prof. Asaph Hall[1] finds that the eccentricities of the orbits of Mimas, Enceladus, Tethys, Dione, and Rhea are insensible, that of Titan is ·0284, of Hyperion ·1000, and that of Iapetus ·0278. The satellite Iapetus appears always to present the same face to the planet.

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[1] Mr Nolan considers the theory inapplicable to the case of Mars; see *Nature*, 29th July 1886.

Uranus and Neptune.

Concerning Uranus and Neptune there is not much to be said, as their systems are very little known; but their masses are much larger than that of the earth, and their satellites revolve with a short periodic time The retrograde motion and high inclination of the satellites of Uranus are very remarkable. The theory of the inclination of the orbit has been based on an assumed smallness of inclination, and it is not very easy to see to what results investigation might lead if the inclination were large. It must be admitted, however, that the Uranian system points to the probability of the existence of a primitive planet, with retrograde rotation, or at least with a very large obliquity of equator.

It appears from this review that the other members of the solar system present some phenomena which are strikingly favourable to the tidal theory of evolution, and none which are absolutely condemnatory. We shall show in the following section that there are reasons why the tidal friction arising in the planetary systems cannot have had so much effect as in the case of the earth and moon. That the indications which we have just noted were not more marked, but yet seemed to exist, agrees well with this conclusion.

§ 52. *Influence of Tidal Friction on the Evolution of the Solar System.*

Solar system as a whole.

According to the nebular hypothesis, the planets and the satellites are portions detached from contracting nebulous masses. In the following discussion that hypothesis will be accepted in its main outline, and we shall examine what modifications are necessitated by the influence of tidal friction. It may be shown that the reaction of the tides raised in the sun by the planets must have had a very small influence in changing the dimensions of the planetary orbits round the sun. From a consideration of numerical data with regard to the solar system and the planetary subsystems, it appears improbable that the planetary orbits have been sensibly enlarged by tidal friction since the origin of the several planets. But it is possible that some very small part of the eccentricities of the planetary orbits is due to this cause.

Planetary sub-systems.

From arguments similar to those advanced with regard to the solar system as a whole, it appears unlikely that the satellites of Mars, Jupiter, and Saturn originated very much nearer the present surfaces of the planets than we now observe them. But, the data being insufficient, we cannot feel sure that the alteration in the dimensions of the orbits of these satellites has not been considerable. It remains, however, nearly certain that they cannot have first originated almost in contact with the present surfaces of the planets, in the same way as in the preceding sketch (§ 50) has been shown to be probable with regard to the moon and earth. Numerical data concerning the distribution of moment of momentum in the several planetary sub-systems exhibit so striking a difference between the terrestrial system and those of the other planets that we should from this alone have grounds for believing that the modes of evolution have been considerably different. The difference appears to lie in the genesis of the moon close to the present surface of the planet, and we shall see below that solar tidal friction may be assigned as a reason to explain how it has happened that the terrestrial planet had contracted to nearly its present dimensions before the genesis of a satellite, but that this was not the case with the exterior planets. The efficiency of solar tidal friction is very much greater in its action on the nearer planets than on the further ones. The time, however, during which solar tidal friction has been operating on the external planets is probably much longer than the period of its efficiency for the interior ones, and a series of numbers proportional to the total amount of rotation destroyed in the several planets would present a far less rapid decrease as we recede from the sun than numbers simply expressive of the efficiency of tidal friction at the several planets. Nevertheless it must be admitted that the effect produced by solar tidal friction on Jupiter and Saturn has not been nearly so great as on the interior planets. And, as already stated, it is very improbable that so large an amount of momentum should have been destroyed as to materially affect the orbits of the planets round the sun.

Distribution of satellites amongst the planets.

We will now examine how the differences of distance from the sun would be likely to affect the histories of the several planetary masses. According to the nebular hypothesis, a planetary nebula contracts, and rotates quicker as it contracts. The rapidity of the revolution causes it to become unstable, or perhaps an equatorial belt gradually detaches itself; it is immaterial which of these two really takes place. In either case the separation of that part of the mass which before the change had the greatest angular momentum permits the central portion to resume a planetary shape. The contraction and the increase of rotation proceed continually until another portion is detached, and so on. There thus recur at intervals a series of epochs of instability or of abnormal change. Now tidal friction must diminish the rate of increase of rotation due to contraction, and therefore if tidal friction and contraction are at work together the epochs of instability must recur more rarely than if contraction alone acted. If the tidal retardation is sufficiently great, the increase of rotation due to contraction will be so far counteracted as never to permit an epoch of instability to occur. Since the rate of retardation due to solar tidal friction decreases rapidly as we recede from the sun, these considerations accord with what we observe in the solar system. For Mercury and Venus have no satellites, and there is a progressive increase in the number of satellites as we recede from the sun. Moreover, the number of satellites is not directly connected with the mass of the planet, for Venus has nearly the same mass as the earth and has no satellite, and the earth has relatively by far the largest satellite of the whole system. Whether this be the true cause of the observed distribution of satellites amongst the planets or not, it is remarkable that the same cause also affords an explanation, as we shall now show, of that difference between the earth with the moon and the other planets with their satellites which has caused tidal friction to be the principal agent of change with the former but not with the latter. In the case of the contracting terrestrial mass we may suppose that there was for a long time nearly a balance between the retardation due to solar tidal friction and the acceleration due to contraction, and that it was not until the planetary mass had contracted to nearly its present dimensions that an epoch of instability could occur. It may also be noted that if there be two equal planetary masses which generate satellites, but under very different conditions as to the degree of condensation of the masses, the two satellites will be likely to differ in mass; we cannot of course tell which of the two planets would generate the larger satellite. Thus, if the genesis of the moon was deferred until a late epoch in the history of the terrestrial mass, the mass of the moon relatively to the earth would be likely to differ from the mass of other satellites relatively to their planets. If the contraction of the planetary mass be almost completed before the genesis of the satellite, tidal friction, due jointly to the satellite and to the sun, will thereafter be the great cause of change in the system; and thus the hypothesis that it is the sole cause of change will give an approximately accurate explanation of the motion of the planet and satellite at any subsequent time. We have already seen that the theory that tidal friction has been the ruling power in the evolution of the earth and moon coordinates the present motions of the two bodies and carries us back to an initial state when the moon first had a separate existence as a satellite; and the initial configuration of the two bodies is such that we are led to believe that the moon is a portion of the primitive earth detached by rapid rotation or other causes. There seems to be some reason to suppose that the earliest form in which the moon had a separate existence was as a ring or chain of meteorites; but this condition precedes that to which the dynamical investigation leads back.

Case of earth and moon different from others.

Let us now turn to the other planetary sub-systems. The satellites of the larger planets revolve with short periodic times; this admits of a simple explanation, for the smallness of their masses would have prevented tidal friction from being a very efficient cause of change in the dimensions of their orbits, and the largeness of the planet's masses would have caused them to proceed slowly in their evolution. If the planets be formed from chains of meteorites or of nebulous matter, their rotation has arisen from the excess of orbital momentum of the exterior over that of the interior matter. As we have no means of knowing how broad the chain may have been in any case, nor how much it may have closed in on the sun in course of concentration, we are unable to compute the primitive angular momentum of a planet. A rigorous method of comparison of the primitive rotations of the several planets is thus wanting. If, however, the planets were formed under similar conditions, then we should expect to find the exterior planets now rotating more rapidly than the interior ones. On making allowance for the different degrees of concentration of the planets, this is the case. That the inner satellite of Mars revolves with a period of less than a third of the planet's rotation is perhaps the most remarkable fact in the solar system. The theory of tidal friction explains this perfectly; and this will be the ultimate fate of all satellites, because the solar tidal friction retards the planetary rotation without directly affecting the satellite's orbital motion. Numerical comparison shows that the efficiency of solar tidal friction in retarding the terrestrial and martian rotations is of about the same degree of importance, notwithstanding the much greater distance of the planet Mars. In the above discussion it will have been apparent that the earth and moon do actually differ from the other planets to such an extent as to permit tidal friction to have been the most important factor in their history.

Satellites of Mars.

Summary.

By an examination of the probable effects of solar tidal friction on a contracting planetary mass, we have been led to assign a cause for the observed distribution of satellites in the solar system, and this again has itself afforded an explanation of how it happened that the moon so originated that the tidal friction of the lunar tides in the earth should have been able to exercise so large an influence. We have endeavoured not only to set forth the influence which tidal friction may have, and probably has, had in the history of the system, if sufficient time be granted, but also to point out what effects it cannot have produced. These investigations afford no grounds for the rejection of the nebular hypothesis; but, while they present evidence in favour of the main outlines of that theory, they introduce modifications of considerable importance. Tidal friction is a cause of change of which Laplace's theory took no account; and, although the activity of that cause may be regarded as mainly belonging to a later period than the events described in the nebular hypothesis, yet it seems that its influence has been of great, and in one instance of even paramount importance in determining the present condition of the planets and their satellites. Throughout the whole of this discussion it has been supposed that sufficient time is at our disposal; Sir W. Thomson and others have, however, adduced reasoning which goes to show that the history of the solar system must be comprised within a period considerably less than a hundred million years.[1] It would perhaps be premature to accept this as the final and definite conclusion of science. If, however, it be confirmed, we shall only be permitted to accept the doctrine that tidal friction has effected considerable modification in the configuration of the moon and earth, and must reject the earlier portion of the history sketched above. (G. H. D.)

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[1] See *Brit. Assoc. Report*, 1882, p. 343.

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TIDOR, or **TIDORE**, an island (0° 39′ N. lat. and 127° 23′ E. long.) of the East Indian Archipelago, off the west coast of **JILOLO** (*q.v.*) and south of Ternate, is nearly circular in form, and has an area of about 58 square miles. A volcano (5900 feet), now quiescent, rises in the centre and occupies nearly the whole of the island; its sides are densely covered with forests. The principal productions are sago, rice, cocoa-nuts, and bananas. The capital, Tidor, on the east coast, is a walled town and the seat of a sultan tributary to the Dutch. The population is estimated at 7500. Tidor, which is included in the residency of Ternate, is administered by a "controleur."

TIECK, LUDWIG (1773-1853), the most conspicuous figure of the German romantic school of literature, was born at Berlin on 31st May 1773. His father, a ropemaker, was dry, sarcastic, and matter-of-fact; his mother, gentle and pious, with a leaning to mysticism. Tieck partook of both characteristics: half his work and half his genius seem a sceptical commentary on the other half. He emancipated himself from the prosaic influence of his father's house by a passionate study of Shakespeare. After a brilliant career at school he repaired in 1792 to the university at Halle, and, returning to Berlin in 1794, devoted himself to authorship, in which he had already made experiments. As is so commonly the case with young writers of genius, his first tales (*Abdallah*, *William Lovell*) partook too largely of the melodramatic, and have little permanent value. But the romantic school of Germany, a movement comparable to the Lake school of England, was already in the air, and Tieck was deeply sensitive to its influence. He was strongly fascinated by two of its aspects in particular—the reaction in favour of German mediæval art and the revived interest in fairy tales and folk-lore in general. Inspired by his friend Wackenroder, a youth of pious ardour and most pious simplicity, he wrote his unfortunately unfinished romance *Sternbald's Travels*, a very gospel for the artist, at once the complement and the antitype of *Wilhelm Meister*. His studies in popular literature resulted in the entertaining adaptation of Blue Beard entitled *Peter Lebrecht* and several kindred works. *Fair Eckbert*, his masterpiece, and the masterpiece of all romantic fiction, came to him, he said, by inspiration. He may well be believed: no artifice could have created the pervading sensation of dreamy solitude or the intense thrill of the catastrophe. The happy idea of dramatizing popular legend led to the production of a greatly improved *Blue Beard*, and subsequently of *Puss in Boots*, a satire on Kotzebue and Iffland, such an alliance of broad humour and dainty irony as we might expect to find in the lost Middle Comedy of Athens.

It might almost have been better if Tieck had continued to walk in his own way. His was a susceptible nature, too sensitive for perfect independence. In 1798 he made the acquaintance of the Schlegels, and was drawn into their circle. Novalis, undoubtedly the greatest genius of the romantic school, was for a time a compensation to him for the death of Wackenroder, whose essays on art he edited with additions of his own. But Novalis himself soon died, and the influence of the Schlegel circle, with its bickerings and its "chopping and changing of ribs," was not wholly salutary either in a moral or a literary point of view. August Schlegel inspired Tieck with a passion for the Spanish drama. He also spent much time on a translation of *Don Quixote*, certainly a masterpiece, and rendered Ben Jonson's *Silent Woman*, having previously adapted *Volpone*. One important production of his own nevertheless belongs to this period, the romantic drama of *Genoveva*, enthusiastically admired by so clear-headed and impartial a judge as Bishop Thirlwall. He also produced his delightful miniature drama of *Little Red Riding Hood*, and was working with great spirit on *The Emperor Octavian* when he was suddenly attacked by rheumatic gout, which tormented him more or less for the remainder of his life. Between pain and unpleasant literary disputes his activity was long greatly impeded. The narrowness of his means also troubled him. He had married the daughter of Pastor Alberti, and, although he was an amiable man and nothing is alleged against his wife, his household does not seem to have been entirely comfortable. He lived alternately in Jena, Berlin, and Dresden, where he became very intimate with Steffens, and wrote his powerful but dismal tale, *The Runenberg*. *The Emperor Octavian* was completed in 1804, with less success than had been hoped. In the following year Tieck repaired to Italy, nominally to visit the baths of Pisa; but he made this medical injunction the plea for a long stay in the country. The effect of Italian scenery, plastic art, and new impressions in general was to wean him from much of the mysticism in which he had hitherto indulged, and to direct him to the criticism of life. The transition to his new manner is indicated by the additions to his former tales and dramas, which, after several years spent in wandering and in sickness, he published in 1812. *The Elves*, *The Philtre*, and *The Goblet* are tales, distinguished, the last two more especially, by brilliant colouring and elaborate art. *Fortunatus*, a drama in two parts, added in 1816, wants the spirit of its predecessors, but is pervaded by a quiet sarcastic humour exceedingly enjoyable. Plays and stories were set in a framework of æsthetic conversation, and the entire collection was entitled *Phantasus*. By this publication Tieck settled accounts with the romantic school, and could no more be regarded as its leader.

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[1] Thomson and Tait's *Nat. Phil.*, App. E; *Nature*, 27th January 1887; Wolf, *Théories Cosmogoniques*, 1886.

Tieck's power of original composition failed him for some years. He devoted himself especially to antiquarian and dramatic studies. In pursuance of the latter he visited England, saw Kemble and Kean on the stage, and renewed acquaintance with Coleridge, whom he had known in Italy. The friendship of Solger was highly important to him, and helped him to the clear definite principles of composition and criticism in which he had previously been deficient. The period of reflexion gradually worked itself into a period of productiveness, beginning with his charming novelette of *The Pictures*, translated by Thirlwall. It was followed by a series of similar works extending over nearly twenty years, very unequal in value, but in their best examples belonging to a very high class of art. Their great peculiarity is the blending of narrative with disquisition and comment, so thoughtful and ingenious that, interesting as the action commonly is, the interruption is not resented. They have usually a strongly marked ironical element, as though the writer were only half in earnest, a self-criticism of which a great creative genius would have been incapable, but which bestows unusual piquancy on productions of the second order. *The Pictures*, already mentioned, is a fine instance of the masterly conduct of a story, and contains a very original figure, the shrewd, sottish, graceless old painter Eulenböck, who, with talent enough to have made a name and a fortune, gains a precarious livelihood by forging old masters. *The Betrothal*, also translated by Thirlwall, is a severe satire on hypocritical pietism. Among the best of the other novelettes in this style may be mentioned *The Travellers*, one of the most perfect specimens of the author's irony; *Luck brings Brains*, a fine study of the power of a weak character to rise to its opportunities when elevated by a sense of responsibility; and *The Superfluities of Life*, an anecdote delightfully told. *The Old Book* and *The Scarecrow*, two of the most fantastically imaginative, resolve themselves into literary satire. The motive of the latter was borrowed by Hawthorne in his *Mother Rigby's Pipe*. Of fictions with an historical basis, the most popular are those derived from the lives of poets—*A Poet's Life*, of which Shakespeare is the hero, and *A Poet's Death*, relating the sad history of Camoens. *The Revolt in the Cevennes* is an historical romance of considerable compass; but Tieck's masterpiece in this department is his *Witches' Sabbath*, a tale almost unparalleled in literature for its delineation of heart-breaking, hopeless misery. *The Young Carpenter* (1836, but commenced much earlier) can hardly be assigned to any of these classes. It has a strong affinity to *Wilhelm Meister*, and may be compared with *Sternbald*, both for its resemblance and its contrast. Finally, in *Vittoria Accorambona* (1840) Tieck takes yet another new departure, indicating affinities with the modern French school of fiction. The novel has been translated into English, but is probably best known to English readers by Mrs Carlyle's half-earnest half-mocking admiration of the hero Bracciano, a Blue Beard on the highest principles, and her wish that she could have lived two hundred years before, "to have been—his mistress, not his wife."

These novels were all written at Dresden, where Tieck had settled in 1819. He enjoyed especial favour at court, took an active part in the direction of the royal theatre, and gained a new description of celebrity by his semi-public readings from dramatic poets in the court circle. According to the almost unanimous testimony of his hearers, he was the finest dramatic reader of his age. His daughter Dorothea, who united her father's literary talent to her grandmother's mystic piety, was of great assistance to him, especially in the translation of Shakespeare which passes under his name. Schlegel had translated seventeen plays. Tieck had undertaken to translate the remainder, and it has been generally supposed that he kept his word. In fact the translation was almost entirely executed by Dorothea Tieck and Count Wolf Baudissin, Tieck contributing hardly anything but his advice and his name. The truth slips out quite innocently in the pages of his biographer Köpke, and is fully told by Gustav Freytag (*Im Neuen Reich*, January 1880). During his residence at Dresden he collected his critical writings, produced his excellent translation of the English dramatists anterior to Shakespeare, and edited the works of Novalis, Kleist, Lenz, and other contemporaries. In 1842 he accepted the invitation of Frederick William IV. to settle in Berlin, where he had already been to conduct the representation of the *Antigone* with Mendelssohn's music. He found himself but little in his element in the city of his birth, and the dramatic representations directed by him, including revivals of some of his own plays, were rarely successful.. In 1851 his health failed entirely, and he withdrew altogether from the world. He died on 28th April 1853.

Though not a writer of the highest rank, Tieck is nevertheless a most original genius, very unjustly neglected by his countrymen. The best of his compositions in the taste of the romantic school are absolute masterpieces; and his later productions, if imperfect, occupy a unique position in literature. He may be compared to Wieland, whom he decidedly surpasses, and to Ariosto, whom he would have more than rivalled if he had been capable of a great sustained effort. His susceptibility and self-distrust checked his genius, but at the same time gave it that peculiar ironic flavour which constitutes its special distinction. He is like an exquisite side dish, not sufficiently substantial for a full meal. The attempts to extract a moral significance from the stories in *Phantasus* seem entirely thrown away; the purpose of his later writings, when there is any, is always definite. Perhaps the soundest criticism upon him, at bottom, is Heine's in his *Romantic School*, though written at a time when it was his cue to show the works of that school as little quarter as possible. Carlyle's criticism is excellent, but only refers to the *Phantasus*.

The principal contribution to Tieck's biography is the delightful book of Rudolf Köpke (Leipsic, 1855), chiefly drawn from his oral communications and containing his opinions on a number of subjects. Particulars of his residence at Dresden, more especially of his connexion with the theatre, are given in the memoirs of Friesen (Weimar, 1871). Tales from *Phantasus* have been translated in Carlyle's *Specimens of German Romance*, and are reprinted in his miscellanies. A greatly inferior version, in some places unscrupulously altered from Carlyle, was published in 1845 with an elaborate preface signed by J. A. F., who does not, however, appear to have been the translator Several of Tieck's other works have been translated into English, but the only remarkable rendering is Bishop Thirlwall's of *The Pictures* and *The Betrothal*. A complete chronological list of his writings is appended to Köpke's work. (R. G.)

TIEDEMANN, Friedrich (1781-1861), German anatomist and physiologist, the son of a philosopher and psychologist of considerable repute, was born at Cassel on 23d August 1781. He graduated in medicine at Marburg in 1804, but soon abandoned practice owing to disappointment at his failure to check his father's last illness. Repelled on the one hand by the brilliant but unsubstantial discourses of Schelling on the "Naturphilosophie," and attracted on the other hand by the practical skill and intelligence of the surgical anatomist Sommering, he returned to the study of natural science. He betook himself to Paris, and became an ardent follower of Cuvier. On his return to Germany he maintained the claims of patient and sober anatomical research against the prevalent speculations of the school of Oken (see Oken and Morphology), whose foremost antagonist he was long reckoned. His manifold labours in the field of Cuvierian anatomy cannot be recorded here; but his remarkable studies of the development of the human brain, as correlated with his father's studies on the development of intelligence, may be mentioned. He spent most of his life (from 1816) as professor of anatomy and physiology at Heidelberg, and died at Munich on 22d January 1861.

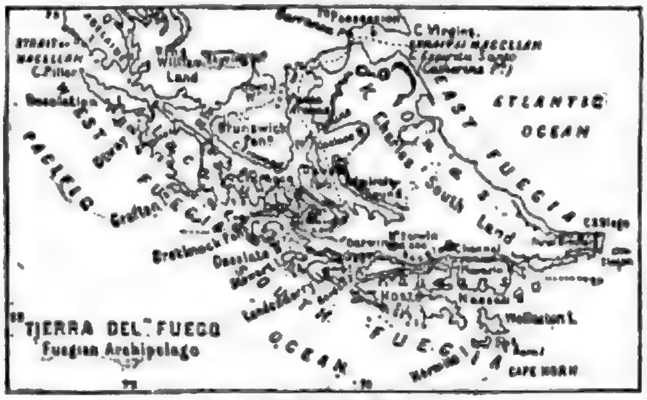
T'IENTSIN is the largest commercial city in Chih-li, the metropolitan province of China. It is situated in 39° 7′ N. lat. and 117° 11′ E. long., at the junction of the Peiho and the Wan-ho, which is connected by the Grand Canal with the Yang-tsze-kiang. It is a prefectural city, and the residence of the viceroy of the province during a great portion of the year. The town is built on a vast alluvial plain, which extends from the mountains beyond Peking to the sea, and through which the Peiho runs a circuitous course, making the distance by water from T'ientsin to the coast about 70 miles, as against 35 miles by road. The soil of the surrounding country being strongly impregnated with soda and nitre is not fertile, but produces sorghum and other coarse grains. The city walls are well built, though not always kept in good order, and measure about three quarters of a mile each way. As in all Chinese cities, the more wealthy inhabitants live in the suburbs, but even their houses have a mean appearance, being built mainly of mud or dried bricks. The streets are for the most part unpaved, and in wet weather are little better than quagmires. Some improvements have, however, been made in this respect of late. The city has always been a great commercial depôt. In 1885 the foreign imports amounted to £3,226,972 and the exports to £980,852, and 375 foreign vessels of 279,829 tons visited the port, tea to the value of about £904,496 being landed for carriage overland, *via* Kalgan and Kiachta, to Siberia. During the winter the river is frozen, so that communication has to be carried on overland to Chin-kiang on the Yang-tsze-kiang, to which point also a line of telegraph (now extended to Peking) was opened in 1881. The principal articles of import are shirtings, drills, T-cloths, jeans and twills, opium, woollens, steel, lead, needles, Japanese sea-weed, and sugar; and of export, skins, beans and pease, straw braid, coal, dates, wool, tobacco, and rhubarb. The coal exported is brought from the Kaiping colliery to the east of T'ientsin; its output in 1885 was 181,039 tons, 54,976 tons more than in 1884. An experimental railway nearly two miles long has lately been constructed at T'ientsin.

In 1853 T'ientsin was besieged by an army of Taiping rebels, which had been detached from the main force at Nanking for the capture of Peking. The defences of T'ientsin, however, saved the capital, and the rebels were forced to retreat. Five years later Lord Elgin, accompanied by the representative of France, steamed up the Peiho, after having forced the barriers at Taku, and took peaceable possession of the town. Here the treaty of 1858 was signed. Two years later, in consequence of the treacherous attack made on the English plenipotentiary the preceding year at Taku, the city and suburbs were occupied by an allied English and French force, and were held for two years. The city was constituted an open port. On the establishment of Roman Catholic orphanages some years later the pretensions of the priests so irritated the people that on the occurrence of an epidemic in the schools they attacked the French and Russian establishments and murdered twenty of the foreign inmates, besides numbers of their native followers. The Chinese Government at once suppressed the riot, and sent a representative to Europe to apologize for the outbreak.

TIERNEY, George (1761-1830), an English Whig politician, was born at Gibraltar on 20th March 1761, being the son of a wealthy merchant resident in Spain. He was sent to Peterhouse, Cambridge, where he took the degree of LL.D. in 1784, and was called to the bar; but, having inherited an ample fortune, he abandoned law and plunged into politics. He contested Colchester in 1788, when both candidates received the same number of votes, but Tierney was declared elected. He was, however, defeated in 1790. He sat for Southwark from 1796 to 1806, and then represented in turn Athlone (1806-7), Bandon (1807-12), Appleby (1812-18), and Knaresborough (1818-30). When Fox seceded from the House of Commons, Tierney became a prominent, if not the leading, opponent of Pitt's policy. It was perhaps for this reason that he was disliked by Fox. In 1797—such was the height of political passion at this epoch—Wilberforce noted in his diary that Tierney's conduct was "truly Jacobinical"; and in May 1798 Pitt accused him of want of patriotism. As the words were not withdrawn, a duel ensued at Putney Heath on Sunday, 27th May 1798; but neither combatant was injured. In 1803 Tierney, partly through gratitude for the peace which had been ratified with France and partly because Pitt was out of office, joined the ministry of Addington as treasurer of the navy, and was created a privy councillor; but this ill-advised step alienated many of his supporters among the middle classes, and offended most of the influential Whigs. On the death of Fox he joined (1806) the Grenville ministry as president of the board of control, with a seat in the cabinet, and thus brought himself once more into line with the Whigs. After the death of Ponsonby in 1817 Tierney became the recognized leader of the opposition in the House of Commons. In the neutral ministry of Canning, the place of master of the mint was held by him, and when Lord Goderich succeeded to the lead Tierney was admitted to the cabinet; but he was already suffering from ill-health and took little part in its deliberations. He died suddenly at Savile Row, London, on 25th January 1830.

Tierney was a shrewd man of the world, with a natural aptitude for business. His powers of sarcasm were a cause of terror to his adversaries, and his presence in debate was much dreaded. His arguments were felicitous, and, though he never aimed at the highest flights of eloquence, his choice of language was the theme of constant admiration. Lord Lytton, in his poem of St Stephen's, alludes to "Tierney's airy tread," and praises his "light and yet vigorous" attack, in which he inflicted, "with a placid smile," a fatal wound on his opponent.

TIERRA DEL FUEGO, a large archipelago at the southern extremity of South America, from which it is separated by Magellan Strait, at the Narrows and other points scarcely a mile wide. The group lies between 52° 40′ and 55° 59′ S. lat. and 63° 30′ and 74° 35′ W. long. stretching nearly in a line with the Patagonian Andes for over 400 miles north-west and south-east, between Capes Pillar and Horn, and for about 270 miles west and east from Cape Pillar to Cape Espiritu Santo (Catherine Point) in the north; southwards it tapers to 120 miles between Capes Horn and St Diego, the latter being continued eastwards to Staten Island, which is not usually included in the group. Although on ordinary maps this region presents to the eye a hopelessly confused aggregate of islands, channels, and fjord-like inlets, as if it had been submerged sufficiently to convert its deep valleys and gorges into marine passages, bays, and bights, it is nevertheless clearly disposed in three main sections, which may be conveniently named East, West, and South Fuegia.



Map of Tierra del Fuego.

East Fuegia consists of the single island of King Charles's South Land (eastern Tierra del Fuego), which is very much larger than all the rest of the group together, being considerably over 200 miles long from north to south. It obviously forms a southern extension of the Patagonian pampas, which it greatly resembles in its physical constitution, climate, flora, and fauna. The low-lying, flat or slightly rolling plains are covered with a rich growth of tall herbage, which is frequented by the rhea, guanaco, and other animals common to the adjoining mainland, and also peopled by a branch of the same Tehuelche (Patagonian) family. In the south a long peninsula projects westwards to the Pacific. This western limb assumes a mountainous character, Mount Darwin (6800 feet) being situated about midway on its south side and Mount Sarmiento (6900, or perhaps 7000 feet), the culminating point of the archipelago, much nearer the Pacific. Although generally supposed to be volcanic, this peak presents such extremely precipitous, in fact, almost vertical flanks that John Ball considers it more probably "a portion of the original rock skeleton that formed the axis of the Andean chain during the long ages that preceded the great volcanic outbursts that have covered the framework of the western side of South America."[1] This is altogether an alpine region with numerous snow-clad summits and glaciers descending down to the sea (Darwin).

Along the south side of East Fuegia flows Beagle Channel, about 55° S. lat., separating it from South Fuegia, which comprises the islands of Hoste, Navarin, Gordon, Londonderry, Stewart, Wollaston, and numerous islets, disposed in triangular form with the base on Beagle Channel and the apex at the rocky headland of Cape Horn. At its western end Beagle Channel takes the name of Darwin Sound, which leads to the Pacific at Londonderry and Stewart Islands. North of these lies Brecknock Peninsula, the westernmost extension of East Fuegia, cutting off South Fuegia from Clarence Island and Desolation Land, which with Dawson Island and numerous rocks and islets constitute West Fuegia. Desolation Land, so named by Cook, who supposed it to form a continuous mass stretching from the western entrance of Magellan Strait to Cockburn Channel, really consists of at least three, and possibly more islands, separated from each other by very narrow channels flowing between the Pacific and the western branch of Magellan Strait. The name Desolation has been reserved for the northern member of the group terminating at Cape Pillar; the one next to it has been called Santa Iñez; the other or others are still unnamed. When Ball passed through the strait, he was shown one of the narrow sounds "which have lately been ascertained to penetrate entirely through what used to be considered a single island" (*op. cit.*, p. 241).

Lying almost in a line with the main Andean axis, both West and South Fuegia are essentially highland regions, conforming in their general characteristics to the intervening western extension of East Fuegia. As compared with the great mass of the latter, they are everywhere extremely rugged and mountainous, having a mean elevation of not less than 3000 feet, a much moister climate, and arboreal instead of grassy vegetation. The isothermals of 32° Fahr. for July (winter) and 50° Fahr. for January (summer), with a mean annual temperature of 42° Fahr., show that tolerably mild winters are followed by cool summers, both seasons being accompanied by overcast skies, constant and sudden changes from fair to foul weather; whilst fogs, mists, rains, snows, and high winds (prevailing throughout the year) endanger the navigation of the intricate inland channels, and render the archipelago one of the dreariest regions on the globe.

A botanical parting line seems to be constituted by the range of hills running back of Punta Arenas along the east side of Brunswick Peninsula (which, although attached by a narrow neck of land to Patagonia, belongs physically to the insular domain), and terminating at Cape Froward (53° 54′ S. lat.), the southernmost point of the American mainland. West and south of this line the pampas are replaced by lofty mountains clothed with a dense forest vegetation from the water's edge to heights of 1000 and 1200 feet, above which stretches a zone of peaty soil with stunted alpine plants as far as the snow line (3000 to 3500 feet). The forest species are chiefly an evergreen beech (*Fagus antarctica*, S.) and the winter bark (*Winteria aromatica*), also evergreen, with tall smooth stem and glossy leaves like the laurel. Wild celery, cress, cochlearia, and other anti-scorbutic plants occur on both sides of Magellan Strait, and the beech nourishes a large yellow mushroom, which, with the berries of a dwarf shrub, is the only vegetable food of the natives.

In West and South Fuegia the fauna is restricted mainly to two species of fox, a bat, rats, mice, the sea otter, the penguin and other aquatic birds, and various cetaceans in the surrounding waters.

To the three geographical divisions correspond three well-marked ethnical groups,—the Onas of East, the Yaghans of South, and the Alacalufs of West Fuegia. The first are estimated to number 2000, the others 3000 each, making a total population of some 8000 for the whole archipelago. The Onas are Patagonians who have crossed the strait. The Alacalufs are also immigrants from the mainland, but probably they came at an earlier date, and from the western uplands, being apparently a branch of the Auca (Araucanian) race of the Patagonian and Chilian Cordilleras. They differ altogether in speech both from the Onas, with whom they come scarcely anywhere in contact, and from the Yahgans, who are the true aborigines of the archipelago. These last are in exclusive possession of South Fuegia, and also occupy the north side of Beagle Channel about Mount Darwin and further west. To them alone missionary enterprise has hitherto been extended, and the English station of Ushiwaya on Beagle Channel has for some years been the only centre of civilizing influences in the archipelago. As Lieutenant Bove of the Italian Antarctic expedition has made a special study of this branch,[1] they are much better known than either of the neighbouring races. If they represent an earlier Araucanian immigration than that of the Alacalufs, their extremely low social state, on which all observers are unanimous, may be regarded as the result of degradation from a higher condition during their long sojourn in their present inhospitable environment. But it seems more probable that they are the direct descendants of the primitive race by which the archipelago has been occupied from a vastly remote period, as is shown by the very great number of kitchen-middens recently discovered on the coast. Although taller than the Negritoes of the eastern hemisphere (4 feet 10 inches to 5 feet 4 inches), the Yahgans present in some respects a more debased type, characterized by low brows, prominent zygomatic arches, large tumid lips, flat nose, loose wrinkled skin ("pelle grinzosa e cadente," says Bove), black restless eyes very wide apart, coarse black unkempt hair, and head and chest disproportionately large compared with the extremely slender and outwardly curved legs, conveying an impression of top-heaviness like that of the Akkas of equatorial Africa. Their mental qualities are on the same low level, as is indicated by the almost total absence of clothing under such inclement skies, by the brutal treatment of their women, who when old and useless are often eaten, by the lack of human affections or love of offspring, who in rough weather are thrown overboard (Dr Fenton), either as a peace offering to the spirits of the storm or to lighten the canoe, and by many repulsive practices connected with their food and social habits. The tribal organization has not yet been reached, each family circle living apart and combining only in small groups against some common enemy, but recognizing no hereditary chief or even any temporary leader. Yet the missionaries, who have reduced the language to writing (Gospel of St Luke, London, 1881), assert that it contains no less than 30,000 words, although the numerals stop at *five*, already a compound form (*cu-pash-pa*), and although the same word expresses both *hand* and *finger*. But they have obviously failed to distinguish between distinct terms and the endless grammatical intricacies in which this, like so many other rude forms of speech, is still involved.

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[1] *Notes of a Naturalist in South America*, London, 1887, p. 245.

[1] See Guido Cora's *Cosmos* for May 1883.

Since 1881 the eastern portion of Fuegia (with Staten Island) has belonged to the Argentine Republic and the western to Chili. The boundary line, which is purely conventional, runs from Cape Espiritu Santo due south to Beagle Channel. Neither power has hitherto occupied any part of Fuegia, except Punta Arenas (Sandy Point) on the Patagonian side of Magellan Strait, where the Chilians have for some years maintained a convict and coaling station.

Fuegia was discovered by Magellan in 1520, when he sailed through the strait named after him, and called this region the "Land of Fire," either from now extinct volcanic flames, or much more probably from the fires kindled by the natives along parts of his course. In 1578 Drake first sighted the point which in 1616 was named Cape Hoorn (Anglicized Horn) by the Dutch navigators Lemaire and Schouten. In 1619 the brothers Nodal first circumnavigated the archipelago, which was afterwards visited at intervals by Wood and Narborough (1670), Gennes and Froger (1696), Byron (1764), Wallis and Carteret (1767), Cook (1768), and Weddell (1822). But no systematic exploration was attempted until the British Admiralty undertook a thorough survey of the whole group by King (1826-28) and Fitzroy (1831-36). The latter expedition (*Voyage of the "Beagle"*) was accompanied by Charles Darwin, then a young man. To these admirable surveys is due most of the present geographical terminology of the archipelago. Since then the work of exploration has been continued and nearly completed by Dumont d'Urville (1837), Charles Wilkes (1839), Parker Snow (1855), Bove (1883), and various English, American, and Roman Catholic missionaries.

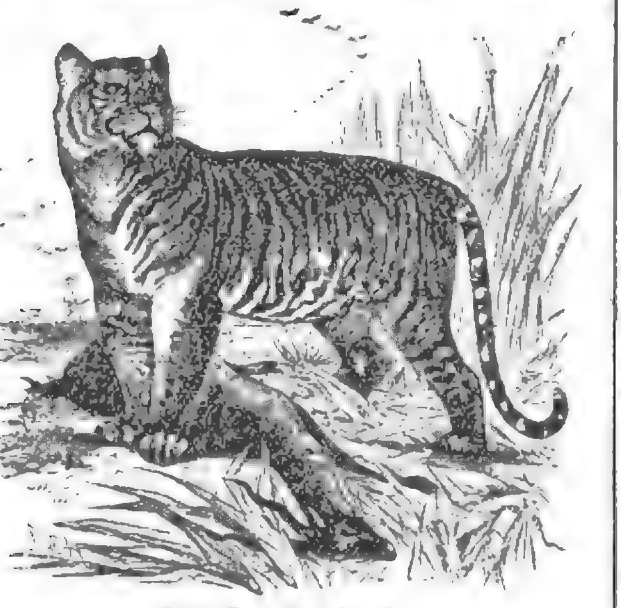
Bibliography.—De Brosses, *Histoire des Navigations aux Terres Australes*, Paris, 1756; J. Burney, *History of Voyages and Discoveries in the South Sea*, London, 1803-17; J. Weddell, *A Voyage towards the South Pole and to Tierra del Fuego*, London, 1825; Charles Darwin, *Journal of Researches, &c., during the Voyage of the "Beagle" round the World*, London, 1845; W. Parker Snow, *A Two Years' Cruise of Tierra del Fuego*, London, 1857; G. Marguin, "La Terre de Feu," in *Bull. de la Soc. de Géogr.*, November 1875; J. G. Kohl, *Gesch. d. Entdeckungsreisen, &c., zur Magellan's Strasse*, Berlin, 1877; "La Terre de Feu et ses Habitants," in *Journal des Missions Évangéliques*, August 1876; D. Lovisato, *Appunti Etnografici con Accenni Geologici sulla Terra del Fuoco*, Turin, 1884; John Ball, *Notes of a Naturalist in South America*, London, 1887; R. W. Coppinger, *Cruise of the "Alert,"* London, 4th ed. 1885; G. Sergi, *Antropologia Fisica della Fuegia*, Rome, 1887; Ramon Lista, "East Fuegia," in *Petermann's Mitteilungen*, May 1887; and the works already mentioned. (A. H. K.)

TIFFIN, a city of the United States, in Seneca county (of which it is the county seat), Ohio, stands upon the Sandusky river, in 41° 7′ N. lat., 83° 11′ W. long., 42 miles south-east of Toledo. The city is situated in the midst of an agricultural region, for which it serves as a shipping and supply point, and has three railroads—the Baltimore and Ohio, the Indiana, Bloomington, and Western, and the North-Western Ohio. It is the seat of Heidelberg College, one of the minor educational institutions of the State. Tiffin had in 1880 a population of 7879, an increase of 2231 over that in 1870.

TIFLIS, capital of the province of the same name and of Russian Caucasia, is picturesquely situated (44° 48′ E. long., 41° 42′ N. lat.) at the foot of high mountains, on both banks of the river Kúr, some 500 feet above the level of the Black Sea. The heat in summer is excessive, owing to the confined position; but the surrounding hills (1350 to 2400 feet) shelter the town effectively from the cold winds of a generally severe winter. A large square, the cathedral, one or more handsome streets, gardens, bridges, many fine or neat buildings—among them the grand-ducal palace, the opera-house, and the museum—European shops, the club or circle, hotels, and public offices are evidence that Western civilization has not only penetrated but has long prevailed in this geographically remote town. Of its 54 churches 26 are Armenian, 2 Lutheran, and 1 Catholic. The (Sion) cathedral traces back its origin to the 5th century; but in the interval it has suffered much and often. Other churches date from the 14th and 15th centuries, the Armenian cathedral of Vank from 1480, and the Catholic church from the 14th century. Tiflis has two gymnasia and pro-gymnasia for boys and two for girls, and a number of other schools; several scientific societies, of which the Caucasian branch of the geographical society is well known; an astronomical and a physical observatory; and a public library. The manufactures of the place are limited to a few cotton and silk factories, tanneries, soap-works, and brick-works. But the petty trades are largely developed; and the artisans of Tiflis (about 8000) are renowned as silversmiths, gunsmiths, and sword-makers. Since 1883 Tiflis has been in railway connexion with Poti and Batum on the Black Sea and with Baku on the Caspian; but the line from Russia to Vladikavkaz has not yet crossed the main chain of the Caucasus The trade is of great importance, as Tiflis is the chief centre for the import of raw silk and silken goods, raw cotton, carpets, and dried fruits from Persia, as well as from trans-Caucasia, while a variety of manufactured wares are imported from Russia. The foreign trade of trans-Caucasia with Asia, mostly carried on from Tiflis, in 1884 reached the value of £1,729,800 for exports, and £857,070 for imports. In 1883 the population numbered 104,024, as against 71,051 in summer 1865 and 60,085 in winter, exclusive of a garrison of 6800. Ethnologically, the numbers are—Armenians 31,180, Georgians 14,787, and Russians 12,142, with an admixture of about 1200 Germans, 7150 Persians (in summer), 1500 Tatars, and some Jews and Greeks.

Many chroniclers and travellers have written about Tiflis. Perhaps one of the fullest accounts is contained in Brosset's edition of the *Description Géographique de la Géorgie* (St Petersburg, 1842), by the illegitimate son of Wakhtang VI., king of Karthli, who became a pensioner of Peter the Great. English travellers since 1849 describe Tiflis in its main features much in the same terms. Lady Sheil, writing in 1849, calls it "most thriving, active, and bustling." Edward Eastwick (1860), estimating its population at 40,000 and the height of the mountains overhanging it at 3000 feet, represents the plain in which the city is situated to be so barren that "even the Kúr . . . imparts to it but a limited fertility." Mounsey (1866) speaks in warm terms of its social charms and the great hospitality of its inhabitants, and notes it as the seat of government for the "Caucasian provinces of Russia, headquarters of an army of 150,000 men, and the residence of the governor-general." In the old division of Tiflis three distinct towns were included,—Tiflis, Kal'a (the fort), and Isni; subsequently Tiflis seems to have become known as Sáiyidábád, Kal'a as Tiflis, and Isni as Aulabár. Kal'a and Isni possessed citadels; that of the former contained the church of St Nicholas and a royal palace, that of the latter the church of the Holy Virgin and the residence of the archimandrite. The town is now divided into quarters:—the Russian (the finest of all), the German, the Armenian, and that in which are congregated Jews, Mohammedans, and the mass of Orientals. Tiflis can lay claim to a very considerable antiquity. In 455 the chieftain of Georgia, Wakhtang, transferred his capital from Mhtset to the warm springs of Tpilisi, where he erected several churches and a fort. In 570 the Persians took the place and made it the residence of their rulers, but retained it only for ten years. Tiflis underwent successive plunderings and devastations at the hands of the Greeks in 626, of one of the commanders of Omar in 731, of the Khazars in 828, and of the Saracens in 851. The Georgians, however, always managed to return to it and to keep it in their permanent possession. In the course of the succeeding centuries Tiflis fell repeatedly into Persian hands; and it was plundered by Timur about the end of the 14th century. Afterwards the Turks seized it several times, and towards the end of the 17th century the Lesghians made attacks upon it. In 1795, when the shah of Persia plundered Tiflis, Russia sent troops to its protection, and the Russian occupation became permanent in 1799.

TIGER. Although this name is often applied by settlers and sportsmen to several of the larger *Felidæ*, as the leopard of Africa and the jaguar of America, it should properly be restricted to the well-known striped species of Asia, *Felis tigris* of Linnæus, an animal which is only rivalled by the lion in size, strength, and ferocity among the cat-like beasts of prey. It is a true cat on a large scale, and possesses all the essential characters of the genus as defined in the article MAMMALIA (vol. xv. p. 434). It belongs to the section in which the pupil of the eye contracts under the stimulus of light into a round spot and not a vertical slit, and in which the hyoid bone is nected loosely with the skull by a long ligament, instead of by a continuous chain of bones. In these points it agrees with the lion and the leopard and differs from the common cat. Almost everything that is said in the article Lion (vol. xiv. pp. 680-681) of the structure of the skeleton, teeth, and claws of that animal will apply equally well to the tiger, the difference between the two lying mainly in the skin and its coverings. There are, however, slight distinctions in the proportionate size of the lower teeth, the general form of the cranium, and the relative length of the nasal bones and ascending processes of the maxillaries by which the skull of the lion and tiger can be easily discriminated by the practised observer.



Tiger (*Felis tigris*, Linn.).

Although examples of both species present considerable variations in size, and reliance cannot always be placed upon alleged dimensions, especially when taken from skins stripped from the body, it seems well ascertained that the length of the largest-sized Bengal tiger may exceed that of any lion. Larger specimens are certainly recorded, but 10 feet from the tip of the nose to the end of the tail is, according to Jerdon, an unusual length for a large male tiger. The female is somewhat smaller and has a lighter and narrower head. The tiger has no mane, but in old males the hair of the cheeks is rather long and spreading. The ground colour of the upper and outer parts of the head, body, limbs, and tail is a bright rufous fawn, and these parts are beautifully marked with transverse stripes of a dark, almost black colour. The markings vary much in different individuals, and even on the two sides of the same individual. The under parts of the body, the inside of the limbs, the cheeks, and a large spot over each eye are nearly white. The tigers which inhabit hotter regions, as Bengal and the south Asiatic islands, have shorter and smoother hair, and are more richly coloured and distinctly striped than those of northern China and Siberia, in which the fur is longer, softer, and lighter coloured.

The tiger is exclusively Asiatic, but has a very wide range in that continent, having been found in almost all suitable localities south of a line drawn from the river Euphrates, passing along the southern shores of the Caspian and Sea of Aral by Lake Baikal to the Sea of Okhotsk. Its most northern range is the territory of the Amur, its most southern the islands of Sumatra, Java, and Bali. Westward it reaches to Turkish Georgia and eastward to the island of Saghalin. It is absent, however, from the great elevated plateau of Central Asia, nor does it inhabit Ceylon, Borneo, or the other islands of the Indo-Malayan Archipelago, except those named.

The principal food of the tiger in India is cattle, deer, wild hog, and pea-fowl, and occasionally human beings. The regular "man-eater" is generally an old tiger whose vigour is passed, and whose teeth are worn and defective; it takes up its abode in the neighbourhood of a village, the population of which it finds an easier prey than the larger or wilder animals named above. Though chiefly affecting grassy plains or swamps, it is also found in forests, and seems to be fond of haunting the neighbourhood of old ruins. As a rule, tigers do not climb trees; but when pressed by fear, as during an inundation, they have been known to do so. They take to the water readily and are good swimmers. The tigers of the Sundarbans (Ganges delta) continually swim from one island to the other to change their hunting-grounds for deer. The following extract from Sir J. Fayrer's *Royal Tiger of Bengal* (1875) may complete this notice of the tiger's habits.

"The tigress gives birth to from two to five, even six cubs; but three is a frequent number. She is a most affectionate and attached mother, and generally guards and trains her young with the most watchful solicitude. They remain with her until nearly full-grown, or about the second year, when they are able to kill for themselves and begin life on their own account. Whilst they remain with her she is peculiarly vicious and aggressive, defending them with the greatest courage and energy, and when robbed of them is terrible in her rage; but she has been known to desert them when pressed, and even to eat them when starved. As soon as they begin to require other food than her milk, she kills for them, teaching them to do so for themselves by practising on small animals, such as deer and young calves or pigs. At these times she is wanton and extravagant in her cruelty, killing apparently for the gratification of her ferocious and bloodthirsty nature, and perhaps to excite and instruct the young ones, and it is not until they are thoroughly capable of killing their own food that she separates from them. The young tigers are far more destructive than the old. They will kill three or four cows at a time, whilst the older and more experienced rarely kill more than one, and this at intervals of from three or four days to a week. For this purpose the tiger will leave its retreat in the dense jungle, proceed to the neighbourhood of a village or gowrie, where cattle feed, and during the night will steal on and strike down a bullock, drag it into a secluded place, and then remain near the "murrie," or "kill," for several days, until it has eaten it, when it will proceed in search of a further supply, and, having found good hunting ground in the vicinity of a village or gowrie, continue its ravages, destroying one or two cows or buffaloes a week. It is very fond of the ordinary domestic cattle, which in the plains of India are generally weak, half-starved, under-sized creatures. One of these is easily struck down and carried or dragged off. The smaller buffaloes are also easily disposed of; but the buffalo bulls, and especially the wild ones, are formidable antagonists, and have often been known to beat the tiger off, and even to wound him seriously." (W. H. F.)

TIGER CAT. See Ocelot.

TIGRANES, or Dikran, a name borne by several kings of ancient Armenia. According to the legend of the Armenians, the first of these kings was the Tigranes who in Xenophon's romance appears as the schoolfellow of Cyrus, and to him they ascribe the foundation of Tigranocerta (Dikranagerd) on the Tigris. But in reality, as classical writers relate, this city was built by the first historical Tigranes of Armenia, variously known as Tigranes II. and Tigranes I., for whose history see Persia, vol. xviii. p. 595 *sq.* His son Tigranes is known by his rebellion against his father (Persia, *ut supra*). Tigranes III. (II.), grandson of Tigranes II. (I.), had a short reign, which he owed to a revolution at home and the favour of Augustus. He came to the throne in 20 B.C., having previously been an exile at Rome. Tigranes IV. (III.) was seated on the throne by the Parthians (Persia, p. 600). For Tigranes V. (*c.* 60 A.D.), a great-grandson on his mother's side of Herod the Great, see Persia, vol. xviii. p. 602.

TIGRIS,[1] the shorter of the two large rivers rising in the highlands of Armenia and Kurdistan, and (when turned southward) running each its own independent course to the Persian Gulf. Like the Euphrates, the Tigris rises from two principal sources, of which the western and more distant—in 38° 10′ N. lat. and about 39° 20′ E. long—is a little south of Lake Giuljek, in a peninsula formed by the Euphrates, and some 2 or 3 miles only from the channel of that river. The names and sources of the different streams forming the Western Tigris—or that part of the upper river which runs, roughly speaking, from Diarbekr to the junction with the Eastern Tigris, about 50 miles north-north-west from Jezira Ibn Omar—are given by Consul Taylor as the Arganeh M'adan and the Dibeneh Su, uniting at Ammaneh castle; the Ambar Su, rising at Heyni; the Batman Su, formed by the Kulp, the Kaushan, and the Sarum, rising north and north-west of Nerjiki; and the Khuzu or Huzu and the Arzen-Redhwan or Yezid Khaneh Su. Of the Eastern Tigris the chief tributaries are the Bohtan Su and its feeder the Bitlis (which receives the Keyzer or Shirwan), the Möx, the Shattak, the Chamkari, and the Sarhal Su. Of these the most northerly points may be found on the Kulp or Dibeneh Su about 38° 40′ N. lat. and the most easterly on the Shattak in 42° 50′ E. long.

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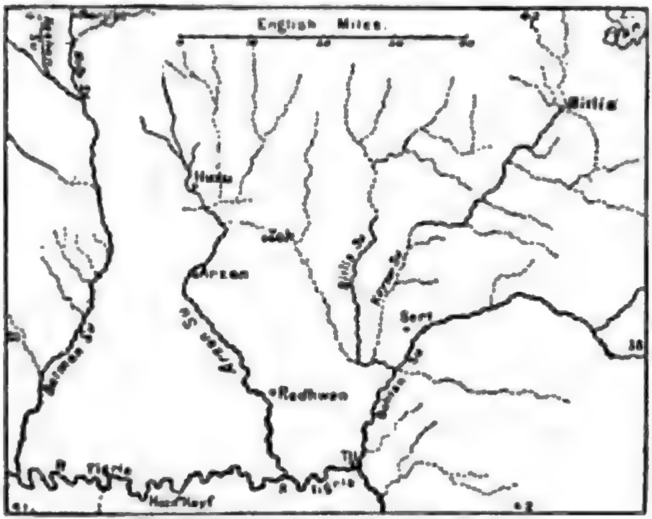
[1] The Tigris is the Hiddekel of the Bible, the Diklat or Idiklat of the cuneiform monuments. The old Persian form Tigrā ("swift as an arrow"), whence Tigris, seems to be connected etymologically with

After the junction of the eastern and western branches (see the accompanying map) the river pursues a winding course, generally south-east, for about 800 miles, *via* Mosul and Baghdad, to the point of union with the Euphrates at Kurna, whence it becomes known as the Shattu 'l-Arab, and falls into the sea some 70 miles farther down. Between Mosul and Baghdad the Tigris receives from its left the Great and the Little Zab and other tributaries from the Kurdish Mountains. Below the confluence of the latter it is joined by the Diyála, also from the left, while on the right canals and watercourses connect it more or less directly with the Euphrates, which in the vicinity of Baghdad it approaches to within 30 or 35 miles. The Tigris is navigable for light freight-bearing steamers up to Baghdad, and for vessels of lighter draught to 20 miles below Mosul, but thence to Diarbekr only for rafts. "But owing to the rapidity of the current the traffic is all down stream, carried on mainly by a primitive style of craft, which is broken up at Baghdad and transported by camels back to Mosul. The journey between these points occupies three or four days during the floods and from twelve to fourteen at other times."



Map showing the tributaries of the Tigris.

TILBURG, or **Tilborg**, a town of Holland, in the province of North Brabant, 13 miles to the east-south-east of Breda, contains numerous and extensive woollen-factories, employing from 5000 to 6000 persons, and also some calico-printing establishments. It has the usual public buildings, including four Roman Catholic churches, a Reformed church, and a synagogue, but none of architectural or historical interest. The population in 1879 was 28,390 and in 1887 32,016.

TILDEN, Samuel Jones (1814-1886), American statesman, was born at New Lebanon, New York, on the 9th of February 1814. He studied at Yale and at the university of New York, but ill-health prevented him from finishing his course. He studied law and rose rapidly to the first rank at the New York bar. From boyhood he had had a fondness for politics, but had sacrificed it to the practice of law. After 1860 he drifted into New York State politics, and became chairman of the Democratic State Committee in 1866. The Tweed "ring" in New York city dreaded him, and in 1869 attempted to remove him from his chairmanship. Tilden then became the soul of the legal attacks upon the "ring," and worked for the removal of the corrupt judges who were their tools; and in the "ring trials" he accomplished the mathematical feat of ascertaining and demonstrating from bank-books the principle on which the spoils had been divided. In 1874 he was elected governor of the State by the Democrats. For years another "ring" had been making money out of the State canals. This, too, Tilden succeeded in breaking up. In 1876 the National Democratic Convention nominated him for the presidency, the Republicans nominating Governor Hayes of Ohio. The result was the disputed election of 1876-77, when each party secured about the same number of electors outside of the three Southern states of Florida, South Carolina, and Louisiana. The Democrats had a majority in these States; but the returning boards, by rejecting votes which they believed had been obtained by fraud or intimidation, gave their States to the Republicans. Two sets of certificates were therefore sent to Washington, and as no provision had been made in the United States constitution for a dispute of this kind there was no power authorized to decide between the two parties. In this emergency Tilden consented to the appointment of an extra-constitutional body, an "electoral commission," to decide disputed cases, the decisions of which were to hold good unless reversed by concurrent vote of the two houses. The commission decided all the cases in favour of the Republican candidates, and Tilden was defeated. He continued in retirement until his death, which took place at Greystone, New York, on 4th August 1886.

TILES (Saxon *tigel*, connected with Lat. *tegula*) are used for a great variety of architectural purposes, such as covering roofs, floors, and walls, and are made of many different materials.

1. *Roofing Tiles.*[1]—In the most important temples of ancient Greece the roof was covered with tiles of white marble, fitted together in the most perfect way so as to exclude the rain. In most cases, as in the Athenian Parthenon and the existing temple at Ægina, the tiles were large slabs of marble, with a flange along each side, over which joint-tiles (ἁρμοί) were accurately fitted (see A in fig. 1). In the temple of Apollo at Bassæ, though the main building was of limestone, the roof was covered with very beautiful tiles of Parian marble, which are specially mentioned by Pausanias as being one of the chief beauties of the temple. Some of these were found by Mr Cockerell during his excavations at Bassæ early in the 19th century.[2] In design they resemble the other examples mentioned

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these names. The modern Arabic name is Dijla (Aramaic Deklath, Digla).

[1] In Egypt and Assyria temples and palaces were mostly roofed with stone, while inferior buildings had flat roofs covered with beaten clay.

[2] See Cockerell, *Temples of Ægina and Bassæ*, London, 1860.

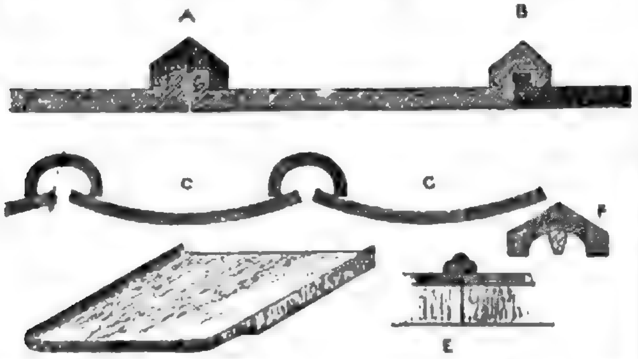

FIG. 1.—Examples of roofing tiles from Greek temples. A, B, marble tiles from Ægina and Bassæ, showing two methods of working the joint-tiles. C, C, clay tiles from Olympia. D, sketch showing method of jointing at the lower edge. E, longitudinal section of a clay joint-tile (ἁρμός). F, joint-tile with peg to fix it.

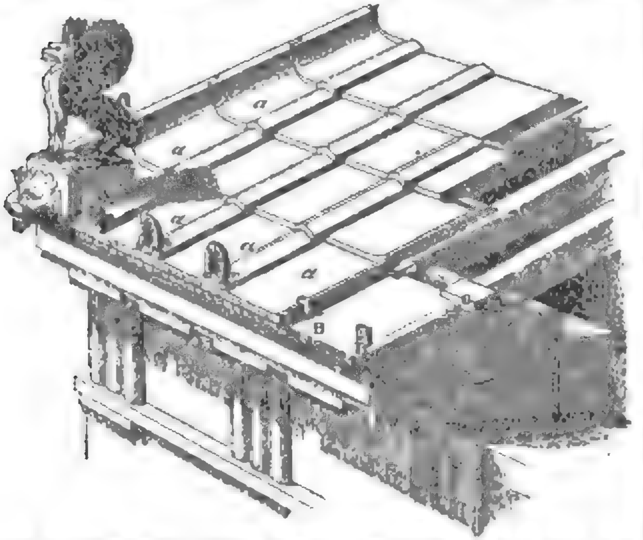

FIG. 2.—Perspective sketch showing the arrangement of tiles B in fig. 1, at Bassæ. B, B, Dowels to fix the joint-tiles. C, tilting piece. a, a, flat surface of tiles.

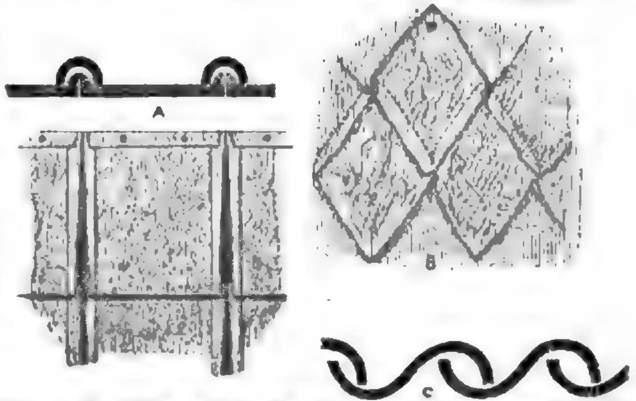

FIG. 3.—A, section and elevation of the clay tiles commonly used in ancient Rome. B, Roman stone tiles, each fixed with one iron nail at the top angle. C, pan-tiles used in mediæval and modern times.

above, but are peculiar in having the joint-piece worked out of the same slab of marble as the adjacent tiles (see B in fig. 1), at a great additional cost of both material and labour, in order to secure a more perfect fit. Fig. 2 shows the way in which they were set on the roof. Great splendour of effect must have been gained by continuing the gleaming white of the columns and walls on to the roof. All along the eaves each end of a row of joint-tiles was usually covered by an *antefixa*, an oval-topped piece of marble with honeysuckle or some other conventional pattern carved in relief.[1] In most cases the Greeks used terra-cotta roofing tiles, shaped like the marble ones of fig. 1, A. Others were without a flange, being formed with a concave upper surface to prevent the rain getting under the joint-tiles. The lower edge of the tile, whether of marble or of clay, was usually half-lapped and fitted into a corresponding rebate in the upper edge of the next tile (see D in fig. 1). The ἁρμοί also were half-lapped at the joints (see E in fig. 1). All these were usually fastened with bronze nails to the rafters of the roof. In some cases each joint-tile had a projecting peg to fix it to the next ἁρμός, as shown at F. In the temples of imperial Rome marble roofing tiles were used like those shown at fig. 1. These were copied from the Greeks along with most other architectural features. For domestic and other less important work clay tiles (*tegulæ*) were employed, of the form shown in A, fig. 3. These are narrower at the lower edge, so as to fit in to the upper edge of the next tile, and the joints were covered with a semicircular joint-tile (*imbrex*). Rows of terra-cotta antefixæ were set along the eaves of the roof, and were often moulded with very beautiful reliefs. In localities which supplied laminated stone, such as Gloucestershire and Hampshire in Britain, the Romans often roofed their buildings with stone tiles, fastened with iron nails. Fig. 3, B, shows an example from a Roman villa at Fifehead Neville in Dorset, England. Each slab had a lap of about 2 inches over the row of tiles below it; many large iron nails were found with these stone tiles. In a few cases, in the most magnificent temples of ancient Rome, as in those of Capitoline Jupiter and of Venus and Rome, and also the small circular temple of Vesta,[2] tiles of thickly gilded bronze were used, which must have had the most magnificent effect. Those of the last-named building are specially mentioned by Pliny (*H.N.*, xxxiv. 7) as having been made of Syracusan bronze,[3]—an alloy in great repute among the Romans. The bronze tiles from the temples of Jupiter Capitolinus and of Venus and Rome were taken by Pope Honorius I. (625-638) to cover the basilica of St Peter, whence they were stolen by the Saracens during their invasion of the Leonine city in 846.[4]

In mediæval times lead or copper[5] in large sheets was used for the chief churches and palaces of Europe; but in more ordinary work clay tiles of very simple form were employed. One variety, still very common in Italy, is shown in C, fig. 3. In this form of so-called "pan-tile" each tile has a double curve, forming a tegula and imbrex both in one. Stone tiles were also very common throughout the Middle Ages. Another kind of roofing tile, largely used in pre-Norman times and for some centuries later for certain purposes, was made of thin pieces of split wood, generally oak; these are called "shingles." They stand the weather fairly well, and many old examples still exist, especially on the wooden towers and spires of East Anglia. At the present day, when slate is not used, tiles of burnt clay are the ordinary roofing material, and many complicated forms have been invented to exclude rain. Most of these are, however, costly and do not answer better than a plain rectangular tile about 9 by 6 inches, fastened with two copper or even stout zinc nails, and well bedded on mortar mixed with hair. For additional security clay tiles are usually made with two small projections at the upper edge, which hook on to the battens to which they are nailed. Broseley (Shropshire) is one of the chief places in England for the manufacture of roofing tiles of the better sort. The common kinds are made wherever good clay exists. In some places pan-tiles are still used and have a very picturesque effect; but they are liable to let in the rain, as they cannot be securely nailed or well bedded in mortar. In Gloucestershire, Yorkshire, and other counties of England, stone tiles are still employed, but are rapidly going out of use, as they require very strong roof-timbers to support them, and the great extension of railways has made the common purple slates cheap in nearly every district.

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[1] Marble tiles are said to have been first made by Byzes of Naxos about 620 B.C.; see Pausanias, v. 10, 2.

[2] The dome of the Pantheon was covered with tiles or plates of bronze thickly gilt, as were also the roofs of the forum of Trajan.

[3] Bronze tiles for small buildings such as this were usually of a pointed oval form, something like the feathers of a bird. This kind of tiling is called *pavonaceum* by Pliny, *H.N.*, xxxvi. 22.

[4] Part of the bronze tiles had been stripped from the temple of Jupiter by the Vandals in 455; see Procopius, *Bell. Van.*, i. 5.

[5] The gilt domes of Moscow are examples of this use of copper.

Some of the mosques and palaces of Persia are roofed with the most magnificent enamelled lustred tiles, decorated with elaborate painting, so that they shine like gold in the sun. They were specially used from the 13th to the 15th century. In style and method of manufacture the finest of them resemble the frieze shown in fig. 5.

2. *Wall Tiles.*—These have been partly described under MURAL DECORATION (vol. xvii. p. 35).[1] In most Oriental countries tiles were used in the most magnificent way throughout the Middle Ages, especially in Damascus, Cairo, Moorish Spain, and in the chief towns of Persia. Fig. 4 shows a fine example from a mosque in Damascus. From the 12th to the 16th century a special kind of lustred tile was largely employed for dadoes, friezes, and other wall surfaces, being frequently made in large slabs and modelled boldly in relief, with sentences from sacred books or the names and dates of reigning caliphs. The whole was picked out in colour, usually dark or turquoise blue, on a ground of cream-white enamel, and in the last firing minute ornaments in copper lustre were added over the whole design, giving the utmost splendour of effect (see fig. 5). Great skill and taste are shown by the way in which the delicate painted enrichments are made to contrast with the bold decoration in relief. These lustred tiles sometimes line the prayer-niche in houses and mosques; in such cases the slabs usually have a conventional representation of the kaaba at Mecca, with a lamp hanging in front of it and a border of sentences from the Koran.[2] The mosques of Persia are specially rich in this method of decoration, magnificent examples existing at Natenz, Seljuk, Tabriz, Ispahan, and other places.[3] In the 16th and 17th centuries tiles of a coarse kind of majolica were used for wall decoration in southern Spain; some rich examples still exist in Seville. These appear to be the work of Italian potters who had settled in Spain. The *azulejos* (wall tiles) in the Alhambra and other buildings in Spain are among the most beautiful productions of Hispano-Moorish art.[4] In technique they resemble majolica; but the finest kinds, dating from the 14th and 15th centuries, have designs taken from mosaic patterns, with complicated lines of geometrical interlacings.[5]

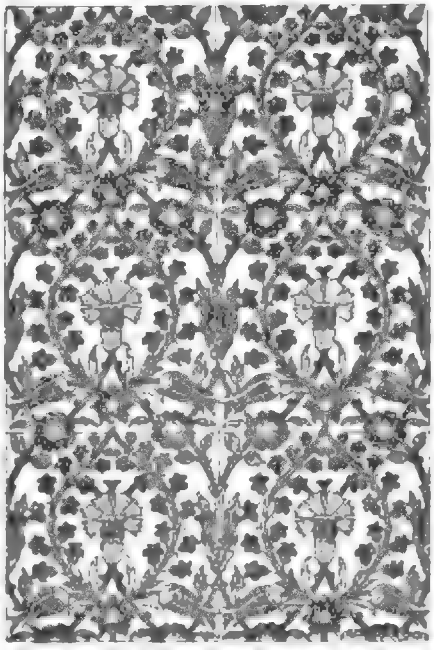

FIG. 4.—Wall tiles from Damascus, of the 16th century.

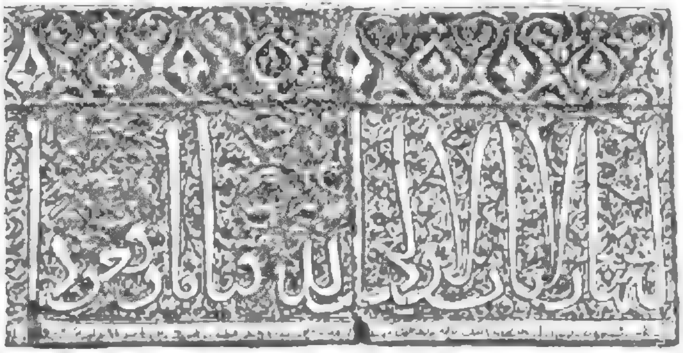

FIG. 5.—Persian lustred tiles of the 13th century, forming part of a frieze. (South Kensington Museum.)

3. *Floor Tiles.*—From the 12th to the 16th century floor tiles in most northern countries of Europe were made by filling up with clay of a different colour patterns sunk in slabs of clay (see ENCAUSTIC TILES). In Italy, during the latter part of the 15th and the first half of the 16th century, majolica tiles, rich both in pattern and in colour, were used for pavements in many places. Comparatively few examples now exist; the majolica enamel was too soft to stand the wear of feet. One of the small south chapels in the church of S. Maria del Popolo in Rome has a very fine pavement of these tiles, executed, probably at Forli, about 1480 for Cardinal della Rovere (Julius II.), whose arms—an oak tree—are repeated frequently among the rich decorations. A still more magnificent tile floor in the uppermost of Raphael's Vatican loggie is mentioned under ROBBIA (vol. xx. p. 591). The same article (p. 589) describes the exquisite majolica tiles which Luca della Robbia made as a border for the tomb of Bishop Federighi at Florence. Fine examples of tile paving of 1487 exist in the basilica of S. Petronio at Bologna, and others of

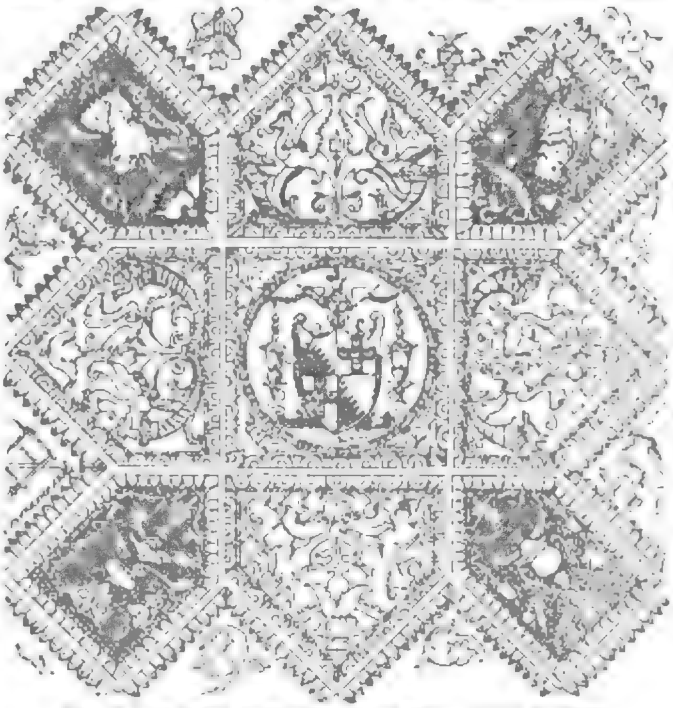

FIG. 6.—Majolica paving tiles from Siena, made in 1509. (South Kensington Museum.)

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[1] For the enamelled wall tiles of ancient Egypt, see POTTERY, vol. xix. p. 603.

[2] The South Kensington Museum, London, contains many fine examples, as well as of the later sorts, like those shown in fig. 4.

[3] See Coste, *Monuments de la Perse*, Paris, 1867.

[4] The method of manufacture employed by Moslem races for tiles is the same as that used for their pottery; see vol. xix. p. 620, also MURAL DECORATION, vol. xvii. pp. 35-36.

[5] For the decorative use of tiles, see Julien Foy, *La Céramique des Constructions*, Paris, 1883.

rather earlier date in S. Paolo at Parma. The chapel of St Catherine at Siena and the church of S. Sebastiano at Venice have majolica paving of about 1510. Fig. 6 shows an example of about this date from the Petrucci Palace in Siena, now in the South Kensington Museum.[1] In the early part of the 16th century majolica tiles from Spain were occasionally imported into England. At the south-east of the mayor's chapel at Bristol there exists, though much worn, a fine pavement of Spanish tiles dating from about 1520. Others have been found in London, at Newington Butts, and in other places. At the present time imitations of the unfortunately named "encaustic tiles" are almost the only sort employed in England and other northern countries. Very coarse and poorly designed majolica tiles are still made and used for paving in Italy and Spain. (J. H. M.)

TILLEMONT, SÉBASTIEN LE NAIN DE (1637-1698), ecclesiastical historian, was born at Paris on 30th November 1637, and received his education in the "petites écoles" of the Port Royalists, Nicole being his principal master. At an early age he became an admiring student of Livy and Baronius and began to accumulate those vast collections which form the basis of his monumental works. He continued to carry on his studies in the seminary at Beauvais, where the bishop was a warm patron; but it was not until 1676, two or three years after his return to Paris, that, under the influence of Isaac de Sacy, he entered the priesthood. He took up his abode in a humble dwelling at Port Royal des Champs, where he remained till the dispersion of the "solitaires" in 1679, after which event he spent the remainder of his life (with the exception of a visit to Arnauld in Holland in 1685) at Tillemont, between Montreuil and Vincennes. He died on 28th January 1698 and was buried at Port Royal; in 1711 his remains were removed to the church of St André des Arcs, Paris.

His great work, *Mémoires pour servir à l'histoire ecclésiastique des six premiers siècles* to 513 A.D. (1693-1712, 16 vols., 4to), is a model of patient, exhaustive, and what Gibbon has called "sure-footed" erudition (see vol. v. p. 765). Of his equally learned *Histoire des empereurs et des autres princes qui ont régné durant les six premiers siècles de l'église* (1690-1738, 4to) no more than four volumes were published. Tillemont also gave valuable assistance to Hermant, Du Fossé, and other Port Royalists in their historical work.

TILLOTSON, JOHN (1630-1694), archbishop of Canterbury, was the son of a Puritan clothier in Sowerby, Yorkshire, where he was born in October 1630. He entered as a pensioner of Clare Hall, Cambridge, in 1647, graduated in 1650, and was made fellow of his college in 1651. Chillingworth's *Religion of Protestantism* biassed his mind against Puritanism, and the bias was further confirmed by intercourse with Cudworth and others at Cambridge. In 1656 he became tutor to the son of Edward Prideaux, attorney-general to Cromwell. In what year he took orders is unknown, but, according to the *Life* published in 1717, the person who ordained him was Dr T. Sydserf, a Scottish bishop. Tillotson was present at the Savoy Conference in 1661, and remained identified with the Presbyterians till the passing of the Act of Uniformity in 1662. Shortly afterwards he became curate of Cheshunt, Herts, and in June 1663 rector of Keddington, Suffolk. For several years after his ordination he devoted himself to an exact study of the Scriptures, ancient ethics, and the writings of the early fathers, especially Basil and Chrysostom. The result was seen in the general tone of his preaching, which was practical rather than theological, and, though regarded by some as latitudinarian, was characterized by the earnestness of sincere conviction and the balanced wisdom gained by thoughtful reflexion. He was, moreover, a man of the world as well as a divine, and in his sermons he exhibited a certain indefinable tact which enabled him at once to win the ear of his audience. His style is chiefly remarkable for its simplicity and clearness, and in this respect it mirrored his own candour and sincerity. The qualities above mentioned won him in his lifetime the reputation of "having brought preaching to perfection"; and probably it was because he was neither brilliant, original, nor profound that his preaching was so universally admired. "His sermons," says Burnet, "were so well heard and liked, and so much read, that all the nation proposed him as a pattern and studied to copy after him." In 1664 he became preacher at Lincoln's Inn. The same year he married Miss French, daughter of the canon of Christ Church, Oxford, and niece of Oliver Cromwell; and he also became Tuesday lecturer at St Lawrence, Jewry. Tillotson employed his controversial weapons with some skill against "atheism" and "Popery." In 1663 he published a characteristic sermon on "The Wisdom of being Religious," and in 1666 replied to Sergeant's *Sure Footing in Christianity* by a pamphlet on the *Rule of Faith*. The same year he received the degree of D.D. In 1670 he became prebendary and in 1672 dean of Canterbury. Through his wife Tillotson became connected with Dr Wilkins, the second husband of her mother. In 1675 he edited Wilkins's *Principles of Natural Religion*, completing what was left unfinished of it, and in 1682 his *Sermons*, with a preface in which he vindicated Wilkins from certain misrepresentations of Wood in his *History and Antiquities of the University of Oxford*. In 1680 he brought out Barrow's *Treatise of the Pope's Supremacy*, and in 1683 his *Sermons*. On 5th November 1678 Tillotson preached a sermon against Popery before the House of Commons, in which he maintained that it was their duty to make provision against the propagation of a religion more mischievous than irreligion itself; but in a sermon on the Protestant religion in 1680 before the king he propounded the proposition that Catholics could enjoy their own faith, but not openly draw men off from the profession of the established religion. Along with Burnet, Tillotson attended Lord Russell on the scaffold in 1683, and after the publication of Lord Russell's speech was appointed to appear before the privy council; but his explanations were regarded as satisfactory, the chief suspicions in connexion with the speech resting on Burnet. Tillotson afterwards enjoyed the friendship of Lady Russell, and it was partly through her that he obtained so much influence with Princess Anne, who followed his advice in regard to the settlement of the crown on William of Orange. He possessed the special confidence of William and Mary, and was made clerk of the closet to the king, 27th March 1689. It was chiefly through his advice that the king appointed an ecclesiastical commission for the reconciliation of the Dissenters, and he was regarded as the representative in the commission of the views of the king and queen. In August of this year he was appointed by the chapter of his cathedral to exercise the archiepiscopal jurisdiction of the province of Canterbury during the suspension of Sancroft. He was also about the same time named dean of St Paul's. Soon afterwards he was elected to succeed Sancroft; but he accepted the promotion with extreme reluctance, and it was deferred from time to time at his request till April 1691. His attempts to reform certain abuses of the church, especially that of non-residence among the clergy, awakened against him much ill-will, and of this the Jacobites took every possible advantage and pursued him to the end of his life with insult and reproach. "This," Burnet says, "could neither provoke him, nor fright him from his duty; but it affected his mind so much that this was thought to have shortened his days." He died of palsy on 24th November 1694.

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[1] See Vanzolini, *Fabbriche di Maioliche*, Pesaro, 1879, ii. p. 229 *sq.*; and Frati, *Pavimento nella Bas. Petroniana*, Bologna, 1853.

For his manuscript sermons Tillotson's widow received 2500 guineas, then an unexampled sum, and for many years their popularity remained unrivalled. During his lifetime he published *Sermons on Several Occasions*, 1671, republished with a second volume added in 1678; *Fifty Sermons and the Rule of Faith*, 1691; *Four Sermons concerning the Divinity and Incarnation of our Blessed Saviour*, 1693; *Six Sermons on Several Occasions*, 1694. His *Posthumous Sermons*, edited by Dr Ralph Baker, appeared in 14 vols., 1694; third edition, 1704. His *Works* were published in 1707-1710, and were frequently reprinted. In 1752 an edition appeared in 3 vols. with *Life* by Thomas Birch, D.D., compiled from Tillotson's original papers and letters. Of the many subsequent editions the best is that, with *Life* by Birch, of 1820, 10 vols. Various selections from his sermons and works have been published separately.

See in addition to Birch's *Life*, Welford's *Memorials*, Burnet's *Own Times*, and Macaulay's *History of England*.

TILLY, Johann Tserclaes, Count of (1559-1632), a famous general, was born in February 1559 at the chateau of Tilly in Brabant. It was originally intended that he should become a priest, and he was strictly educated by the Jesuits. He preferred, however, the life of a soldier, and began his military career in the Netherlands, under Alessandro Farnese, in the Spanish service. Afterwards he joined the imperial army, and as lieutenant-colonel under Duke Philip Emmanuel of Lorraine greatly distinguished himself in Hungary in the war against the Turks. For his brilliant achievements he was raised to the rank of field-marshal. In 1610 he was put by Maximilian I. at the head of his Bavarian army; and soon after the outbreak of the Thirty Years' War he was made commander-in-chief of the troops of the Catholic League. In this position he displayed qualities which placed him among the foremost generals of the age. After the battle of Prague (the White Hill) in 1620 he thoroughly subdued Bohemia, and in 1622 conquered the Palatinate,—a service for which Ferdinand II. gave him the title of count. In 1623 he defeated Christian of Brunswick at Stadtlohn in Westphalia, and in 1626 Christian IV. of Denmark at Lutter in Brunswick. The consequence of the latter victory was that Tilly and Wallenstein were able to cross the Elbe; but, as Tilly was wounded before Pinneberg in Schleswig-Holstein, the task of finally compelling the king of Denmark to accept terms of peace had to be left to Wallenstein alone. When Wallenstein was obliged in 1630 to withdraw for a while into private life, Tilly added to the functions he already discharged those of commander of the imperial forces. From this time the only important success achieved by him was the storming of Magdeburg (May 1631), a success accompanied by frightful cruelties, for which he was at least in part responsible. Gustavus Adolphus had now come forward as the champion of Protestantism, and Tilly, with all his genius and tenacity, was not a match for the Swedish king. Four months after the capture of Magdeburg Tilly was defeated at Breitenfeld in Saxony, and was himself so severely wounded that he escaped from the field with difficulty. In March 1632 he drove the Swedes from Bamberg and placed himself in an entrenched camp at Rain to prevent them from passing over the Lech. Gustavus Adolphus crossed the stream, and in the fight which ensued Tilly was mortally wounded. He died in April 1632 at Ingolstadt, and was buried at Alt-Oetting in Bavaria.

Tilly was of medium height, reserved in manner, and wholly indifferent to external marks of honour. The Roman Church never had a more devoted servant, and he gave evidence of the essential simplicity of his character by declining the offer of the emperor to make him a prince and to grant to him the principality of Calenberg. As he was not married, his title and estates descended to his nephew.

See Klopp, *Tilly im dreissigjährigen Kriege*, Stuttgart, 1861, and Villermont, *Tilly*, Tournay, 1859.

TILSIT, a commercial town of East Prussia and the capital of Prussian Lithuania, is situated on the left bank of the Memel or Niemen, 52 miles south-east of the town of Memel and 60 north-east of Königsberg. The town is spacious, and has a number of handsome modern buildings, including a town-house, post-office, law-courts, and a large hospital. It contains three Protestant churches, a Roman Catholic church, and a Jewish synagogue. The manufactures include soap, leather, shoes, glass, and other articles, and there are iron-foundries and steam flour and saw mills. Tilsit carries on trade in timber, grain, hemp, flax, herrings, and other northern produce; but its trade with Russia, at one time considerable, has fallen off since the construction of the railway from Königsberg *via* Insterburg and Gumbinnen to Kovno. The river is navigable beyond the town. The market-gardening of the neighbourhood deserves mention, and the annual horse-fair and markets are of considerable local importance. In 1783 the population was 8060; in 188[illegible] it had increased to 21,400, and in 1885 to 22,42[illegible].

Tilsit, which received town-rights in 1552, grew up around a castle of the Teutonic order, known as the "Schalauner Haus," founded in 1288. It owes most of its interest to the peace signed here on 9th July 1807, the preliminaries of which were settled by the emperors Alexander and Napoleon on a raft moored in the Memel. The peace of Tilsit, which constituted the kingdom of Westphalia and the duchy of Warsaw, registers the nadir of Prussia's humiliation under Napoleon (see Prussia, vol. xx. p. 11). The poet Max von Schenkendorf (1784-1817) was born at Tilsit.

TIMBER. See Building, Forests, and Strength of Materials; also Fir, Oak, Pine, Teak, &c.

TIMBUKTU, or Timbuctoo (Sonrhai, *Timbutu*; Berber, *Tumbutku*; Arab, *Tin-buktu*), a city of the Sahara, on the southern verge of the desert, in 18° 4′ N. lat. and 1° 45′ W. long., at the north-east extremity of the Fulah state of Moassina (Massina), 9 miles north of its riverine port Kabara, on the left bank of the Niger, at the confluence of the numerous branches of the Joliba (upper Niger) where it trends eastwards, and at the converging point of the main trade routes from the Gulf of Guinea and from the Mediterranean across the western Sahara. Timbuktu lies on a terrace formed by the southern scarp of the desert, about 800 feet above sea-level, and overlooking a chain of *dhayas* or marshy hollows, fringed here and there with a few mimosas and palm thickets, amid the surrounding sandy wastes. These dhayas, which are flooded every three or four years, converting the lowland tracts between the terrace and the main stream into a labyrinth of channels and backwaters, mark the bed of a navigable creek which formerly branched from the Niger northwards to the foot of the scarp, and which in 1640 inundated a low-lying quarter of the city. According to Pouyanne and Sabatier, the main stream followed this course before it took its present easterly curve to Burum, where it bends southwards to the coast. Here also it was probably joined at some remote period by the now dried up Wady Messaura from the Tuát oases south of Algeria, although the rough levels taken by Oscar Lenz and others make it uncertain whether the flow through this depression was northwards or southwards. In any case Timbuktu has been left, so to say, high and dry by the general process of desiccation going on throughout the Saharian region. It was founded, or more probably captured, by the Tuareg Berbers about the 11th century, and under the Mandingo kings of Mali (Mallé) was a noted mart for gold and salt in the 14th century, mention of "Timboutch" occurring on a Catalan map dated 1373. Under Askia, founder of the extensive but short-lived Sonrhai empire (1492), it rose to great splendour and became with Gogo a chief centre of Mohammedan culture for the peoples of western Sudan. But since the overthrow (1591) of the Sonrhai dynasty by the Morocco captain, the Andalusian Jodar with his Ruma followers, Timbuktu has continued to be the prey of the surrounding unruly populations—Tuaregs, Arabs or Arabized Berbers, Fulahs (1800), and Toucouleurs (1865). Being thus at the mercy of all, it has ceased to rebuild its dismantled walls, being content to pay tribute to each in turn and sometimes to more than one simultaneously, for which it indemnifies itself by peaceful intervals of trade whenever the land routes are open and the upper and lower reaches of the Niger are clear of pirates. But at times even the short tract separating it from Kabara is so beset with marauders that it bears the ominous name of "Ur-immandess," that is, "He (God) hears not." Recently, however, it has enjoyed a considerable interval of peace, and the population, estimated by Barth at 11,000 in 1853, had risen to 20,000 in 1880 (Lenz). These form a motley group of Sonrhais, Tuaregs, Mandingoes, Arabs from Morocco, Berabish Arabs, Bambaras, Fulahs, and since 1850 a few Jewish traders. Apart from some Christian captives, the place was reached during the 19th century by only four Europeans—Laing from Tripolitana (1826), who was murdered on his return journey, Caillié from the north (1828), Barth from central Sudan (1853), and Lenz from Morocco (1880). Since 1884, however, regular relations have been opened with the French on the upper Niger.

From the ruins covering extensive tracts on the north and west sides, it is evident that Timbuktu was formerly a much larger place than at present. Even the great mosque, which must at one time have stood in the centre, now lies near the outskirts, where its high but unsightly earth tower forms a striking landmark. The aggregate of mean hovels or mud houses of which the place consists is only relieved by a few structures of a better class. As in former times, a great staple of trade is salt from Taudeni and other parts of the Sahara, here exchanged with gold dust for kola nuts from the south, Manchester goods, and some other European wares, which with tea are imported from Morocco or penetrate from the British protected territories along the lower Niger. Cowries, slowly yielding to European moneys, are the chief currency. The local industries are mainly confined to some fancy and other leatherwork prepared by the Tuareg women. The local administration is in the hands of an hereditary *kahia*, a kind of mayor, descended from one of the Ruma families. The kahia is himself more or less under the control of a neighbouring Tuareg chief and of the powerful Bakhai family, who, as "sherifs" and marabouts, are revered throughout the western Sahara. Timbuktu, which possesses some valuable Arabic manuscripts and is still a centre of Moslem teaching, is a converging point of the chief west Sudanese and Saharan races—Arabs or Arabized Berbers to the west; Sonrhais in the immediate vicinity, and thence south-eastwards along the Niger; Ireghenaten or "mixed" Tuaregs southwards across the Niger as far as the Hombori Hills and in the fertile Libbako plains beyond them; Fulahs, Mandingoes, and Bambaras in and about the city; and Imóhag or Imósharh Tuaregs belonging to the Awellimiden confederation mainly to the north and east.

TIME, Measurement of. Time is measured by successive phenomena recurring at regular intervals. The only astronomical phenomenon which rigorously fulfils this condition, and the most striking one,—the apparent daily revolution of the celestial sphere caused by the rotation of the earth,—has from the remotest antiquity been employed as a measure of time. The interval between two successive returns of a fixed point on the sphere to the meridian is called the sidereal day; and sidereal time is reckoned from the moment when the "first point of Aries" (the vernal equinox) passes the meridian, the hours being counted from 0 to 24. Clocks and chronometers regulated to sidereal time are only used by astronomers, to whom they are indispensable, as the sidereal time at any moment is equal to the right ascension of any star just then passing the meridian. For ordinary purposes solar time is used. In the article Astronomy (vol. ii. p. 771) it is shown that the solar day, as defined by the successive returns of the sun to the meridian, does not furnish a uniform measure of time, owing to the slightly variable velocity of the sun's motion and the inclination of its orbit to the equator, so that it becomes necessary to introduce an imaginary mean sun moving in the equator with uniform velocity. The equation of time (*loc. cit.*, pp. 772-773) is the difference between apparent (or true) solar time and mean solar time. The latter is that shown by clocks and watches used for ordinary purposes. Mean time is converted into apparent time by applying the equation of time with its proper sign, as given in the *Nautical Almanac* and other ephemerides for every day at noon. As the equation varies from day to day, it is necessary to take this into account, if the apparent time is required for any moment different from noon. The ephemerides also give the sidereal time at mean noon, from which it is easy to find the sidereal time at any moment, as 24 hours of mean solar time are equal to $24^h\ 3^m\ 56^s{\cdot}5554$ of sidereal time. About 21st March of each year a sidereal clock agrees with a mean-time clock, but it gains on the latter $3^m\ 56^s{\cdot}5$ every day, so that in the course of a year it has gained a whole day. For a place not on the meridian of Greenwich the sidereal time at noon must be corrected by the addition or subtraction of $9^s{\cdot}8565$ for each hour of longitude, according as the place is west or east of Greenwich.

While it has for obvious reasons become customary in all civilized countries to commence the ordinary or civil day at midnight, astronomers count the day from noon, being the transit of the mean sun across the meridian, in strict conformity with the rule as to the beginning of the sidereal day. The hours of the astronomical day are also counted from 0 to 24. An international conference which met in the autumn of 1884 at Washington, to consider the question of introducing a universal day (see below), has recommended that the astronomical day should commence at midnight, to make it coincide with the civil day. The great majority of American and Continental astronomers have, however, expressed themselves very strongly against this change; and, even if it should be made in the *British Nautical Almanac*, it appears very doubtful whether the other great ephemerides will adopt it, the more so as astronomers have hitherto felt no inconvenience from the difference between the astronomical and the civil day.

Determination of Time.—The problem of determining the exact time at any moment is practically identical with that of determining the apparent position of any known point on the celestial sphere with regard to one of the fixed (imaginary) great circles appertaining to the observer's station, the meridian or the horizon. The point selected is either the sun or one of the standard stars, the places of which are accurately determined and given for every tenth day in the modern ephemerides. The time thus determined furnishes the *error* of the clock, chronometer, or watch employed, and a second determination of time after an interval gives a new value of the error and thereby the *rate* of the timekeeper.

The ancient astronomers, although they have left us very ample information about their dials, water or sand clocks (*clepsydræ*), and similar timekeepers, are very reticent as to how these were controlled. Ptolemy, in his *Almagest*, states nothing whatever as to how the time was found when the numerous astronomical phenomena which he records took place; but Hipparchus in the only book we possess from his hand gives a list of forty-four stars scattered over the sky at intervals of right ascension equal to exactly one hour, so that one or more of them would be on the meridian at the commencement of every sidereal hour. In a very valuable paper[1] Schjellerup has shown that the right ascensions assumed by Hipparchus agree within about 15′ or one minute of time with those calculated back to the year 140 B.C. from modern star-places and proper motions. The accuracy which, it thus appears, could be attained by the ancients in their determinations of time was far beyond what they seem to have considered necessary, as they only record astronomical phenomena (*e.g.*, eclipses, occultations) as having occurred "towards the middle of the third hour," or "about 8½ hours of the night," without ever giving minutes.[1] The Arabians had a clearer perception of the importance of knowing the accurate time of phenomena, and in the year 829 we find it stated that at the commencement of the solar eclipse on 30th November the altitude of the sun was 7° and at the end 24°, as observed at Baghdad by Ahmed ibn Abdallah, called Habash.[2] This seems to be the earliest determination of time by an altitude; and this method then came into general use among the Arabians, who on observing lunar eclipses never failed to measure the altitude of some bright star at the beginning and end of the eclipse. In Europe this method was adopted by Purbach and Regiomontanus, apparently for the first time in 1457. Bernhard Walther, a pupil of the latter, seems to have been the first to use for scientific purposes clocks driven by weights: he states that on 16th January 1484 he observed the rising of the planet Mercury and immediately attached the weight to a clock having an hour-wheel with fifty-six teeth; at sunrise one hour and thirty-five teeth had passed, so that the interval was an hour and thirty-seven minutes. For nearly two hundred years, until the application of the pendulum to clocks became general, astronomers could place little or no reliance on their clocks, and consequently it was always necessary to fix the moment of an observation by a simultaneous time determination. For this purpose Tycho Brahe employed altitudes observed with quadrants; but he remarks that they are not always of value, for if the star is taken too near the meridian the altitude varies too slowly, and if too near the horizon the refraction (which at that time was very imperfectly known) introduces an element of uncertainty. He therefore preferred azimuths, or with the large "armillary spheres" which played so important a part among his instruments he measured hour-angles or distances from the meridian along the equator.[3] Transits of stars across the meridian were also observed with the meridian quadrant, an instrument which is alluded to by Ptolemy and was certainly in use at the Marágha (Persia) observatory in the 13th century, but of which Tycho was the first to make extensive use. It appears, however, that he chiefly employed it for determining star-places, having obtained the clock error by the methods already described.

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[1] "Recherches sur l'Astronomie des Anciens: I. Sur le chronomètre céleste d'Hipparque," in *Copernicus: An International Journal of Astronomy*, i. p. 25.

In addition to these methods, that of "equal altitudes" was much in use during the 17th century. That equal distances east and west of the meridian correspond to equal altitudes had of course been known as long as sun-dials had been used, but, now that quadrants, cross-staves, and parallactic rules[4] were commonly employed for measuring altitudes more accurately, the idea naturally suggested itself to determine the time of a star's or the sun's meridian passage by noting the moments when it reached any particular altitude on both sides of the meridian. But Tycho's plan of an instrument fixed in the meridian was not forgotten, and from the end of the 17th century, when Roemer invented the transit instrument, the observation of transits across the meridian became the principal means of determining time at fixed observatories, while the observation of altitudes, first by portable quadrants, afterwards by reflecting sextants, and during the 19th century by portable alt-azimuths or theodolites, has been used on journeys. During the last fifty years the small transit instrument, with what is known as a "broken telescope," has also been much employed on scientific expeditions; but great caution is necessary in using it, as the difficulties of getting a perfectly rigid mounting for the prism or mirror which reflects the rays from the object-glass through the axis to the eyepiece appear to be very great, for strange discrepancies in the results have often been noticed. The gradual development of astronomical instruments has been accompanied by a corresponding development in timekeepers. From being very untrustworthy, astronomical clocks are now made to great perfection by the application of the pendulum and by its compensation, while the invention of chronometers has placed a portable and equally trustworthy timekeeper in the hands of travellers.

We shall now give a sketch of the principal methods of determining time.

In the spherical triangle ZPS between the zenith, the pole, and a star the side $ZP=90°-\phi$ (ϕ being the latitude), $PS=90°-\delta$ (δ being the declination), and ZS or $Z=90°$ minus the observed altitude. The angle $ZPS=t$ is the star's hour-angle or, in time, the interval between the moment of observation and the meridian passage of the star. We have then

$$\cos t=\frac{\cos Z-\sin\phi\sin\delta}{\cos\phi\cos\delta},$$

which formula can be made more convenient for the use of logarithms by putting $Z+\phi+\delta=2S$, which gives

$$\tan^2\tfrac{1}{2}t=\frac{\sin(S-\phi)\sin(S-\delta)}{\cos S\cos(S-Z)}.$$

According as the star was observed west or east of the meridian, t will be positive or negative. If a be the right ascension of the star, the sidereal time $=t\mp a$, a as well as δ being taken from an ephemeris. If the sun had been observed, the hour-angle t would be the apparent solar time. The altitude observed must be corrected for refraction, and in the case of the sun also for parallax, while the sun's semi-diameter must be added or subtracted, according as the lower or upper limb was observed. The declination of the sun being variable, and being given in the ephemerides for noon of each day, allowance must be made for this by interpolating with an approximate value of the time. As the altitude changes very slowly near the meridian, this method is most advantageous if the star be taken near the prime vertical, while it is also easy to see that the greater the latitude the more uncertain the result. If a number of altitudes of the same object are observed, it is not necessary to deduce the clock error separately from each observation, but a correction may be applied to the mean of the zenith distances. Supposing n observations to be taken at the moments $T_1, T_2, T_3, \ldots$, the mean of all being T_0, and calling the z corresponding to this Z, we have

$$z_1=Z+\frac{dZ}{dt}(T_1-T_0)+\frac{1}{2}\frac{d^2Z}{dt^2}(T_1-T_0)^2;$$

$$z_2=Z+\frac{dZ}{dt}(T_2-T_0)+\frac{1}{2}\frac{d^2Z}{dt^2}(T_2-T_0)^2;$$

and so on, t being the hour-angle answering to T_0. As $\Sigma(T-T_0)=0$, these equations give

$$Z=\frac{z_1+z_2+z_3+\ldots}{n}-\frac{1}{2}\frac{d^2Z}{dt^2}\frac{(T_1-T_0)^2+(T_2-T_0)^2+\ldots}{n};$$

$$=\frac{z_1+z_2+z_3+\ldots}{n}-\frac{d^2Z}{dt^2}\frac{\Sigma 2\sin^2\frac{1}{2}(T-T_0)}{n}.$$

But, if in the above-mentioned triangle we designate the angles at Z and S by $180°-A$ and p, we have

$$\sin z\sin A=\cos\delta\sin t;$$
$$\sin z\cos A=-\cos\phi\sin\delta+\sin\phi\cos\delta\cos t;$$

and by differentiation

$$\frac{d^2Z}{dt^2}=\frac{\cos\phi\cos\delta\cos A\cos p}{\sin Z},$$

in which A and p are determined by

$$\sin A=\frac{\sin t}{\sin Z}\cos\delta \text{ and } \sin p=\frac{\sin t}{\sin Z}\cos\phi.$$

With this corrected mean of the observed zenith distances the hour-angle and time are determined, and by comparison with T_0 the error of the timekeeper.

The method of equal altitudes gives very simply the clock error equal to the right ascension minus half the sum of the clock times corresponding to the observed equal altitudes on both sides of the meridian. When the sun is observed, a correction has to be applied for the change of declination in the interval between the observations. Calling this interval $2t$, the correction to the apparent noon given by the observations x, the change of declination in half the interval $\Delta\delta$, and the observed altitude h, we have

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[1] For astronomical purposes the ancients made use of mean-time hours—*ὧραι ἰσημεριναί*, *horæ equinoctiales*—into which they translated all indications expressed in civil hours of varying length—*ὧραι καιρικαί*, *horæ temporales*. Ptolemy counts the mean day from noon.

[2] Caussin, *Le livre de la grande table Hakémite*, Paris, 1804, p. 100.

[3] See his *Epistolæ astronomicæ*, p. 73.

[4] See NAVIGATION, vol. xvii. pp. 251 and 253.

$$\sin h = \sin\phi \sin(\delta - \Delta\delta) + \cos\phi \cos(\delta - \Delta\delta) \cos(t + x)$$

and

$$\sin h = \sin\phi \sin(\delta + \Delta\delta) + \cos\phi \cos(\delta + \Delta\delta) \cos(t - x),$$

whence, as $\cos x$ may be put $= 1$, $\sin x = x$, and $\tan \Delta\delta = \Delta\delta$,

$$x = -\left(\frac{\tan\phi}{\sin t} - \frac{\tan\delta}{\tan t}\right)\Delta\delta,$$

which, divided by 15, gives the required correction in seconds of time. Similarly an afternoon observation may be combined with an observation made the following morning to find the time of apparent midnight.

The observation of the time when a star has a certain azimuth may also be used for determining the clock error, as the hour-angle can be found from the declination, the latitude, and the azimuth. As the azimuth changes most rapidly at the meridian, the observation is most advantageous there, besides which it is neither necessary to know the latitude nor the declination accurately. In the article GEODESY (vol. x. p. 166) it has been shown how the observed time of transit over the meridian is corrected for the deviations of the instrument in azimuth, level, and collimation. This corrected time of transit, expressed in sidereal time, should then be equal to the right ascension of the object observed, and the difference is the clock error. In observatories the determination of a clock's error (a necessary operation during a night's work with a transit circle) is generally founded on observations of four or five "clock stars," these being standard stars not near the pole, of which the absolute right ascensions have been determined with great care, besides observation of a close circumpolar star for finding the error of azimuth and determination of level and collimation error.[1]

Observers in the field with portable instruments often find it inconvenient to wait for the meridian transits of one of the few close circumpolar stars given in the ephemerides. In that case they have recourse to what is known as the method of time determination in the vertical of a pole star. The alt-azimuth is first directed to one of the standard stars near the pole, such as α or δ Ursæ Minoris, using whichever is nearest to the meridian at the time. The instrument is set so that the star in a few minutes will cross the middle vertical wire in the field. The spirit-level is in the meantime put on the axis and the inclination of the latter measured. The time of the transit of the star is then observed, after which the instrument, remaining clamped in azimuth, is turned to a clock star and the transit of this over all the wires is observed. The level is applied again, and the mean of the two results is used in the reductions. In case the collimation error of the instrument is not accurately known, the instrument should be reversed and another observation of the same kind taken. The observations made in each position of the instrument are separately reduced with an assumed approximate value of the error of collimation, and two equations are thus derived from which the clock error and correction to the assumed collimation error are found. This use of the transit or alt-azimuth out of the meridian throws considerably more work on the computer than the meridian observations do, and it is therefore never resorted to except when an observer during field operations is pressed for time. The formulæ of reduction as developed by Hansen in the *Astronomische Nachrichten* (vol. xlviii. p. 113 *sq.*) are given by Chauvenet in his *Spherical and Practical Astronomy* (vol. ii. pp. 216 *sq.*, 4th ed., Philadelphia, 1873). The subject has also been treated at great length by Dollen in two memoirs, *Die Zeitbestimmung vermittelst des tragbaren Durchgangsinstrument im Verticale des Polarsterns* (St Petersburg, 1863 and 1874, 4to).

Longitude.—Hitherto we have only spoken of the determination of local time. But in order to compare observations made at different places on the surface of the earth a knowledge of their difference of longitude becomes necessary, as the local time varies proportionally with the longitude, one hour corresponding to 15°. Longitude can be determined either geodetically or astronomically. The first method supposes the earth to be a spheroid of known dimensions. Starting from a point of departure of which the latitude has been determined, the azimuth from the meridian (as determined astronomically) and the distance of some other station are measured. This second station then serves as a point of departure to a third, and by repeating this process the longitude and latitude of places at a considerable distance from the original starting-point may be found. Referring for this method to the articles EARTH (FIGURE OF THE), GEODESY, and SURVEYING, we shall here only deal with astronomical methods of determining longitude.

The earliest astronomer who determined longitude by astronomical observations seems to have been Hipparchus, who chose for a first meridian that of Rhodes, where he observed; but Ptolemy adopted a meridian laid through the "Insulæ Fortunatæ" as being the farthest known place towards the west.[2] When the voyages of discovery began the peak of Teneriffe was frequently used as a first meridian, until a scientific congress, assembled by Richelieu at Paris in 1630, selected the island of Ferro for this purpose. Although various other meridians (*e.g.*, that of Uranienburg and that of San Miguel, one of the Azores, 29° 25′ west of Paris) continued to be used for a long time, that of Ferro, which received the authorization of Louis XIII. on 25th April 1634, gradually superseded the others. In 1724 the longitude of Paris from the west coast of Ferro was found by Louis Feuillée, who had been sent there by the Paris Academy, to be 20° 1′ 45″; but on the proposal of Guillaume de Lisle (1675-1726) the meridian of Ferro was assumed to be exactly 20° west of the Paris observatory. Modern maps and charts generally give the longitude from the observatory of either Paris or Greenwich according to the nationality of the constructor; the Washington meridian conference of 1884 has recommended the exclusive use of the meridian of Greenwich. On the same occasion it was also recommended to introduce the use of a "universal day," beginning for the whole earth at Greenwich midnight, without, however, interfering with the use of local time.[3]

The simplest method for determining difference of longitude consists in observing at the two stations some celestial phenomenon which occurs at the same absolute moment for the whole earth. Hipparchus pointed out how observations of lunar eclipses could be used in this way, and for about fifteen hundred years this was the only method available. When REGIOMONTANUS (*q.v.*) began to publish his ephemerides towards the end of the 15th century, they furnished other means of determining the longitude. Thus Amerigo Vespucci observed on 23d August 1499, somewhere on the coast of Venezuela, that the moon at $7^{h}\ 30^{m}$ P.M. was 1°, at midnight 5½° east of Mars; from this he concluded that they must have been in conjunction at $6^{h}\ 30^{m}$, whereas the Nuremberg ephemeris announced this to take place at midnight. This gave the longitude of his station as roughly equal to 5½ hours west of Nuremberg. The instruments and the lunar tables at that time being very imperfect, the longitudes determined were very erroneous; see NAVIGATION (vol. xvii. p. 251), to which article we may also refer for a history of the long-discussed problem of finding the longitude at sea. The invention of the telescope early in the 17th century made it possible to observe eclipses of Jupiter's satellites; but there is to a great extent the same drawback attached to these as to lunar eclipses, that it is impossible to observe with sufficient accuracy the moments at which they occur.

Eclipses of the sun and occultations of stars by the moon were also much used for determining longitude before the invention of chronometers and the electric telegraph offered better means for fixing the longitude of observatories. These methods are now hardly ever employed except by travellers, as they are very inferior as regards accuracy. For the necessary formulæ see Chauvenet's *Spherical and Practical Astronomy*, vol. i. pp. 518-542 and 550-557.

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[1] The probable error of a clock correction found in this way from one star with the Dunsink transit circle was $\pm 0^{s}\cdot052$.

[2] This was probably first done in the first century by Marinus of Tyre.

[3] This proposal was chiefly dictated by a wish to facilitate the international telegraph and railway traffic. In the United States, where the large extent of the country in longitude makes it impossible to use the time of one meridian, four standard meridians were adopted in 1883, viz., 75°, 90°, 105°, 120° west of Greenwich, so that clocks showing "Eastern, Central, Mountain, or Pacific time" are exactly five, six, seven, or eight hours slower than a Greenwich mean-time clock.

We now proceed to consider the four methods for finding the longitudes of fixed observatories, viz., by (1) moon culminations, (2) rockets or other signals, (3) transport of chronometers, and (4) transmission of time by the electric telegraph.

1. *Moon Culminations.*—Owing to the rapid orbital motion of the moon the sidereal time of its culmination is different for different meridians. If, therefore, the rate of the moon's change of right ascension is known, it is easy from the observed time of culmination at two stations to deduce their difference of longitude. Let the right ascension of the moon α and its differential coefficients be computed for the Greenwich time T, and let the culmination be observed at two places whose longitudes from Greenwich are λ and λ', the time of observation being $T+t$ and $T+t'$ Greenwich time, or in local time $T+t+\lambda=\theta$ and $T+t'+\lambda'=\theta'$; we have then

$$\theta'-\theta=(t'-t)\frac{d\alpha}{dt}+\frac{1}{2}(t'^2-t^2)\frac{d^2\alpha}{dt^2}+\dots,$$

and, as the difference of longitude is $\lambda'-\lambda=(\theta'-\theta)-(t'-t)$, we have only to determine $t'-t$ from the first equation. This is simply done by a suitable selection of T. Calling $T+\frac{1}{2}(t+t')=T'$, we have to put $T'-\frac{1}{2}(t'-t)$ and $T'+\frac{1}{2}(t'-t)$ for $T+t$ and $T+t'$. It is then easy to see that

$$\theta'-\theta=(t'-t)\frac{d\alpha}{dt}+\frac{1}{24}(t'-t)^3\frac{d^3\alpha}{dt^3},$$

and, solving this equation by first neglecting the second term on the right side and then substituting the value of $t'-t$, thus found in that term,

$$t'-t=\frac{\theta'-\theta}{d\alpha/dt}-\frac{1}{24}\left[\frac{\theta'-\theta}{d\alpha/dt}\right]^3\frac{d^3\alpha}{dt^3}.$$

In order to be as much as possible independent of instrumental errors, some standard stars nearly on the parallel of the moon are observed at the two stations; these "moon-culminating stars" are given in the ephemerides in order to secure that both observers take the same stars. As either the preceding or the following limb, not the centre, of the moon is observed, allowance must be made for the time the semi-diameter takes to pass the meridian and for the change of right ascension during this time. This method was proposed by Pigott towards the end of the 18th century, and has been much used; but, though it may be very serviceable on journeys and expeditions to distant places where the chronometric and telegraphic methods cannot be employed, it is not accurate enough for fixed observatories. This is due, not only to the difficulties attending the observation (the difference of personal error in observing the moon and stars, the different apparent enlargement of the moon by irradiation in different telescopes and under different atmospheric circumstances, &c.), but chiefly to the large coefficient with which $\theta'-\theta$ has to be multiplied in the final equation for $\lambda'-\lambda$. Errors of four to six seconds of time have therefore frequently been noticed in longitudes obtained by this method from a limited number of observations: the longitude of the Madras observatory was for many years assumed to be $5^h\,21^m\,3^s\cdot77$, but subsequently by a telegraphic determination this was found to be $4^s\cdot37$ too great.

2. *Signals.*—In 1671 Picard determined the difference of longitude between Copenhagen and the site of Tycho Brahe's observatory by watching from the latter the covering and uncovering of a fire lighted on the top of the observatory tower at Copenhagen. Powder or rocket signals have been in use since the middle of the 18th century; they are nowadays never used for this purpose, although several of the principal observatories of Europe were connected in this manner early in the 19th century.[1]

3. *Transport of Chronometers.*—This means of determining longitude was first tried in cases where the chronometers could be brought the whole way by sea, but the improved means of communication on land led to its adoption in 1828 between the observatories at Greenwich and Cambridge, and in the following years between many other observatories. A few of the more extensive expeditions undertaken for this object deserve to be mentioned. In 1843 more than sixty chronometers were sent sixteen times backwards and forwards between Altona and Pulkowa, and in 1844 forty chronometers were sent the same number of times between Altona and Greenwich.[2] In 1844 the longitude of Valentia on the south-west coast of Ireland was determined by transporting thirty pocket chronometers *via* Liverpool and Kingstown and having an intermediate station at the latter place. The longitude of the United States naval observatory has been frequently determined from Greenwich. The following results will give an idea of the accuracy of the method.[3]

Previous to 1849, 373 chronometers	$5^h\,8^m\,12^s\cdot52$
Expedition of 1849, Bond's discussion	$11^s\cdot20$
" " Walker's "	$12^s\cdot06$
" " Bond's second result	$12^s\cdot26\pm0^s\cdot90$
" 1855, 52 chronometers, 6 trips, Bond	$12^s\cdot49\pm0^s\cdot19$

The value now accepted from the telegraphic determination is $5^h\,8^m\,12^s\cdot09$. The probable errors of the results for Pulkowa-Altona and Altona-Greenwich were supposed to be $\pm0^s\cdot039$ and $\pm0^s\cdot042$. It is of course only natural that the uncertainty of the results for the trans-Atlantic longitude should be much greater, considering the length of time which elapsed between the rating of the chronometers at the observatories of Boston (Cambridge, Massachusetts) and Liverpool. The difficulty of the method consists in determining the "travelling rate." Each time a chronometer leaves the station A and returns to it the error is determined, and consequently the rate for the time occupied by the journeys from A to B and from B to A and by the sojourn at B. Similarly a rate is found by each departure from and return to B, and the time of rest at A and B is also utilized for determining the stationary rate. In this way a series of rates for overlapping intervals of time are found, from which the travelling rates may be interpolated. It is owing to the uncertainty which necessarily attaches to the rate of a chronometer during long journeys, especially by land, where they are exposed to shaking and more or less violent motion, that it is desirable to employ a great number. It is scarcely necessary to mention that the temperature correction for each chronometer must be carefully investigated, and the local time rigorously determined at each station during the entire period of the operations.

4. *Telegraphic Determination of Longitude.*—This was first suggested by the American astronomer S. C. Walker, and owed its development to the United States Coast Survey, where it was employed from about 1849. Nearly all the more important public observatories on the continent of Europe have now been connected in this way, chiefly at the instigation of the "Europäische Gradmessung," while the determinations in connexion with the transits of Venus and those carried out in recent years by the American and French Governments have completed the circuit of the greater part of the globe. The telegraphic method compares the local time at one station with that at the other by means of electric signals. If a signal is sent from the eastern station A at the local time T, and received at the western station B at the local time T_1, then, if the time taken by the current to pass through the wire is called x, the difference of longitude is

$$\lambda=T-T_1+x,$$

and similarly, if a signal is sent from B at the time T_2 and received at A at T_3, we have $\lambda=T_3-T_2-x$,

from which the unknown quantity x can be eliminated.

The operations of a telegraphic longitude determination can be arranged in two ways. Either the local time is determined at both stations and the clocks are compared by telegraph, or the time determinations are marked simultaneously on the two chronographs at the two stations, so that further signals for clock comparison are unnecessary. The first method has to be used when the telegraph is only for a limited time each night at the disposal of the observers, or when the climatic conditions at the two stations are so different that clear weather cannot often be expected to occur at both simultaneously, also when the difference of longitude is so considerable that too much time would be lost at the eastern station waiting for the arrival of the transit record of one star from the western station before observing another star. The independent time determination also offers the advantage that the observations may be taken either by eye and ear or by the chronograph, and that the signals may be either audible beats of a relay or chronographic signals, the rule being to have observations and signals made by similar operations. The best way of using audible beats of a relay is to let the circuit pass through an auxiliary clock, which from second to second alternately makes and breaks the current, the making of the current being rendered audible by the tapping of the relays at both stations. If, now, the auxiliary and the observing clocks are regulated to a different rate, the coincidences of the beats of the relay with those of the observing clock can be noted with great accuracy, from which the difference between the two observing clocks is found. It has been proved by experience that the degree of accuracy with which the clock comparison can be made by one coincidence is exactly equal to that of one chronograph signal, the probable error being in both cases about $\pm0^s\cdot015$. It should, however, be mentioned that the interval between two consecutive coincidences cannot be made less than two minutes, whereas the chronograph signals may be given every second, and, as the observations made with the chronograph are also somewhat more accurate than those made by eye and ear, the chronograph should be used wherever possible. The other method, that of simultaneous registration at both stations of transits of the same stars, has also its advantages. Each transit observed at both stations furnishes a value of the difference of longitude, so that the final result is less dependent on the clock rate than in the first method, which necessitates the combination of a series of clock errors determined during the night to form a value of the clock error for the time when the exchange of signals took place. When using this method it is advisable to select the stars in such a manner that only one station at a time is at work, so that the intensity of the current can be readjusted (by means of a rheostat) between every despatch and receipt of signals. This attention to the intensity of the current is necessary whatever method is employed, as the constancy of the transmission time (x in the above equations) chiefly depends on the constancy of the current. The probable error of a difference of longitude deduced from one star appears to be[1]

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[1] For instance, Greenwich and Paris in 1825 (*Phil. Trans.*, 1826). The result, $9^m\,21^s\cdot6$, is only about $0^s\cdot6$ too great.

[2] As a great many of the chronometers used in 1844 were made by Dent and were of superior excellence, a smaller number was considered sufficient.

[3] Gould, *Transatlantic Longitude*, p. 3, Washington, 1869.

$$\text{for eye and ear transits } \pm 0^{s}\cdot 08,$$
$$\text{for chronograph transits } \pm 0^{s}\cdot 07\,;$$

while the probable error of the final result of a carefully planned and well executed series of telegraphic longitude operations is generally between $\pm 0^{s}\cdot 015$ and $\pm 0^{s}\cdot 025$.

It is evident that the success of a determination of longitude depends to a very great extent on the accurate determination of time at the two stations, and great care must therefore be taken to determine the instrumental errors repeatedly during a night's work. But, in addition to the uncertainty which enters into the results from the ordinary errors of observation, there is another source of error which becomes of special importance in longitude work, viz., the so-called personal error. The discovery of the fact that all observers differ more or less in their estimation of the time when a star crosses one of the spider lines in the transit instrument was made by Bessel in 1820[2]; and, as he happened to differ fully a second of time from several other observers, this remarkably large error naturally caused the phenomenon to be carefully examined. Bessel also suggested what appears to be the right explanation, viz., the co-operation of two senses in observing transits by eye and ear, the ear having to count the beats of the clock while the eye compares the distance of the star from the spider line at the last beat before the transit with the distance at the first beat after it, thus estimating the fraction of second at which the transit took place. It can easily be conceived that one person may first hear and then see, while to another these sensations take place in the reverse order; and to this possible source of error may be added the sensible time required by the transmission of sensations through the nerves to the brain and for the latter to act upon them. As the chronographic method of observing dispenses with one sense (that of hearing) and merely requires the watching of the star's motion and the pressing of an electric key at the moment when the star is bisected by the thread, the personal errors should in this case be much smaller than when the eye and ear method is employed. And it is a fact that in the former method there have never occurred errors of between half and a whole second such as have not unfrequently appeared in the latter method.

In astronomical observations generally this personal error does not cause any inconvenience, so long as only one observer is employed at a time, and unless the amount of the error varies with the declination or the magnitude of the star; but when absolute time has to be determined, as in longitude work, the full amount of the personal equation between the two observers must be carefully ascertained and taken into account. And an observer's error has often been found to vary very considerably not only from year to year but even within much shorter intervals; the use of a new instrument, though perhaps not differing in construction from the accustomed one, has also been known to affect the personal error. For a number of years this latter circumstance was coupled with another which seemed perfectly incomprehensible, the personal error appearing to vary with the reversal of the instrument, that is, with the position of the illuminating lamp east or west. But in 1869-70 Hirsch noticed during the longitude operations in Switzerland that this was caused by a shifting of the reflector inside the telescope, by means of which the field is illuminated, which produced an apparent shifting of the image of the spider lines, unless the eye-piece was very accurately focused for the observer's sight. The simplest and best way to find the equation between two observers is to let one observe the transits of stars over half the wires in the telescope, and the other observe the transits over the remainder, each taking care to refocus the eye-piece for himself in order to avoid the above-mentioned source of error. The single transits reduced to the middle wire give immediately the equation; and, in order to eliminate errors in the assumed wire-intervals, each observer uses alternately the first and the second half of the wires. Another method is in vogue at Greenwich, where each observer with the transit circle from a series of stars determines the clock error and reduces this to a common epoch (0^{h} sid. time) by means of a clock rate found independently of personal error. The differences between the clock errors thus found are equal to the personal equations. This method cannot, however, be recommended, as the systematic errors in the right ascensions of the stars and any slight variation of the clock rate would affect the personal equation; the first method is therefore generally used in longitude work. It is advisable to let the observers compare themselves at the beginning, middle, and end of the operations and, if possible, at both the instruments employed. A useful check on the results is afforded by simultaneous experiments with one of the instruments contrived by C. Wolf, Kaiser, and others (sometimes called "time collimators"), by which the absolute personal error of an observer can be determined. Though differing much in detail, these instruments are all constructed on the same principle: an artificial star (a lamp shining through a minute hole in a screen mounted on a small carriage moved by clockwork) passes in succession across a number of lines drawn on oiled paper, while an electric contact is made at the precise moment when the star is bisected on each line by the carriage passing a number of adjustable contact makers. The currents thus made register the transits automatically on a chronograph, while the observer, viewing the apparatus through his telescope, can observe the transits in the usual manner either by eye and ear or by chronograph, thus immediately finding his personal error. On the Continent these contrivances have frequently been used to educate pupils learning to observe, and experience has repeatedly shown that a considerable personal error can be generally somewhat diminished through practice.

Literature.—General treatises on spherical astronomy, such as Brünnow's *Lehrbuch der sphärischen Astronomie* (3d ed., Berlin, 1871; translated into English and several other languages) and Chauvenet's *Manual*, treat very fully of the numerous methods of determining time by combination of altitudes or azimuths of several stars. The best handbook of telegraphic longitude work is Albrecht's already mentioned; but any one engaging in practical work of this kind should consult the accounts of the numerous longitude determinations carried out during recent years, particularly the *Publicationen des kon. preussischen geodätischen Institute*; *Telegraphic Determination of Differences of Longitude by Officers of the United States Navy* (Washington, 1880); *Telegr. Determ. of Longitudes in Mexico, Central America, and on the West Coast of South America* (Washington, 1885); the *Reports* of the United States Coast and Geodetic Survey; vol. ix. of the *Account of the Great Trigonometrical Survey of India*; and vol. iii. of Dun Echt observatory *Publications*. A discussion of all the investigations on personal errors up to 1875 was published by Dreyer in *Proc. R. Irish Acad.*, 2d series, vol. ii., 1876, pp. 484-528. (J. L. E. D.)

TIMOLEON. The life of Timoleon, one of the noblest and most interesting of the men of old Greece, is closely bound up with the history of SICILY (*q.v.*), and more particularly of SYRACUSE (*q.v.*), in the latter half of the 4th century B.C. It is as the champion of Greece against Carthage, and of constitutional government against violence and oppression, that he stands out as such a grand figure. His early career in his native Corinth was shaped by a tragic incident. Timoleon had saved the life of his brother, Timophanes, on the field of battle; but, when that same brother, at the head of a band of mercenary soldiers, took possession of the acropolis and made himself practically a military despot and master of the city, Timoleon, after an ineffectual protest, let him be struck down by his brother-in-law and one or two other friends who had joined in his remonstrance. By the public opinion of Corinth generally his conduct was approved as patriotic; but the curses of his mother and the cold looks of some of his kinsfolk and acquaintances drove him from the city into the solitude of the fields, and there, it would seem, for some years he pined away, hating life and even bent on ending it by voluntary starvation. He must have reached middle life when, in 344 B.C., envoys came from Syracuse to Corinth to appeal to the mother-city for relief from the intestine feuds and foreign mercenaries under which the Syracusans, and all the Greeks of Sicily, suffered. Carthage too, their old and bitter foe, after some years of quiet, was again bestirring herself and intriguing with the local despots. Corinth could not refuse her help, though her chief citizens declined the responsibility of attempting to establish a settled government in the factious and turbulent Syracuse. By a sort of Divine inspiration, says Plutarch (*Tim.*, 3), Timoleon, being named by an unknown voice in the popular assembly, was chosen by a unanimous vote to undertake the mission. He sailed for Sicily with a few of the leading citizens of Corinth and a small troop of Greek mercenaries. On arriving at Rhegium he found that his movements were watched by a Carthaginian squadron, acting under the advice of a Syracusan, Hicetas, who had made himself master of Leontini and aimed at supplanting with Carthaginian aid the younger Dionysius, still nominally tyrant of Syracuse, but actually in possession only of the island citadel. Hicetas, whilst seeming to favour Corinthian intervention, was really working with Carthage on behalf of the tyrants. Timoleon, however, slipped away from the Carthaginian watch and landed at Tauromenium (Taormina), where he had a very friendly reception. At Adranum, an inland town, to which he came by invitation from a party among the citizens, he surprised Hicetas, and drove him back, with his troops utterly defeated, to Syracuse. The Sicilian Greeks now rallied round him, and the following year (343) saw the surrender of Dionysius and Timoleon master of the entire city. Hailed by the citizens as a heaven-sent deliverer, he at once began the work of restoration, bringing in a multitude of new settlers from the mother-city and from Greece generally, and establishing a popular government on the basis of the laws of Diocles, which had been forgotten under the Dionysian *régime*. The impress of Timoleon's reforms seems to have lasted to the days of Augustus. The tyrants, too, in the other Sicilian cities were put down, and his old enemy Hicetas went back to Leontini, where he lived as a private though powerful citizen. He made one more attempt to overthrow Timoleon, and induced Carthage to send (340-339) a great army, which landed at Lilybæum (Marsala). The Syracusans could hardly be brought to face the invader; but with a miscellaneous levy of about 12,000 men, most of them mercenaries, Timoleon marched westwards across the island into the neighbourhood of Selinus and won a great and decisive victory on the Crimisus. The Carthaginian host is said to have outnumbered Timoleon's army in the proportion of seven to one. The general himself led on his infantry in person (Plut., *Tim.*, 27), and their enemy's discomfiture was completed by a blinding storm of rain and hail driven straight in their faces (Diod., xvi. 79). This victory gave the Greeks of Sicily many years of peace and safety from Carthage. Carthage made, however, one more effort and despatched some mercenaries to prolong the conflict between Timoleon and the tyrants. But it soon ended (338 B.C.) in the defeat of Hicetas, who was taken prisoner and put to death, and in a treaty which confined the dominion of Carthage in Sicily to the west of the Halycus (Platani). Timoleon, having put down the despots and given freedom to the Greek cities of Sicily, retired into private life, though he remained practically supreme not only at Syracuse but throughout Sicily. This island, notwithstanding the many elements of discord which political revolution, with the return of exiles and the influx of new settlers, must have brought in, seems to have been during Timoleon's lifetime tranquil and contented. There are some characteristic stories told of his last days. Although blind, he used to come in his car into the assembly in the theatre and give his opinion, which was commonly accepted by a unanimous vote. An officious person once insisted on his giving the ordinary bail in a lawsuit; but he replied that he had himself always been the consistent champion of law and of legal rights for them all. Again, when his military strategy was unfavourably criticized, he expressed his gratitude to heaven that he had won for the Syracusans the privilege of liberty of speech. He died in 337, and was buried at the cost of the citizens of Syracuse, who erected a grand monument to his memory in their market-place.

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[1] Albrecht, *Bestimmung von Längendifferenzen mit Hülfe des electrischen Telegraphen*, p. 80, Leipsic, 1869, 4to.

[2] Maskelyne had in 1795 noticed that one of his assistants observed transits more than half a second later than himself, but this was supposed to arise from some wrong method of observing adopted by the assistant, and the matter was not further looked into.

Plutarch's *Life of Timoleon* and portions of Diodorus Siculus are our chief sources of original information. There is an admirable and most interesting account of his life and work in chap. lxxxv. of Grote's *History of Greece*.

TIMON of Athens, a noted misanthrope, lived during the Peloponnesian War. He is more than once alluded to by Aristophanes and other comedians of the Attic stage. Plutarch takes occasion to introduce a short account of his life in the biography of Mark Antony (ch. 70), and he gives his name to one of Lucian's dialogues. Shakespeare probably derived his knowledge of Timon mainly from Plutarch; but the Timon of Shakespeare resembles the Timon of Lucian in so many points that some critics think Shakespeare (or whoever wrote the first sketch of the play) must have had access to the dialogue in question.

TIMON of Phlius, the well-known sillograph and sceptic philosopher, flourished about 280 B.C. He studied philosophy under Stilpo the Megarian and Pyrrho of Elis, the famous sceptic. Thereafter he spent some time in Chalcedon, where he made a fortune by teaching and lecturing. The rest of his life was passed chiefly at Athens, where he died at an advanced age.

The writings of Timon, if we may trust Diogenes Laertius (ix. ch. 12), were exceedingly numerous both in prose and in verse: besides the Σίλλοι, he is asserted to have written epic poems, tragedies, comedies, satyric dramas, and other varieties. But he is best known as the author of the Σίλλοι or sarcastic hexameter verses written against the Greek philosophers. They were divided into three books; in the first the author spoke in his own person, while in the second and third Xenophanes of Colophon replied to inquiries addressed to him by Timon about early and late philosophers. From the fragments that remain (about 140 lines or parts of lines, printed in Mullach, *Frag. Phil. Græc.*, i. pp. 84-98) we see that Timon possessed some of the qualities of a great satirist together with a thorough command of the hexameter; but there is no trace of any loftier aim than to awaken derisive laughter. Philosophers are "excessively cunning murderers of many wise saws" (ver. 96); the only two whom he spares are Xenophanes, "the modest censor of Homer's lies" (v. 29), and Pyrrho, against whom "no other mortal dare contend" (v. 126). Besides the Σίλλοι we have some lines preserved from the Ἰνδαλμοί, a poem in elegiac verse, which appears to have inculcated the tenets of scepticism, and one or two lines or parts of lines which cannot be with certainty assigned to either poem.

TIMOR, an island of the East Indian Archipelago, the easternmost and largest of the lesser Sundanese group, stretching south-west and north-east for 300 miles between 8° 40′ and 10° 40′ S. lat. and 123° 30′ and 127° E. long. It has a mean breadth of 60 miles, an area of over 11,000 square miles, and a population roughly estimated at about 500,000. Timor lies in deep water a little to the west of the hundred fathom line, which marks in this direction the proper limit of the shallow Arafura Sea, flowing between it and northern Australia. It differs considerably from the other members of the Sundanese group both in the lie of its main axis (south-west and north-east instead of west and east), and in the great prevalence of old rocks, such as schists, slates, sandstones, carboniferous limestones, and other more recent sedimentary formations, and in its correspondingly slighter volcanic character. It comes, however, within the great volcanic zone which sweeps in a vast curve from the northern extremity of Sumatra, through Java and the other Sundanese islands, round to Amboina, Tidor, Ternate, Jilolo, and the Philippines. There appear to be at least two quiescent and other extinct cones, and the surface is everywhere extremely rugged and mountainous, with numerous irregular ridges from 4000 to 8000 feet high, forming altogether a very confused orographic system. Mount Kabalaki in the eastern district of Manufahi rises above 10,000 feet (H. O. Forbes); the culminating point appears to be Mount Allas (11,500 feet) near the south coast. Owing to the prevalent dry easterly winds from the arid plains of North Australia, Timor, like Ombay, Flores, and other neighbouring islands, has a much drier climate, with a correspondingly poorer vegetation, than Java, and has few perennial streams and no considerable rivers. Hence, apart from almost untouched and unsurveyed stores of mineral wealth, such as iron, copper, and gold, which occur apparently in considerable quantities at several points, the island is poor in natural resources. The uplands, however.

yield good wheat and potatoes, while the woodlands, which nowhere form veritable forests, contain much excellent sandalwood. This and a noted breed of hardy ponies form the chief articles of export. Owing doubtless to the zone of deep water flowing between Timor and the Arafura Sea, the fauna of Timor presents, beyond a marsupial cuscus, scarcely any Australian types. The few mammals, such as a deer, a civet, a pig, a shrew, and monkeys, as well as the birds and insects, resemble ordinary Malayan forms as met with in Java and more especially in Celebes and the Moluccas. In its natural history, as well as its physical constitution and oceanic surroundings, Timor is thus entirely separated from Australia and should perhaps be grouped with Celebes, Buru, Ceram, and Jilolo as the surviving fragments of a Miocene continent intervening between Asia and Australia, but at no time connected with either.

The bulk of the population is certainly Papuan, but intermingled in the most varied proportions with Malayan, Indonesian, and other elements; hence it presents an extraordinary diversity of physical types, as is clearly shown by the portraits figured in H. O. Forbes's *Naturalist's Wanderings in the Eastern Archipelago.* The natives, still mainly independent of their nominal Dutch and Portuguese rulers, are divided into a large number of more or less hostile tribes, speaking as many as forty distinct Papuan and Malayan languages or dialects. Some are extremely rude and still addicted to head-hunting, at least during war, and to other barbarous practices. In their *uma-luli*, or sacred (tabooed) enclosures, rites are performed resembling those of the Pacific islanders.

Politically Timor is divided between Holland and Portugal, the Dutch claiming the western section of 4500 square miles and 200,000 inhabitants, the Portuguese the eastern of nearly 6500 square miles and 300,000 inhabitants; the respective capitals, centres of government, and outports are Kupang at the western extremity and Deli on the north-east coast. But there are a large number of practically independent petty states, as many as forty-seven in the Portuguese territory alone, where they take the name of "renos," or kingdoms, under absolute "leoreis" or kinglets. The Dutch section forms with Sumba, Savu, Rotti, and the surrounding islets a residency administered by a Dutch resident stationed at Kupang, which has a population of 8000.

TIMOR LAUT ("Seaward Timor"), called also TENIMBER, an insular group in the East Indian Archipelago, forming the central and largest link in a double chain of islands which stretches from Timor through Kei and Aru to New Guinea. It lies nearly midway between Timor and Aru, and forms, not one continuous mass, as used to be supposed, but a group of three large islands,—Yamdena in the centre, separated by Wallace Channel from Larat in the north and by Egeron Strait from Selaru in the south, besides a cluster or chain of islets on the west and north sides. From one of these the name *Tenimber* appears to have been extended to the whole group, which stretches for about 100 miles south-west and north-east, nearly parallel with Timor, from which, however, it differs altogether in its physical constitution. H. O. Forbes, who surveyed Wallace Channel and the northern districts in 1882, describes it as a low coralline group seldom rising above 100 feet, except at Egeron Strait, where the cliffs are 400 feet high, and at Laibobar, apparently a volcanic islet on the west side, which has an extinct crater 2000 feet high. There are no streams, and the poor soil, covered with a typically coral island flora, yields little beyond maize—the staple food—manioc, sweet potatoes, tobacco, some sugar-cane, cotton, and a little rice. The fauna includes buffaloes in a wild state, a marsupial cuscus, some bats, the beautiful scarlet lory, new or rare varieties of the ground-thrush, honey-eater, and oriole. The birds seem to have come mainly from New Guinea, the insects from Timor, and a few of both from Australia.

The aborigines are evidently Papuans, with a language like that of the Kei Islanders; but there is a large intermingling of Malayan and perhaps Indonesian elements. They are a fine race, often over 6 feet, and, like all Papuans, noted for their artistic sense, which is shown especially in their wood and ivory carvings. In other respects they are pagans in a low state of culture, mostly divided into hostile communities and addicted to piracy. The group belongs to the Dutch, who have a "post-holder" stationed at Ritabel on the west coast of Larat, a trading station of the Bughis from Celebes.

TIMOTHEUS, a distinguished Athenian general, was a son of Conon, who restored the walls of Athens. To the military qualities of his father he added a love of letters, which found scope in his friendship with Isocrates. The considerable fortune which he inherited from his father seems to have been exhausted by him in the public service. In 375 B.C. the Athenians, then at war with Sparta, sent Timotheus with a fleet to the Ionian Sea, where he gained over Cephalonia and secured the friendship of the Acarnanians and of Alcetas, king of the Molossians. He also made himself master of Corcyra, but used his victory with a moderation which won the goodwill of the conquered. At the same time he defeated a Spartan fleet at Alyzia on the Acarnanian coast. In 373 he was appointed to the command of a fleet destined for the relief of Corcyra, then beleaguered by the Spartans. But his ships were not fully manned, and to recruit their strength he first cruised in the Ægean. The delay excited the indignation of the Athenians, who brought him to trial; but, thanks to the exertions of his friends, Jason, tyrant of Pheræ, and Alcetas, king of the Molossians, both of whom came to Athens personally to plead his cause, he was acquitted, but removed from the command, Iphicrates being appointed in his room. Being reduced to great poverty—for he had pledged his private property in order to put the fleet in an efficient state—he left Athens and took service with the king of Persia. We next hear of him in 367 or 366, when he was sent by the Athenians with an armament to support Ariobarzanes, satrap of Phrygia. But, finding that the satrap was in open revolt against Persia, Timotheus abstained from helping him and turned his arms against Samos, which was occupied by a Persian garrison. He took it after a ten months' siege (365 B.C.). Sailing north, he then captured Sestus, Crithote, Torone, Potidæa, Methone, Pydna, and many more cities. In 358 or 357, when Eubœa was in danger of falling into the hands of Thebes, the Athenians, in response to a spirited appeal of Timotheus, crossed over into the island and expelled the Thebans in three days. In the course of the Social War, which broke out shortly afterwards, Timotheus was despatched with Iphicrates, Menestheus, son of Iphicrates, and Chares to put down the revolt. The hostile fleets sighted each other in the Hellespont; but a gale was blowing, and Iphicrates and Timotheus decided not to engage. Chares, disregarding their opposition, lost many ships, and in his despatches he incriminated his colleagues so bitterly that the Athenians recalled them and put them on their trial for having taken bribes from the enemy to betray the fleet. The accusers were Chares and Aristophon. The former was an officer of notoriously bad character; the latter had himself stood in the dock no less than seventy-five times. Iphicrates was not above browbeating the jury, who accordingly acquitted him and his son. Timotheus, who condescended to no such means of securing an acquittal, was condemned to pay a very heavy fine. Being unable to pay, he withdrew to Chalcis. The time and place of his death are not mentioned by ancient writers. The Athenians afterwards did what they could to repair the wrong they had done to Timotheus by remitting the greater part of the fine to his son Conon, by burying his remains in the Ceramicus, and by raising statues to his memory in the agora and the acropolis.

Our materials for the life of Timotheus are very imperfect, and the chronology is in some points uncertain. The chief authorities are Isocrates, *Or.*, xv.; Xenophon, *Hellenica*, v. and vi.; Diodorus, xv. and xvi.; Cornelius Nepos, *Vit. Tim.*; and Polyænus, *Strat.*, iii. 10. Other scraps are to be gleaned from the orators, Plutarch, &c. The speech *Against Timotheus* which has come down to us under the name of Demosthenes is probably not by the orator. It is chiefly interesting as illustrating the straits to which Timotheus was reduced by his sacrifices in the public cause.

TIMOTHEUS, a celebrated Greek musician and poet, was a native of Miletus, and died, according to the Parian marble, in 357 or 356 B.C., at the age of ninety. He added one or more strings (the number is uncertain) to the lyre, whereby he incurred the displeasure of the conservative Spartans. The few fragments of his poems are collected by Bergk in his *Poetæ Lyrici Græci*.

TIMOTHY, or TIMOTHEUS (Acts xvi. 1, xvii. 14, &c.), a Lycaonian, the son of a Gentile father but of a Jewish mother, Eunice (2 Tim. i. 5), became a disciple of Paul at the time of his visit to Derbe and Lystra, and in deference to Jewish feeling was circumcised. He accompanied the apostle on many of his journeys, and was employed by him on important missions (1 Thess. iii. 2; 1 Cor. iv. 17, xvi. 10). His name is associated with that of Paul in the opening salutations of both epistles to the Thessalonians, the second epistle to the Corinthians, and those to the Philippians and Colossians. He was therefore with Paul at Rome. At a later date he is mentioned in Heb. xiii. 23 as having undergone imprisonment but been released. For the epistles of Paul to Timothy, see PASTORAL EPISTLES (vol. xviii. p. 348). On the basis of them he is traditionally represented as bishop of Ephesus, and tradition also tells that he suffered under Domitian. His martyrdom is celebrated on 24th January. The apocryphal *Acta Timothei* (Greek and Latin) have been edited by Usener (Bonn, 1877); compare Lipsius, *Apokr. Apostelgeschichten*, ii. 2 (1884).

TIMUR. TIMÚR BEY or TIMÚR LANG (*Tímur i Leng*), "the lame Timur"—vulgarized into TAMERLANE—the renowned Oriental conqueror, was born in 1336 at Kesh, better known as Shahr-i-Sabz, "the green city," situated some 50 miles south of Samarkand in Transoxiana. His father Teragai was head of the tribe of Berlas. Great-grandson of Karachar Nevian (minister of Jagatai, son of Jenghiz Khan, and commander-in-chief of his forces), and distinguished among his fellow-clansmen as the first convert to Islamism, Teragai might have assumed the high military rank which fell to him by right of inheritance; but like his father Burkul he preferred a life of retirement and study. Under the paternal eye the education of young Timúr was such that at the age of twenty he had not only become an adept in manly outdoor exercises but had earned the reputation of being an attentive reader of the Koran. At this period, if we may credit the *Memoirs* (*Malfúẓát*), he exhibited proofs of a tender and sympathetic nature.

About 1358, however, he came before the world as a leader of armies. His career for the next ten or eleven years may be thus briefly summarized from the *Memoirs*. Allying himself both in cause and by family connexion with Kurgan, the dethroner and destroyer of Kezan, chief of the Jagatai, he was deputed to invade Khorasan at the head of a thousand horse. This was the second warlike expedition in which he was the chief actor, and the accomplishment of its objects led to further operations, among them the subjection of Khwarizm and Urganj. After the murder of Kurgan the contentions which arose among the many claimants to sovereign power were arrested by the invasion of Tughlaḳ Timúr of Kashgar, a descendant of Jenghiz. Timúr was despatched on a mission to the invader's camp, the result of which was his own appointment to the government of Máwará'lnahr (Transoxiana). By the death of his father he was also left hereditary head of the Berlas. The exigencies of his quasi-sovereign position compelled him to have recourse to his formidable patron, whose reappearance on the banks of the Sihon created a consternation not easily allayed. Máwará'lnahr was taken from Timúr and entrusted to a son of Tughlaḳ; but he was defeated in battle by the bold warrior he had replaced at the head of a numerically far inferior force. Tughlaḳ's death facilitated the work of reconquest, and a few years of perseverance and energy sufficed for its accomplishment, as well as for the addition of a vast extent of territory. During this period Timúr and his brother-in-law, Hosain—at first fellow-fugitives and wanderers in joint adventures full of interest and romance—became rivals and antagonists. At the close of 1369 Hosain was assassinated and Timúr, having been formally proclaimed sovereign at Balkh, mounted the throne at Samarkand, the capital of his dominions.

The next thirty years or so were spent in various wars and expeditions. He not only consolidated his rule at home by the subjection of intestine foes, but sought extension of territory by encroachments upon the lands of contemporary potentates. His conquests to the west and north-west led him among the Mongols of the Caspian, and to the banks of the Ural and the Volga; those to the south and south-west comprehended almost every province in Persia, including Baghdad, Kerbela, and Kurdistan. To this time belong the vestiges of his presence that still remain, such as the ruined monastery at Keghut near the Aras (Araxes), the cleft stone in the church at Dayiru 'l-'Omar (M'ar Jibráil) near Mardin, and the ruinless sites of such ancient cities as Zaranj in Sistan. In 1398, when Timúr was more than sixty years of age, Farishta tells us that, "informed of the commotions and civil wars of India," he "began his expedition into that country," and on 12th September "arrived on the banks of the Indus." His passage of the river and upward march along the left bank, the reinforcement he provided for his grandson Pir Mohammed (who was invested in Multán), the capture of towns or villages accompanied, it might be, with destruction of the houses and the massacre of the inhabitants, the battle before Delhi and the easy victory, the triumphal entry into the doomed city, with its outcome of horrors,—all these circumstances belong to the annals of India. In April 1399, some three months after quitting the capital of Mahmúd Tughlaḳ, Timúr was back in his own capital beyond the Oxus. It need scarcely be added that an immense quantity of spoil was conveyed away. According to Clavijo, ninety captured elephants were employed merely to carry stones from certain quarries to enable the conqueror to erect a mosque at Samarkand. The war with the Turks which succeeded the return from India was rendered notable by the capture of Baghdad, Aleppo, and Damascus, and especially by the defeat and imprisonment of Sultan Bayazid. This was Timúr's last campaign. Another was projected against China, but the old warrior was attacked by fever and ague when encamped on the further side of the Sihon (Syr-Daria) and died at Atrár (Otrar) on the 17th February 1405. Markham, in his introduction to the narrative of Clavijo's embassy, states that his body "was embalmed with musk and rose water, wrapped in linen, laid in an ebony coffin, and sent to Samarkand, where it was buried." Timur had carried his victorious arms on one side from the Irtish and the Volga to the Persian Gulf and on the other from the Hellespont to the Ganges.

Timúr's generally recognized biographers are—'Alí Yazdí, commonly called Sharifu 'd-Dín, author of the Persian *Zafarnáma*, translated by Petis de la Croix in 1722, and from French into English by J. Darby in the following year; and Ahmed ibn Mohammed ibn Abdallah, al Dimashki, al 'Ajmi, commonly called Ibn 'Arabsháh, author of the Arabic *'Ajaibu 'l Makhlukát*, translated by the Dutch Orientalist Golius in 1636. In the work of the former, as Sir William Jones remarks, "the Tartarian conqueror is represented as a liberal, benevolent, and illustrious prince"; in that of the latter he is "deformed and impious, of a low birth and detestable principles." But the favourable account was written under the personal supervision of Timúr's grandson, Ibráhím, while the other was the production of his direst enemy. Few indeed, if any, original annals of this class are written otherwise than to order, under patronage, or to serve a purpose to which truth is secondary. Among less reputed biographies or materials for biography may be mentioned a second *Zafarnáma*, by Mauláná Nizámu 'd-Dín Shanab Ghházáni (Nizám Shámí), stated to be "the earliest known history of Timúr, and the only one written in his lifetime"; and vol. i. of the *Matla'u's-Sa'dain*—a choice Persian MS. work of 1495—introduced to Orientalists in Europe by Hammer, Jahrbücher, Dorn, and (notably) Quatremère. There are also the *Memoirs* (*Malfúẓát*) and *Institutes* (*Tuzukát*), of which an important section is styled *Designs and Enterprises* (*Tadbírát wa Kangdshahá*). Upon the genuineness of these doubt has been thrown. The circumstance of their alleged discovery and presentation to Shah Jahán in 1637 was of itself open to suspicion. Alhazen, quoted by Purchas in his quaint notice of Timúr, and referred to by Sir John Malcolm, can hardly be accepted as a serious authority. His assumed memoir was printed for English readers in 1597 by William Ponsonby under the title of a *Historie of the Great Emperor Tamerlan, drawn from the ancient monuments by Messire Jean du Bec, Abbot of Mortimer*; and another version of the same book is to be found in the *Histoire du Grand Tamerlan*, by De Sainctyon, published at Amsterdam in 1678. But, although the existence of this Alhazen of Jean de Bec has been believed by many, the more trustworthy critics consider the history and historian to be equally fictitious.

Reference may be made to two more sources of information. (1) Supposed likenesses of Timúr are to be found in books and in the splendid collection of Oriental manuscripts and drawings in the British Museum. One contained in the *Shah Jahán Náma*—a gorgeous specimen of illuminated Persian manuscript and exquisite caligraphy—represents a most ordinary, middle-aged Oriental, with narrow black whisker fringing the cheek and meeting the tip of the chin in a scanty, pointed beard; a thin moustache sweeps in a semicircle from above the upper lip; the eyebrow over the almond-shaped eye is marked but not bushy. But it were vain to seek for an expression of genius in the countenance. Another portrait is included in a set of sketches by native artists, some of which, taken probably from life, show great care and cleverness. Timúr is here displayed as a stoutish, long-bodied man, below the middle-height, in age and feature not unlike the first portrait, but with thicker and more straggling hair, and distincter, though not more agreeable character in the facial expression, yet not a sign of power, genius, or any elements of grandeur or celebrity. The uncomfortable figure in the Bodleian Library does not give much help. Sir John Malcolm has been at some pains to invest his portrait of Timúr with individuality. But an analysis of his results leaves the reader in more perplexity than satisfaction at the kind of information imparted, and he reverts insensibly to the sources from which his instructor has himself been instructed. (2) As regards plays, in Marlowe's *Tamburlaine* Timúr is described as tall of stature, straightly fashioned, large of limb, having joints strongly knit, long and sinewy arms, a breadth of shoulders to "bear old Atlas's burden," pale of complexion, and with "amber hair wrapp'd in curls." The outline of this description might be from Sharifu 'd-Dín, while the colours are the poet's own. A Latin memoir of Tamerlane by Perondinus, printed in 1600, entitled *Magni Tamerlanis Scytharum Imperatoris Vita*, describes Timúr as tall and bearded, broad-chested and broad-shouldered, well-built but lame, of a fierce countenance, and with receding eyes, which express cruelty and strike terror into the lookers-on. But Jean du Bec's account of Timúr's appearance is quite different. Now *Tamburlaine* was written in 1586. The first English translation of Jean du Bec is dated in 1595, the *Life* by Perondinus in 1600, and Petis de la Croix did not introduce Sharifu 'd-Dín or 'Alí Yazdí to European readers till 1722. The dramatist must have heard of Timúr in other quarters, equally reliable it may be with those available in the present stage of Oriental research. At the beginning of the 18th century Timúr was represented in Rowe's *Tamerlane* as a model of valour and virtue. The plot, however, has little to do with history, and is improbable and void of interest. By Matthew Gregory Lewis again "Timour" is depicted as the conventional tyrant of a gorgeous melodrama, slaying, burning, slaughtering, and committing every possible atrocity until checked by violent death and a poetical climax.

Apart from modern European *savants* and historians, and the more strictly Oriental chroniclers who have written in Persian, Turkish, or Arabic, the following authorities may be cited—Laonicus Chalcondylas, Joannes Leunclavius, Joachimus Camerarius, Petrus Perondinus, Lazharo Soranzo, Simon Mairlus, Matthew Michiovius. A score or so of other names are given by Samuel Purchas. See also Clements Markham's *Clavijo*, in the Hakluyt Society's publications; White's edition of Davy's translation of the *Institutes* (1783); Stewart's translation of the *Malfúẓát*; Malcolm's *History of Persia*; and *Trans. Roy. Soc.*, 1885. (F. J. G.)

TIN (Lat. *stannum*, whence the chemical symbol "Sn"; atomic weight = 117·6, O = 16), being a component of bronze, was used as a metal thousands of years prior to the dawn of history. But it does not follow that prehistoric bronzes were made of metallic tin. When the unalloyed metal was first introduced cannot be ascertained with certainty. All we know is that about the 1st century the Greek word *κασσίτερος* designated tin, and that tin was imported from Cornwall into Italy after, if not before, the invasion of Britain by Julius Cæsar. From Pliny's writings it appears that the Romans in his time did not realize the distinction between tin and lead: the former was called *plumbum album* or *candidum* to distinguish it from *plumbum nigrum* (lead proper). The word *stannum* definitely assumed its present meaning in the 4th century (H. Kopp).

Grains of metallic tin occur as a subordinate admixture in the gold ores of Siberia, Guiana, and Bolivia. Of tin mineral compounds (which are not numerous) tinstone, SnO_2, is the most important; besides it only tin pyrites, which, according to Rammelsberg, exists in two varieties, $FeCu_2SnS_4$ and $ZnFeCu_4Sn_2S_8$, need be named here.

Tinstone or Cassiterite.—This native oxide of tin, SnO_2, forms very hard quadratic crystals of specific gravity 6·8. The pure mineral is colourless, and it is very scarce; most specimens are brown owing to the presence of ferric or manganic oxide. The faces of the crystals exhibit diamond lustre. There is also another native form, known as "wood tin," occurring in roundish masses with a fibrous radiating fracture. The ore is found in veins or layers within the older crystalline rocks and slates. Being much more highly proof against the action of water and carbonic acid than its matrix, the ore often presents itself in loose crystals as part of the sand of rivers (stream tin). The oldest known deposit of tinstone is that of Cornwall, where it occurs in granite and in the "killas" (a kind of metamorphic clayish slate), associated with wolframite, apatite, topaz, mica, tourmaline, arsenide of iron, and other minerals. Cornish tin ore is characteristically rich in arsenic. Minor European deposits occur in the Erzgebirge, in Brittany, and in Galicia (Spain). A very considerable deposit of pure ore (chiefly stream tin) exists in the island of Banca; and in Malacca tinstone is found. Other relatively abundant deposits occur in Bolivia and Peru, and in Queensland and New South Wales (lately discovered).

Metallurgy.—In the extraction of tin from tinstone ore the first step is to pound the crude ore and wash away the lighter gangue with water (see METALLURGY, vol. xvi. p. 59). The washed ore is "roasted" to burn away the arsenic and sulphur and to convert the iron, originally present in the heavy and compact form of pyrites or arsenide, into light friable oxide, which is removed by a second washing process. If much oxide of copper is contained in the product, it is extracted with dilute sulphuric acid, and from the solution is recovered by precipitation with metallic iron (see COPPER, vol. vi. p. 347). The purified ore, known as "black tin," goes to the smelting furnace. During the roasting process the ore must be constantly agitated to prevent caking, and to bring the arseniferous, &c., parts to the surface. To save manual labour, Oxland and Hocking have constructed a mechanical roaster. It consists of a slanting tube of boiler-iron, coated inside with fire-brick. The lower end opens into the fire-place; the upper communicates with a set of chambers for the condensation of the white arsenic produced. The washed ore, after being dried on the top of the chamber, is run thence by a funnel into the pipe, which is made to rotate about its axis from three to eight times per minute. Before the ore has travelled far down the arsenic and sulphur catch fire, and by the time it reaches the bottom it is fully roasted. It falls into a receptacle below the level of the fire. Of the impurities of the ore the wolframite (tungstate of iron and manganese) is the most troublesome, because on account of its high specific gravity it cannot be washed away as gangue. To remove it, Oxland fuses the ore with a certain proportion of carbonate of soda, which suffices to convert the tungsten into soluble alkaline tungstate, without producing noteworthy quantities of soluble stannate from the oxide of tin; the tungstate is easily removed by treatment with water.

Smelting.—The purified ore is mixed with about one-fifth of its weight of anthracite smalls, the mixture being moistened to prevent it from being blown off by the draught, and is then fused on the sole of a reverberatory furnace for five or six hours. The slag and metal produced are then run off and the latter is cast into bars; these are in general contaminated with iron, arsenic, copper, and other impurities. To refine them, the bars are heated cautiously on an inclined hearth, when relatively pure tin runs off, while a skeleton of impure metal remains. The metal run off is further purified by *poling*, *i.e.*, by stirring it with the branch of a tree,—the apple tree being preferred traditionally. This operation is no doubt intended to remove the oxygen diffused throughout the metal as oxide, part of it perhaps chemically by reduction of the oxide to metal, the rest by conveying the finely diffused oxide to the surface and causing it to unite there with the oxide scum. After this the metal is allowed to rest for a time in the pot at a temperature above its freezing point and is then ladled out into ingot forms, care being taken at each stage to ladle off the top stratum. The original top stratum is the purest, and each succeeding lower stratum has a greater proportion of impurities; the lowest consists largely of a solid or semi-solid alloy of tin and iron.

To test the purity of the metal, the tin-smelter heats the bars to a certain temperature just below the fusing point, and then strikes them with a hammer or lets them fall on a stone floor from a given height. If the tin is pure it splits into a mass of granular strings. Tin which has been thus manipulated and proved incidentally to be very pure is sold as grain tin. A lower quality goes by the name of block tin. Of the several commercial varieties Banca tin is the purest; it is indeed almost chemically pure. Next comes English grain tin. For the preparation of chemically pure tin two methods are employed. (1) Commercially pure tin is treated with nitric acid, which converts the tin proper into an insoluble hydrate of SnO_2, while the copper, iron, &c., become nitrates; the oxide is washed first with dilute nitric acid, then with water, and is lastly dried and reduced by fusion with black flux or cyanide of potassium. (2) A solution of pure stannous chloride in very dilute hydrochloric acid is reduced with a galvanic current. According to Stolba, beautiful crystals of pure tin can be obtained as follows. A platinum basin, coated over with wax or paraffin outside, except a small circle at the very lowest point, is placed on a plate of amalgamated zinc, lying on the bottom of a beaker, and is filled with a solution of pure stannous chloride. The beaker also is cautiously filled with acidulated water up to a point beyond the edge of the platinum basin. The whole is then left to itself, when crystals of tin gradually separate out on the bottom of the basin.

Properties of Pure Tin.—An ingot of pure tin is pure white (except for a slight tinge of blue); it exhibits considerable lustre and is not subject to tarnishing on exposure to normal air. The metal is pretty soft and easily flattened out under the hammer, but almost devoid of tenacity. That it is elastic, within narrow limits, is proved by its clear ring when struck with a hard body under circumstances permitting of free vibration. The specific gravity of ingot tin is 7·293 at 13° C. (Matthiessen). A tin ingot, though seemingly amorphous, has a crystalline structure, consisting of an aggregate of quadratic octahedra; hence the characteristic crackling noise which a bar of tin gives out when being bent. This structure can be rendered visible by superficial etching with dilute acid. As the minuter crystals dissolve more quickly than the larger ones, the surface assumes a frosted appearance (*moirés métallique*), not unlike that of a frozen window-pane in winter time. Its crystalline structure must account for the striking fact that the ingot, when exposed for a sufficient time to very low temperatures (to −39° C. for 14 hours), becomes so brittle that it falls into powder under a pestle or hammer; it indeed sometimes crumbles into powder spontaneously. At ordinary temperatures tin proves fairly ductile under the hammer, and its ductility seems to increase as the temperature rises up to about 100° C. At some temperature near its fusing point it becomes brittle (*vide supra*), and still more brittle from −14° C. downwards. This behaviour of the metal may probably be explained by assuming that in any tin crystal the coefficient of thermic expansion has one value in the direction of the principal axis and another in that of either of the subsidiary axes. From 0° to 100° the two coefficients are practically identical; below −14° and from somewhere above 100° C. upwards they assume different values; and, as the several crystals are oriented in a lawless fashion, this must tend to disintegrate the mass. Tin fuses at 232°·7 (Persoz); at a red heat it begins to volatilize slowly; at 1600° to 1808° C. (Carnelley and Williams) it boils. The hot vapour produced combines with the oxygen of the air into white oxide, SnO_2.

Industrial Applications.—Commercially pure tin is used (principally in Germany) for the making of pharmaceutical apparatus, such as evaporating basins for extracts, infusion pots, stills, &c. It is also employed for making two varieties of tin-foil,—one for the silvering of mirrors (see MIRROR, vol. xvi. p. 500), the other for wrapping up chocolate, toilet soap, tobacco, &c. The mirror foil must contain some copper to prevent it from being too readily amalgamated by the mercury. For making tin-foil the metal is rolled into thin sheets, pieces of which are beaten out with a wooden mallet. As pure tin does not tarnish in the air and is proof against acid liquids, such as vinegar, lime juice, &c., it is utilized for culinary and domestic vessels. But it is expensive, and tin vessels have to be made very heavy to give them sufficient stability of form; hence it is generally employed merely as a protecting coating for utensils made essentially of copper or iron. The tinning of a copper basin is an easy operation. The basin, made scrupulously clean, is heated over a charcoal fire to beyond the fusing point of tin. Molten tin is then poured in, a little powdered sal-ammoniac added, and the tin spread over the inside with a bunch of tow. The sal-ammoniac removes the last unavoidable film of oxide, leaving a purely metallic surface, to which the tin adheres firmly. For tinning small objects of copper or brass (*i.e.*, pins, hooks, &c.) a wet-way process is followed. One part of cream of tartar, two of alum, and two of common salt are dissolved in boiling water, and the solution is boiled with granulated metallic tin (or, better, mixed with a little stannous chloride) to produce a tin solution; and into this the articles are put at a boiling heat. In the absence of metallic tin there is no visible change; but, as soon as the metal is introduced, a galvanic action sets in and the articles get coated over with a firmly adhering film of tin. Tinning wrought iron is effected by immersion. The most important form of the operation is making tinned from ordinary sheet iron (making what is called "sheet tin"). The iron plates, having been carefully cleaned with sand and muriatic or sulphuric acid, and lastly with water, are plunged into heated tallow to drive away the water without oxidation of the metal. They are next steeped in a bath, first of molten ferruginous, then of pure tin. They are then taken out and kept suspended in hot tallow to enable the surplus tin to run off. The tin of the second bach dissolves iron gradually and becomes fit for the first bath. To tin cast-iron articles they must be decarburetted superficially by ignition within a bath of ferric oxide (powdered hæmatite or similar material), then cleaned with acid, and tinned by immersion, as explained above. By far the greater part of the tin produced metallurgically is used for making tin alloys, the majority of which have been treated of in preceding articles; see LEAD, vol. xiv. p. 378; PEWTER, vol. xviii. p. 725; BRONZE, vol. iv. p. 366; PHOSPHORUS, vol. xviii. p. 817.

Tin Compounds.—The most important of these may be arranged into two classes, namely, stannous compounds, SnX_2, and stannic compounds, SnX_4, where X stands for Cl, Br, $\frac{1}{2}$O, &c. Stannous compounds are, in general at least, characteristically prone to pass into the stannic form by taking up additional X_2 in the form of oxygen, chlorine, &c.

Stannous Chloride, $SnCl_2$.—This can be obtained pure only by heating pure tin in a current of pure dry hydrochloric acid gas. It is a white solid, fusing at 250° C. and volatilizing at a red heat in nitrogen, a vacuum, or hydrochloric acid, without decomposition. The vapour density below 700° C. corresponds to Sn_2Cl_4, above 800° C. to nearly $SnCl_2$ (Von Meyer and Züblin). The chloride readily combines with water into an easily soluble crystallizable hydrate ("tin crystals"). This is made without difficulty by dissolving tin in strong hydrochloric acid and allowing it to crystallize. For its industrial preparation Nöllner passes sufficiently hydrated hydrochloric acid gas over granulated tin contained in stoneware bottles and evaporates the concentrated solution produced in tin basins over granulated tin. The basin itself is not attacked. The crystals contain one H_2O according to Berzelius, while Marignac finds two; probably both are right. The crystals are very soluble in cold water, and if the salt is really pure a small proportion of water forms a clear solution; but on adding much water most of the salt is decomposed, with the formation of a precipitate of oxy-chloride—

$$2SnCl_2 + 3H_2O = 2HCl + Sn_2OCl_2,2H_2O.$$

According to Michel and Kraft, one litre of cold saturated solution of tin crystals weighs 1827 grammes and contains 1333 grammes of $SnCl_2$. The same oxy-chloride is produced when the moist crystals, or their solution, are exposed to the air; by the action of the atmospheric oxygen

$$O + 3SnCl_2 = Sn_2Cl_2O + SnCl_4.$$

Hence all tin crystals as kept in the laboratory give with water a turbid solution, which contains stannic in addition to stannous chloride. The complete conversion of stannous into stannic chloride may be effected by a great many reagents,—for instance, by chlorine (bromine, iodine) readily; by mercuric chloride, $HgCl_2$, in the heat, with precipitation of calomel, HgCl, or metallic mercury; by ferric chloride in the heat, with formation of ferrous salt, $FeCl_2$; by arsenious chloride in strongly hydrochloric solutions, with precipitation of chocolate-brown metallic arsenic. All these reactions are available as tests for stannosum or the respective agents. In opposition to stannous chloride, even sulphurous acid (solution) behaves as an oxidizing agent. If the two reagents are mixed, a precipitate of yellow stannic sulphide is produced. By first intention

$$SO_2H_2 + 3Sn^{II}Cl_2 = 3Sn^{IV}Cl_2O + H_2S.$$

The stannic oxy-chloride readily exchanges its O for Cl_2 at the expense of the hydrochloric acid, which is always present, and the H_2S decomposes one-half of a molecule of $SnCl_4$ with formation of SnS_2. A strip of metallic zinc when placed in a solution of stannous chloride precipitates the tin in crystals and takes its place in the solution. Stannous chloride is largely used in the laboratory as a reducing agent, in dyeing as a mordant.

Stannous Oxide.—This as a hydrate is obtained from a solution of stannous chloride by addition of carbonate of soda; it forms a white precipitate, which can be washed with air-free water and dried at 80°C. without much change by oxidation. If the hydrate is heated in carbonic acid, the black anhydride SnO remains (Otto). Precipitated stannous hydrate dissolves readily in caustic potash ley; if the solution is evaporated quickly, it suffers decomposition, with formation of metal and stannate,

$$2SnO + K_2O = SnO_2K_2O + Sn.$$

If it is evaporated slowly, anhydrous stannous oxide crystallizes out at a certain stage (Otto). Dry stannous oxide, if touched with a glowing body, catches fire and burns into binoxide, SnO_2. Stannous oxalate when heated by itself in a tube leaves stannous oxide (Liebig).

Stannic chloride, $SnCl_4$, is obtained by passing dry chlorine over granulated tin contained in a retort; the tetrachloride distils over as a heavy liquid, from which the excess of chlorine is easily removed by shaking with a small quantity of tin filings and re-distilling. It is a colourless fuming liquid of specific gravity 2·269 at 0° (Pierre) and 2·234 at 15° C. (Gerlach), is fluid at − 29° C., and boils at 115°·4 C. under 753·1 mm. pressure (Pierre). The chloride unites energetically with water into crystalline hydrates (ex. $SnCl_4,3H_2O$), easily soluble in water. It combines readily with alkaline and other chlorides into double salts: thus $SnCl_4 + 2KCl = SnCl_6K_2$, analogous to the chloro-platinate; another example is the salt $SnCl_6(NH_4)_2$, known industrially as "pink salt," because it is used as a mordant to produce a pink colour. The plain chloride solution is similarly used. It is usually prepared by dissolving the metal in aqua regia.

Stannic Oxide, SnO_2.—This, if the term is taken to include the hydrates, exists in a variety of forms. (1) *Tinstone* (see above) is proof against all acids. Its disintegration for analytical purposes can be effected by fusion with caustic alkali in silver, with the formation of soluble stannate, or by fusion with sulphur and carbonate of soda, with the formation of a soluble thio-stannate, $SnS_2 + xNa_2S$. (2) A similar oxide is produced by burning tin in air at high temperatures or exposing any of the hydrates to a strong red heat. Such *tin-ash*, as it is called, is used for the polishing of optical glasses. (3) *Meta-stannic acid* (H_2OSnO_2, generally written $H_{10}Sn_5O_{15}$, to account for the complicated composition of meta-stannates, *e.g.*, the soda salt $H_8Na_2Sn_5O_{15}$) is the white hydrate produced from the metal by means of nitric acid. It is insoluble in water and in nitric acid and apparently so in hydrochloric acid; but if heated with this last for some time it passes into a hydrochlorate, which, after the acid mother liquor has been decanted off, dissolves in water. The solution when subjected to distillation behaves pretty much like a physical solution of the oxide in hydrochloric acid, while a solution of ortho-stannic acid in hydrochloric acid behaves like a solution of $SnCl_4$ in water, *i.e.*, gives off no hydrochloric acid and no precipitate of hydrated SnO_2. (4) *Ortho-stannic acid* is obtained as a white precipitate on the addition of carbonate of soda or the exact quantity of precipitated carbonate of lime to a solution of the chloride. This hydrate, SnO_2H_2O, is readily soluble in acids forming stannic salts, and in caustic potash and soda, with the formation of ortho-stannates. Of these stannate of sodium, Na_2SnO_3, is produced industrially by heating tin with Chili saltpetre and caustic soda, or by fusing very finely powdered tinstone with caustic soda in iron vessels. A solution of the pure salt yields fine prisms of the composition $Na_2SnO_3 + 10H_2O$, which effloresce in the air. The salt is much used as a mordant in dyeing and calico-printing. Alkaline and other stannates when treated with aqueous hydrofluoric acid are converted into fluo-stannates (*e.g.*, K_2SnO_3 into K_2SnF_6), which are closely analogous to, and isomorphous with, fluo-silicates.

Sulphides.—If tin is heated with sulphur the two unite very readily into stannous sulphide, SnS, a lead-grey mass, which under the circumstances refuses to take up more sulphur. But, if a mixture of tin (or, better, tin amalgam), sulphur, and sal-ammoniac in proper proportions be heated, stannic sulphide, SnS_2, is produced in the beautiful form of *aurum musivum* (mosaic gold),—a solid consisting of golden yellow, metallic lustrous scales. It is used chiefly as a yellow "bronze" for plaster-of-Paris statuettes, &c.

Analysis.—Tin compounds when heated on charcoal with carbonate of soda in the reducing blowpipe flame yield metal and a scanty ring of white SnO_2. The reduction, however, succeeds better with cyanide of potassium as a flux. Stannous salt solutions yield a brown precipitate of SnS with sulphuretted hydrogen, which is insoluble in cold dilute acids and in real sulphide of ammonium, $(NH_4)_2S$; but the yellow, or the colourless reagent on addition of sulphur, dissolves the precipitate as SnS_2 salt. The solution on acidification yields a yellow precipitate of this sulphide. Stannic salt, $SnCl_4$, solutions give a yellow precipitate of SnS_2 with sulphuretted hydrogen, which is insoluble in cold dilute acids but readily soluble in sulphide of ammonium, and is re-precipitated therefrom as SnS_2 on acidification. Only stannous salts (not stannic) give a precipitate of calomel in mercuric chloride solution. A mixture of stannous and stannic chloride when added to a sufficient quantity of solution of chloride of gold, gives an intensely purple precipitate of gold purple (purple of Cassius),—a compound which, although known for centuries, is to this day little understood chemically. It behaves on the whole like a compound of Sn_2O_3 with Au_2O. The test is very delicate, although the colour is not in all cases a pure purple. (W. D.)

TINAMOU, the name given in Guiana to a certain bird as stated in 1741 by Barrere (*France Equinoxiale*, p. 138), from whom it was taken and used in a more general sense by Buffon (*Hist. Nat. Oiseaux*, iv. p. 502). In 1783 Latham (*Synopsis*, ii. p. 724) adopted it as English, and in 1790 (*Index*, ii. p. 633) Latinized it *Tinamus*, as the name of a new and distinct genus. The "Tinamou" of Barrere has been identified with the "Macucagua" described and figured by Marcgrave in 1648, and is the *Tinamus major* of modern authors.[1]

Buffon and his successors saw that the Tinamous, though passing among the European colonists of South America as "Partridges," could not be associated with those birds, and Latham's step, above mentioned, was generally approved. The genus he had founded was usually placed among the *Gallinæ*, and by many writers was held to be allied to the Bustards, which, it must be remembered, were then thought to be "Struthious." Indeed the likeness of the Tinamou's bill to that of the RHEA (vol. xx. p. 506) was remarked in 1811 by Illiger. On the other hand L'Herminier in 1827 saw features in the Tinamou's sternum that in his judgment linked the bird to the *Rallidæ*. In 1830 Wagler (*Nat. Syst. Amphibien*, &c., p. 127) placed the Tinamous in the same Order as the Ostrich and its allies; and, though he did this on very insufficient grounds, his assignment has turned out to be not far from the mark, as in 1862 the great affinity of these groups was shown by Prof. Parker's researches, which were afterwards printed in the Zoological *Transactions* (v. pp. 205-232, 236-238, pls. xxxix.-xli.), and was further substantiated by him in the *Philosophical Transactions* (1866, pp. 174-178, pl. xv.). Shortly after this Prof. Huxley in his often-quoted paper in the Zoological *Proceedings* (1867, pp. 425, 426) was enabled to place the whole matter in a clear light, urging that the Tinamous formed a very distinct group of birds which, though not to be removed from the *Carinatæ*, presented so much resemblance to the *Ratitæ* as to indicate them to be the bond of union between those two great divisions.[1] The group from the resemblance of its palatal characters to those of the EMEU (vol. viii. p. 171), *Dromæus*, he called *Dromæognathæ*, and his decision, if not his name, has since been widely accepted.

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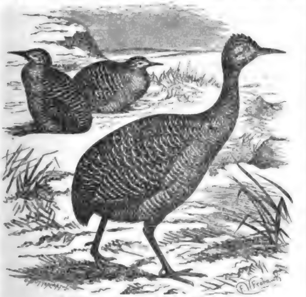
[1] Brisson and after him Linnæus confounded this bird, which they had never seen, with the TRUMPETER (*q.v.*).

The Tinamous thus—by whatever name we call them, *Dromæognathæ*, *Tinami*, or *Crypturi*—will be seen to be of great importance from a taxonomer's point of view, though in regard to numbers they are comparatively insignificant. In 1873 Messrs. Sclater and Salvin in their *Nomenclator* (pp. 152, 153) recognized nine genera and thirty-nine species, since which time about half a dozen other species may have been described; but in 1880 Schlegel (*Mus. Pays-Bas*, viii., Monogr. 41, pp. 1-51) would only admit five genera and thirty-one species—the latter because it was the number possessed by the Leyden museum. They are peculiar to the Neotropical Region—four species only finding their way into southern Mexico and none beyond. Some of them inhabit forests and others the more open country; but setting aside size (which in this group varies from that of a Quail to that of a large common Fowl) there is an unmistakable uniformity of appearance among them as a whole, so that almost anybody having seen one species of the group would always recognize another. Yet in minor characters there is considerable difference among them; and first of all the group may be divided into two sub-families, the first, *Tinaminæ*, having four toes, and the second, *Tinamotidinæ*, having but three—the latter containing, so far as is known, but two genera, *Calopezus* and *Tinamotis*, each consisting of a single species, while the former, according to Messrs. Sclater and Salvin (*ut supra*), may be separated into seven genera, two being *Tinamus* and *Nothocercus*, characterized by the roughness of their posterior tarsal scales, the others, *Crypturus*, *Rhynchotus*, *Nothoprocta*, *Nothura*, and *Taoniscus*, having smooth legs.

To the ordinary spectator Tinamous have much the look of Partridges, but the more attentive observer will notice that their elongated bill, their small head and slender neck, clothed with very short feathers, give them a different air. The plumage is generally inconspicuous: some tint of brown, ranging from rufous to slaty, and often more or less closely barred with a darker shade or black, is the usual style of coloration; but some species are characterized by a white throat or a bay breast. The wings are short and rounded, and in some forms the feathers of the tail, which in all are hidden by their coverts, are soft. In bearing and gait the birds show some resemblance to their distant relatives the *Ratitæ*, and Mr Bartlett shows (*Proc. Zool. Society*, 1868, p. 115, pl. xii.) that this is especially seen in the newly-hatched young. He also notices the still stronger Ratite character, that the male takes on himself the duty of incubation. The eggs are very remarkable objects, curiously unlike those of other birds; and, as before stated (BIRDS, vol. iii. p. 775), their shell[2] looks as if it were of highly-burnished metal or glazed porcelain, presenting also various colours, which seem to be constant in the particular species, from pale primrose to sage-green or light indigo, or from chocolate-brown to pinkish orange. All who have eaten it declare the flesh of the Tinamou to have a most delicate taste, as it has a most inviting appearance, the pectoral muscles being semi-opaque. Of their habits not much has been told. Darwin (*Journal*, chap. iii.) has remarked upon the silliness they show in allowing themselves to be taken, and this is wholly in accordance with what Prof. Parker observes of their brain capacity, and is an additional testimony to their low morphological rank. At least one species of Tinamou has bred not unfrequently in confinement, and an interesting account of what would have been a successful attempt by Mr John Bateman to naturalize this species, *Rhynchotus rufescens*, in England, at Brightlingsea in Essex, appeared in *The Field* (23d Feb. 1884 and 12th Sept. 1885). The experiment unfortunately failed owing to the destruction of the birds by foxes. (A. N.)



Rufous tinamou (*Rhynchotus rufescens*).

TINDAL, MATTHEW (1656-1733), one of the ablest and most popular of the English deists, the son of a clergyman, was born at Beer Ferris, Devonshire, in 1656. He studied law at Lincoln College, Oxford, where he came under the influence of the High Churchman George Hickes, dean of Worcester; and in his twenty-second year he was elected fellow of All Souls College, and held his fellowship till his death. About 1685 he saw "that upon his High Church notions a separation from the Church of Rome could not be justified," and accordingly he joined the latter. But, discerning the baselessness and absurdity of Rome's claims, he returned to the Church of England at Easter 1688. In 1694 he published an *Essay of Obedience to the Supreme Powers*, in which he justified the Revolution against notions of passive obedience and *jus divinum*; in 1697 an *Essay on the Power of the Magistrate and the Rights of Mankind in Matters of Religion*, an able vindication of liberty of conscience, though he allows no right of toleration to "atheists"; and in 1698 an essay on *The Liberty of the Press*, a vigorous exposure of the proposal to appoint licensers of the press and a powerful plea for the free discussion of religion. The first of his two larger works, *The Rights of the Christian Church associated against the Romish and all other priests who claim an independent power over it*, part i., appeared anonymously in 1706 (2d ed., 1706; 3d, 1707; 4th, 1709). The book was regarded in its day as an extremely forcible defence of the Erastian theory of the supremacy of the state over the church, and at once provoked a storm of counter-argument and abuse on the part of those who maintained the independent rights and authority of the church. The law also was invoked against it, and, after several attempts to proscribe the work had failed, one against the author, publisher, and printer succeeded on 12th December 1707, and another against a bookseller for selling a copy the next day. The prosecution did not prevent the issue of a fourth edition and gave the author the opportunity of issuing *A Defence of the Rights of the Christian Church*, in two parts (2d ed., 1709). The book continued to be the subject of denunciation for years, and Tindal believed he was charged by Dr Gibson, bishop of London, in a *Pastoral Letter*, with having undermined religion and promoted atheism and infidelity,—a charge to which he replied in an anonymous tract, *An Address to the Inhabitants of London and Westminster*, a second and larger edition of which appeared in 1730. In this tract[1] he makes a valiant defence of the deists and of the use of reason in religious matters, and anticipates here and there his *Christianity as Old as the Creation; or the Gospel a Republication of the Religion of Nature*, London, 1730 (2d ed., 1731; 3d, 1732; 4th, 1733), which was regarded by friends and foes alike as the "Bible" of deism. It was really only the first part of the whole work, and the second, though written and entrusted in manuscript to a friend, never saw the light. It was said that Dr Gibson prevented its publication. The first part made a great noise, and the answers to it were numerous, the most able being by Dr James Foster (1730), Dr John Conybeare (1732), Dr John Leland (1733), and Bishop Butler (1736). It was translated into German by J. Lorenz Schmidt (1741), and from it dates the influence of English deism on German theology. It is by this book that Tindal is now chiefly remembered; but he had probably adopted substantially the principles it expounds before he wrote his essay of 1697. He objected to be called a simple deist, and claimed the name of "Christian deist," as he held that true Christianity is identical with the eternal religion of nature. He died at Oxford on 16th August 1733.

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[1] M. Alix also has from an independent investigation of the osteology and myology of *Nothura major* come to virtually the same conclusion (*Journ. de Zoologie*, iii. pp. 169 and 252, pls. viii.-xi.).

[2] Herr von Nathusius has described its microscopic structure (*Journ. für wissensch. Zoologie*, 1871, pp. 330-355).

The religious system expounded in Tindal's *Christianity as Old as the Creation*, unlike the earlier system of Lord Herbert of Cherbury, was based on the empirical principles of Locke's philosophy. It assumed the traditional deistic antitheses of external and internal, positive and natural, revelations and religions, and perpetuated at the same time the prevalent misconceptions as to the nature of religion and revelation. The system was, moreover, worked out by the purely *a priori* method, with all but a total disregard of the facts of religious history. It starts from the tremendous assumptions that true religion must, both from the nature of God and the nature of things, be eternal, universal, simple, and perfect; it maintains that this religion can consist of nothing but the simple and universal duties towards God and man, the first consisting in the fulfilment of the second,—in other words, the practice of morality. The author's moral system is somewhat confused and inconsistent, but is essentially utilitarian. From such principles it follows necessarily that the true revealed religion can be nothing more nor less than a republication of the religion of nature or reason, and that, if Christianity is the perfect religion, it can only be that republication, and must be as old as the creation. The special mission of Christianity, therefore, was simply to deliver men from the superstition which had in course of time got mixed up with the religion of nature. True Christianity consequently must be a perfectly "reasonable service"; arbitrary and positive precepts can form no true part of it; revelation and reason can never disagree; reason must be supreme, and the Scriptures as well as all religious doctrines must submit to its tests; and only such writings can be regarded as Divine Scripture which tend to the honour of God and the good of man. Thus tested, much in the Old and the New Testaments must be rejected as defective in morality or erroneous in fact and principle. The strength of Tindal's position was the underlying conviction of the essential harmony between man's religious and rational nature, and consequently of the rationality of Christianity. Its weakness was that, like the whole religious philosophy of the time, it was founded on a total misconception of the nature of religion and of revelation, and on as complete a disregard of the course of man's religious development. Weak points in it were ably exposed by Foster, Conybeare, Butler, and others; but its radical errors needed for their complete exposure the higher conceptions of religion and religious history which were originated by Lessing, Schleiermacher, and Hegel.

See Leland, *View of the Principal Deistical Writers* (London, 1798); Lechler, *Geschichte des Englischen Deismus* (Stuttgart, 1841); *Theological Review*, November 1864; Hunt, *Religious Thought in England from the Reformation to the End of last Century* (London, 1870-73); Leslie Stephen, *History of English Thought in the Eighteenth Century* (London, 1876-80); A. S. Farrar, Bampton Lecture (1862), lect. iv.

TINGHAE. See **Chusan.**

TINNE, Alexandrine (1839-1869), African traveller, born at The Hague on 17th October 1839, was the daughter of an English merchant and his wife, Baroness van Steengracht-Capellen. Her father died when she was five years old, leaving her the richest heiress in the Netherlands. After travelling in Norway, Italy, and the East, and visiting Egypt, when she ascended the Nile to near the equator, Mademoiselle Tinné left Europe again in 1861 for a prolonged sojourn in the Nile regions. Accompanied by her mother and her aunt, she set out from Cairo on 9th January 1862. After a short stay at Khartoum, the party ascended the White Nile as far as Gondokoro and explored a part of the Sobat, returning to Khartoum in November. Baron von Heuglin and Dr Steudner having meantime joined the ladies at Khartoum, the whole party set out in February 1863 to explore the Bahr-el-Ghazal. The limit of navigation at the Bahr-el-Homr was reached on 10th March. From Lake Rek a journey was made overland, across the Bahr Jur and south-west by the Bahr Kosango, to Jebel Kosango, on the borders of the Niam-Niam country. During the journey all the travellers suffered severely. Steudner died in April and Madame Tinné in June, and after many fatigues and dangers the remainder of the party reached Khartoum in July 1864. Mademoiselle Tinné returned to Cairo by Berber and Suakim. The geographical and scientific results of the expedition, largely into a new country, were highly important, as will be seen in Heuglin's narrative in *Petermann's Mittheilungen* (Erg.-hft, Nov. 15, 1865), and in his own *Travels in the Region of the White Nile* (1869). At Cairo Mademoiselle Tinné lived in somewhat Oriental style during the next four years, visiting Algeria, Tunis, and other parts of the Mediterranean. In January 1869 she started from Tripoli with a caravan, intending to proceed to Lake Tchad, and thence by Wadai, Darfur, and Kordofan to the Upper Nile. In July, however, on the route from Murzuk to Rhat, she was murdered by her escort.

Besides the references already given, see John A. Tinné's *Geographical Notes of an Expedition in Central Africa by three Dutch Ladies*, Liverpool, 1864.

TINNEVELLI, or Tinavelly, a district of British India, in the Madras presidency, lying between 8° 9′ and 9° 56′ N. lat. and 77° 16′ and 78° 27′ E. long. It has an area of 5381 square miles, and a coast-line of nearly 100 miles. Madura district bounds it on the N. and N.E., on the S. and S.E. the Gulf of Mannár, and on the W. the southern Ghats. Tinnevelli is a large plain, with an average elevation of 200 feet, sloping to the east with slight undulations. Along the western boundary the mountains rise to 4000 feet; but they send out no spurs into the district, nor are there any isolated hills. The district is watered by numerous short streams, the principal being the Támbraparní (length 80 miles). In the north the scenery is unattractive and the soil poor; in the south red sandy soil prevails, in which little save the Palmyra palm will grow. But along the banks of the rivers are rice-fields and a variety of trees and crops. Many shoals occur near the shore, and in the north-east numerous rocks and reefs. The hills which divide Tinnevelli from Travancore are chiefly granite and gneiss; and along the coast stretches the broad belt of alluvium common to the whole east coast of India, and in it are many salt marshes, divided by sand-dunes from the sea. Several veins of calc spar cross the district from east to west, and the beds of all the rivers are more or less encrusted with a deposit of lime. The district contains many ancient and magnificent buildings; but the most interesting antiquities are the large sepulchral earthen urns of prehistoric races which have been found at several places, especially along the course of the Támbrapaní, and which contain bones, pottery of all sorts, beads and bronze ornaments, iron weapons, implements, &c. As the seat of Dravidian civilization Tinnevelli possesses more antiquarian interest than any other part of Madras. The climate is very hot and dry except at the season of the monsoons; the average annual rainfall throughout the district is less than 25 inches. Tinnevelli possesses several roads, but no canals. The South Indian Railway enters the district five miles north of Virudupatti and runs to Tuticorin (77 miles); a branch line (18 miles) connects this last town with Tinnevelli.

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[1] *A Second Address to the Inhabitants, &c.*, with replies to some of the critics of that book, bears the same date, 1730, though some of the works it refers to appeared in 1731.

In 1881 the population numbered 1,699,747 (males 825,887, females 873,860), of whom 1,468,977 were Hindus, 89,767 Mohammedans, and 140,946 Christians. Tinnevelli has twelve towns with over 10,000 inhabitants each, viz., TINNEVELLI (see below); Srivilliputur, 18,256; Palamcotta, 17,964; Tuticorin, 16,281; Kulase Kharapatnam, 14,972; Sivagiri, 13,632; Víravanallur, 12,318; Rajapalayam, 12,021; Tenkási, 11,987; Káyalpatnam, 11,806; Kalladakúrchi, 10,936; and Sivakási, 10,833. Out of the total area of 5381 square miles 1403 are uncultivable waste. In 1885-86 cereals, chiefly rice and spiked millet or *kambu*, the staple food of the district, occupied 842,741 acres, pulses 192,341, oil seeds 78,127, and cotton 206,717. The total area of forest is roughly estimated at 1500 square miles. Tuticorin is the only port of any importance. The chief exports are cotton, coffee, jaggery, chillies, &c.; sheep, horses, cattle, and poultry are also sent to Ceylon. There is a considerable inland trade with Travancore. The pearl fishery on the coast is now unimportant. Coastal navigation is dangerous. In 1885-86 the total revenue of the district was £365,744, of which the land-tax yielded £305,850.

The early history of Tinnevelli is mixed up with that of Madura and Travancore. Down to 1781 it is a confused tale of anarchy and bloodshed. In that year the nawab of Arcot assigned the revenues to the East India Company, whose officers then undertook the internal administration of affairs. Several risings subsequently took place, and in 1801 the whole Carnatic, including Tinnevelli, was ceded to the British. Tinnevelli is now the most Christian district of all India, both Roman Catholic and Protestant.

TINNEVELLI, chief and largest town of the above district, is situated 1¼ miles from the left bank of the Támbraparní in 8° 43′ 47″ N. lat. and 77° 43′ 49″ E. long. The town was rebuilt about 1560 by Visvanátha, the founder of the Náyakkan dynasty of Madura, who erected many temples, &c., among them the great Siva temple. Tinnevelli is an active centre of Protestant missions in south India. In 1881 the population was 23,221 (10,963 males and 12,258 females).

TINTORETTO. See ROBUSTI.

TIPPERAH, a district of British India, in the Chittagong division of the lieutenant-governorship of Bengal, situated between 23° 0′ and 24° 16′ N. lat. and 90° 36′ and 91° 32′ E. long., with an area of 2491 square miles. It is bounded on the N. by Maimansinh and Sylhet, on the S. by Noákhálí, on the W. by the river Meghna, separating it from Maimansinh, Dacca, and Bákarganj, and on the E. by the state of Hill Tipperah. The district presents a continuous flat and open surface, with the exception of the isolated Lálmái range (100 feet), and is for the most part laid out in well-cultivated fields, intersected in all directions by rivers and *khals* (creeks), which are partially affected by the tides. In the lowlands the soil is uniformly light and sandy; but in the higher parts a deep alluvial soil alternates with bands of clay and sand. The principal rivers are the Meghna, which is navigable throughout the year for boats of 4 tons burden, and the Gumti, Dákátiá, and Titás, which are also navigable for craft of 4 tons for a considerable portion of their course. There are many marshes or bhils. The principal road is the grand trunk (63 miles), which traverses the district from east to west. The wild animals include elephants, tigers, leopards, wild boars, jackals, and buffaloes. The climate is mild, agreeable, and healthy.

The population of the district in 1881 was 1,519,338 (males 770,893, females 748,445); of these Hindus numbered 511,025, Mohammedans 1,007,740, and Christians 199. There are only two towns with more than 10,000 inhabitants each, viz., Comillah (13,372) and Bráhmánbária (17,438). Comillah is the chief town of the district and is situated on the south bank of the Gumti, in 23° 28′ N. lat. and 91° 14′ E. long. Rice is the staple crop of the district; wheat and barley, Indian corn and millet, pease, gram, and several other pulses are also cultivated, as well as betel-leaf and betel-nut, sugar-cane, tobacco, &c. The chief exports are rice, jute, and betel-nuts; and the principal imports sugar, timber, cotton goods, cocoa-nut oil, bamboos, spices, salt, tobacco, &c. In 1885-86 the net revenue of the district amounted to £181,481, the land-tax contributing £102,866. Tipperah came under the East India Company in 1765; but more than a fifth of its present area was under the immediate rule of the raja of Hill Tipperah, who paid a tribute of ivory and elephants. At that time Tipperah formed part of Jalálpur; but in 1822 it was separated, and since then great changes have been made in its boundaries. With the exception of a serious raid in 1860 by the Kukís or Lusháis, nothing has disturbed the peace of the district.

TIPPERARY, an inland county of Ireland, in the province of Munster, is bounded N.W. by Galway, N.E. by King's county, E. by Queen's County and Kilkenny, S. by Waterford, and W. by Cork, Limerick, Clare, and Galway. Its greatest length north to south, from the confluence of the Little Brosna and the Shannon to the Knockmealdown Mountains, is 70 miles, and its greatest breadth west and east 40. The area is 1,061,731 acres, or about 1659 square miles.

The surface is extremely varied and picturesque. The Knockmealdown Mountains on the southern border (2609 feet) are principally of clay slate formation. To the north of this range are the picturesque Galtees, composed of Silurian strata overlaid by Old Red Sandstone (Galtymore 3015 feet). To the east, bordering Kilkenny, are the Slieveardagh Hills, composed of coalstone shales and sandstones, and near Templemore the Devil's Bit Mountains, with a curious gap on the summit. In the north-west there is a Silurian and sandstone group (Keeper Hill 2265 feet). The greater part of the county is a gently undulating plain, belonging to the central Carboniferous limestone plain of Ireland. From the rich level country the rock of Cashel, also composed of limestone, rises with great boldness and abruptness. Tipperary has only one river, the Suir, which has its source in the Devil's Bit Mountains, and flows southwards by Templemore, Thurles, Caher, and Clonmel. The Nore, which also rises in the Devil's Bit Mountains, soon passes into Queen's county, and the Shannon forms part of the western border. A spur of the Leinster coal-field, the most important in Ireland, runs into Tipperary, extending to Cashel, a distance of 20 miles with an average breadth of 5 miles. All the measures are represented. The productive portion of the field is at Killenaule. It consists of a narrow trough ranging in a north-east direction, the beds dipping towards the axis at a high angle. The coal is anthracite and the seams are thin, the workable portion being of limited extent. In the lower measures are marine fossils, and plant impressions are numerous. Copper is obtainable at Lackamore and at Hollyford near Thurles, but only in small quantities. There is a vein of lead at Shallee, and zinc has recently been dug in considerable quantities at Silvermines on the north side of the Keeper Mountains. Manganese, malachite, galena, and barytes are also obtainable. There are slate quarries at Killaloe. Between Caher and Clonmel are extensive deposits of fine pipe-clay. The Mitchelstown stalactite caverns, discovered accidentally in 1833, attract a large number of visitors.

Agriculture.—Tipperary ranks among the best agricultural districts of Ireland. The subsoil in the lower grounds is limestone, which is overlaid by a rich calcareous loam, capable of yielding the finest crops. The centre of the county is occupied by the Golden Vale, the most fertile district in Ireland, which stretches from Cashel to the town of Limerick. On the higher districts the soil is light and thin, partaking much of the character of the clay slate and sands on which it rests. Detached portions of the Bog of Allen encroach on the north-eastern parts of the county. The total number of holdings in 1885 was 23,768, of which 14,369 were under 30 acres in extent,—4841 between 15 and 30 acres, 4444 between 5 and 15, 2861 between 1 and 5, and 2223 less than 1 acre. Of the total area 24·8 per cent. was under crops, including meadow and clover, 57·9 under grass, ·1 fallow, 2·5 plantations, 4·9 bog and marsh, 6·4 barren mountain land, and 3·4 water, roads, fences, &c. The area under corn crops decreased from 85,858 acres in 1876 to

73,753 in 1885, the decrease having taken place since 1882, the areas in the previous years having been remarkably uniform. The area under wheat decreased from 13,423 acres in 1882 to 5474 in 1885, and that of oats from 57,332 to 50,196. But the area under barley, for which distillation causes a steady demand, rose from 13,551 acres in 1876 to 17,998 in 1885. The area under green crops manifests also a tendency to decrease; the total area in 1885 was 58,833 acres, 33,042 being under potatoes, 19,196 turnips, 2096 mangolds and beetroot, and 4499 other green crops. The area under meadow and clover has been steadily increasing, being 114,149 in 1876 and 127,478 in 1885. The total number of horses in 1885 was 27,365, of which 17,173 were used for agriculture; the number of cattle 254,488, of which 80,508 were milch cows, the manufacture of butter occupying considerable attention; of sheep 203,798, pigs 80,475, goats 13,011, and poultry 681,239. According to the latest landowners' *Return* (1876), the county was divided among 2372 proprietors owning 1,042,457 acres of an annual value of £676,683, the average value of the land being nearly 13s. per acre. The following possessed upwards of 10,000 acres each:—Viscount Lismore, 34,945; Lord Dunalley, 21,081; G. K. S. M. Dawson, 19,093; Lady Margaret Charteris, 16,617; marquis of Ormonde, 15,765; Viscount Hawarden, 15,272; N. Buckley, 13,260; earl of Clonmel, 11,098; and A. Moore, 10,200.

Manufactures.—A few persons are employed in mining, but the occupation of the inhabitants is chiefly agricultural. There are a considerable number of meal and flour mills.

Railways.—The county is remarkably well supplied with railways. A branch of the Great Southern and Western runs from Roscrea to Nenagh, where it joins a branch of the Limerick and Waterford, which in its progress south-eastwards from Limerick crosses the southern corner of the county by Limerick Junction, Tipperary, Caher, and Clonmel. The main line of the Great Southern and Western to Cork and Killarney crosses the centre of the county by Templemore, Thurles, and Limerick Junction. A branch of the Limerick and Waterford connects Thurles with Clonmel.

Administration and Population.—Tipperary is divided into a north and south riding, each consisting of six baronies. For parliamentary purposes it is separated into four divisions—East, Mid, North, and South—each returning one member. It contains 193 parishes and 3253 town lands. It is in the Leinster circuit. Assizes for the north riding are held in Nenagh and for the south riding in Clonmel. Quarter sessions are held at Cashel, Clonmel, Nenagh, Roscrea, Thurles, and Tipperary. There are twenty-four petty sessions districts and parts of six others. The county is within the Cork military district. Ecclesiastically it belongs to the dioceses of Cashel, Emly, Killaloe, and Lismore. Since 1841 the population has decreased more than one-half. From 435,553 in that year it fell to 216,718 in 1871 and to 199,612 in 1881. The following towns in 1881 possessed over 4000 inhabitants each, viz.—Clonmel (partly in Waterford), 9325; Tipperary, 7274; Carrick-on-Suir (partly in Waterford), 6583; Nenagh, 5422; and Thurles, 4850. The number of persons who could read and write was 115,185, who could read only, 24,386; the remainder—60,041—were unable to read or write. There were 248 persons who spoke Irish only and 23,558 able to speak Irish as well as English.

History and Antiquities.—Anciently Tipperary was included in the territory of the Tuatha Dé Danann, and afterwards probably of the clan of Degaid. Henry II., who landed at Waterford in October 1172, received at Cashel the homage of Donald O'Brien, king of Thomond. It was made a county by King John in 1210; in 1328 Edward III. made it a county palatine in favour of the earl of Ormonde; and, though the king shortly afterwards resumed his regal prerogative, the county was regranted in 1337. In 1372 the grant was confirmed to James, second earl of Ormonde, the lands belonging to the church retaining, however, a separate jurisdiction,—a division which continued till the Restoration. In 1617 James I. took the county palatine into his own hands. It was, however, restored in 1661 to James, twelfth earl and first duke, whose regalities were further made to include the portions of the county formerly under ecclesiastical jurisdiction. On the attainder of James, second duke, in 1715 the jurisdiction reverted to the crown. There are two round towers within the county,—one at Roscrea and the other on the rock of Cashel. Of the old castles there are few important examples. That built by the first earl of Ormonde at Thurles has now disappeared. On the rock of Cashel there are a massive guard tower and some remains of the ancient wall. The stronghold of Caher, now occupied as a barrack, is still in good preservation. At Roscrea one of the towers of the castle built by King John still remains, and the stronghold of the Ormondes, erected in the reign of Henry VIII., forms the depôt attached to the barracks. The ecclesiastical ruins on the rock of Cashel are among the most remarkable in Ireland. They consist of a cathedral in the Pointed style of the 13th century, partly destroyed by fire in 1495; a curious Saxon chapel, ascribed to Cormac MacCullinan, archbishop of Cashel (b. 831); the bishop's palace; the "vicar's choral-house,"—on the summit of the rock; and Hore abbey at its foot, founded for Benedictines in 1272. The abbey of Holy Cross was founded in 1182 for Cistercian monks, and is one of the finest monastic ruins in Ireland. The relic of the true cross, from which the abbey takes its name, is in possession of the Catholic hierarchy of the district. The other principal ecclesiastical ruins are the priory of Athassel, founded for Augustinian monks about 1200; Fethard abbey, founded in the 14th century, now used as a chapel; the gable and porch of the abbey of Roscrea, founded by St Cronan in the 7th century; and a portion of the Franciscan friary founded in the same town in 1490.

TIPPERARY, a market town in the above county, is beautifully situated near the base of the Slieve-na-muck or Tipperary Hills, a branch of the Galtee range, on the Waterford and Limerick Railway, 3 miles south-east of Limerick junction and 110 south-west of Dublin. It contains a handsome Protestant church, a Catholic chapel, an endowed grammar-school, a town-hall, and a new corn and butter market. Owing to its situation in the centre of a fine agricultural district, it enjoys considerable prosperity, and its butter market ranks next to that of Cork. The town is of great antiquity, but first acquired importance by the erection of a castle by King John, of which there are now no remains. A monastery founded for Augustinians by Henry III., which has also disappeared, gave a second impulse to its growth. Formerly it was a corporation from a grant made in 1310 by Edward II., but is now governed by commissioners under provision of the Town Improvement Act of 1854. The population in 1871 was 6638, and in 1881 it was 7274.

TIPPOO SAHIB (1749-1799), sultan of Mysore, was the son of Hyder Ali (*q.v.*), and was born in 1749. He received a careful Mohammedan education, and was instructed in military tactics by the French officers in the employment of his father. In 1767 in the invasion of the Carnatic he commanded a corps of cavalry, and he subsequently distinguished himself in the Mahratta War of 1775-79. On the outbreak of the first Mysore War in 1780 he was put at the head of a large body of troops, with which he achieved several successes; in particular he entirely defeated Brathwaite on the banks of the Colerun in February 1782. He succeeded his father in December 1782, and in 1784 concluded a treaty of peace with the English. In the same year he assumed the title of sultan. In 1787-88 he subjugated the Nairs of Malabar, and in 1789 provoked English invasion by ravaging the territories of the rajah of Travancore. When the English entered Mysore in 1790, he retaliated by a counter-invasion, but he was ultimately compelled by Cornwallis's victory at Arikera, near Seringapatam, to purchase peace by the cession of the half of his dominions (16th March 1792). The English having deemed it necessary to renew hostilities in March 1799, he was in less than two months shut up in Seringapatam and accidentally killed during the siege (4th May 1799). See India, vol. xii. pp. 803-4.

TIPTON, a town of England, in Staffordshire, is situated in the valley of the Stour, on the London and North-Western Railway, 4½ miles south-east of Wolverhampton and 121 north-west of London. It is built in a somewhat scattered and irregular manner, with coal-pits and iron and other works interspersed. Branches of the Birmingham Canal supply it with water communication. It depends chiefly on its iron manufactures, especially of a heavy kind, and has numerous large furnaces and rolling-mills. Its principal goods are rails, engine-boilers, tubes, fenders, and fire-irons. It also possesses works for making iron bridges and stations, cement-works, brick-works, and maltings. There are no public buildings of importance. Tipton has six churches. The parish church is of very ancient date, and its registers go back to the year 1513. Formerly the town was sometimes called Tibbington. It is under the government of a local board formed in 1866. The population of the urban sanitary district (area, 2697 acres) in 1871 was 29,445, and in 1881 it was 30,013.

TIRABOSCHI, Girolamo (1731-1794), the first historian of Italian literature, was born at Bergamo on 18th December 1731. He studied at the Jesuit college at Monza, entered the order, and was appointed in 1755 professor of eloquence in the university of Milan. Here he produced (1766-68) *Vetera Humiliatorum Monumenta* (3 vols.), a history of the extinct order of the Umiliati, which gave him at once a distinguished place in literature. Nominated in 1770 librarian to Francis III., duke of Modena, he turned to account the copious materials there accumulated for the composition of his *Storia della Letteratura Italiana*. This vast work, in which the progress of Italian literature from the time of the Etruscans to the end of the 17th century is traced in detail, occupied eleven assiduous years, 1771-82, and the thirteen quarto volumes embodying it appeared successively at Modena during that period. A second enlarged edition (16 vols.) was issued from 1787 to 1794, and was succeeded by many others, besides abridgments in German, French, and English. Tiraboschi died at Modena on 3d June 1794, leaving a high reputation for virtue, learning, and piety.

Tiraboschi wrote besides *Biblioteca Modenese* (6 vols., 1781-86); *Notizie de' Pittori, Scultori, Incisori, ed Architetti Modenesi* (1786); *Memorie Storiche Modenesi* (5 vols., 1793-94), and many minor works. He edited the *Nuovo Giornale dei Letterati d'Italia* (1773-90), and left materials for a work of great research entitled *Dizionario Topografico-Storico degli Stati Estensi* (2 vols. 4to, Modena, 1824-25).

TIRESIAS, a famous Theban seer of Greek legend, was a son of Everes and Chariclo, and a descendant of Udæus, one of the men who had sprung up from the serpent's teeth sown by Cadmus. He was blind, for which various causes were alleged. Some said that the gods had blinded him because he had revealed to men what they ought not to know. Others said that Athene (or Artemis) blinded him because he had seen her naked; when his mother prayed Athene to restore his sight, the goddess instead purged his ears so that he could understand the speech of birds and gave him a staff wherewith to guide his steps. Another story was that on Mount Cyllene (or on Cythærum) he saw two snakes coupling; he killed the female and became himself a woman. Seven years afterwards he saw the same sight, and killing the male became himself a man again. When Zeus and Hera disputed whether more pleasure was enjoyed by the male or the female sex, they referred the question to Tiresias, as he had experience of both. He decided in favour of the female sex, and Hera in her anger blinded him; but Zeus gifted him with long life and infallible divination. He lived for seven or, according to others, nine generations. In the war of the Seven against Thebes he foretold to the Thebans that they would be victorious if Menœceus offered himself in sacrifice. In the war of the Epigoni he advised the Thebans to flee. They fled, and he with them; but coming to the Tilphusian well he drank of it and died. According to others, Tiresias was taken prisoner by the victorious Argives and died while they were taking him to Delphi. The Argives took his daughter Manto (or Daphne) prisoner and sent her to Apollo at Delphi, where, being as skilled a seer as her father, she gave oracles. A different version of the legend of Tiresias was given by the elegiac poet Sostratus (reported by Eustathius on *Od.*, x. 492). According to him, Tiresias was originally a girl, but had been changed into a boy by Apollo at the age of seven; after undergoing several more transformations from one sex to the other, she (for the final sex was feminine) was turned into a mouse and her lover Arachnus into a weasel. Tiresias's grave was at the Tilphusian spring; but there was a cenotaph of him at Thebes, where also in later times his "observatory," or place for watching for omens, was pointed out. He had an oracle at Orchomenus, but during a plague it became silent and remained so in Plutarch's time. According to Homer, Tiresias was the only person in the world of the dead whom Proserpine allowed to retain intelligence. He figured in the great paintings by Polygnotus in the Lesche at Delphi. The story of his transformation into a woman is perhaps to be explained by the custom of medicine-men dressing like women, which prevails in Borneo, Patagonia, Kadiak (off Alaska), and probably elsewhere.[1]

TIRHUT, or Tirhoot, a district of British India, was formerly the largest and most populous in Bengal. On 1st January 1875 it was divided into the two districts of Darbhangah and Muzaffarpur. For the latter, see Muzaffarpur. The former, with an area of 3335 square miles, lies between 25° 30′ and 26° 40′ N. lat. and 85° 34′ and 86° 46′ E. long., and is bounded on the N. by Nepal, on the E. by Bhágalpur, on the S. by Monghyr, and on the W. by Muzaffarpur. The population of Darbhangah in 1881 was 2,633,447 (males 1,295,788, females 1,337,659); of these Hindus numbered 2,323,979, Mohammedans 308,985, and Christians 325. Its chief towns are Darbhangah, the capital, with 65,955 inhabitants; Madhubani, 11,911; and Rusera, 11,578. The total revenue of Darbhangah district in 1885-86 amounted to £157,037, of which the land revenue yielded £80,442.

The alluvial tract of country formerly known as Tirhut is varied by undulations, with groves, orchards, and woods. The principal rivers are the Ganges, Gandak, Bághmati, Tiljugá, and Karái, which are rarely navigable, except during the rainy season, when they are mostly rapid and dangerous. Tirhut produces all sorts of crops, rice being the principal; others are wheat, barley, maize, oil-seeds, &c.; opium and tobacco are largely grown for export. The chief industries include the manufacture of indigo, saltpetre, coarse cloth, pottery, and mats. The Tirhut State Railway runs from Mokameh on the left bank of the Ganges through Darbhangah and Muzaffarpur districts north-west into Champaran district as far as Bettia. A ferry over the Ganges at Mokameh connects it with the East Indian Railway. There are two branches, one extending from Muzaffarpur south-west to Hajipur (to be connected with the Bengal and North-Western Railway at Sonapur by a bridge over the Gandak), the other (226 miles open for traffic in March 1886) from Samastipur *via* Darbhangah to Janjarpur, from which it will extend eastwards to Partabganj, a mart upon the Kosi river near the Nepal frontier.

TIRLEMONT (Flem. *Thienen*), a town of Belgium, in the province of Brabant, 29½ miles by rail to the east of Brussels, on the Great Geete. The old walls, dismantled since 1804, are nearly 6 miles in circuit, but enclose a large extent of arable and garden ground. The streets are regular, and there are some spacious squares; the market-place contains the town-hall, recently restored, and the church of Notre Dame du Lac, founded in 1298, enlarged in the 15th century, but still unfinished. The church of St Germain dates partly from the 9th century. The industries of the place include the making of steam-engines, brewing, distilling, soap-making, tanning, and various woollen and cotton manufactures. The population in 1876 was 13,296.

Tirlemont was once a much larger and more flourishing town than it now is; it has suffered much in war and was taken by the French in 1635, by Marlborough in 1705, and again by the French in 1793. John Bolland, the famous editor of the *Acta Sanctorum*, was born here in 1596.

TIRYNS, the *Τίρυνς τειχιόεσσα* of Homer (*Il.*, ii. 559), was a small Peloponnesian city, in the prehistoric period of the Achæan race, long before the Dorian immigration. It stood on a small rock in the marshy plain of Argolis, about 3 miles from the sea, and was fabled to have been founded by King Prœtus, the brother of Acrisius, who was succeeded by the hero Perseus. It was the scene of the early life of Heracles, who is hence called Tirynthius. The massive walls were said to have been the work of Cyclopean masons. Its period of greatest splendour was during the 11th and 10th centuries B.C.; but the city continued to exist till about 468 B.C., when it was destroyed through the jealousy of the inhabitants of the neighbouring Argos,[1] who had not assisted in the final defeat of the Persians at Platæa.[2]

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[1] On this custom see *Journals of James Brooke of Sarawak*, ii. p. 65 *sq.*; H. Low, *Sarawak*, p. 175 *sq.*; Perelaer, *Ethnogr. Beschrijving der Dajaks*, p. 32 *sq.*; Carl Bock, *Head Hunters of Borneo*, p. 222 n.; Falkner, *Description of Patagonia*, p. 117; *Trans. Ethnolog. Soc. Lond.*, new series, vii. p. 323; Holmberg, "Ethnogr. Skizzen," in *Acta Soc. Scient. Fennicæ*, iv. p. 400 *sq.*

Excavations made in 1884-85 by Schliemann and Dörpfeld over part of the rock on which Tiryns stood have exposed a most interesting building, quite unique as an example of a Greek palace of the 11th or 10th century B.C., and of special interest from the way in which it closely illustrates the Homeric palaces of Alcinous and Odysseus, and throws a new light on scenes such as the slaughter of the suitors (*Od.*, xxi. and xxii.).

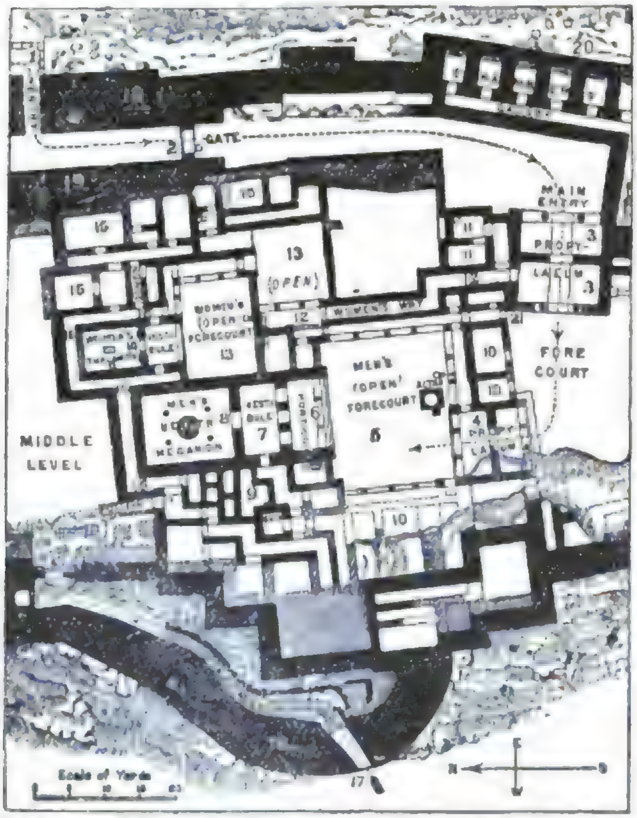

FIG. 1.—Plan of the palace in the upper part of Tiryns. 1. Main gate in the outer wall. 2. Inner gate, approached between massive walls. 3. Main propylæum. 4. Inner propylæum. 5. Court (αὐλή) of the men, surrounded by a colonnade on three sides; the altar to Zeus Herceus is by the entrance. 6. Αἴθουσα, portico of the men's megaron. 7. Πρόδομος, inner porch. 8. Men's megaron, with roof supported on four columns, and the circular hearth in the middle. 9. Bath-room and small θαλάμοι. 10, 10. Chambers round the great court. 11, 11. Guard chambers by the main propylæum. 12. Passage (λαύρη) from the main propylæum to the women's part. 13, 13. Courts of the women. 14. Women's megaron. 15. Chambers (θαλάμοι) in the women's part. 16. Passage from women's part to the rock-cut stairs. 17. Small postern door in the semicircular bastion, approached by flight of rock-cut steps. 18, 18. Massive outer wall of city. 19. Inner wall to guard the entrance passage. 20. Part of outer wall, with intermediate passage and rows of chambers, as shown in fig. 2.

The rock on which Tiryns is built is of an irregular oval shape, about 330 yards long by 112 at the widest part, and is surrounded by a very massive wall, varying from 30 to 40 feet in thickness and averaging when complete about 50 feet in height, measuring from its base outside. Inside, the wall was probably not more than 10 or 12 feet high above the ground, so the masonry acts as a retaining wall to a considerable depth of earth which covers the rock (see fig. 2 below). The wall is built of very large hammer-dressed blocks, some as much as 10 feet long by 3 feet 3 inches or 3 feet 6 inches wide, with smaller ones to fill up the interstices. The whole was bedded, not in mortar, but in clay, which has mostly been washed out of the joints; originally the surface was probably protected with a coating of stucco. The only important gateway, which was on the east side, away from the sea, probably resembled the "lion gate" at Mycenæ. The other entrances are mere slits in the wall. One of these and the chief gate are shown in fig. 1. Internally the area of the city was divided by cross walls into three parts at successive levels. The lowest and middle divisions have not yet been excavated; the upper part at the south end of the rock was completely exposed in 1884-85 by Schliemann and Dörpfeld, and the almost complete plan of the various structures clearly made out. This division contains the palace of the ruler of Tiryns, a building which shows careful and skilful construction, elaborate decoration, and a well-arranged plan, suitable to the wants of a wealthy autocratic chief, who lived in a manner which partly recalls the luxury of an Oriental king, and also resembled the feudal state of a mediæval baron, surrounded by a crowd of vassals. From the main gate, which was defended by a tower, a strong passage led between the outer wall and an inner one to an inner gate, thence to a propylæum or double porch, with two wooden columns on each side,[3] adjoining which were chambers for guards. Then came another similar, but smaller propylæum, and opposite to that was the entrance to the great court (αὐλή), nearly 53 by 70 feet, in which stands the altar to Zeus Herceus, with a circular pit beneath it to catch the victims' blood. This court was surrounded by wooden columns supporting a roof, like a mediæval cloister; on the south side are chambers for attendants (θαλάμοι). On the north side is the great hall (μέγαρον[4]), with an outer portico supported by two columns (αἴθουσα) and an inner vestibule (πρόδομος) with three doors.[5] The hall is about 40 by 30 feet, with a circular hearth-stone in the centre (ἑστία or ἐσχάρα). Four columns supported the roof, the central part of which probably rose above the rest like a mediæval "lantern"; and in this there was probably a door leading out to the flat roof round it—possibly the ὀρσοθύρη of Homer (*Od.*, xxii. 126), through which one of the suitors escaped and so got arms from the treasury or armoury, which was on an upper floor (see *Od.*, xxii. 142 and xxi. 5). On the west side of the hall are a number of small chambers (θαλάμοι) for the unmarried men, and a bath-room about 12 by 10 feet, with its floor formed of one great slab of stone, sloped so as to drain out at one side through a pipe which passes through the wall. The women's part of the house is of equal importance to that of the men, and has its hall and two open courts with pillars. It is approached in a very circuitous way,[6] either by a passage (λαύρη) leading from a side

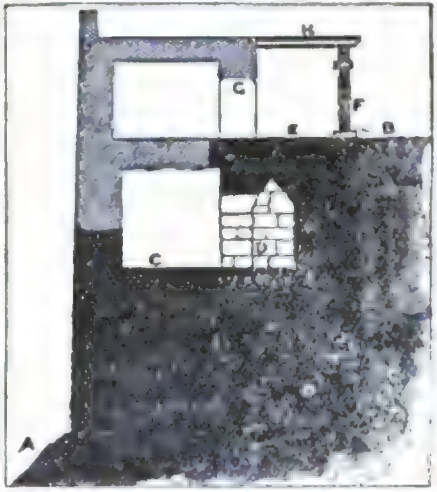

FIG. 2.—Section through the outer wall of the city at 20 in fig. 1. A. Outer base of wall. B. Inside level of city. C. Intermediate platform for the garrison. D. Chambers opening on to it, with roof formed of projecting courses of stone in large blocks. E. Top of main wall, paved with clay, level with the inside. F. Wooden columns on existing stone bases, forming a porticus or covered walk along the top of the wall. G. Outer wall of the colonnade built of brick, now missing. H. Probable roof of the colonnade of wood, covered with beaten clay.

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[1] Homer (*Il.*, ii. 559) speaks of the Tirynthians as subject to Argos.

[2] See Diod., iv. 10; Paus., ii. 25; and Herod., vi. 83, ix. 28. Schliemann (*Tiryns*, London, 1886) and Mahaffy (in *Hermathena*, Dublin), however, deny the truth of this statement, believing that Tiryns ceased to exist some centuries earlier, in spite of the strong evidence given by the inscription on the bronze column (now in Constantinople), formed by three twisted serpents, which once supported the golden tripod dedicated to Apollo out of the spoils from Platæa. Tiryns occurs in the list of allied states present at that battle; moreover, recent discoveries have brought to light remains of an important building of about 600 B.C.

[3] The arrows in fig. 1 show the way from the city gate to the palace court and hall.

[4] The women's hall is also called the megaron; see *Od.*, xviii. 198.

[5] The πρόδομος is mentioned by Homer (*Il.*, ix. 473, and *Od.*, iv. 302); but in the palace of Odysseus the αἴθουσα seems to have been the only vestibule to the megaron. In several respects the palace of Tiryns is more magnificent than that of Odysseus, whose hall was paved with clay, not concrete as at Tiryns; see *Od.*, xxi. 122, where Telemachus ἀμφὶ δὲ γαῖαν ἔναξε, after cutting a trench to fix the row of axes.

[6] The way to the harem in a modern Oriental house is similarly made as circuitous as possible, for the sake of privacy.

door in the main propylæum or by another long passage which winds round the back of the men's hall, and so leads by a long flight of steps, cut in the rock, to the little postern door in the semicircular bastion. The many small rooms in this part of the palace were probably the bedrooms of the women and married couples of the chief's family. A staircase at 16 led to an upper floor, like the *κλίμαξ ὑψηλή* of *Od.* xxi. 5. The circuit wall round the palace is more strongly constructed than the rest. On the south side it is built in two offsets, forming a level platform for the garrison halfway up. In the upper and thinner part of the wall two narrow passages at different levels are formed in its thickness. They are roofed by projecting courses of stone in large blocks. The wall on the east side has a similar intermediate platform, on to which open a series of small chambers formed in the mass of the upper wall (see fig. 2). At the top level the wall was covered by a colonnade of wood pillars resting on circular stone blocks. This supported a flat roof and was open to the inside of the city. The back of the colonnade was built of brick, and is now missing, as are all the brick parts of the city, owing to the bricks having been only sun-dried.

The methods of construction employed in the Tiryns palace are of the highest interest. The foundations and about 3 feet of the walls above the ground are made of large blocks of stone bedded in clay; above this the wall was of brick, sun-dried, and covered with stucco. The upper story was probably of wood. Some of the thresholds of the doors were massive blocks of stone (*λάϊνος οὐδός*); others were of wood (*δρύϊνος οὐδός*). Wood was also used for all the columns, doorposts, and antæ (*παραστάδες*), and in some cases the walls of the rooms were lined with wood, carefully fixed by dowels, the holes for which still exist.[1] The doors had pivots of bronze revolving in well-fitted bronze cup-like sockets let into the thresholds. In the megaron and other rooms the floors are of good concrete, decorated with a simple series of incised lines, coloured blue and red. The stucco of the internal wall is decorated with bold and very effective patterns—birds and scroll-work of semi-Oriental style; in many cases the motives are obviously taken from textile ornaments, as in the most archaic style of vase painting. One example of rich and costly decoration remains,—part of a frieze of white alabaster, sculptured in relief with rosettes and interlacing patterns, and studded with jewel-like pieces of blue glass or enamel, the *θριγκὸς κυάνοιο* of *Od.* vii. 87.[2] Further excavations in the lower parts of the city will probably bring to light the dwellings of the citizens who garrisoned the place. The great bulk of the Tirynthians must have lived in houses outside the citadel, but under the shelter of its protection, just as in mediæval Italy villages grew up round the castles of any powerful lord.[3] (J. H. M.)

TISCHENDORF,[4] LOBEGOTT FRIEDRICH KONSTANTIN (1815-1874), an eminent Biblical critic, the son of a physician, was born on 18th January 1815 at Lengenfeld, near Plauen, in the Saxon Voigtland. From the gymnasium at Plauen he passed in 1834 to the university of Leipsic, where he was mainly influenced by Winer, and began to take special interest in New Testament criticism. In 1840 he qualified as university lecturer in theology with a dissertation on the recensions of the New Testament text, the main part of which reappeared in the following year in the prolegomena to his first edition of the New Testament. The importance of these early textual studies was that they convinced him of the absolute necessity of new and exacter collations of MSS., and to this work he now gave himself. Above all he desired to go to Rome; but lack of help and money compelled him to turn first towards Paris, where he remained from October 1840 till January 1843, busy with the treasures of the great library, eking out his scanty means by making collations for other scholars, and producing for Didot several editions of the Greek New Testament, one of them exhibiting the form of the text corresponding most closely to the Vulgate. The great triumph of these laborious months was the decipherment of the palimpsest *Codex Ephraemi Rescriptus*, of which the New Testament part was printed before he left Paris and the Old Testament in 1845. His success in dealing with a MS. much of which had been illegible to earlier collators brought him into note and gained public and private support for more extended critical expeditions. From Paris he had paid short visits to Holland (1841) and England (1842). In 1843 he visited Italy, and after a stay of thirteen months went on to Egypt, Sinai, Palestine, and the Levant, returning by Vienna and Munich.[5] From Sinai he brought a great treasure, forty-three leaves of what is now known as the *Codex Sinaiticus* (א). For the time he kept the place of discovery a secret, hoping to return and procure the rest of the book, and the fragments were published in 1846 as the *Codex Friderico-Augustanus*, a name given in honour of the king of Saxony. He now became professor in Leipsic and married (1845). His teaching was apparently not very remarkable; but his vacations were often occupied by fruitful critical journeys, and in 1853 and 1859 he made a second and a third voyage to the East. In the last of these, in which he had the active aid of the Russian Government, he at length got access to the remainder of the precious Sinaitic codex, and persuaded the monks to present it to the czar, at whose cost it was published in 1862. To gain for critical study a manuscript in point of age second only to the famous Vatican Bible was a splendid triumph; but Tischendorf's Eastern journeys were rich enough in other less sensational discoveries to deserve the highest praise.[6] Side by side with his industry in collecting and collating MSS., Tischendorf pursued a constant course of editorial labours, mainly on the New Testament, until he was broken down by overwork in 1873. He died on 7th December 1874 at Leipsic.

The great edition, of which the text and apparatus appeared in 1869 and 1872,[7] was called by himself *editio viii.*; but this number is raised to twenty or twenty-one if mere reprints from stereotype plates and the minor editions of his great critical texts are included; posthumous prints bring up the total to forty-one. Four main recensions of Tischendorf's text may be distinguished, dating respectively from his editions of 1841, 1849, 1859 (*ed. vii.*), 1869-72 (*ed. viii.*). The edition of 1849 may be regarded as historically the most important from the mass of new critical material it used; that of 1859 is distinguished from Tischendorf's other editions by coming nearer to the received text; in the eighth edition the testimony of the Sinaitic MS. received great (probably too great) weight. The readings of the Vatican MS. were given with more exactness and certainty than had been possible in the earlier editions, and the editor had also the advantage of using the published labours of Tregelles. Whatever judgment may be passed on Tischendorf's critical tact and power, the apparatus of this final edition will not soon be superseded, and sums up a vast series of most important services to Biblical study.

Much less important was Tischendorf's work on the Greek Old Testament. His edition of the Roman text, with the variants of the Alexandrian MS., the Codex Ephraemi, and the Friderico-Augustanus, was of service when it appeared in 1850, but being stereotyped was not greatly improved in subsequent issues. Its imperfections, even within the limited field it covers, may be judged of by the aid of Nestle's appendix to the sixth issue (1880). Besides this may be mentioned editions of the New Testament Apocrypha (*Acts of Apostles*, 1851; *Gospels*, 1853, 2d ed. 1876; *Apocalypses*, 1866), and various minor writings, in part of an apologetic character, such as *Wann wurden unsere Evangelien verfasst?* (1865) and *Haben wir den echten Schrifttext der Evangelisten und Apostel?* (1873).

TISIO, or TISI, BENVENUTO (1481-1559), commonly called IL GAROFALO, a painter of the Ferrarese school. He was born in 1481 at Garofolo, in the Ferrarese territory, and constantly used the gillyflower (*garofalo*) as a symbol with which to sign his pictures. He took to drawing in childhood, and was put to study under Domenico Panetti (or Laneto), and afterwards at Cremona under his maternal uncle, Niccolò Soriani, a painter of credit, who died in 1499; he also frequented the school of Boccaccio

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[1] The marks of the wooden wall linings are specially clear in the little bath-room.

[2] The genuineness of this line has been questioned, but apparently without much reason.

[3] In modern Italian *castello* means a "village" as well as a "castle."

[4] In 1869 he became Konstantin von Tischendorf, having been raised to a place in the hereditary nobility of Russia.

[5] See his *Reise in den Orient*, Leipsic, 1845-46.

[6] The MSS. brought to Europe on the first two journeys are catalogued in the *Anecdota Sacra et Profana* (Leipsic, 1855, enlarged 1861). See also the *Monumenta Sacra Inedita* (Leipsic, 1846), and *Nova Collectio* of the same (1855-69). The third volume of the *Nova Coll.* gives the results of his last Eastern journey.

[7] The prolegomena remained unfinished at his death, and are being supplied by C. R. Gregory.

Boccaccino. Removing to Rome, he stayed fifteen months with Giovanni Baldini, acquiring a solid style of draughtsmanship, and finally to Mantua, where he remained two years with Lorenzo Costa. He then entered the service of the marquis Francesco Gonzaga. Afterwards he went to Ferrara, and worked there four years, showing diligence and delicacy without much severity or elevation of style. Attracted by Raphael's fame, and invited by a Ferrarese gentleman, Geronimo Sagrato, he again removed to Rome, and found the great painter very amicable; here he stayed two years, rendering some assistance in the Vatican frescos. From Rome family affairs recalled him to Ferrara; there Duke Alphonso I. commissioned him to execute paintings, along with the Dossi, in the Villa di Belriguardo and in other palaces. Thus the style of Tisio partakes of the Lombard, the Roman, and the Venetian modes. He painted extensively in Ferrara, both in oil and in fresco, two of his principal works being the Massacre of the Innocents (1519), in the church of S. Francesco, and the Betrayal of Christ (1524), accounted his masterpiece. For the former he made clay models for study and a lay figure, and executed everything from nature. Both in the Ferrarese territory and in Rome his pictures of small dimensions are very numerous. He continued constantly at work until in 1550 blindness overtook him,—an affliction which he bore with patience, being a man of pleasant friendly disposition and of devout feeling. In the later years of his work he painted on all feast-days in monasteries for the love of God. He had married at the age of forty-eight and died at Ferrara on 6th (or 16th) September 1559, leaving two children.

Garofalo combined sacred inventions with some very familiar details. A certain archaism of style, along with a strong glow of colour, suffices to distinguish from the true method of Raphael even those pictures in which he most closely resembles the great master, and this is sometimes *very* closely. He was a friend of Giulio Romano, Giorgione, Titian, and Ariosto; in a picture of Paradise he painted this poet between St Catherine and St Sebastian. In youth he was fond of lute-playing and also of fencing. He ranks as the best of the Ferrarese painters; his leading pupil was Girolamo Carpi. The Adoration of the Magi, in the church of St George near Ferrara, and a Peter Martyr, in the Dominican church, Ferrara (sometimes assumed to have been done in rivalry of Titian), are among his principal works not already mentioned. The Palazzo Chigi and the Palazzo Borghese contain numerous examples, and the London National Gallery four, one of them being a Madonna and Christ enthroned, with St Francis and three other saints.

TITANIUM (atomic weight[1] = 48·08, O = 16), designates in chemistry a relatively rare element, which is customarily classed with the metals, although it comes nearer in its character to silicon than to any of the ordinary metals. Its discovery as an element was due to William Gregor, who found in the mineral menaccanite a new earth, which was regarded as the oxide of a new metal, menachin. Independently of him Klaproth in 1793 discovered a new metal in rutile and called it titanium; he subsequently found that it was identical with Gregor's element. The latter name was, however, retained. Titanium, although pretty widely diffused throughout the mineral kingdom, is not found in abundance. The commonest titanium mineral is rutile (TiO_2); anatase and brookite, though mineralogically different from rutile and each other, are forms of the same binoxide.

Metallic titanium is little known. In 1822 Wollaston examined a specimen of those beautiful copper-like crystals which are occasionally met with in iron-furnace slags, and declared them to be metallic titanium. This view had currency until 1849, when Wöhler showed that the crystals are a compound, $Ti(NC)_2 + 3Ti_3N_2$, of a cyanide and a nitride of the metal. Real titanium was made by Wöhler and Deville in 1857 by heating to redness fluo-titanate of potassium (see below) in vapour of sodium in an atmosphere of dry hydrogen, and extracting the alkaline fluoride formed by water. The metal thus produced had the appearance of iron as obtained by the reduction of its oxide in hydrogen. When heated in air, it burns brilliantly, with the formation of binoxide. Its most curious property is the readiness with which it unites with nitrogen gas into a nitride. The exact composition of this nitride is not known; but when heated in hydrogen it loses part of its nitrogen as ammonia, and becomes Ti_3N_4, a metallic-looking yellow solid, and this when heated in nitrogen gas passes into higher nitrides, which are again available for the production of ammonia. Tessié du Mothay in 1872 proposed to utilize these reactions for the production of ammonia from atmospheric nitrogen. Of other titanium compounds the most important are those formed on the type of TiX_4, when $X = Cl, Br,$ or $\tfrac{1}{2}O$, &c.

The binoxide TiO_2 exists as rutile. One method of preparing a purer oxide from the mineral is to fuse it, very finely powdered, with six times its weight of bisulphate of potash in platinum, then extract the fuse with cold water, and boil the filtered solution for a long time. Titanic oxide separates out as a white hydrate, which, however, is generally contaminated with ferric hydrate and often with oxide of tin, SnO_2. A better method is Wöhler's. He fuses the finely powdered mineral with twice its weight of carbonate of potash in a platinum crucible, pounds the fuse, and treats it in a platinum basin with aqueous hydrofluoric acid. The alkaline titanate first produced is converted into crystalline fluo-titanate, TiF_6K_2, which is with difficulty soluble, and is extracted with hot water and filtered off. The filtrate, which may be collected in glass vessels if an excess of hydrofluoric acid has been avoided, deposits the greater part of the salt on cooling. The crystals are collected, washed, pressed, and recrystallized, whereby the impurities are easily removed. The pure salt is dissolved in hot water and decomposed with ammonia to produce a slightly ammoniacal hydrated oxide; this, when ignited in platinum, leaves pure TiO_2 in the form of brownish lumps, the specific gravity of which varies from 3·9 to 4·25, according to the temperature at which it was kept in igniting. The more intense the heat the denser the product. The oxide is fusible only in the oxy-hydrogen flame. It is insoluble in all acids, except in hot concentrated sulphuric, when finely powdered. Supposing the excess of vitriol to have been boiled away, the residue, after cooling, dissolves in cold water. The solution, if boiled, deposits its titanic oxide as a hydrate called meta-titanic acid, because it differs in its properties from ortho-titanic acid, obtained by decomposing a solution of the chloride in cold water with alkalies. The ortho-body dissolves in cold dilute acids; the meta-body does not. If titanic oxide is fused with excess of alkaline carbonate it expels CO_2 parts of carbonic acid for TiO_2 parts of itself. The salt R_2OTiO_2 is decomposed by water with the formation of a solution of alkali free of titanium, and a residue of an acid titanate, which is insoluble in water but soluble in cold aqueous mineral acids.

The chloride $TiCl_4$ is obtained as a distillate by heating to dull redness an intimate dry mixture of the binoxide and ignited lampblack in dry chlorine. The reaction may be carried out in a hard glass tube. For methods of purification we refer to the handbooks of chemistry. The pure chloride is a colourless liquid of 1·7604 specific gravity at 0° C., boiling at 136°·4 under 753·3 mm. pressure (T. E. Thorpe). It fumes strongly in moist air. When dropped very cautiously into cold water it dissolves into a clear solution, which, however, when boiled, deposits most of its oxide in the meta-hydrate form. There are, at least, two lower chlorides of titanium,—one of the composition Ti_2Cl_6 and another of the composition $TiCl_2$, both solids and both extremely prone to pass into titanic compounds. A solution of the tetrachloride in water, as well as of the soluble hydroxide in dilute acid generally, when kept in contact with metallic zinc, is reduced to one of the lower chlorides with development of a violet colour. With regard to the detection of titanium we need not add much to what we have already given incidentally. Acid solutions of TiO_2 are not precipitated by sulphuretted hydrogen; but sulphide of ammonium acts on them as if it were ammonia, the H_2S being liberated. Oxide of titanium when fused with microcosmic salt (*i.e.*, $NaPO_3$) in the oxidizing flame yields a bead which is yellowish in the heat but colourless after cooling. In the reducing flame the bead becomes violet, more readily on the addition of tin; in the presence of iron it becomes blood-red. Titanic oxides when fused on charcoal, even with cyanide of potassium, yield no metal.

TITANS, powerful beings of Greek mythology, the children of Sky and Earth. According to Hesiod, the male Titans were Oceanus, Cœus, Crius, Hyperion, Iapetus, and Cronus; the female were Thea, Rhea, Themis, Mnemosyne, Phœbe, and Tethys, to whom Apollodorus adds Dione. For the rebellion of the Titans against their father Sky (Uranus), the success and reign of Cronus, and the final consignment of the Titans to Tartarus by Zeus, see MYTHOLOGY, vol. xvii. p. 155, and SATURN, vol. xxi. p. 320 *sq.*

TITHES. It has been explained in SACRIFICE (vol. xxi. p. 133) that among ancient peoples sacrificial gifts frequently assume the character of a tribute in kind, paid to the deity in acknowledgment of the fruits of the land, or the increase of flocks attributed to his blessing. At first this tribute is not measured or enforced by law: the gift is a voluntary one, the magnitude of which may be fixed by a vow, or influenced by public opinion as to what is reasonable, but is not prescribed by any stated authority having power to exact what is prescribed. In the oldest Hebrew legislation sacrificial gifts to Jehovah (firstlings and first-fruits) are demanded; but apart from the consecration of the firstlings, which is imperative (Exod. xxii. 29 *sq.*, xxxiv. 19 *sq.*), the amount is not fixed. In Deuteronomy (xiv. 22 *sqq.*), on the other hand, the tithe or tenth of corn, wine, and oil is required in addition to the firstlings of the flock and the herd. This precept, written down in the 7th century B.C., is plainly no innovation, but rests on older usage (cp. Gen. xxviii. 22; Amos iv. 4); the new point emphasized is not that tithes must be paid, but that they must be consumed at the central, instead of a local, sanctuary (Deut. xii. 6, 11, xiv. 23 *sqq.*), apparently at the great autumn feast or Feast of TABERNACLES (*q.v.*).[1] Such a tithe is still nothing more than the old offering of first-fruits (*bikkūrīm*) made definite as regards quantity, and it was only natural that as time went on there should be some fixed standard of the due amount of the annual sacred tribute.[2] The establishment of such a standard does not necessarily imply that full payment was exacted; in Gen. xxviii. 22 Jacob vows of his own free will to pay tithes, just as the Arabs used to vow the tithe of the increase of the flock (schol. on Ḥárith, *Moall.*, l. 69, ed. Arnold). The Arab did not always fulfil his vow, and there was no force to make him do so. But, however inexactly it may often have been paid, the proportion of one part in ten seems to have been accepted in many ancient nations as the normal measure of sacred tribute paid from the gains of husbandry, trade, or even of war.[3] The tithe, in fact, appears to have been a common form of tax upon the produce of land or other revenues, for civil as well as for sacred purposes. We find it in Greece (as at Athens), and in Sicily and Asia, under the Roman empire; but its special home was in the East. It was exacted on agricultural products and flocks by Hebrew kings (1 Sam. viii. 15, 17), and on imports by the monarchs of Babylon (Aristotle, *Œcon.*, ed. Berlin, p. 1352b). Aristotle gives the tithe on fruits of the soil the first place among the revenues of satraps (*Ibid.*, p. 1345b), and it still forms an important element in the fiscal system of Mohammedan states. It will be observed that the proportion of one in ten has been applied in the East, and in antiquity generally, to imports of very different kinds, and in Mohammedan taxation we find the name retained in cases where much less than a tenth is actually taken. In like manner Aristotle (*ut supra*) makes δεκάτη a mere synonym of ἐκφόριον, or tax on produce; the proportion of one to ten, it would seem, was so commonly taken in antiquity as the basis of *ad valorem* taxes that any such tax or tribute might be called a tithe. As regards the sacred tithe of the Hebrews, a distinction is drawn in Deuteronomy between the ordinary annual tithe, which may not have been a full tenth, and the "whole" or "full tithe," paid once in three years (Deut. xiv. 28, xxvi. 12), which the legislator directs to be stored at home, and spent in feeding the poor.

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[1] According to T. E. Thorpe's researches, published in 1883.

From Amos iv. 4 it is sometimes inferred that in the 8th century B.C. the sacrificial tithe, presented at a sanctuary, was triennial. But when the prophet, mocking the false zeal of the people, says, "Bring your sacrifices every morning and your tithes every three days" (not "years," as E. V.), he hardly implies more than that occasions of sacrifice were three times as frequent as tithe-day, and so alludes to the fact that there were by old usage three annual feasts and one annual tithe. A triennial sacrificial tithe is inconceivable when it is remembered that the tithe is only an extension of the first-fruits. The triennial tithe in Deuteronomy seems to be rather an innovation necessary in the interests of the poor, when sacrificial feasts were transferred to the central sanctuary, and ceased to benefit the neighbours of the offerer, who had a prescriptive claim to be considered on such occasions (comp. 1 Sam. xxv. 8 *sqq.*; Neh. viii. 10; Luke xiv. 13).

The priests of the sanctuaries had of old a share in the sacrificial feasts, and among those who are to share in the triennial tithe Deuteronomy includes the Levites, *i.e.*, the priests of the local sanctuaries who had lost their old perquisites by the centralization of worship. After the return, and before the work of Ezra, when Deuteronomy was still the law of the new Israel, but the Levites had become subordinate ministers of the temple, and required a more regular provision, the "whole tithe" was naturally fixed on for this purpose; but, instead of remaining in the hands of the tithe-payers to be doled out in charity, it was stored in the temple. Such, at least, was the plan proposed, though from Mal. iii. 8 *sqq.* it appears that it was very imperfectly carried out. As Malachi speaks in Deuteronomic phrase of the "whole tithe," the payment to the Levites was perhaps still only triennial; and, if even this was difficult to collect, we may be sure that the minor sacrificial tithe had very nearly disappeared. The indifference complained of in Mal. i. was in great part due to the fundamental changes in the religion of Israel, which made private altar gifts and feasts almost meaningless. On the other hand, the provision of regular support for the priests and Levites, the ministers of the public ritual, was now all important, and received special attention from Ezra and Nehemiah (Neh. x. 37 *sqq.*, xiii. 10 *sqq.*). They effected it by enforcing the new law of the priestly code (Num. xviii. 21 *sqq.*), in which it is formally laid down that the tithe is a tribute paid to the Levites, who in turn pay a tithe of it to the priests. The plain intention of the priestly code is to allow the old tithe of Deuteronomy to drop; but the harmonistic interpretation of the later scribes was to the effect that two tithes were to be paid every year, and a third tithe, for the poor, on every third year (Tob. i. 7 *sq.*; Jos., *Ant.*, iv. 8, § 22). The last change in the system was the appropriation of the Levitical tithe by the priests, which apparently was effected by John Hyrcanus, though a tradition glaringly inconsistent with Nehemiah ascribes it to Ezra (*Mishnah*, "Ma'aser Sh.," v. 15; "Sota," ix. 10, and Wagenseil's note).[4] (W. R. S.)

Tithes in Law.

Tithes were generally regarded up to the 17th century as existing *jure divino*, and as having been payable to the support of the church ever since the earliest days of Christianity. History, as Selden showed in his learned and exhaustive treatise (*History of Tithes*, 1618), does not bear out this view.[5] In the words of Hallam, "the slow and gradual manner in which parochial churches became independent appears to be of itself a sufficient answer to those who ascribe a great antiquity to the universal payment of tithes."[6]

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[1] Cp. Deut. xxvi. with 1 Sam. i. 21 (Sept.), and Jerome on Ezek. i. 3; and see Wellhausen, *Prolegomena*, p. 94 (Eng. tr., p. 92 *sq.*).

[2] In Deuteronomy, accordingly, the first-fruits (*bikkūrīm*) are not mentioned; the tithe takes their place. The word translated "first-fruits" in Deut. (*rēshīth*) is a small gift to the priests, a mere basketful (xviii. 4, xxvi. 2 *sq.*).

[3] For instances see Spencer, *De Legibus Hebræorum*, lib. iii., cap. 10, § 1. Among the Semites in particular note the tithe paid by the Carthaginians to the Tyrian Melkarth (Diod., xx. 14), and the tithe of frankincense paid in Arabia to the god Sabis (Pliny, *H.N.*, xii. 32; and comp. W. R. Smith, *Prophets of Israel*, p. 382 *sq.*). A tithe of cattle appears in Lydia (Nic. Damasc., fr. 24).

[4] A cattle tithe is demanded in Levit. xxvii. 32, and spoken of in 2 Chron. xxxi. 6. It is doubtful if this was ever acknowledged in practice. See Kuenen, *Godsdienst*, ii. 269 *sq.*, and Wellhausen, *op. cit.*, v. 1, § 2 (Eng. tr., p. 155 *sq.*), who argue that the passage in Leviticus is a later addition. The tendency of the Pharisees was to pay tithe on everything, and to make a self-righteous boast of this (Matt. xxiii. 23; Luke xviii. 12).

[5] It was his denial of the divine right of tithes that brought down the wrath of the Star Chamber upon the author. He was forced to retract an opinion too liberal for the time. See SELDEN.

[6] Hallam, *Middle Ages*, ii. 205.

Long before the 8th century payment of tithes was enjoined by ecclesiastical writers and by councils of the church; but the earliest authentic example of anything like a law of the state enforcing payment appears to occur in the Capitularies of Charlemagne at the end of the 8th or beginning of the 9th century. Tithes were by that enactment to be applied to the maintenance of the bishop and clergy, the poor,[1] and the fabric of the church. In course of time the principle of payment of tithes was extended far beyond its original intention. Thus they became transferable to laymen and saleable like ordinary property, in spite of the injunctions of the third Lateran council, and they became payable out of sources of income which were not originally tithable. The canon law contains numerous and minute provisions on the subject of tithes. The *Decretum* forbade their alienation to lay proprietors, denounced excommunication against those who refused to pay, and based the right of the church upon Scriptural precedents.[2] The Decretals contained provisions as to what was and what was not tithable property, as to those privileged from payment, as to sale or hypothecation to laymen, as to priority over state taxes, &c.[3] Various questions which arose later were settled by Boniface VIII.[4] The council of Trent enjoined due payment of tithes, and excommunicated those who withhold them.[5]

In England the earliest example of legal recognition of tithes is, according to Selden, a decree of a synod in 786.[6] Other examples before the Conquest occur in the *Fœdus Ælfredi et Guthrami* and the laws of Athelstan, Edgar, and Canute.[7] The tripartite division of tithes does not appear to have been recognized in England by any genuine legal enactment except as what Mr. Freeman calls "a counsel of perfection."[8] The earliest mention of tithes in statute law proper is in the Statute of Westminster the Second in 1285, c. 5 of which deals with the patron's writ *de advocatione decimarum*. From that date until the present year (1887) there have been a large number of Acts dealing with tithes,—the earliest which is still law being 2 Hen. IV. c. 4, making it an offence to purchase a bull from the pope for the discharge of land from tithes. The law has only attained its present condition by slow degrees, and by the combined effect of statutes and judicial decisions. The effect of the Tithe Commutation Act of 1836 has been to make most of the old law of merely historical interest, as in the course of the commutation all the questions of law as to prescription, exemptions, &c., would have been duly considered by the commissioners before the rent-charge was finally apportioned.

Tithes in English law are of three kinds,—predial, arising immediately from the soil, as of corn; mixed, arising from things nourished by the soil, as of milk or wool; personal, as of the profits of manual occupations or trades. The right to the last was considerably restricted by 2 and 3 Edw. VI. c. 13. They are also divided from other points of view into ordinary and extraordinary,—the latter being a tithe at a heavier rate charged on hop and market gardens,—and into great and small, as a rule those which go to the rector and vicar respectively. In general great tithes are predial, small are mixed and personal. It is not everything that is tithable; exemptions are claimable either from the nature of the property or the privilege of the owner. Stone, lime, and such other substances as are not of annual increase are exempt. So are creatures *feræ naturæ*. Exempt by privilege are the crown by its prerogative, and spiritual corporations in accordance with the maxim recognized equally by canon and common law, *ecclesia decimas non solvit ecclesiæ*. Thus a rector pays no tithes to his vicar, or a vicar to his rector. On the same principle it is a ground of exemption that lands were anciently the property of the privileged orders (at the time of the dissolution of monasteries, the Cistercians and Hospitallers), or were lands of the greater monasteries discharged from tithe by 31 Hen. VIII. c. 13. Exemption may also be claimed by redemption, by substitution of a rent-charge, by a real composition (that is, an agreement between the incumbent and the landowner, with the consent of the ordinary and patron, for the discharge from payment of tithe by means of satisfaction by giving of land or some other real recompense), by a *modus* (that is, a partial discharge owing to some customary method of tithing or *modus decimandi*), or by prescription under 2 and 3 Will. IV. c. 100. Tithes in extra-parochial places belonged at common law to the crown, except by custom. Tithes are incorporeal hereditaments (see REAL ESTATE), and may be dealt with like any other real estate of that nature. Thus they are, if in lay hands, tenements which may be entailed or leased, are subject to dower and curtesy, are assets for the payment of debts, and are (whether in lay hands or not) within the Statute of Limitations. They do not, however, issue out of the land like rents, but are collateral to it. Accordingly tithes are always freehold, even though they are charged on copyhold lands. Tithes are presumed to go to the parson of the parish. This presumption may be rebutted by proof that some or all the tithes go to the vicar, where the rector is in holy orders, or to a lay impropriator. It is said that about a third part of the tithes in England is in the hands of laymen. At one time arbitrary consecration of tithes was allowed,—that is, payment to any priest at the will of the tithe payer. This was forbidden by a decretal epistle of Innocent III., about 1200. "This epistle decretall," says Coke, "bound not the subjects of this realm, but the same being just and reasonable they allowed the same, and so became *lex terræ*."[9] A vestige of the arbitrary consecration perhaps exists in the rarely occurring right of the parson of one parish to a portion of the tithes of another. Tithes are payable by all persons alike, whether members of the Church of England or not. Special enactments deal with their recovery from Roman Catholics and Quakers. Up to 1836 tithes were paid in kind, unless where any other method of payment applied in a particular case, such as a *modus* in the nature of a pecuniary compensation, or a pecuniary payment under the terms of a public or private Act, as in the city of London by 37 Hen. VIII. c. 12, 22 and 23 Car. II. c. 15, and other Acts. Even before 1836, however, the bulk of the tithes had been commuted, but such commutation was in ordinary cases good only during the tenure of a particular incumbency, and did not bind the incumbent's successors. The Act of 1836 merely completed and gave legislative sanction to a tendency which had been long on the increase.

The effect of the Tithe Commutation Act, 1836 (6 and 7 Will. IV. c. 71, frequently amended since), was to substitute for the tithe paid in kind or the fluctuating commuted tithe a rent-charge—commonly called the tithe rent-charge—equivalent to the market value from time to time on a septennial average of the exact quantities of wheat, barley, and oats which made up the legal tithes by the estimate in 1836. Excepted from the operation of the Act are (unless where there is a special provision approved by the commissioners) tithes of fish or of fishing, or any personal tithes other than those of mills, or any mineral tithes, or payments or rent-charges in lieu of tithes in London and other places, resting on the authority of local Acts. The Act has not been wholly successful in its working. By the transfer of estates, and by changes in local agriculture, the old estimates are no longer fairly applicable in all cases. The commutation has been, on the whole, to the advantage of the landowners, for the tithe remains fixed while the rental of land since 1836 has risen, according to Sir James Caird, from 33 millions to 52 millions per annum. Commutation under the Act is either by a voluntary agreement, confirmed by the tithe commissioners,[10] or by an award of the commissioners. The machinery for determining the tithe for any given year is as follows:—the Board of Trade is to cause the average prices per imperial bushel of each sort of British corn to be computed from the summaries sent by the inspectors of corn returns, obtained from the averages stated by the inspectors, and published in the *London Gazette* weekly, quarterly, and yearly, and a septennial average is to be obtained from the sum of the annual averages divided by seven (45 and 46 Vict. c. 37, superseding sect. 56 of the Act of 1836). The rent-charge is computed on the basis of one-third for wheat, one-third for barley, and one-third for oats. The respective prices were originally fixed by 7 Will. IV. and 1 Vict. c. 69, s. 7 (as altered by the *London Gazette* of 9th December 1837), at 7s. 1¼d. for wheat, 3s. 11½d. for barley, and 2s. 9d. for oats per bushel. The prices for 1887 were 4s. 11d., 3s. 10d., and 2s. 7½d. respectively. Owing to this fall in prices, tithe rent-charge which stood at £100 in 1836 was worth in 1887 only £87, 8s. 10d.

After the coming into force of the Act of 1836 all lands were discharged from tithe, and the tithe rent-charge was substituted, payable by equal half-yearly payments, each 1st of July and 1st of January. A tenant paying the rent-charge is to be allowed the same in account with his landlord. The charge thus ultimately falls upon the landlord, whether or not he pays it in the first instance to the tithe-owner. Land may be given instead of a rent-charge where the tithe-owner is an ecclesiastical person. Gardens or small tenements may be exempt from tithe by 3 and 4 Vict. c. 15. Later Acts give a power of redemption of rent-charge in the case of land required for public purposes, settled land, &c. (9 and 10 Vict. c. 73; 23 and 24 Vict. c. 93; 41 and 42 Vict. c. 42; 45 and 46 Vict. c. 38). Merger of the rent-charge is allowed by tenants in fee or in tail under the Act of 1836, and by persons having powers of appointment, tenants for life, and owners of glebes under 1 and 2 Vict. c. 64 and 2 and 3 Vict. c. 62. The mode of recovery of arrears provided by the Act of 1836 was a new one. Up to that time arrears could not be distrained for, unless in exceptional cases. The remedy of the parson was a suit for subtraction of tithes, which, by 2 and 3 Edw. VI. c. 13, could only be brought in a spiritual court. The remedy of the lay holder was a suit or action in any temporal court by 32 Hen. VIII.

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[1] See Dante, *Par.* xii. 93, "*decimas quæ sunt pauperum Dei.*"

[2] Pt. ii. 16, 7.

[3] Bk. iii. 30.

[4] *Extrav. Comm.*, bk. iii. 7.

[5] Sess. xxv. 12.

[6] C. viii. s. 2.

[7] The grant said to have been made by Æthelwulf in 855, to which the general payment of tithes in England has been commonly traced, appears not to rest on satisfactory evidence; see Hallam, *Middle Ages*, Supplemental Notes, p. 190.

[8] See Rev. Morris Fuller in *National Review*, November 1886.

[9] 2 *Inst.*, 641.

[10] By the Settled Land Act, 1882, the tithe commissioners have, with other bodies, been merged in the land commissioners constituted by the Act.

c. 7. It is provided by the Act of 1836 that, if the rent-charge be in arrear for twenty-one days, the person entitled to it may, after ten days' notice in writing, distrain upon the lands liable to the payment of it. If it be in arrear for forty days, and there be no sufficient distress on the premises, a writ of *habere facias possessionem* may issue, directing the sheriff to summon a jury to assess arrears. Not more than two years' arrears can be recovered by either means. It appears from these sections of the Act that the charge binds the land alone, and that there is no personal liability of either landlord or tenant. Though the charge is on the land, it is not on the inheritance, and it has been recently decided that arrears are not recoverable by sale of the lands out of which the rent-charge issues. The assessment of the rent-charge on wastes, common or Lammas lands, coppice wood, turnips, cattle agisted, &c., and the commutation of corn rents created by local Acts, are the subject of special provisions. The Act of 1836 and later Acts provided for the division of the charge upon hop grounds, orchards, fruit plantations, and market gardens into the ordinary and extraordinary charge, the latter to be a rate per acre in addition to the ordinary charge. The extraordinary tithe applies only while the land is cultivated as a hop ground, &c., and in case of new cultivation comes into operation gradually, the full rate not being levied at once. The incidence of the extraordinary tithe having been found an impediment to agriculture, especially in Kent, the Extraordinary Tithe Commutation Act, 1886 (49 and 50 Vict. c. 54), was passed as a remedy. It provides that no extraordinary tithe is to be charged upon any land newly cultivated after the passing of the Act. With regard to land subject at the passing of the Act to extraordinary tithe, the Act enables the land commissioners to certify the capital value of the extraordinary tithe on each farm or parcel of land, the land to be charged in lieu of the tithe with the payment of an annual rent-charge equal to 4 per cent. on the capital value. The owner or any other person interested in the land may redeem the charge at its capital value. Tithe rent-charge is subject by the Act of 1836 to all parliamentary, parochial, and county rates, and is an hereditament within the Poor Rate Act of the same year (6 and 7 Will. IV. c. 96). The latter Act further enacts that in estimating the net annual value of rateable hereditaments, the rent is to be estimated free, *inter alia*, of tithe commutation rent-charge, if any.[1]

Scotland.—The terms "tithes" and "teinds" are both in use, but the latter is the more common. Teinds are either drawn in kind, valued, or redeemed. Originally they were all drawn in kind, as in England, but their commutation or redemption was the subject of many Acts of the Scottish parliament, especially those passed in 1633, the practical effect of which has been to make a fixed burden on the land take the place of a fluctuating payment, and to substitute a payment of one-fifth of the rent for one-tenth of the produce. In the first instance all teinds went to the church; but, when at the Reformation the crown became proprietor of the church lands, grants were made by it to the lords of erection or titulars of the tithes, laymen holding of the crown. The Act 1587, c. 29, annexed the church lands to the crown, with certain exceptions in favour of lay holders and others. All bishops' teinds and those formerly part of the revenue of the chapel royal are now crown property. The Church Patronage Act of 1874 does not affect the right to teinds of a patron or titular. Teinds in lay hands are subject to the burden of providing a suitable provision for the minister, the stipend being fixed by the Court of Teinds. All lands are subject to teinds except those which before the Reformation were feued *cum decimis inclusis et nunquam antea separatis*, so that the grantee held lands and teinds together. In order to prove such an exemption, the person claiming under a *decimæ inclusæ* title must show that the lands and teinds belonged to a monastery, that the lands were never teindable, that they were *novalia*, or reclaimed by the monks themselves, that the title bears that the lands are held *cum decimis inclusis*, &c., and that it is previous to 1587. The judges of the Court of Session sit as commissioners of teinds,—a jurisdiction specially preserved by art. xix. of the Act of Union,—and exercise wider powers than any existing body in England, as they possess at once the jurisdiction of a court of justice and of the English land commissioners. The constitution and procedure of the Court of Teinds is regulated by 48 Geo. III. c. 138 and subsequent Acts.[2]

Ireland.—Many Acts of the Irish parliament deal with tithes, both generally and locally, the earliest being 33 Hen. VIII. c. 12, based upon the English Act, 28 Hen. VIII. c. 20. After the "tithe war" at the beginning of the 19th century, a tithe composition payable by the occupier was fixed by 4 Geo. IV. c. 99. In 1838 an annual rent-charge equal in amount to three-fourths of the tithe composition was substituted for the latter by 1 and 2 Vict. c. 109. The rent-charge is recoverable by distress where the person liable is the occupier, in other cases by action in the High Court of Justice, or by civil bill in claims under £20. The Irish Church Act, 1869 (32 and 33 Vict. c. 42), vests all tithe rent-charge then belonging to clergy of the Irish Church in the commissioners of church temporalities in Ireland. By that Act and the amending Act, 35 and 36 Vict. c. 90, the commissioners are enabled to purchase the surrender or assignment of any subsisting lease of tithe rent-charge made by an ecclesiastical person or corporation, and to sell any rent-charge vested in them to the owner of the land charged therewith for a sum equal to twenty-two and a half years' purchase. . . (J. Wt.)

TITHONUS, a character of Greek mythology, a son or, according to others, a brother of Laomedon, king of Troy. He was beloved by Eos (the Morning), who carried him away and dwelt with him at the limit of the world, by the Ocean stream. Eos begged of Zeus that her lover might live for ever, and her request was granted; but she forgot to ask immortal youth for him, so he shrivelled up into a hideous old man, whom Eos kept shut up in a chamber. At last Tithonus prayed to be rid of the burden of old age and was turned into a grasshopper. Eos had two sons by him—Memnon, king of Æthiopia, and Emathion. Memnon was killed before Troy by Achilles; but the legend is later than the *Iliad*, which does not mention it. As to Eos herself, her name is etymologically identical with the Sanskrit *ush* and the Latin *aurora*, both meaning "morning." According to Hesiod, Eos was a daughter of Hyperion and Thea, and sister of the Sun and Moon. Homer represents her arising every morning from the couch of Tithonus to carry light to gods and men, drawn in a chariot up the sky by her swift steeds Lampus and Phaethon. Her common epithet in Homer is "rosy-fingered," the meaning of which is disputed. Besides Tithonus she loved Orion, till Artemis shot him with an arrow in Ortygia. She also loved and carried off the youthful hunter Cephalus; he was already married to Procris, to whom, in spite of his infidelity, he was afterwards reconciled. A peculiar form of the Cephalus legend is given by Apollodorus (iii. 14, 3): Cephalus, a son of Hermes and Herse, was carried off by Eos, and from their union in Syria sprang Phaethon. By Astræus, Eos became the mother of the Morning Star and all the starry host.

With regard to representations in art, the combat between Achilles and Memnon was figured on the chest of Cypselus (Pausanias, v. 19, 1), and it appears on early Greek vases of Melos, Corinth, and Chalcis. There was a group of Eos carrying off Cephalus on the roof of the Stoa Basileios at Athens, and the same scene was represented on the throne at Amyclæ (Paus., i. 3, 1; iii. 18, 12). It also appears on vases, and formed an *acroterion* group on the temple at Delos. Eos in her chariot is represented on vases.

See Roscher, *Ausführliches Lexikon der griech. u. röm. Mythologie*, p. 1252 sq.

TITIAN (1477-1576). Tiziano Vecellio, or Vecelli, one of the greatest painters of the world, and in especial the typical representative of the Venetian school, was commonly called during his lifetime "Da Cadore," from the place of his birth, and has also been designated "Il Divino." The country of Cadore, in the Friuli, barren and poor, is watered by the Piave torrent poured forth from the Carnic Alps, and is at no great distance from Tyrol. Titian, therefore, was not in any sense a Venetian of the lagoons and Adriatic, but was native to a country, and a range of association, perception, and observation, of a directly different kind. Venice conquered Friuli at a date not very remote from the birth of Titian; and Cadore, having to choose between Venetian and imperial allegiance, declared for the former. Approaching the castle of Cadore from the village Sotto Castello, one passes on the right a cottage of humble pretensions, inscribed as Titian's birthplace; the precise locality is named Arsenale. The near mountain—all this range of hills being of dolomite formation—is called Marmarolo. At the neighbouring village of Valle was fought in Titian's lifetime the battle of

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[1] See, in addition to the authorities already cited, Montesquieu, *Esprit des Lois*, bk. xxxi. c. 12; Prideaux, *On Tithes*; Eagle, *On Tithes*; Shelford, *On the Tithe Commutation Acts*; Phillimore, *Ecclesiastical Law*, vol. ii., 1463; Stephen, *Comm.*, vol. ii. bk. iv. pt. ii. ch. iii.

[2] See Selden, *History of Tithes*, c. vii. s. 9; G. J. Bell, *Principles*, §§ 837, 1147; W. Bell, *Law Dict. and Digest*, "Teinds."

Cadore, a Venetian victory which he recorded in a painting. In the 12th century the count of Camino became count also of Cadore. He was called Guecello; and this name descended in 1321 to the podestà (or mayor) of Cadore, to the stock to which the painter belonged. Titian, one of a family of four, and son of Gregorio Vecelli, a distinguished councillor and soldier, and of his wife Lucia, was born in 1477.

It used to be said that Titian, when a child, painted upon the wall of the Casa Sampieri, with flower-juice, a Madonna and Infant with a boy-angel; but modern connoisseurs say that the picture is a common work, of a date later than Titian's decease. He was still a child when sent by his parents to Venice, to an uncle's house. There he was placed under an art-teacher, who may perhaps have been Sebastiano Zuccato, a mosaicist and painter now forgotten. He next became a pupil of Gentile Bellini, whom he left after a while, because the master considered him too offhand in work. Here he had the opportunity of studying many fine antiques. His last instructor was Giovanni Bellini; but Titian was not altogether satisfied with his tutoring. The youth was a contemporary of Giorgione and Palma (Vecchio); when his period of pupilage expired, he is surmised to have entered into a sort of partnership with Giorgione. A fresco of Hercules on the Morosini Palace is said to have been one of his earliest works; others were the Virgin and Child, in the Vienna Belvedere, and the Visitation of Mary and Elizabeth (from the convent of S. Andrea), now in the Venetian academy. In 1507-8 Giorgione was commissioned by the state to execute frescos on the re-erected Fondaco de' Tedeschi. Titian and Morto da Feltre worked along with him, and some fragments of Titian's paintings, which are reputed to have surpassed Giorgione's, are still discernible. According to one account, Giorgione was nettled at this superiority, and denied Titian admittance to his house thenceforth. Stories of jealousies between painters are rife in all regions, and in none more than in the Venetian,—various statements of this kind applying to Titian himself. One should neither accept nor reject them uninquiringly; counter-evidence of some weight can be cited for Vecelli's vindication in relation to Moroni, Correggio, Lotto, and Coello. Towards 1511, after the cessation of the League of Cambrai—which had endeavoured to shatter the power of the Venetian republic, and had at any rate succeeded in clipping the wings of the lion of St Mark—Vecelli went to Padua, and painted in the Scuola di S. Antonio a series of frescos, which continue to be an object of high curiosity to the students of his genius, although they cannot be matched against his finest achievements in oil painting. Another fresco, dated 1523, is St Christopher carrying the Infant Christ, at the foot of the doge's steps in the ducal palace of Venice. From Padua Titian in 1512 returned to Venice; and in 1513 he obtained a broker's patent in the Fondaco de' Tedeschi, termed "La Sanseria" or "Senseria" (a privilege much coveted by rising or risen artists), and became superintendent of the Government works, being especially charged to complete the paintings left unfinished by Giovanni Bellini in the hall of the great council in the ducal palace. He set up an atelier on the Grand Canal, at S. Samuele,—the precise site being now unknown. It was not until 1516, upon the death of Bellini, that he came into actual enjoyment of his patent; at the same date an arrangement for painting was entered into with Titian alone, to the exclusion of other artists who had heretofore been associated with him. The patent yielded him a good annuity—120 crowns—and exempted him from certain taxes,—he being bound in return to paint likenesses of the successive doges of his time at the fixed price of eight crowns each. The actual number which he executed was five. Titian, it may be well to note as a landmark in this all but centenarian life of incessant artistic labour and productiveness, was now in the fortieth year of his age. The same year, 1516, witnessed his first journey to Ferrara. Two years later was produced, for the high altar of the church of the Frari, one of his most world-renowned masterpieces, the Assumption of the Madonna, now in the Venetian academy. It excited a vast sensation, being indeed the most extraordinary piece of colourist execution on a great scale which Italy had yet seen. The signoria took note of the facts, and did not fail to observe that Titian was neglecting his work in the hall of the great council.

Vecelli was now at the height of his fame; and towards 1521, following the production of a figure of St Sebastian for the papal legate in Brescia (a work of which there are numerous replicas), purchasers became extremely urgent for his productions. It may have been about 1523, after some irregular living and a consequent fever, that he married a lady of whom only the Christian name, Cecilia, has come down to us; her first child, Pomponio, was born in 1525, and two (or perhaps three) others followed. Towards 1526 he became acquainted, and soon exceedingly intimate, with Pietro Aretino, the literary bravo, of influence and audacity hitherto unexampled, who figures so strangely in the chronicles of the time. Titian sent a portrait of him to Gonzaga, duke of Mantua. A great affliction befell him in August 1530, in the death of his wife. He then, with his three children—one of them being the infant Lavinia, whose birth had been fatal to the mother—removed to a new home, and got his sister Orsa to come from Cadore and take charge of the household. The mansion, difficult now to find, is in the Biri Grande, then a fashionable suburb, being in the extreme end of Venice on the sea, with beautiful gardens and a look-out towards Murano. In 1532 he painted in Bologna a portrait of the emperor Charles V., and was created a count palatine and knight of the Golden Spur, his children also being made nobles of the empire,—for a painter, honours of an unexampled kind.

The Venetian Government, dissatisfied at Titian's neglect of the work for the ducal palace, ordered him in 1538 to refund the money which he had received for time unemployed; and Pordenone, his formidable rival of recent years, was installed in his place. At the end of a year, however, Pordenone died; and Titian, who had meanwhile applied himself diligently to painting in the hall the battle of Cadore, was reinstated. This great picture, which was burned with several others in 1577, represented in life-size the moment at which the Venetian captain, D'Alviano, fronted the enemy, with horses and men crashing down into the stream. Fontana's engraving, and a sketch by Titian himself in the gallery of the Uffizi in Florence, record the energetic composition. As a matter of professional and worldly success, his position from about this time may be regarded as higher than that of any other painter known to history, except Raphael, Michelangelo, and at a later date Rubens. In 1540 he received a pension from D'Avalos, Marquis del Vasto, and an annuity of 200 crowns (which was afterwards doubled) from Charles V. on the treasury of Milan. Another source of profit—for he was always sufficiently keen after money—was a contract, obtained in 1542, for supplying grain to Cadore, which he visited with regularity almost every year, and where he was both generous and influential. This reminds us of Shakespeare and his relations to his birthplace, Stratford-on-Avon; and indeed the great Venetian and the greater Englishman had something akin in the essentially *natural* tone of their inspiration and performance, and in the personal tendency of each to look after practical success and "the main chance" rather than to work out aspirations and pursue ideals. Titian had a favourite villa on the neighbouring Manza Hill, from which (it may be inferred) he made his chief observations of landscape form and effect. The so-called Titian's mill, constantly discernible in his studies, is at Collontola, near Belluno. A visit was paid to Rome in 1546, when he obtained the freedom of the city, his immediate predecessor in that honour having been Michelangelo in 1537. He could at the same time have succeeded the painter Fra Sebastiano in his lucrative office of the piombo, and he made no scruple of becoming a friar for the purpose; but this project lapsed through his being summoned away from Venice in 1547 to paint Charles V. and others in Augsburg. He was there again in 1550, and executed the portrait of Philip II., which was sent to England and proved a potent auxiliary in the suit of the prince for the hand of Queen Mary. In the preceding year Vecelli had affianced his daughter Lavinia, the beautiful girl whom he loved deeply and painted various times, to Cornelio Sarcinelli of Serravalle; she had succeeded her aunt Orsa, now deceased, as the manager of the household, which, with the lordly income that Titian made by this time, was placed on a corresponding footing. The marriage took place in 1554. She died in childbirth in 1560. The years 1551 and 1552 were among those in which Titian worked least assiduously,—a circumstance which need excite no surprise in the case of a man aged about seventy-five. He was at the council of Trent towards 1555, of which his admirable picture or finished sketch in the Louvre bears record. He was never in Spain, notwithstanding the many statements which have been made in the affirmative. Titian's friend Aretino died suddenly in 1556, and another close intimate, the sculptor and architect Sansovino, in 1570. With his European fame, and many sources of wealth, Vecelli is the last man one would suppose to have been under the necessity of writing querulous and dunning letters for payment, especially when the defaulter addressed was lord of Spain and of the American Indies; yet he had constantly to complain that his pictures remained unpaid for and his pensions in arrear, and in the very year of his death (February) he recites the many pictures which he had sent within the preceding twenty years without receiving their price. In fact, there is ground for thinking that all his pensions and privileges, large as they were nominally, brought in but precarious returns. It has been pointed out that in the summer of 1566 (when he was elected into the Florentine academy) he made an official declaration of his income, and put down the various items apparently below their value, not naming at all his salary or pensions. Possibly there was but too much reason for the omission.

In September 1565 Titian went to Cadore and designed the decorations for the church at Pieve, partly executed by his pupils. One of these is a Transfiguration, another an Annunciation (now in S. Salvatore, Venice), inscribed "Titianus fecit fecit," by way of protest (it is said) against the disparagement of some persons who cavilled at the veteran's failing handicraft. He continued to accept commissions to the last. He had selected as the place for his burial the chapel of the Crucifix in the church of the Frari; and, in return for a grave, he offered the Franciscans a picture of the Pietà, representing himself and his son Orazio before the Saviour, another figure in the composition being a sibyl. This work he nearly finished; but some differences arose regarding it, and he then settled to be interred in his native Pieve. Titian was ninety-nine years of age (more or less) when the plague,[1] which was then raging in Venice, seized him, and carried him off on 27th August 1576. He was buried in the church of the Frari, as at first intended, and his Pietà was finished by Palma Giovane. He lies near his own famous painting, the Madonna di Casa Pesaro. No memorial marked his grave, until by Austrian command Canova executed the monument so well known to sightseers. Immediately after Titian's own death, his son and pictorial assistant Orazio died of the same epidemic. His sumptuous mansion was plundered during the plague by thieves, who prowled about, scarce controlled.

Titian was a man of correct features and handsome person, with an uncommon air of penetrating observation and self-possessed composure,—a Venetian presence worthy to pair with any of those "most potent, grave, and reverend signors" whom his pencil has transmitted to posterity. He was highly distinguished, courteous, and winning in society, personally unassuming, and a fine speaker, enjoying (as is said by Vasari, who saw him in the spring of 1566) health and prosperity unequalled. The numerous heads currently named Titian's Mistress might dispose us to regard the painter as a man of more than usually relaxed morals; the fact is, however, that these titles are mere fancy-names, and no inference one way or the other can be drawn from them. He gave splendid entertainments at times; and it is related that, when Henry III. of France passed through Venice on his way from Poland to take the French throne, he called on Titian with a train of nobles, and the painter presented him as a gift with all the pictures of which he inquired the price. He was not a man of universal genius or varied faculty and accomplishment, like Leonardo da Vinci and Michelangelo; his one great and supreme endowment was that of painting.

Ever since Titian rose into celebrity the general verdict has been that he is the greatest of painters, considered technically. In the first place neither the method of fresco painting nor work of the colossal scale to which fresco painting ministers is here in question. Titian's province is that of oil painting, and of painting on a scale which, though often large and grand, is not colossal either in dimension or in inspiration. Titian may properly be regarded as the greatest manipulator of paint in relation to colour, tone, luminosity, richness, texture, surface, and harmony, and with a view to the production of a pictorial whole conveying to the eye a true, dignified, and beautiful impression of its general subject-matter and of the objects of sense which form its constituent parts. In this sense Titian has never been deposed from his sovereignty in painting, nor can one forecast the time in which he will be deposed. For the complex of qualities which we sum up in the words colour, handling, and general force and harmony of effect, he stands unmatched, although in particular items of forcible or impressive execution—not to speak of creative invention—some painters, one in one respect and another in another, may indisputably be preferred to him. He carried to its acme that great colourist conception of the Venetian school of which the first masterpieces are due to the two Bellini, to Carpaccio, and, with more fully developed suavity of manner, to Giorgione. Pre-eminent inventive power or sublimity of intellect he never evinced. Even in energy of action and more especially in majesty or affluence of composition the palm is not his; it is (so far as concerns the Venetian school) assignable to Tintoretto. Titian is a painter who by wondrous magic of genius and of art satisfies the eye, and through the eye the feelings,—sometimes the mind.

Titian's pictures abound with memories of his home-country and of the region which led from the hill-summits of Cadore to the queen-city of the Adriatic. He was almost the first painter to exhibit an appreciation of mountains, mainly those of a turreted type, exemplified in the Dolomites. Indeed he gave to landscape generally a new and original vitality, expressing the quality of the objects of nature and their control over the sentiments and imagination with a force that had never before been approached. The earliest Italian picture expressly designated as "landscape" was one which Vecelli sent in 1552 to Philip II. His productive faculty was immense, even when we allow for the abnormal length of his professional career. In Italy, England, and elsewhere more than a thousand pictures figure as Titian's; of these about 250 may be regarded as dubious or spurious. There are, for instance, 9 pictures in the London National Gallery, 18 in the Louvre, 16 in the Pitti, 18 in the Uffizi, 7 in the Naples museum, 8 in the Venetian academy (besides the series in the private meeting-hall), and 41 in the Madrid museum.

Naturally a good deal of attention has been given by artists, connoisseurs, and experts to probing the secret of how Titian managed to obtain such astonishing results in colour and surface. The upshot of this research is but meagre; the secret seems to be not so much one of workmanship as of faculty. His figures were put in with the brush dipped in a brown solution, and then altered and worked up as his intention developed. The later pictures were touched off rapidly, telling well from a distant view. He himself averred that after his visit to Rome in 1546 he had greatly improved in art; and in his very last days he said—certainly with the modesty of genius, perhaps also with some of the tenacity of old age—that he was then beginning to understand what painting meant. In his earlier pictures the gamut of colour rests mainly upon red and green, in the later ones upon deep yellow and blue. The pigments which he used were nothing unusual; indeed they were both *few* and common. Palma Giovano records that Vecelli would set pictures aside for months, and afterwards, examining them with a stern countenance as if they were his mortal enemies, would set to work upon them like a man possessed; also that he kept many pictures in progress at the same time, turning from one to the other, and that in his final operations he worked far more with finger than with brush. It has been said, and probably with truth, that he tried to emulate Palma Vecchio in softness as well as Giorgione in richness. Michelangelo's verdict after inspecting the picture of Danae in the Rain of Gold, executed in 1546, has often been quoted. He said, "That man would have had no equal if art had done as much for him as nature." He was thinking principally of severity and majesty of draughtsmanship, for he added, "Pity that in Venice they don't learn how to draw well." As a draughtsman of the human figure Titian was not only competent but good and fine, and he is reported to have studied anatomy deeply; but one can easily understand that he fell not a little short of the standard of Michelangelo, and even of other leading Florentines. He was wont to paint in a nude figure with Venetian red, supplemented by a little lake in the contour and towards the extremities. He observed that a colourist ought to manipulate white, black, and red, and that the carnations cannot be done in a first painting, but by replicating various tints and mingling the colours. He distanced all predecessors in the study of colour as applied to draperies,—working on the principle (in which Giorgione may perhaps have forestalled him) that red comes forward to the eye, yellow retains the rays of light, and blue assimilates to shadow. In his subject-pictures the figures are not very numerous, and the attitudes are mostly reserved; even in bacchanals or battles the athletic display has more of facility than of furor. His architectural scenes were sometimes executed by other persons, especially the Rosas of Brescia. The glow of late afternoon, or the passionate ardour of early sundown, was much affected by Titian in the lighting of his pictures. Generally it may be said that he took great pains in completing his works, and pains also in concealing the traces of labour. He appears to have had little liking for teaching, partly from distaste of the trouble, and partly (if we are to believe biographers) from jealousy. He was quite willing, however, to turn to some account the work of his scholars: it is related that on going out-of-doors he would leave his studio open, so that the pupils had a clandestine opportunity of copying his works, and if the copies proved of saleable quality he would buy them cheap, touch them up, and resell them.

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[1] Out of a total population of 190,000 there perished at this time 50,000.

Titian's family relations appear to have been happy, except as regards his eldest son Pomponio. This youth, at the age of six, was launched upon the ecclesiastical career; but he proved wasteful and worthless, and Titian at last got so disgusted with him that he obtained the transfer to a nephew of a benefice destined for Pomponio. The fortune which he left was, after his decease, squandered by the tonsured prodigal. The other son Orazio, born towards 1528, who (as we have seen) assisted Titian professionally, became a portrait-painter of mark,—some of his likenesses, almost comparable with Titian's own, being often confounded with his by owners and connoisseurs. He executed an important picture in the hall of the great council, destroyed by fire. He gave to alchemy some of the time which might have been bestowed upon painting. Several other artists of the Vecelli family followed in the wake of Titian. Francesco Vecelli, his elder brother, was introduced to painting by Titian (it is said at the age of twelve, but chronology will hardly admit of this), and painted in the church of S. Vito in Cadore a picture of the titular saint armed. This was a noteworthy performance, of which Titian (the usual story) became jealous; so Francesco was diverted from painting to soldiering, and afterwards to mercantile life. Marco Vecelli, called Marco di Tiziano, Titian's nephew, born in 1545, was constantly with the master in his old age, and learned his methods of work. He has left some able productions,—in the ducal palace, the Meeting of Charles V. and Clement VII. in 1529; in S. Giacomo di Rialto, an Annunciation; in SS. Giovanni e Paolo, Christ Fulminant. A son of Marco, named Tiziano (or Tizianello), painted early in the 17th century. From a different branch of the family came Fabrizio di Ettore, a painter who died in 1580. His brother Cesare, who also left some pictures, is well known by his book of engraved costumes, *Abiti Antichi e Moderni*. Tommaso Vecelli, also a painter, died in 1620. There was another relative, Girolamo Dante, who, being a scholar and assistant of Titian, was called Girolamo di Tiziano. Various pictures of his were touched up by the master, and are difficult to distinguish from originals. Apart from members of his family, the scholars of Titian were not numerous; Paris Bordone and Bonifazio were the two of superior excellence. Domenico Teoscopoli (or Domenico Greco) was employed by the master to engrave from his works. It is said that Titian himself engraved on copper and on wood, but this may well be questioned.

We must now briefly advert to Titian's individual works, taking them in approximate order of time, and merely dividing portraits from other pictures. Details already given indicate that he did not exhibit any extreme precocity; the earliest works which we proceed to mention may date towards 1505. In the chapel of S. Rocco, Venice, is his Christ Carrying the Cross, now greatly dilapidated, which was an object of so much popular devotion as to produce offerings which formed the first funds for building the Scuola di S. Rocco; in the scuola itself is his Man of Sorrows. The singularly beautiful picture (see SCHOOLS OF PAINTING, vol. xxi. p. 436, fig. 16) in the Borghese Palace in Rome, commonly named Divine and Human Love (by some, Artless and Sated Love), bears some obvious relation to the style of Palma Vecchio. The story goes that Titian was enamoured of Palma's daughter; but nothing distinct on this point is forthcoming. The Tribute Money (Christ and the Pharisee), now in the Dresden gallery, dates towards 1508; Titian is said to have painted this highly finished yet not "niggling" picture in order to prove to some Germans that the effect of detail could be produced without those extreme minutiæ which mark the style of Albert Dürer. The St Mark in the church of the Salute—the evangelist enthroned, along with SS. Sebastian, Roch, Cosmo, and Damiano—a picture much in the style of Giorgione, belongs to 1512. Towards 1518 was painted, also in the same class of style, the Three Ages, now in Bridgewater House,—a woman guiding the fingers of a shepherd on a reed-pipe, two sleeping children, a cupid, an old man with two skulls, and a second shepherd in the distance, —one of the most poetically impressive among all Titian's works. Another work of approximate date was the Worship of Venus, in the Madrid museum, showing a statue of Venus, two nymphs, numerous cupids hunting a hare, and other figures. Two of the London National Gallery pictures—the Holy Family and St Catherine and the Noli Me Tangere—were going on at much the same time as the great Assumption of the Madonna. In 1521 Vecelli finished a painting which had long been due to Duke Alphonso of Ferrara, probably the Bacchanal, with Ariadne dozing over her wine-cup, which is now in Madrid. The famous Bacchus and Ariadne in the National Gallery was produced for the same patron, in 1523. The Flora of the Uffizi, the Venus of Darmstadt, and the lovely Venus Anadyomene of the Bridgewater Gallery may date a year or so earlier. Another work of 1523 is the stupendous Entombment of Christ in the Louvre, whose depth of colour and of shadow stands as the pictorial equivalent of individual facial expression; the same composition, a less admirable work, appears in the Manfrini Gallery. The Louvre picture comes from the Gonzaga collection and from the gallery of Charles I. in Whitehall. In 1530 Titian completed the St Peter Martyr for the church of SS. Giovanni e Paolo; for this work he bore off the prize in competition with Palma Vecchio and Pordenone. Of all his pictures this was the most daring in design of action, while it yielded to none in general power of workmanship and of feeling. It showed the influence of Michelangelo, who was in Venice while Vecelli was engaged upon it. A calamitous fire destroyed it in 1867; the copy of it which has taken its place is the handiwork of Cardi da Cigoli. To 1530 belongs also the Madonna del Coniglio (Louvre), painted for Gonzaga; to 1536 the Venus of Florence; to 1538 the portraits of the Twelve Cæsars, for Gonzaga; and to 1539 the Presentation of the Virgin in the Temple,—one of the conspicuous examples in the Venetian academy, yet not of the first interest or importance. About 1540 were done the forcible but rather uninspired paintings for S. Spirito, Venice, now in the church of the Salute—Cain Killing Abel, the Sacrifice of Abraham, and David and Goliath; in 1543 the Ecce Homo of the Vienna gallery, where Aretino figures as Pilate. The Venus and Cupid of Florence, the Venus of Madrid, and the Supper of Emmaus in the Louvre were still in hand, or just completed, when Titian was summoned to Augsburg in 1547. In 1554 he sent to Philip II. in England a second Danae and a Venus and Adonis. About the same time he sent to Charles V. a Trinity (or, as Titian himself termed it, Last Judgment), which represented the emperor, with his family and others, all in shrouds, praying to the Godhead; Moses and various other personages are also portrayed. This was the object upon which Charles continued to keep his eyes fixed until the film of death closed on them. Later pictures, from 1558 onwards, are the Martyrdom of St Lawrence, Christ Crowned with Thorns (Louvre), Diana and Actæon, Diana and Callisto, Jupiter and Antiope, the Magdalene, Christ in the Garden, and Europa,—the last six for Philip II.; of the two Diana subjects there are duplicates in London and in Vienna. Philip, it will be observed, was equally *au fait* with nudities and with sanctities. The Jupiter and Antiope, now much restored, is commonly called La Vénus del Pardo, having at first been in the Pardo Palace. The Magdalene here spoken of (1561) seems to be the picture now in the Uffizi of Florence; Titian, in one of his letters, said that it was the most popular picture he had ever painted. In 1568 Vecelli offered to Philip II. his Last Supper, which had been in hand for six years; it was cut down in the Escorial to suit a particular space, and offers now little noticeable beyond the fine grouping. The St Jerome of the Brera Gallery in Milan, a work of wonderful energy, spirit, and force, especially for a more then octogenarian hand, was probably rather earlier than this; there is a replica of it in the Escorial. One of the master's latest pictures (1574-75) is in Madrid, and commemorates the Battle of Lepanto; it is a work of failing power—but still the power of a Titian. Two of the mosaics in St Mark's church, Venice,—the Mark in pontificals, and the sword-sheathing angel on the right of the high altar,—are after Vecelli's designs; but they are contrary to the true spirit of mosaic work, and the Mark in especial is a decided eyesore.

We now turn to the portraits,—works so great in style, so stately, and in the best sense so simple in perception and feeling that, after allowing everything which can be said on behalf of some other masters of the craft, such as Raphael, Velazquez, Rubens, and Rembrandt, one is still compelled to say that Titian stands on the whole supreme. Among the highest examples are—Alphonso, duke of Ferrara (Madrid); the same duke and his second wife Laura Dianti (Louvre), commonly called Titian and his Mistress; Francis I. (Louvre), painted towards 1536, but not from direct sittings, for Titian never saw the French king; various likenesses of himself, one of about 1542, and another of 1562; Paul III., also the same pope with his grandsons Cardinal Alessandro and Duke Ottavio (Naples),—the former, done in about four weeks, was presented to the pontiff in May 1543, and cost two gold ducats; Pietro Aretino (Pitti); Titian's daughter Lavinia (with a fan in the Dresden gallery, with a jewelled casket in Lord Cowper's collection); the Cornaro Family (Alnwick Castle); L'Homme au Gant (Louvre), an unknown personage, youthful and handsome, the *ne plus ultra* of portraiture; Sansovino, Eleonora duchess of Urbino, Francesco duke of Urbino, Catherine Cornaro queen of Cyprus (these four are in the Uffizi); Charles V. on horseback (Madrid); Cardinal Bembo (Naples), discovered in an uncared-for condition in 1878, very unlike the portrait in the Barberini Gallery. The female portraits done by Titian are few, and are almost invariably of women of exalted rank. Of Ariosto, with whom Titian was intimate in Ferrara, though there may probably have been nothing approaching to a romantic friendship between them, the painter is said to have done three portraits. Much uncertainty, however, besets this matter. One of the three appears as a woodcut in an edition of the *Orlando Furioso*. A second, now at Cobham Hall, corresponds with the woodcut likeness, and is signed "Titianus F." The third, a work of admirable beauty, and a most fitting likeness of a poet, is in the National Gallery of London. It is difficult, however, to reconcile the features here with the other portraits, and some connoisseurs do not admit that the work is really a Titian.

Authorities.—For English readers, the *Life and Times of Titian* by Crowe and Cavalcaselle (1877) has superseded all previous works, such as those of Sir Abraham Hume (1829) and Northcote (1830). Mr Josiah Gilbert's book, *Cadore, or Titian's Country* (1869), supplies many interesting side-lights on the subject. Mr R. F. Heath's monograph (1885) is founded mainly on Crowe and Cavalcaselle and on Gilbert, and forms a very convenient compendium. In Italian, see the usual authorities—Ticozzi, Ridolfi, Lanzi, &c. (W. M. R.)

TITLES OF HONOUR are words and phrases used for marking and distinguishing the rank or station of the persons to whom they are assigned and appropriated. Whatever may have been their actual or verbal origin, it is certain that among nations which have made any considerable progress in civilization their immediate derivation has been in the great majority of cases from some kind of public office or employment. As Mr Freeman has pointed out,[1] the principal exceptions to this rule are the merely complimentary additions which it is usual to accord in Europe and America to persons who have no ascertained place or precedence in the social scale. Among ourselves "mister" or "master" (*magister*) and its feminine equivalents, and on the Continent *signor*, *señor*, and *sieur* (*senior*) and their feminine equivalents, are the leading examples. They are employed simply to avoid the necessity of calling those to whom they are applied by their proper names only, and are not indicative of any special rank or station. In France, however, *maître*, which answers to our mister or master, is the professional designation of an *avocat*, and in England "sir," which answers to *signor*, *senor*, and *sieur*, is the appropriate prefix to the Christian name and surname of a baronet or a knight. Of the derivatives of *dominus*—*don*, *donna*, and *dame*—the last in French compounded like *sieur* with the possessive pronoun in ordinary speech and appearing in *madame* as the feminine equivalent of *monsieur*, much the same may be said as of the derivatives of *magister* and *senior*. And, although our word "lord" has a special reference to the House of Lords, as the German *Herr* has to the *Herrenhaus* in certain of its uses, it largely partakes of the character which belongs to them. Its derivation is analogous to theirs, and within somewhat narrower limits it is almost as indiscriminately employed. More strictly lord and lady are the equivalents of baron and baroness, the fifth grade of the British peerage.[2] But colloquially it is applied to all grades of the peerage except the first; and, though duchesses are not called ladies in society, dukes are unquestionably lords in their capacity as members of the second chamber of the legislature. Certain of the sons and daughters of peers are lords and ladies by courtesy, while the wives of baronets are legally and the wives of knights are conventionally called ladies, although the wives of knights are more accurately described as dames. But besides this we have our lord the king and our lady the queen, lord bishops, lord lieutenants, lord justices, lord advocates, lord mayors, lord provosts, lords of the council, lords of the treasury, lords of the admiralty, lords of manors, and a variety of other lords who have no necessary connexion with the nobility. Lord and lady in fact are among the titles of honour which have never been historically associated with any particular function. Lord was originally in Anglo-Saxon *hlâford*, probably a corruption of *hlâfweard*, "the warden of bread." Lady in Anglo-Saxon is *hlæfdige*, and has also some connection with *hlâf*. Neither name acquired by means of official association any definite signification beyond the more or less general ascription of superiority.[3]

It is exceedingly difficult to distribute titles of honour into rigidly distinct categories. The following is as near an approximation as we are able to make.

I. *Supreme Sovereign Titles.*—Among titles implying sovereignty the first place is occupied by "emperor" and "king." Under existing international arrangements the crowned heads of Europe take precedence according to the date of their accession, and their rank is precisely the same, whether their style is imperial or royal. But the proper meaning of emperor is the chief of a confederation of states of which kings are members. The German emperor is an emperor in this sense, and he of course has precedence of the kings of Saxony, Bavaria, and Würtemberg, whose dominions are included in his empire. But neither he nor the emperors of Russia and Austria have any precedence as such of the queen of the United Kingdom or the kings of Italy and Spain. Originally the title of king was superior to that of emperor, and it was to avoid the assumption of the superior title of *rex* that the chief magistrates of Rome adopted the names of *Cæsar*, *imperator*, and *princeps* to signalize their authority. As *imperator* was the distinctive title of the ruler of the Western empire, so *βασιλεύς* was the distinctive title of the ruler of the Eastern empire, and the Greek *βασιλεύς* is the exact equivalent of the Latin *rex*. The emperor of the East was called *αὐτοκράτωρ* as well as *βασιλεύς*. But *βασιλεύς* came to mean the same as *imperator* in so special a way that the word *ῥήξ* was borrowed to express what had grown to be the inferior dignity of king.[4] Under Charlemagne the imperial style of Rome and the royal style of Germany were united.[5] It was, however, from Cæsar, which was common to the Western and the Eastern emperors alike, that the Teutonic word for emperor—*kaiser*—was derived. Until recent times, in fact, no sovereign thought of calling himself emperor unless he claimed in some way to represent the Roman Cæsars. Down to the beginning of the 19th century a German emperor who was not Roman emperor would have been an anomaly. At remote periods more than one of the West-Saxon kings called himself emperor of Britain, and more than one king of Castile called himself emperor of the Spains. But these assumptions appear to have been merely intended as protests against the assertion of superiority over them by the Roman emperors, German or Greek. Later on the kings of Portugal called themselves emperor of the Indies. But that title, like the queen of the United Kingdom's title of empress of India, was secondary only and did not affect their official designation in the hierarchy of European sovereigns.

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[1] In *Longman's Mag.*, vol. ii. p. 477 *sq.*

[2] "The baron alone among the ranks of peerage can hardly be called official, except so far as peerage itself is an office. His title rather marks a rank or class than an office; it does not at once point out even the memory of distinct functions like those of the duke, the marquis, or the earl" (*Longman's Mag.*, vol. ii. p. 483).

[3] Müller, *Lect. Sci. Lang.*, 2d ser., p. 255.

[4] Freeman, *Comparative Politics*, pp. 161-162.

[5] "The great triumph in the life of Charles the Great was when the ambassadors of the Eastern emperor Michael addressed him according to the full, imperial style (Eginhard, *Annals*, 812), 'Aquisgrani, ubi ad Imperatorem venerunt . . . more suo, id est, Græca lingua, laudes ei dixerunt, *Imperatorem* eum et *Basileum* appellantes'" (Freeman, *Comparative Politics*, p. 353). Mr Freeman notices also the great controversy concerning the imperial titles, especially the word *βασιλεύς*, which arose three generations later between the emperors Basil the Macedonian and Lewis the Second. See also John Lydus, *De Magistratibus*, 1, 3, on the distinction between *τύραννος*, *βασιλεύς*, and *αὐτοκράτωρ*, discussed in Freeman, *Comp. Pol.*, p. 445.

The title of king does not suggest any of the questions which have been raised by that of emperor. "There is," as Mr Freeman says, "a common idea of kingship which is at once recognized, however hard it may be to define it. This is shown among other things by the fact that no difficulty is ever felt as to translating the word king and the words which answer to it in other languages."[1] Etymologically indeed the Romance and Teutonic words for king have quite distinct origins. The Latin *rex* corresponds to the Sanskrit *rajah*, and meant originally steersman. The Teutonic king on the contrary corresponds to the Sanskrit *ganaka*, and "simply meant father, the father of a family, the king of his own kin, the father of a clan, the father of a people."[2] In English there is no feminine form of king like *königin*, the feminine form of *könig* in German. As the feminine equivalent of king, queen is used, which Prof. Max Müller says is "the old word for mother." He also cites the translation of the Bible by Ulfilas in the 4th century to prove its meaning at that early period as wife or woman. The queen was in fact in a special sense "the woman," or "the wife," the highest of women and the highest of wives in the kingdom.[3] King should properly describe the head of a nation in distinction from the head of a tribe, as emperor should properly describe the head of a confederation in distinction from the head of a nation. The idea of territorial sovereignty, of kingship over a land instead of over a people, grew up under the feudal system. In Britain it was unknown until long after the Norman Conquest. William the Conqueror, like Harold or Edward, was king of the English, and it was only from the reign of Henry II. that his successors were transformed into kings of England. The Eastern titles of sultan and shah are accepted as equivalent to those of emperor and king in the West. The sovereigns of China and Japan are called emperors both in common and in diplomatic parlance.

II. *Honorary Religious Titles of Sovereigns.*—The German emperors were formerly styled "defenders of the church," while the kings of France were called "very christian majesty" and "eldest sons of the church." The queen of England is "defender of the faith," the emperor of Austria as king of Hungary "apostolic majesty," the emperor of Russia as king of Poland "orthodox majesty," the king of Spain "catholic majesty," and the king of Portugal "very faithful majesty." All these titles were originally conferred by the popes. But the queen of the United Kingdom and the emperor of Austria alone employ them as part of their official description.

III. *Inferior Titles of Sovereignty.*—Grand-dukes rank next to kings. Grand-duke was the original title of the czars and was introduced into western Europe by Pope Pius V., who created Cosimo de' Medici grand-duke of Tuscany in the last half of the 16th century. There are now seven reigning grand-dukes in Germany. Prince and duke are titles also borne by the reigning chiefs of minor Germanic states. There are reigning princes of Monaco and Montenegro. The Eastern equivalents for these subordinate titles are khedive, emir, khan, and bey.

IV. *Titles of Nobility.*—The titles of the greater nobility are prince, duke, marquis, earl or count, viscount, and baron, and most of them exist in all European empires and kingdoms. In the United Kingdom there are no princes outside the royal family. In Russia there are no dukes except the imperial grand-dukes and neither marquises nor viscounts. In Germany there are no viscounts. Among the titles of the lesser nobility or gentry baronet and esquire are peculiar to the United Kingdom. Knight, chevalier, and ritter are recognized throughout Europe, and as far as Persia and Japan. Of old time in Scotland baron, now represented by laird, was not a title of the greater nobility, and the same may be said of *freiherr* in Germany. The peculiar designations of the chiefs of some of the Scottish clans and Irish septs, as The Chisholm, The O'Donoghue, Cameron of Lochiel, Macgillicuddy of the Reeks, and others must also be included among titles of honour. It would be improper to prefix "mister," or to affix "esquire," to their names in addressing them either orally or in writing, and their wives are always called madam. Pasha, bey, and effendi are the most familiar of the Eastern titles of nobility. The ecclesiastical titles of archbishop, bishop, dean, &c., and the military and naval titles of field-marshal, admiral, general, colonel, major, captain, &c., are common to all the countries of Europe, and are expressed by words in their several languages which are the precise equivalents of each other. But their incidentally dignified character is so overshadowed by their essentially administrative character that they can be regarded as titles of honour only in the same sense as the titles of officers of state or justice.

To the foregoing titles of honour may be added the large assortment of complimentary epithets which are attendant on them, and which are used as alternatively descriptive of the persons by whom they are borne. The Roman Cæsars were by decree of the senate called in Latin *augustus*, or sacred, which was rendered in Greek by *σεβαστός*, or adorable. They were also habitually styled *divi*, *pius* and *felix*, *clemens*, *tranquillus*, and *sanctissimus*. *Augustalis majestas* and *ἁγία βασιλεία* were among the styles of the Western and Eastern emperors respectively. Majesty, sacred majesty, or Cæsarean majesty, was the peculiar title of the emperors, and it was not assumed by any of the other sovereigns of Europe until comparatively modern times. But it is said to have been adopted in France as early as the reign of Louis XI.; in England the first king who used it was Henry VIII. Before that the kings of England had been called grace and highness, and sometimes excellent grace and kingly highness. All emperors are now imperial majesties, and all kings majesties, while grand-dukes, royal highnesses, and all inferior reigning potentates are highnesses of one sort or another. Imperial or royal highness is the proper title of the sons and daughters of emperors and kings, serene highness, or highness merely, being that of the members of princely families. The German *hoheit*, although it is commonly employed as the equivalent of highness or *altesse*, has a special signification of its own. It holds an intermediate rank between *altesse royal* or royal highness and *altesse sérénissime* or serene highness, unless it is qualified by the adjectives *kaiserliche* or *königliche*. For many years, however, it has been appropriated to the less important reigning and the mediatized princely houses, to distinguish them from the princely houses of new creation and the mediatized countly houses, to whom the titles of *durchlaucht* and *erlaucht* are severally assigned. In the United Kingdom grace is the title of dukes and duchesses, and lordship and ladyship of all other grades of the peerage and the bearers of courtesy titles of superior rank to any one of them. Dukes and duchesses are styled most noble, marquises and marchionesses most honourable, and all other peers and peeresses, lords and ladies by courtesy; privy councillors and the lord mayor of London are styled right honourable. Honourable is the title of the younger sons of earls, the sons and daughters of viscounts and barons, and the judges of the High Court of Justice. Archbishops are most reverend, bishops right reverend, deans very reverend, archdeacons venerable, and all clergymen reverend. The pope is his holiness, and cardinals are eminences. Viceroys, ambassadors, and governors are excellencies. But we have not yet rivalled the nice gradations in the descending scale of *illustres*, *spectabiles*, *clarissimi*, *perfectissimi*, and *egregii* which characterized the official or administrative hierarchy of the later Roman empire. (F. DR.)

TITMOUSE (Anglo-Saxon *Mase* and *Tytmase*, German *Meise*, Swedish *Mes*, Dutch *Mees*, French *Mésange*), the name[1] long in use for several species of small English birds, which are further distinguished from one another by some characteristic appellation. These go to make up the genus *Parus* of Linnæus, and with a very uncertain number of other genera form the Family *Paridæ* of modern ornithology. Its limits are, however, very ill-defined; and here only the species best known to English readers can be noticed.

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[1] Freeman, *Comp. Pol.*, p. 138.

[2] Max Müller, *Lect. Sci. Lang.*, 2d ser., p. 255. "All people, save those who fancy that the name *king* has something to do with a Tartar *khan* or with a "canning" or "cunning" man, are agreed that the English *cyning* and the Sanskrit *ganaka* both come from the same root, from that widely spread root whence comes our own *cyn* or kin and the Greek *γένος*. The only question is whether there is any connexion between *cyning* and *ganaka* closer than that which is implied in their both coming from the same original root. That is to say, are we to suppose that *cyning* and *ganaka* are strictly the some word common to Sanskrit and Teutonic, or is it enough to think that *cyning* is an independent formation made after the Teutons had separated themselves from the common stock? . . . The difference between the two derivations is not very remote, as the *cyn* is the ruling idea in any case; but if we make the word immediately cognate with *ganaka* we bring in a notion about 'the father of his people' which has no place if we simply derive *cyning* from *cyn*" (Freeman, *Comp. Pol.*, pp. 450-451; see also his *Norm. Conq.*, vol. i. p. 583, and *Growth of the English Constitution*, p. 171).

[3] "The king's wife was called *regina* in Latin from the beginning; but there is no English word answering to *regina*: we have not and never had any word like the German *königin*. The queen is simply queen (*cwen*), woman, wife, the highest of wives in her husband's dominions. So the earl's wife was simply the earl's wife; the Norman style of countess now came in to fill up what was thought a defect. So with all strictly English titles, knight, sheriff, portreeve, alderman: they have no feminines; in most cases the wife does not share her husband's dignity. But the mayor, being a French title, has his mayoress, just as the duke has his duchess" (Freeman on "Titles," in *Longman's Magazine*, vol. ii. p. 459).

The first to be mentioned is that called from its comparatively large size the Great Titmouse, *P. major*, but known also in many parts as the Oxeye,[2] conspicuous by its black head, white cheeks, and yellow breast, down which runs a black line, while in spring the cock makes himself heard by a loud love-note that resembles the noise made in sharpening a saw. It is widely distributed throughout the British Islands, and over nearly the whole of Europe and northern Asia. The next is the Blue Titmouse, Blue-cap, or Nun, *P. cæruleus*, smaller than the last and more common. Its names are so characteristic as to make any description needless. A third common species, but not so numerous as either of the foregoing, is the Coal-Titmouse, *P. ater*, distinguished by its black cap, white cheeks, and white nape. Some interest attaches to this species because of the difference observable between the race inhabiting the scanty remnants of the ancient Scottish forests and that which occurs throughout the rest of Britain. The former is more brightly tinted than the latter, having a clear bluish grey mantle and the lower part of the back greenish, hardly either of which colours are to be seen in the same parts of more southern examples, which last have been described as forming a distinct species, *P. britannicus*. But it is to be observed that the denizens of the old Scotch fir-woods are nearly midway in coloration between the dingy southern birds and those which prevail over the greater part of the Continent. It would therefore seem unreasonable to speak of two species only: there should be either three or one, and the latter alternative is to be preferred, provided the existence of the local races be duly recognized. Much the same thing is to be noticed in the next species to be mentioned, the Marsh-Titmouse, *P. palustris*, which, sombre as is its plumage, is subject to considerable local variation in its very extensive range, and has been called *P. borealis* in Scandinavia, *P. alpestris* in the Alps, and *P. lugubris* in south-eastern Europe, to say nothing of forms like *P. baicalensis*, *P. camchatkensis*, and others, whose names denote its local variations in northern Asia, while no great violence is exercised if to these be tacked on *P. atricapilla* with several geographical races which inhabit North America. A fifth British species is the rare Crested Titmouse, *P. cristatus*, only found in limited districts in Scotland, though common enough, especially in pine-woods, in many parts of Europe.

It is impossible to state how many species of *Parus* exist, their recognition at present being wholly subjective to the view taken by the investigator of the group. Its latest monographer is Dr Gadow (*Cat. B. Br. Museum*, viii. pp. 3-53), who recognizes forty-eight, besides several sub-species. North-American ornithologists include some fifteen as inhabitants of Canada and the United States; but scarcely two writers agree on this point, owing to the existence of so many local forms. Of the species inhabiting the Indian and Ethiopian Regions there is no space here to treat, and for the same reason the presumably allied forms of Australia and New Zealand must be left unnoticed. During the greater part of the year the various species of the genus *Parus* associate in family parties in a way that has been already described (BIRDS, vol. iii., p. 766), and only break up into pairs at the beginning of the breeding-season. The nests are nearly always placed in a hollow stump, and consist of a mass of moss, feathers, and hair, the last being worked almost into a kind of felt. Thereon the eggs, often to the number of eight or nine, are laid, and these have a translucent white shell, freckled or spotted with rust-colour. The first plumage of the young closely resembles that of the parents; but, so far as is known, it has always a yellower tinge, very apparent on the parts, if there be such, which in the adult are white. Few birds are more restless in disposition, and if "irritability" be the test of high organization, as a much bepraised systematist asserts, the *Paridæ* should stand very near the top of the list. Most of the European species and some of the North-American become familiar, haunting the neighbourhood of houses, especially in winter, and readily availing themselves of such scraps of food, about the nature of which they are not particular, as they can get.[3] By gardeners every Titmouse is generally regarded as an enemy, for it is supposed to do infinite damage to the buds of fruit-trees and bushes; but the accusation is wholly false, for the buds destroyed are always found to be those to which a grub—the bird's real object—has got access, so that there can be little doubt that the Titmouse is a great benefactor to the horticulturist, and hardly ever more so than when the careless spectator of its deeds is supposing it to be bent on mischief.

Akin to the genus *Parus*, but in many respects differing from it, is *Acredula*, containing that curious-looking bird the Long-tailed or Bottle-Titmouse, with its many local races or species, which must be here passed over without a word. The bird itself, having its tail longer than its body, is unlike any other found in the northern hemisphere, while its nest is a perfect marvel of construction, being in shape nearly oval with a small hole in one side. The exterior is studded with pieces of lichen, worked into a firm texture of moss, wool, and spiders' nests, and the inside is profusely lined with soft feathers—2379 having been, says Macgillvray, counted in one example. Not inferior in beauty or ingenuity is the nest built by the Penduline Titmouse, *Ægithalus pendulinus*, of the south of Europe, which differs, however, not merely in composition but in being suspended to a bough, while the former is nearly always placed between two or more branches.

The so-called Bearded Titmouse, *Panurus biarmicus*, has habits wholly unlike those of any of the foregoing, and certainly does not belong to the Family *Paridæ*, though its real affinity has not yet been clearly shown. It was formerly found in many parts of England, especially in the eastern counties, where it bore the name of Reed-Pheasant[4]; but through the draining of meres, the destruction of reed-beds, and (it must be added) the rapacity of collectors it now only exists as a native in a very few localities. It is a beautiful little bird of a bright tawny colour, variegated with black and white, while the cock is further distinguished by a bluish grey head and a black tuft of feathers on each side of the chin. Its chief food seems to be the smaller kinds of freshwater mollusks, which it finds among the reed-beds it seldom quits.

The general affinities of the *Paridæ* seem to lie rather with the *Sittidæ* (*cf.* NUTHATCH, vol. xvii. p. 665) and the Tree-Creepers; and those systematists who would ally them to the *Laniidæ* (SHRIKE, vol. xxi. p. 845), or still more interpose the last between the former Families, have yet to find grounds for so doing. (A. N.)

TITUS. By this, his Roman prænomen, is usually known the eleventh of the Twelve Cæsars, TITUS FLAVIUS SABINUS VESPASIANUS, emperor from 79 to 81 A.D. With his father Vespasian, who rose to empire from the camp, began the Flavian line of emperors, the last three Cæsars. Titus was born in 40, the year of the assassination of the fourth Cæsar, Caius Caligula, and was brought up in the household of Claudius, with that emperor's son, Britannicus. There was a story that he was dining at Nero's table when Britannicus was poisoned, and that he himself tasted the fatal cup, and had in consequence a serious illness. Some time afterwards he erected two statues to the young prince's memory. Educated in the imperial court, he was thoroughly trained in all elegant accomplishments: he could speak Greek fluently, and could compose verses; he was a proficient in music; he could write shorthand, and could imitate handwriting so skilfully that he used to say that he might have been a most successful forger. He was very handsome, with a fine commanding expression, and a vigorous frame, well trained in all the exercises of a soldier. As a young man he served with credit in Germany and in Britain, and he practised at the bar. Soon he had the command of a legion, and joined his father in Syria; he took an active part in the Jewish war, capturing several important fortresses, among them Tarichææ and Gamala. In 68 he went at his father's bidding on a visit of congratulation to the newly proclaimed emperor, Galba; but, hearing of Galba's death and of the general confusion in the Roman world, he returned to his father in Palestine, having in the meantime consulted the oracle of the Paphian Venus as to his prospects and received a favourable answer. In the following year Vespasian, who, through his son's pleasing manner and adroit management, had made a friend of Mucianus, the governor of Syria, became emperor, and left Titus to finally settle the Jewish war by the capture of Jerusalem. Titus conducted the siege of the city, which for some months was defended amid incredible horrors, with signal ability, and took and destroyed it in September 70. The army saluted their victorious general by the title of "imperator"; in the East Titus was now supreme, and practically emperor. On his return to Italy by way of Alexandria he fell in with that strange professor of mystical philosophy and magic, Apollonius of Tyana, and listened, it is said, to his pedantic talk and advice. As soon as he arrived at Rome there was the usual triumph for a decisive victory, and both father and son shared it. On the arch of Titus, as it is called, erected some few years afterwards (see vol. xx. p. 830), may still be seen sculptured representations of Jewish captives and of the captured trophies. Titus was now formally associated with his father in the government, with the title of Cæsar, and during the nine remaining years of Vespasian's reign he controlled the administration, and was in fact emperor. He was anything but popular; he had the character of being luxurious, self-indulgent, profligate, and cruel. Summary execution of obnoxious persons seems to have been not uncommon. There was a bad scandal too about his connexion with the shameless Jewish beauty Berenice, the sister of the Agrippa of the Acts of the Apostles; both brother and sister followed Titus to Rome, and were allowed to reside in the imperial palace. Public opinion at Rome was outraged, and Titus, though he had promised Berenice marriage, felt obliged to send her back to the East. Vespasian died in 79, leaving his son a safe throne and a well-filled treasury. The forebodings of the people were agreeably disappointed, for Titus, who, it was feared, would be a second Nero, was known as the "love and delight of mankind." It is possible that his popularity was in some degree due to the fears which the depravity of his brother Domitian, who, it was known, was to succeed him, had begun to excite; but he had the tact to make himself liked by all. He seems to have been thoroughly kindly and good-natured; he delighted in giving splendid presents, and his memorable saying, "I have lost a day," is said to have been uttered one evening at the dinner table when he suddenly remembered that he had not bestowed a gift on any one that day.

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[1] The prefix "Tit," by heedless writers often used alone, though equally proper to the Titlark (cf. PIPIT, vol. xix. p. 112), is perhaps cognate with the Greek *τιτίς*, which originally meant a small chirping bird (*Ann. Nat. History*, ser. 4, x p. 227), and has a diminutive form in the Icelandic *Tillingur*—the English or at least Scottish *Titling*. It is by false analogy that the plural of Titmouse is made *Titmice*; it should be *Titmouses*. A nickname is very often added, as with many other familiar English birds, and in this case it is "Tom."

[2] The signification of this name is obscure. It may perhaps be correlated with a Swedish name for the bird—*Talgoxe*.

[3] Persons fond of watching the habits of birds may with little trouble provide a pleasing spectacle by adopting the plan, practised by the late Mr A. E. Knox, of hanging a lump of suet or tallow by a short string to the end of a flexible rod stuck aslant into the ground close to the window of a sitting-room. It is seldom long before a Titmouse of some kind finds the dainty, and once found visits are made to it until every morsel is picked off. The attitudes of the birds as they cling to the swinging lure are very diverting, and none but a Titmouse can succeed in keeping a foothold upon it.

[4] The common names given to this bird are so very inapplicable that it is a pity that "Silerella" (from *siler*, an osier) bestowed upon it by Sir T. Browne, its original discoverer, cannot be restored.

Titus, like his father, spent money on great public works and in adding to the magnificence of Rome. The Colosseum was completed and dedicated in his reign, with combats of gladiators, shows of wild beasts, and sham sea-fights and representations of some of the great Greek naval battles. He gave the city what we should now call "a people's palace" in his splendid baths, which surpassed those of Agrippa and of Nero, and supplied the mob with every luxurious appliance free of cost

During his reign, in 79, occurred the memorable eruption of Vesuvius which destroyed Herculaneum and Pompeii. The emperor visited the scenes of desolation and contributed liberally to the relief of the distressed inhabitants. During his absence a fire raged for three days at Rome, in which the Capitol was burnt; then followed a pestilence, and again Titus not only helped freely with his purse, but took pains to acquaint himself with the sufferers and gave them his personal sympathy. Italy and the Roman world generally were quiet and peaceful during this brief reign. The only fighting was in Britain under Agricola, who in the year 80 carried the Roman arms into Scotland as far as the Tay. In the following September Titus died, being in his fortieth year, after a reign of two years and rather more than two months. On his deathbed he said, so the story went, that there was but one thing of which he repented: this was commonly supposed to point to his having spared to punish his brother Domitian, who had more than once plotted against his life, and whose succession to empire he must have felt would be a calamity for Rome. The verdict of history is on the whole favourable to Titus, and perhaps deservedly so; but the general feeling throughout the Roman world after his death was that he had been fortunate in the briefness of his reign.

An admirable account of this emperor will be found in Merivale's *History of the Romans under the Empire*, ch. 60. (W. J. B.)

TITUS, one of the companions of St Paul, was of Greek origin (Gal. ii. 3), and appears to have been among the apostle's earliest converts; he is first mentioned (Gal. ii. 1) as having accompanied Paul, then in the course of his second missionary journey, from Antioch to Jerusalem. Here the Judaizing brethren desired that he should be circumcised; but the liberty of the gospel was successfully maintained. He was afterwards sent by Paul from Ephesus to Corinth, with, it would seem, a letter, no longer extant, more than once referred to in 2 Corinthians (ii. 3, vii. 8; comp. vol. vi. p. 401). He rejoined the apostle with favourable reports from Corinth in Macedonia, and was again sent (from Philippi) with another epistle, probably what is now known as the second, to the Corinthians, and charged with the further duty of promoting the proposed collection for poor Christians in Judæa. This is practically all that is known of him from the undisputed Pauline epistles. He is nowhere mentioned in the Acts. In the pastoral epistle with which his name is associated he is represented (Tit. i. 5) as having been left by Paul in Crete to "set in order the things that are wanting, and ordain elders in every city." He is expected afterwards to join Paul at Nicopolis (iii. 12). In 2 Tim. iv. 10 he is spoken of as having gone to Dalmatia. Tradition, obviously resting on the Epistle to Titus, has it that he died in Crete as bishop at an advanced age.

TITUS, EPISTLE TO. See PASTORAL EPISTLES, vol. xviii. p. 348 *sq.*

TITUSVILLE, a city of the United States, in Crawford county, Pennsylvania, in 41° 38′ N. lat. and 79° 42′ W. long., stands upon Oil Creek, in the midst of the oil region of north-western Pennsylvania. Its predominant industries have reference to the production, refining, and transportation of petroleum. It has two railroads—the Dunkirk, Allegheny, and Pittsburg, and the Buffalo, New York, and Philadelphia. The city had a population of 8639 in 1870 and of 9046 in 1880.

Titusville, originally a small lumbering town, began its career of prosperity in 1859, when oil was discovered in this region, and during the succeeding years it was the scene of very great activity. It was chartered in 1867, when at the zenith of its prosperity. Since that time it has settled down to a less feverish and more healthy growth.

TIUMEN. See TYUMEN.

TIVERTON, a borough of Devonshire, England, is finely situated in the midst of beautiful scenery at the confluence of the Lowman and the Exe, 14½ miles north of Exeter and 184 west-south-west of London. A branch line connects it with the Great Western, and the Exe Valley Railway with Exeter and Dulverton. The greater part of the town is on the left bank of the Exe; the four principal streets are wide and regular. Since 1262, when Amicia, countess of Devon, caused a stream of water to be directed from Norwood to Tiverton, a distance of 5 miles, every street has had a constantly flowing supply. At points now spanned by bridges there were formerly two fords, one over the Exe and the other over the Lowman; hence Twofordton and Twyfordton the former names of the town. There still remain the principal gateway and an octagonal turret of the ancient castle (now a private residence), built in 1106 by Richard de Riparus or Redvers, first earl of Devon, and the chief residence of the Redvers till the execution of Henry Courtenay, marquis of Exeter, in 1539. The most ancient part of the church of St Peter is the Norman doorway; the embattled western tower is 120 feet in height. For Blundell's free grammar-school (1604) new buildings have recently been erected in the Tudor style. Among other educational establishments are the school of science and art, the blue coat charity school (1714; re-established as a middle boys' and middle girls' school in 1876), and the Chilcott free school (1611). The other principal public buildings are the market-house (1830-31), the infirmary (1852), the town-hall (1864), and several almshouses. Tiverton was formerly famed for its woollen manufacture, introduced in the 14th century; its annual returns in 1612 were estimated at £300,000, about 8000 persons being employed in the industry. It is now chiefly noted for its lace manufacture, established by John Heathcoat, the inventor of the bobbin net frame. The population of the municipal borough (area, 17,491 acres) in 1871 was 10,024, and in 1881 it was 10,462.

The town existed in Saxon times. In the reign of Edward the Confessor it was held by vassals or servants, and in Domesday it is entered as *terra regis*. In 1200 it had a market and three annual fairs. After the introduction of the woollen trade in 1353 it rapidly increased, and Camden states that the trade had brought it "much gain and glory." The town and castle were taken by Fairfax in 1645. Tiverton suffered from the plague in 1591 (when it had 5000 inhabitants), and from fire in 1598, 1612, and 1731. It was incorporated by James I. in 1615; but in 1732 its charter was forfeited, and a second was not bestowed till 1737. The borough was deprived of parliamentary representation in 1885.

See Harding's *History of Tiverton*, 2 vols., 1845.

TIVOLI (Lat. *Tibur*), a town of Italy, situated 17 miles east-north-east of Rome on one of the spurs of Monte Ripoli, 830 feet above the sea. Its position is very striking and beautiful; it stands partly at the edge of the lofty cliff over which the river Anio falls in a most imposing mass of water. The present aspect of the fall is very different from what it was in ancient times, as the water has undermined and carried away great masses of the rock. In 1881 the population of the town was 9730, and of the commune 10,297.

Ancient Tibur was founded, according to the legend adopted by the Roman poets, many centuries before Rome, by the Siculi.[1] They were expelled by a Greek named Tiburtus, the son of Catillus, who became the eponymous hero of Tibur.[2] During the early historic period Tibur, which stood on the borders of the Sabine territory, was always a bitter enemy of Rome, and on many occasions allied itself to various peoples, even the Gauls, in their attacks on the city. With the rest of Latium, Tibur was finally conquered by Rome in 335 B.C., and on account of its constant enmity was treated with much severity, not being admitted to the Roman franchise till towards the close of the republican period. Almost no mention of Tibur occurs during the time of the empire; but the town is recorded to have suffered severely during the Gothic invasion in the 6th century Remains of its city wall still exist, built of squared blocks of tufa; but the whole circuit is not clearly determinable. Even the site of the large and wealthy temple of Hercules is doubtful, which stood in an extensive temenos, containing libraries and a porticus, where Augustus sometimes administered justice.[3] At the edge of the cliff still stands a small circular temple, of doubtful dedication, which once had eighteen columns, and closely resembled that in the Forum Boarium of Rome. Its cella walls are of concrete faced with opus reticulatum, and its columns of travertine; it dates from about the time of Christ. Its popular name is the "temple of the Sibyl."[4] Close by is another small prostyle-tetrastyle temple resembling that (so called) of Fortuna Virilis in Rome. Remains of the circuit wall of the forum also exist, with a large apsidal projection, as well as an extensive crypto-porticus, faced with blank arcading and divided internally by a row of twenty-eight columns. Tibur was a favourite summer residence of many wealthy Romans under the empire, and especially of Horace and Mæcenas.[5] One of the chief aqueducts of Rome, "Anio vetus," started from the Anio at Tibur. The ancient "lapis Tiburtinus" (modern travertine) was so called from its chief quarries at Tibur, where it has been during long ages deposited by the water of the river Anio.

Hadrian's villa, which stands at the foot of the Tibur spur of hill about 2 miles distant, is one of the most important Roman remains in the world. Between 1870 and 1882 the greater part of its immense area was excavated; the whole circuit was once no less than 8 miles. The scheme of this wonderful group of buildings was the fancy of the rich and highly educated emperor Hadrian, who desired to reproduce, within a short distance of Rome, a number of the chief Greek sites and buildings which he had visited in different parts of the world. Besides his own palace he built a large stoa pœcile, copied from that at Athens, an odeum, a lyceum, an academy (with its gardens, halls, and porticus), libraries, Latin and Greek theatres, a stadium, palæstra, hippodrome, baths, and many temples. Large gardens, divided into an artificial "Vale of Tempe," "Elysian Fields," and "Tartarus," were watered by a winding stream named the "Euripus." In another place stood a "serapeum," copied from that at Alexandria, and filled with pseudo-Egyptian statues and reliefs, many of which have been recently unearthed. Barracks for the prætorian guard and rows of dwellings for slaves completed this magnificent group of buildings. In many parts the existing remains are well preserved and in some cases the uses of the different buildings can be determined.[6] The main walls are of concrete faced with mixed brick and opus reticulatum, once wholly covered with magnificent Oriental marbles and crowded with fine Greek and Græco-Roman sculpture; mosaic of marble and glass was lavishly used for floors, walls, and vaults, together with the most elaborate painted decorations. A large number of fine works of art have been discovered here, such as the mosaic of "Pliny's doves" and the Faun in rosso antico now in the Capitol. It is probable that the Venus de' Medici came from this villa, together with many other statues found in the 16th century whose *provenance* is now forgotten.

TLAXCALA (*Tlascala*, *i.e.*, "House of Bread"), an historical city of Mexico, capital of the state of Tlaxcala, which nearly coincides with the old native republic of Tlaxcala, occupying the easternmost of the four sections into which the Anahuac plateau is here divided by ranges of hills, between 19° and 20° N. lat. The modern town, standing on the site of the old Indian capital, lies (in 19° 19′ N. lat., 98° 6′ W. long.) on the little river Papagallo (Atoyac, formerly Zahuatl), which flows between two hills at an altitude of considerably over 7000 feet, some 30 miles north of La Puebla and 170 by rail from Vera Cruz. Tlaxcala was founded probably about the close of the 13th century, when the Tlaxcaltecs, a branch of the Nahuatl race closely akin to the Aztecs, withdrew from the western side of the central lacustrine district and established a powerful democratic state in a somewhat secluded, hill-encircled, but highly productive tract, 90 miles in length by 70 in breadth, with a total area of over 1550 square miles. The Tlaxcaltecs, hereditary foes of the Aztecs, became, after a short resistance (September 1519), the firm allies of the Spaniards, their co-operation contributing largely, if not mainly, to the overthrow of the Mexican empire. But the result was the enslavement of Tlaxcala itself, the general decay of the country, and the dispersion of most of the inhabitants by Cortes. Although now reduced to a population of a little over 5000, or, including the commune, to 36,000, and with no monuments beyond a fine church, an old episcopal palace, and a town-hall, the city at the time of the conquest was a very large place, containing nearly as many inhabitants as the whole of the modern state (130,000). When occupied by the Spaniards, its size and splendour excited the admiration of Cortes, who describes it in somewhat exaggerated language as "much larger and much stronger than Granada, with as fine buildings and much more people than Granada had at the time it was captured, also much better supplied with the things of the earth" (*Cartas*, 67). It was disposed in four distinct quarters separated by high stone walls, each with a palace for the ruling chief, besides temples, and stone buildings for the nobles. But most of the other houses were low mud or adobe structures. In the daily market, which was said to be frequented by 30,000 people, were exposed for sale the products of the surrounding country,—maize, maguey (extracted from the aloe), and chilli pepper; to these are now added wheat, barley, pease, lentils, and a great variety of fruits.

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[1] Dion., i. 16, and Plin., *H. N.*, xvi 87

[2] Hor., *Od.*, i. 18, 2; Ov., *Fast.*, v. 74; Virg., *Æn.*, vii. 670.

[3] See App., *Bell. Civ.*, v. 24; and Suet., *Aug.*, 72.

[4] It has also been called the temple of Vesta, but the real site of this last was on the other side of the river.

[5] Hor., *Od.*, i. 7, 10, and ii. 6, 5.

[6] Many of the names given to different parts by the Roman antiquaries are based on mere conjecture.

A prominent feature of the landscape is the Sierra de Malintzi, or Malinche, that is, "Lord of Marina," a name given to Cortes after his alliance with the "heroine of the conquest." The Sierra (originally Matlacuezatl), which rises grandly (more than 16,000 feet) above the plateau, takes a prominent place in Tlaxcaltecan mythology, owing to the peculiar shape of its summit, representing in rough outline the body of a native woman lying at full length in its grave and partly wrapped in its cerements. There are some woollen manufactures, centred chiefly in the capital, and also a few silver, copper, lead, and coal mines in the San Ambrosio and San Mateo ranges; but the state is essentially agricultural, yielding large annual crops of maize and wheat, the total produce being valued at over £1,000,000.

TLEMCEN, or TILIMSÁN, a town of Algeria, chef-lieu of an arrondissement in the department of Oran, lies 86 miles S.W. of Oran, 2625 feet above the sea, on a terrace on the northern slope of a range of rocky hills (3430 feet). Its white minarets, towers, and battlements rise picturesquely above the surrounding verdure, which is nourished by numerous springs, and even in ancient days gave rise to the Roman name *Pomaria*. The various quarters are grouped around the principal mosque,—the Jewish to the south-west, the Moorish to the south-east, that of the merchants to the north-east, while the new town with the civic buildings lies to the north-west. Of the sixty-four mosques which existed at the period of the French conquest, several have disappeared. The great mosque has a minaret adorned with marble columns, and cased with mosaic of the most varied designs; a fountain of alabaster stands in the alabaster-paved inner court; and seventy-two columns support the pointed arches of the interior. The mosque of Abul Hasan, now used as a French and Arab school, has two series of arches, which rest on alabaster pillars, and the courts are ornamented by sculptures of great beauty and richness; the delicately carved cedar ceiling bears traces of polychromatic painting. The mosque of El-Halawi is specially interesting for the sculptured capitals of its magnificent alabaster columns. Tlemcen, besides numerous other mosques, possesses a fine modern Roman Catholic church in the Byzantine style and five synagogues. The military authorities occupy the Mehuar or citadel, built in 1145, which separates the Jewish and Moorish quarters, and was formerly the palace of the rulers of Tlemcen. Only the mosque and the battlemented wall, flanked by two towers, remain of its former magnificence. Among the antiquities preserved in the museum is the epitaph of Boabdil, the last king of Granada, who died at Tlemcen in 1494. The vast basin under the old walls, now used as a reservoir (720 feet in length, 490 in width, and 10 in depth), was apparently made for naval exhibitions by the sovereigns of Tlemcen. The barracks of the Spahis occupy all that remains of Kissaria, a settlement of European merchants from Pisa, Genoa, Catalonia, and Provence. Leather, saddles, Turkish slippers, arms, and woollen goods are manufactured in Tlemcen; the production of oil and flour and market-gardening occupy Europeans and natives; good tobacco is also grown. There is an active trade in cattle, wool, grain, and fruit. A railway (37 miles) is being built (1887) to connect Tlemcen with Rahgun, its port. In 1886 the population (natives, Europeans, and Jews) was 19,745 (26,395 in the commune).

The town was originally at Agadír (*Pomaria*), to the east of the present site, where Roman inscriptions have been found. At the time of the Arab invasion the district was held by the Benî Ifren tribe of Zenáta Berbers, who ultimately founded here the sovereignty of the Benî Ya'lá (1002-1050). In 1080 the Almoravid king, after besieging and sacking the place, built a new town on the site of his camp. His successors reigned sixty-five years, when, after holding Agadír four years against the enemy, they were overcome by the Almohades, who massacred the inhabitants, rebuilt, enlarged, and repeopled the ruined town, and surrounded Tlemcen and Agadír with a common wall. Tlemcen now flourished greatly under the 'Abd al-Wád, also a Zenáta dynasty, who ruled first for the Almohades and after 1242 as nominal vassals of the Hafsites of Tunis. In 1337 their power was temporarily extinguished by the Merinids, who built the town of Mansura, west of Tlemcen. They left some fine monuments of the period of their ascendency, which lasted twenty-two years. Once more, under the 'Abd al-Wád, from 1359 to 1553, Tlemcen enjoyed prosperity, when it had a population of 125,000, an extensive trade, a brilliant court, a powerful army, and its finest buildings were reared. The Spanish occupation of Oran struck a fatal blow at the European commerce of the town, which gradually lost all its territory to the Turks after they had seized Algiers. When the French entered Algeria the sultans of Morocco were worsted by the Kuluglis in their attempt to hold the town. In 1834, and again in 1837, Abd el-Kader sought to re-establish the ancient empire of Tlemcen, but the French definitely took possession in January 1842.

TOAD. This animal belongs to the Anurous division of the *Amphibia*, and toads and frogs are the only representatives of the *Anura* or *Batrachia* indigenous to Britain. To an ordinary observer the toad is proved to be an amphibian by its moist soft skin, an anuran or tailless amphibian by the want of a separate tail. The toad differs from the frog in the following points:—It has no teeth on either of its jaws or on the roof of its mouth, while the frog has a series of fine teeth on the upper jaw and also teeth on the palate; the tongue in both animals is attached in front and free behind, but that of the frog is forked at its free extremity, that of the toad is not; the skin of the toad is rough with large protuberant warts, while that of the frog is smooth; the body of the toad is more globular and puffy than that of the frog; the hind legs in the toad are shorter, and the posterior digits not so completely webbed, the animal being more terrestrial in its habits than the frog. In the toad, as in the frog, there are four digits anteriorly, five posteriorly. The warts of the toad's skin contain large cutaneous glands, which secrete a thick yellowish fluid with acrid properties, capable of irritating and producing slight inflammation on the human skin. The use of this secretion is probably to protect the toad from being devoured by carnivorous animals. Like other *Amphibia*, it has a large membranous bladder communicating with the terminal part of the intestine—the allantoic bladder,—in which fluid accumulates, probably from the kidneys, though the ureters do not open directly into the bladder. The toad, when handled or alarmed in any way, ejects the contents of its bladder. Owing to these peculiarities and its appearance, the animal is commonly regarded with loathing, and credited with far more poisonous properties than it possesses. In its breeding habits the toad resembles the frog: its eggs are fertilized externally at the moment of extrusion, as in the frog, the parents resorting to the water for the purpose of reproduction. The ova are laid in spring, and are arranged, not in shapeless masses, but in a string containing a double series of eggs adhering by their gelatinous envelopes; the string extends to a length of three or four feet. The tadpoles are similar to those of the frog, but blacker; their metamorphosis takes place in the same manner, the three pairs of external gills being first absorbed and replaced for a time by internal gills, which are in their turn lost, the branchial slits being closed by the coalescence of the opercular membrane with the skin. The metamorphosis is complete in autumn. The toad is carnivorous, feeding on flies and other insects and worms. It hibernates in winter, passing its period of torpidity in holes or burrows in the earth. The finding of toads in a state of hibernation has given rise to stories of their being found in the centre of trunks of trees or imbedded in solid rock. The myth of the jewel in the head (Shakespeare) is probably founded on the brightness of the eyes, in which the iris is flame-coloured.

There are two kinds of toad in Britain,—the Common Toad, which is almost black in colour, and the Natter-jack Toad, which is lighter, smaller, and has a bright yellow line along the middle of the back. The length of the common toad is 3½ inches, of the natter-jack 2¾ inches. The male natter-jack possesses a bladder or vocal sack beneath the throat communicating with the mouth, which acts as a resonator to its voice; its cry is "gluck-gluck." The vocal sack is absent in the common toad, and only incompletely developed in the Green Toad of the Continent.

In zoological classification the toad belongs to the genus *Bufo*, first constituted by Laurenti in the *Synopsis Reptilium*, of which the following diagnosis is given in the *Brit. Mus. Cat. Batr. Sal.*, 1882:—

Pupil horizontal. Tongue elliptical or pyriform, entire and free behind. Vomerine and maxillary teeth none. Tympanum distinct or hidden, seldom absent. Fingers free; toes more or less webbed; the tips simple or dilated into small disks. Outer metatarsals united. Omosternum generally missing; if present cartilaginous; sternum a cartilaginous plate, sometimes more or less ossified along the median line. Diapophyses of sacral vertebræ more or less dilated. Terminal phalanges obtuse or triangular. Distribution cosmopolitan, except Australia.

Bufo vulgaris, Laurenti, the Common Toad, is thus distinguished. Crown without bony ridges. First finger as long as or longer than the second. Parotids distinct. Tympanum smaller than the eye. Toes half webbed; no tarsal fold; subarticular tubercles of toes double. The species is widely distributed, occurring throughout Europe, Asia, and north-west Africa.

Bufo calamita, Laurenti, the Natter-jack Toad, shows the following differences from *B. vulgaris*:—toes not half webbed; tympanum rather indistinct; a tarsal fold. It is distributed throughout Europe.

According to Boulenger there are 77 species of *Bufo* known, of which 35 are confined to the Old World, the rest to the American continent. No species is common to the two great continents. The only other species occurring in Europe besides the two which are found in Britain is *Bufo viridis*, Laurenti, which ranges throughout Europe, Asia, and North Africa.

TOBACCO consists of the leaves of several species of *Nicotiana* (nat. ord. *Solanaceæ*), variously prepared for use as a narcotic. While it is principally manufactured for smoking, a large amount is also prepared for chewing, and to a more limited extent it is taken in the form of snuff. Under one or other of these forms the use of tobacco is more widely spread than is that of any other narcotic or stimulant.

History.

Although the fact has been controverted, there cannot be a doubt that the knowledge of tobacco and its uses came to the rest of the world from America. In November 1492 a party sent out by Columbus from the vessels of his first expedition to explore the island of Cuba brought back information that they had seen people who carried a lighted firebrand to kindle fire, and perfumed themselves with certain herbs which they carried along with them. The habit of snuff-taking was observed and described by Ramon Pane, a Franciscan, who accompanied Columbus on his second voyage (1494–6), and the practice of tobacco-chewing was first seen by the Spaniards on the coast of South America in 1502. As the continent of America was opened up and explored, it became evident that the consumption of tobacco, especially by smoking, was a universal and immemorial usage, in many cases bound up with the most significant and solemn tribal ceremonies.

The term tobacco appears not to have been a commonly used original name for the plant, and it has come to us from a peculiar instrument used for inhaling its smoke by the inhabitants of Hispaniola (San Domingo). The instrument, described by Oviedo (*Historia de las Indias Occidentales*, Salamanca, 1535), consisted of a small hollow wooden tube shaped like a Y, the two points of which being inserted in the nose of the smoker, the other end was held into the smoke of burning tobacco, and thus the fumes were inhaled. This apparatus the natives called "tabaco"; but it must be said that the smoking pipe of the continental tribes was entirely different from the imperfect tabaco of the Caribees. Benzoni, on the other hand, whose *Travels in America* (1542–56) were published in 1565, says that the Mexican name of the herb was "tabacco."

The tobacco plant itself was first brought to Europe in 1558 by Francisco Fernandes, a physician who had been sent by Philip II. of Spain to investigate the products of Mexico. By the French ambassador to Portugal, Jean Nicot, seeds were sent from the Peninsula to the queen, Catherine de' Medici. The services rendered by Nicot in spreading a knowledge of the plant have been commemorated in the scientific name of the genus *Nicotiana*. At first the plant was supposed to possess almost miraculous healing powers, and was designated "herba panacea," "herba santa," "sana sancta Indorum"; "divine tobacco" it is called by Spenser, and "our holy herb nicotian" by William Lilly. While the plant came to Europe through Spain, the habit of smoking it was initiated and spread through English example. Ralph Lane, the first governor of Virginia, and Sir Francis Drake brought with them in 1586, from that first American possession of the English crown, the implements and materials of tobacco smoking, which they handed over to Sir Walter Raleigh. Lane is credited with having been the first English smoker, and through the influence and example of the illustrious Raleigh, who "tooke a pipe of tobacco a little before he went to the scaffolde," the habit became rooted among Elizabethan courtiers. During the 17th century the indulgence in tobacco spread with marvellous rapidity throughout all nations, and that in the face of the most resolute opposition of statesmen and priests, the "counterblaste" of a great monarch, penal enactments of the most severe description, the knout, excommunication, and capital punishment.

Botany.

The species of *Nicotiana* number about fifty, but those of which the leaves are used as sources of tobacco are few. With the exception of two species, one native of New Caledonia, the other proper to Australia, they are all of American origin. They form two well-defined groups, the first of which is characterized by the possession of an elongated corolla tube, red in colour, the plants having a single unbranched stalk which attains a height of from 5 to 7 feet; while to the second group belong such as have a swollen corolla tube of a greenish-yellow colour, and a much-branched stem reaching a height of only from 2 to 5 feet. The type of the first group is the Virginian Tobacco, *N. Tabacum*, while the best known representative of the second is the Green Tobacco, *N. rustica*. These two species, together with their numerous varieties, and with the Persian Tobacco, *N. persica*,—the source of the famous Tumbeki or Shíraz tobacco,—are the sole sources of commercial tobacco. *N. Tabacum* is the species from which the tobaccos of Cuba, the United States, and the Philippine Islands, and the Latakia of Turkey, are derived, and it is thus the source of not only the greater proportion of the tobacco of commerce but also the most highly prized and valuable of its varieties. *N. rustica*, originally a native of Brazil, is cultivated to a considerable extent in South Germany, Hungary, and the East Indies.

The Virginian tobacco-plant, *N. Tabacum*, is a coarse rank-growing annual, with a simple unbranched cylindrical stem which attains a height of 6 feet and upwards, terminating in a panicle of pink flowers. It has alternate simple oblong lanceolate leaves, those at the lower part of the stem being slightly stalked, and of large size, reaching to two feet in length, while the upper are semi-amplexicaul and of variable outline. The seeds are brown in colour, with a rough surface, of minute size, and exceedingly numerous, as many as 40,000 having been counted on a single plant. The whole of the green parts of the plant are covered with long soft hairs which exude a viscid juice, giving the surface a moist glutinous feeling. The hairs are multicellular, and of two kinds, one branching and ending in a fine point, while the other, unbranched, terminates in a clump of small cells. Stomata occur on both surfaces of the leaves, and, with the peculiar hair structure, render the microscopic appearance of the plant highly characteristic.

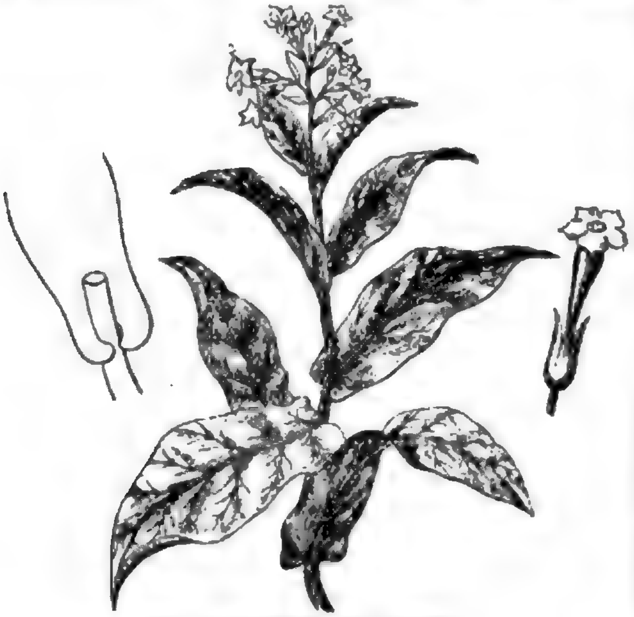

Fig. 1.—Flowering Top of *N. Tabacum*.

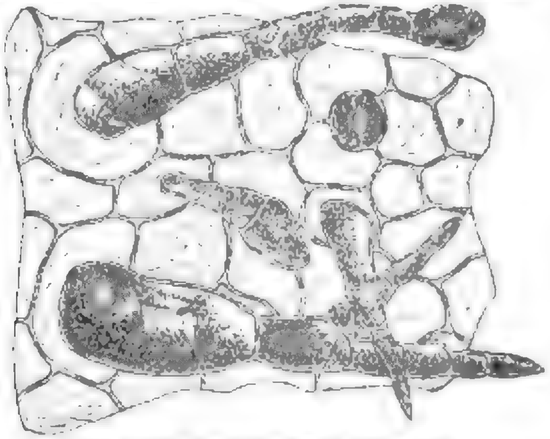

Fig. 2.—Microscopic Structure of Tobacco Leaf.

Cultivation. Tobacco will flourish over wide areas and in very dissimilar climates, but it is best suited for regions having a mean temperature of not less than 40° F. and where early autumn frosts do not occur. It develops the most highly appreciated qualities in tropical lands possessed of a comparatively dry climate. Tobacco is a most exhausting crop, and requires rich and abundant manuring, the character of which exercises a distinct influence on the quality of the product. A crop grown under such widely different conditions of climate and agriculture as is the case with tobacco must of necessity be subject to varied treatment both in cultivation and in curing, and here we can refer only to the general features of the growing and securing of the crop.

In European cultivation, the tobacco-seed is sown in a hotbed about the end of March. The seed-beds are kept covered with damp straw or withered leaves till the seedlings appear above the ground, after which the covering is removed, and, to protect the young plants from frost, to which they are extremely sensitive, the beds are covered at night with mats. So soon as the plants can be handled, they are picked out in rows in a garden bed, where they remain protected from night frost till they have developed five or six leaves and have a height of 3 to 4 inches. They are then ready for transplanting, by preference in moist weather, into prepared drills 20 to 25 inches apart in the field. The transplanting is done about the end of May, or earlier in localities free from night frosts, and in dry weather the field is plentifully soused with liquid manure. The plants are carefully weeded and attended to, and the soil is frequently stirred with narrow hoes until the period when they show symptoms of flowering. This may be when they are only 3 feet high, or not until they have reached their proper height of 6 or 8 feet; but the flowers must not be allowed to form, except in the case of a few plants left purposely for seed. To obtain fine and strong leaves on the plant is the great object of the cultivator, and a fine tobacco plant ought to have from eight to twelve large succulent leaves. Cultivators commonly diminish the number of leaves by "topping" or breaking off the top, under the idea that the remaining ones will afford the strongest tobacco. Suckers or shoots near the root are carefully removed, and everything is done to concentrate the strength of the plant in the leaves. Every leaf injured by insects is removed, and the crop is watched until the leaves have a yellowish tint and begin to droop, when they are fit to be gathered. This is usually in September, so that the plants, from the time of their insertion on the mounds, have occupied the ground four months, during which time they have been subject to many vicissitudes,—from the attacks of insects, from a disease called "firing," caused by the long continuance of very wet or very dry weather, and from the occurrence of autumn frosts while the crop is yet in the field.

In the harvesting of the tobacco crop several distinct methods are followed. In ordinary European cultivation the ripe leaves are separated from the standing stalks in the field. The three lower root-leaves are first stripped off and laid, face downward, around the root to wilt, after which they are bundled and carried to the barn. Afterwards the remainder of the leaves are separated, working from the top downwards, and, similarly, they are spread on the ground till by wilting they lose their brittleness. They are then bundled and packed, tops upward, closely on the floor of the barn for some time to sweat, by which the uniform ripening and subsequent favourable drying are promoted. The bundles are carefully watched to prevent overheating, which would blacken and injure the leaves. In the tobacco-growing districts of the United States the entire plant is cut down in the field close to the ground, then the stalks are spitted on long rods or laths, care being taken to keep the leaves from touching each other, and on these rods they are carried and hung in the barn or curing-house for drying.

Curing. The curing of the leaves which follows has for its objects the drying and preservation of the tobacco, and, by a process of slow fermentation, the modification of certain of the leaf constituents, and the development of the characteristic aroma of the substance. Subject to various minor modifications, the process of curing is carried out either slowly by the air-cure process or rapidly by fire-curing. The European cultivators, who generally cure by the slow process, either spit the leaves through the middle on a long rod or string them on a cord, taking care to keep each leaf from touching its neighbour. These rods or cords of leaves are suspended in a barn or curing-shed in a way which allows the free circulation of the air, and at the same time brings the whole contents of the shed equally under the drying influence of the air currents. When the weather is clear and dry, free circulation of the air is in every way promoted, but on humid days the moist air is excluded and sometimes artificial heat is required to prevent mildew and rotting of the leaves. Under favourable circumstances the tobacco will be dry and ready for further treatment in from six to eight weeks, and the leaves should then have a fine bright warm brown colour.

In the United States the quick-drying process by artificial heat is employed principally for the preparation of export tobacco. Formerly the heat was obtained by means of an open charcoal fire within the curing-barn, but now the structure is heated by a system of flues which permits of the burning of any kind of fuel. For dark shipping tobacco, the entire plants, cut down close to the ground, are immediately housed, and at once dried off. Red shipping qualities are prepared by leaving the cut stems either in the field or hung on scaffolds in the barns for a few days to wilt and wither in the air, after which they are dried by artificial heat. In the treatment of both dark and red kinds the temperature within the barn is gradually raised till it reaches 170° F., and the drying is complete in from four to five days.

By whichever way treated, the tobacco-leaf at this stage is brittle, and cannot be handled without crumbling to powder. The contents of the barn are therefore left till moist weather occurs, and then by the admission of atmospheric air the leaf blades absorb moisture and become soft and pliant. In this condition the leaves are stripped from the stems, sorted into qualities, such as "lugs," or lower leaves, "firsts," and "seconds." These are made up into "hands," or small bundles of from six to twelve leaves. Each bundle is tied round with a separate leaf, and in this condition the tobacco is ready for bulking for fermentation.

For fermentation the tobacco, whether in bundles, hands, or separate leaves, is piled up or bulked on the floor in a barn into a solid stack to the height of 5 or 6 feet. Within this stack a process of fermentation is quickly set up, and the temperature of the mass rises steadily till it reaches about 130° F. Great care is now taken to prevent overheating, and to secure the uniform fermentation of all the tobacco. The pile is from time to time taken down and rebuilt, the tobacco from the top going to the bottom, and that exposed at the edges being turned in to the centre. In from three to five weeks the fermentation should be sufficiently carried out, and the leaves then have a nice uniform brown colour. The cured stack may in this condition be piled up in store without fear of further fermentative activity, till, with increasing summer heat, it is subject to the May sweat, which renders further watchfulness necessary.

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The components of tobacco, like those of all vegetable matters, arrange themselves under the three heads of water, mineral acids and bases (which pass into the ash on combustion), and organic substances. According to an investigation carried out by Beauchef in Gay-Lussac's laboratory, the amount of ash from 100 parts of matter dried at 100° C. is in the roots 6 to 8, in the stems 10 to 13, and in the ribs and leaves 18 to 22 per cent. The greater part of the ash consists of insoluble salts, principally carbonate of lime. The soluble part consists largely of potash salts (KCl, K_2CO_3, K_2SO_4), which may amount to from 5 to 35 per cent., and it is remarkable that tobacco contains no soda. In addition to the mineral salts proper, tobacco contains salts of ammonia and nitrates. In the leaf the proportion of nitrates is greater in the rib than in the laminæ. In the former it may amount to as much as 10 per cent. (calculating the nitric acid as KNO_3). According to Schloesing (*Ann. Chim. Phys.*, [3], xl. 479), the proportion of (combined) nitric acid in tobacco has nothing to do with its combustibility, that is, the length of time a lighted cigar will glow spontaneously. This quality is a function chiefly of the potash present in combination with organic acids. An incombustible tobacco, *i.e.*, a tobacco which does not keep a glowing ash, contains its organic acids in the form of lime and magnesia salts. The explanation is that, while organic potash salts, being fusible, yield when heated a porous charcoal which glows readily, the corresponding infusible lime salts yield a compact charcoal which is far less combustible. A combustible tobacco can be rendered incombustible by the incorporation of sulphate or chloride of calcium or magnesium. By cultivation experiments in a potash-free soil, it has been ascertained that chloride of potassium used as a manure does not add to the organic potash salts in the leaves, but the sulphate, carbonate, and nitrate do give up their potash for the formation of organic salts.

Subjoined is an enumeration of the proximate organic components of tobacco leaves, and their relative proportions in 100 parts, according to the numerous analyses made in the laboratories of the French state tobacco factories:—

Nicotine, $C_{10}H_{14}N_2$, a liquid volatile alkaloid, from 1·5 to 9 per cent.

Essential oil,—according to Schloesing, an important element in the flavour of tobacco, although its proportion is exceedingly small.

Nicotianine, a solid camphor-like body to which, according to other authorities, the odour of tobacco is principally due.

Malic and citric acids, together 10-14 per cent., calculated as anhydrides.

Acetic acid, very little in fresh leaves, but increasing in their fermentation. In snuff it may rise to 3 per cent.

Oxalic acid, 1 to 2 per cent.

Pectic acid, about 5 per cent.

Resins, fats, and other bodies extractable by ether, 4 to 6 per cent.

Sugar, little in the leaves, more in the stems; in the fermentation it disappears.

Cellulose, 7 to 8 per cent.

Albuminoids, calculated from the nitrogen not present as nicotine, nitrates, or ammonia, about 25 per cent.

Excepting the nicotine, the several organic components of the leaves develop, roughly speaking, *pari passu* until fructification, when certain components are attracted to the fruit, suffering chemical changes while so moving. The nicotine determines the strength of a tobacco, but not its flavour or aroma. The manure supplied to a tobacco field does not increase the proportion of nicotine, but affects only the weight of the crop. The percentage of nicotine in the leaves may to some extent be modified in cultivation,—plants wide apart developing few leaves, but these thick, fleshy, and rich in nicotine, while closely packed plants throw out numerous but thin and membranous leaves having little nicotine. The proportion of nicotine present increases with the age of the plant. Schloesing found in leaves at various stages of growth the following percentage of nicotine:—May 25 (very young leaves), 0·79; July 13, 1·21: Aug. 6, 1·93; Aug. 27, 2·27; Sept. 8, 3·36; Sept. 25, 4·32.

Regarding the changes which take place in the manufactured leaf, we take the case of snuff, because with it the chemical changes are carried farthest, and yet, qualitatively speaking, they are of the same nature as those which smoking tobacco undergoes. In the fermentation begun in curing and continued in the sauced leaf, the malic and citric acids and the nicotine undergo partial oxidation. The oxalate of lime and the pectates remain almost unchanged, and there are formed, of intermediate (not fully oxidized) bodies, ammonia, acetic acid, and black humic acid, the last giving to snuff its dark colour. A little methyl-alcohol is also at the same time formed. At this stage the tobacco-leaf is acid in reaction; but after it is powdered, and again submitted for a prolonged period to a slow fermentation in air-tight boxes, it becomes decidedly alkaline by the ammonia, because, while acetic acid continues to be formed and the ammonia and nicotine remain what they are, the malic and citric acids are progressively destroyed. Unless snuff contains free ammonia it is "flat," and destitute of pungency.

As to the composition of tobacco smoke, numerous investigations have been made. Kissling (*Ding. Polyt. Jour.*, ccliv. 234-246), experimenting on cigars, found that a large proportion of the nicotine passes unaltered into the smoke. Dealing with a tobacco containing 3·75 per cent. of nicotine, he recovered from the smoke 52·02 per cent. of the total nicotine consumed, while in the unconsumed remains of the tobacco the proportion of nicotine was increased to 5·03 per cent. With a second sample of tobacco, having likewise 3·75 per cent. of nicotine, the smoke yielded only 27·83 per cent. of the total nicotine consumed, and the percentage in the unconsumed remains was raised to 4·51. From a tobacco containing only 0·30 of nicotine he recovered 84·23 of nicotine in the smoke. The composition of tobacco smoke is highly complex, but beyond nicotine the only substances found in appreciable quantities are the lower members of the picoline series.

Commercial varieties.

The commercial varieties and the sources of supply of leaf-tobacco are exceedingly numerous. Special qualities of tobacco, as of wines, &c., belong to particular localities, outside of which they cannot be cultivated. These tobaccos are therefore natural monopolies. Moreover, as is also the case with wines, the crops vary in richness and delicacy of flavour with the seasons of their growth, so that in certain years the produce is of much greater value than in others. Further, the properties of certain classes of tobacco render them specially suitable for cigar-making. Others are best fitted for smoking in pipes; and there are numerous qualities which are valuable for snuff-making. National tastes and habits again frequently determine the destination of tobacco. Thus heavy, strong, and full-flavoured cigars and tobaccos are in favour in the United Kingdom, while on the Continent lighter and more brisk-burning qualities are sought after, and the materials consumed in the kalians of Persia and the East are not suitable for use in the short pipes of the Western nations.

Of cigar tobaccos the most valuable qualities in the world are cultivated in the north-west portions of the island of Cuba. The district of Vuelta Abajo is the source of the highest quality, after which comes the produce of Partidas and Vuelta Arriba. A large portion of the tobacco is made into cigars in the island, but considerable quantities are also exported to Europe and the United States for mixing with commoner qualities to give Havana character to the home-made cigars. In recent years a large export of tobacco from Brazil, especially from the province of Bahia, has sprung up, most of which goes to Germany and Austria for cigar-making. The "seed-leaf" tobacco of Pennsylvania, Connecticut, and Ohio, grown from Havana seed, is devoted to cigar-making in the United States. In the East the most important cigar-tobacco region is the Philippine Islands, from which come the well-known Manila cheroots and cigars and a large quantity of leaf-tobacco of distinctive aroma. Immense quantities of cigar tobacco are also exported from Java and Sumatra, most of which passes through the markets of Amsterdam and Rotterdam. In the Madras presidency and in Burmah cigar tobacco is largely cultivated, the strong heavy qualities of which are well known to the British public in the Burmese, Lunka, and Dindigul cheroots.

Of ordinary smoking tobacco, among the most esteemed qualities are Varinas or kanaster, grown in the districts of Varinas, Merida, Margarita, &c., in Venezuela. The name kanaster, which covers several varieties of tobacco from South America, is given on account of the wicker baskets (Span. *kanastra*) in which the material is packed for export. The tobacco regions of the United States—Kentucky, Maryland, Virginia, and Ohio—send great supplies of smoking leaf of various qualities into the European market, especially into the United Kingdom, which is almost exclusively supplied from these sources. Smoking tobaccos of the highest quality, rivalling indeed the cigar tobacco of Cuba in flavour and value, are grown in Turkey, and specially in the province of Salonica. The famous Latakia of the English smokers is produced in the province of Saida, in the northern part of Syria (see

LATAKIA), and thoughout Asiatic Turkey there is an extensive cultivation and export of smoking tobacco.

Manufacture. In the manufacture of tobacco for smoking, we have to do with the numerous forms of tobacco used for smoking in pipes, embracing cut smoking mixtures, cake or plug, and roll or spun tobacco. Under this heading come also the cigar and cigarette manufacture.

The raw material in the warehouses is of various qualities: some is strong, rough, and harsh, and so is unfit for ordinary smoking; other samples are mild and fine, with aromatic and pleasant flavour, but devoid of strength. By a proper mixing and blending the manufacturer is enabled to prepare the smoking mixture which is desirable for his purpose; but certain of the rough, bitter qualities cannot be manufactured without a preliminary treatment by which their intense disagreeable taste is modified. The storing of such tobacco for a lengthened period matures and deprives it of harshness, and the same result may be artificially hastened by macerating the leaves in water acidulated with hydrochloric acid, and washing them out with pure water. The most efficient means, however, of improving strong, ill-tasting tobacco is by renewed fermentation artificially induced by moisture and heat.

Smoking mixtures. The manufacturer having prepared his mixture of leaves, proceeds to damp them, pure water alone being used in the United Kingdom, whereas on the Continent and in America certain "sauces" are employed, which consist of mixtures of aromatic substances, sugar, liquorice, common salt, and saltpetre, &c., dissolved in water. The primary object is to render the leaves soft and pliant; the use of the sauces is to improve the flavour and burning qualities of the leaves used. When uniformly damped, the leaves are separately opened out and smoothed, the midrib, if not already removed, is torn out, except when "bird's eye" cut is to be made, in which mixture the midrib gives the peculiar "bird's eye" appearance. The prepared tobacco, while still moist and pliant, is pressed between cylinders into a light cake, and cut into fine uniform shreds by a machine analogous to the chaff-cutter. The cut tobacco is now roasted, partly with the view of driving off moisture and bringing the material into a condition for keeping, but also partly to improve its smoking quality. The roasting is most simply effected by spreading it on heated slabs, on which it is constantly turned · but such a method does not yield uniform results, and it exposes the workers to a most deleterious atmosphere and noxious fumes. A roasting machine is in use, which consists of a revolving drum in which the tobacco is rotated, gradually passing from one end to the other, and all the time under the influence of a current of heated air passing through it.

Roll tobacco. For roll, twist, or pigtail tobacco the raw material is damped or sauced as in the case of cut tobacco. The interior of the roll consists of small and broken leaf of various kinds, called "fillers"; and this is enclosed within an external covering of large whole leaf of bright quality, such leaves being called "covers." The material is supplied to the twisting machinery by an attendant, and formed into a cord of uniform thickness, twisted, and wound on a drum by mechanism analogous to that used in rope-spinning. From the drum of the twisting machine the spun tobacco is rolled into cylinders of various sizes. These are enclosed in canvas, and around the surface of each stout hempen cord is tightly and closely coiled. In this form a large number, after being cooked or stoved in moist heat for about twenty-four hours, are piled between plates in an hydraulic press, and subjected to great pressure for a month or six weeks, during which time a slow fermentation takes place, and a considerable exudation of juice results from the severe pressure. The juice is collected for use as a sheep-dip.

Cake tobacco. Cake or plug tobacco is made by enveloping the desired amount of fillers within covering leaves of a fine bright colour. A large number of such packages are placed in moulds, and submitted to powerful pressure in an hydraulic press, by which they are moulded into solid cakes. Both cake and roll tobacco are equally used for smoking and chewing; for the latter purpose the cake is frequently sweetened with liquorice, and sold as honey-dew or sweet cavendish.

Cigars. For cigar-making the finest and most delicately flavoured qualities of tobacco are generally selected. A cigar consists of a core or central mass of fillers enveloped in an inner and an outer cover or robe. The fillers or inner contents of the cigar must be of uniform quality, and so packed and distributed in a longitudinal direction that the tobacco may burn uniformly and the smoke can be freely drawn from end to end. For the inner cover whole leaf of the same quality as the fillers is used, but for the outer cover only selected leaves of the finest quality and colour, free from all injury, are employed. The covers are carefully cut to the proper size and shape with a sharp knife, and, being damped, a pile of them smoothed out are placed together. In making cigars by the hand, the operator rolls together a sufficient quantity of material to form the filling of one cigar, and experience enables him or her to select very uniform quantities. This quantity is wrapped in the inner cover, an oblong piece of leaf the length of the cigar to be made, and of width sufficient to enclose the whole material. The cigar is then rolled in the hand to consolidate the tobacco and bring it into proper shape, after which it is wrapped in the outer cover, a shaped piece made to enclose the whole in a spiral manner, beginning at the thick end of the cigar and working down to the pointed end, where it is dexterously finished by twisting to a fine point between the fingers. The finished cigars are either spread out in the sunlight to be dried, or, where that is impracticable, they are exposed to a gentle heat. They are then sorted into qualities according to their colour, packed and pressed in boxes, in which they are stored for sale. Machinery is now employed for forming and moulding the fillings of cigars.

Havana cigars are, as regards form, classification, method of putting up, and nomenclature, the models followed by manufacturers of all classes of the goods. Genuine ("legitimas") Havana cigars are such only as are made in the island; and the cigars made in Europe and elsewhere from genuine Cuban tobacco are classed as "Havanas." Other brands of home manufacture contain some proportion of Cuban tobacco; and very good cigars may be made in which the name only of that highly-prized leaf is employed. When we come to the inferior classes of cigars, it can only be said that they may be made from any kind of leaf, the more ambitious imitations being treated with various sauces designed to give them a Havana flavour. The highest class of Cuban-made cigars, called "vegueras," are prepared from the very finest Vuelta Abajo leaf, rolled when it is just half dry, and consequently never damped with water at all. Next come the "regalias," similarly made of the best Vuelta Abajo tobacco; and it is only the lower qualities, "ordinary regalias," which are commonly found in commerce, the finer, along with the "vegueras," being exceedingly high-priced. The cigars, when dry, are carefully sorted according to strength, which is estimated by their colour, and classed in a scale of increasing strength as *claro*, *colorado claro*, *maduro*, and *oscuro*. They are pressed into the cigar boxes for sale, and branded with the name or trade mark of their makers. Cheroots differ from ordinary cigars only in shape, being either in the form of a truncated cone, or of uniform thickness throughout, but always having both ends open and sharply cut across. Cheroots come principally from Manila, but there are now large quantities imported into the United Kingdom from the East Indies and Burmah.

Cigarettes. Cigarettes consist of small rolls of fine cut tobacco wrapped in a covering of thin tough paper specially made for such use. Originally cigarettes were entirely prepared by the smoker himself; but, now that the consumption of cigarettes has attained gigantic proportions, especially in France, they are very largely made with the aid of an elaborate system of automatic machinery. The machines cut the paper, gum its edge, measure out the proper quantity of tobacco, wrap it up, make the gummed edge adhere, cut the ends, and pack the cigarettes in boxes.

Snuff. The manufacture of snuff is the most complex, tedious, and difficult undertaking of the tobacco manufacturer; but it is an art now of relatively little and of decreasing importance. The tobacco best suited for snuff-making is thick fleshy leaf of a dark colour, the finest qualities of snuff being made with dark Virginia leaf and the Amersfoort leaf of Holland; but manufacturers work up many kinds with fragments from the making of smoking tobacco, midribs, &c. The varieties and qualities of snuff are many, the differences being dependent on the material employed, the sauces with which it is treated, and the method of manufacture. The sauces for snuff consist of solutions of common salt, with various aromatic substances according to the flavour desired in the finished snuff, and with occasional additions of potash, sal ammoniac, and other salts. The following is an outline of the method adopted in making snuff on the great scale in the state manufacture of France. The tobacco leaves are moistened with about one-fifth of their weight of salt and water (sp. gr. 1·089), made up into blocks, and piled in large rectangular heaps, in quantities of 40 or 50 tons. The temperature gradually rises to 140° F., and sometimes reaches 170°; but the heat must be regulated, or parts of the mass would become black as if charred. The heaps are made up in spring and autumn, and the fermentation is continued for five or six months, when the temperature remains stationary or begins to decline. The heap is then opened, and the tobacco is ground, by which means a pale brown dryish powder (*râpé sec*) is obtained. This is mixed with about four-tenths of its weight of a solution of common salt, and is passed through a sieve, that the powder may be uniformly moistened. It is then packed in large open chests in quantities of from 25 to 50 tons, where it remains for nine or ten months, and undergoes another fermentation, the temperature rising in the centre of the mass to 120° or 130°. During this process the snuff acquires its dark colour and develops its aroma. But it is not uniform in quality throughout, and is removed to a second chest, in such a way as thoroughly to mix all the different parts together, and, after the lapse of two months, it is again turned over; and the process is sometimes repeated a third time. When the snuff is ripe, the contents of the various chests are mixed together in a large room capable of holding 350 tons of snuff, where it is left for about six weeks, and the whole mass being uniform in quality is sifted into barrels for the market. The process of manufacture occupies in all from eighteen to twenty months. During these repeated fermentations about two-thirds of the nicotine is destroyed, the acidity of the snuff disappears, and the mass becomes distinctly alkaline, notwithstanding that acetic acid is continuously evolved. The destruction of malic and citric acids continues, and the bases thereby set free saturate the acetic acid formed, leaving free ammonia in the snuff. The properties of snuff are dependent on the presence of free nicotine, free ammonia, and the peculiar aromatic principle developed in the fermentation.

The reduction of tobacco-leaf to a snuff powder is a task of considerable difficulty, owing to the gummy nature of the substance, which tends to coat and clog grinding surfaces. In early times the duly sauced and fermented leaves were made up into "carottes,"—tightly tied up spindle-formed bundles, from the end of which the snuffer, by means of a "snuff rasp," rasped off his own supply, and hence the name "râpé," which we have still as "rappee," to indicate a particular class of snuff. The practice of tying up the leaves in the form of carottes is still followed by makers of fine snuff, as the very slow fermentation which goes on within the bundles is favourable to the development of a rich aroma. For pulverization, the leaves are first cut to shreds with a revolving knife, and then powdered either by a kind of mortar and pestle mill, or by falling stampers supplied with knife cutting edges, or more commonly they are treated in a conical mill, in which both the revolving cone and the sides have sharp cutting edges, so that the material undergoes a cutting rather than a grinding action. The snuff from the mill is sifted, and that which remains on the sieve is returned to the mill, the remainder being passed on as *râpé sec* for further treatment as described above.

Fiscal restrictions.

In nearly all civilized countries the cultivation of tobacco and its manufacture are conducted under state supervision, and form an important source of public revenue. In France, Austria-Hungary, Italy, and Spain the cultivation is a state monopoly, and in other countries the crop is subject to heavy excise duties. Since the time of Charles II. the growth of tobacco in England has been practically prohibited, the original legislative exactment to that effect having been passed with the view of encouraging trade with the young colony of Virginia. When that motive ceased to have force the supposed difficulties of collecting the internal taxation still influenced the legislature to continue their prohibition, and consequently a penalty or prohibitive tax equal to sixteen hundred pounds per acre is exigible on the cultivation of tobacco in the United Kingdom. In Ireland the duty on the cultivation of tobacco was abandoned between 1822 and 1830, and in that interval the cultivation grew till about a thousand acres were under the crop. In 1886 the Government permitted the experimental cultivation of tobacco in England, under certain precautions and restrictions for the security of the revenue. Several proprietors in Kent, Norfolk, and other counties grew experimental patches with such success as to warrant the continuance of the experiment and to prove the entire practicability of cultivating tobacco as an English agricultural crop. The climate is, however, so variable that, were all restrictions removed, and tobacco grown subject only to excise supervision for collecting an equitable tax, it is more than doubtful whether its growth would be a safe and profitable undertaking.

Physiological effects.

The influence of tobacco on health and morals has, ever since its introduction into Europe, been a fruitful subject of controversy. On all grounds, except as a medicine, it met the most uncompromising opposition when it first became known; but it was precisely the expectations entertained regarding its medicinal virtues which were completely disappointed. Burton, in the *Anatomy of Melancholy*, gives strong expression to the two views: "Tobacco, divine, rare, superexcellent tobacco, which goes far beyond all the panaceas, potable gold, and philosopher's stones, is a sovereign remedy in all diseases. A good vomit, I confess, a virtuous herb if it be well qualified, opportunely taken, and medicinally used; but, as it is commonly abused by most men, which take it as tinkers do ale, 'tis a plague, a mischief, a violent purge of goods, lands, health,—hellish, devilish, and damned tobacco, the ruin and overthrow of body and soul." Burton's meaning—that tobacco in moderation is a good thing, while its excessive use causes many physical and other evils—has many sympathizers; but the difficulty is to define moderation and excess. Among modern authorities, Dr Jonathan Pereira says, "I am not acquainted with any well-ascertained ill effects resulting from the habitual practice of smoking." Similarly Sir Robert Christison concludes, "In many individuals who use it habitually, the smoke has an extraordinary power in removing exhaustion, listlessness, and restlessness, especially when brought on by bodily or mental fatigue, and this property is the basis of its general use as an article of luxury." Dr E. A. Parkes sums up his observations thus: "I confess myself quite uncertain. I can find nothing like good evidence in books; too often a foregone conclusion, without any evidence to back it, is given. I think we must decidedly admit injury from excess; from moderate use I can see no harm, except it may be in youth." On the other hand, it is asserted by the opponents of tobacco, and by the anti-tobacco societies, that the habitual use of this narcotic leads, especially in the young, to decrease of bodily and mental vigour, and specially produces symptoms of anæmia, palpitation, intermittent pulse, and other affections of the heart and circulation. It is an admitted fact that a disease of the vision—tobacco amblyopia—is contracted by smokers, and is not uncommon among those using strong heavy preparations, such as black twist. Allowing that such incidental evils may arise from even comparatively moderate indulgence in tobacco, they are after all as nothing compared to the vast aggregate of gentle exhilaration, soothing, and social comfort, extracted from the Virginian weed.

Commerce.

With the almost universal prevalence of the use of tobacco, it must be obvious that the amount consumed yearly is very great. In the United Kingdom, which is much less a tobacco-consuming country than the United States or many European countries, the consumption per head has steadily increased, as is shown in the accompanying table.

	Total Consumption.	Per Head.
	lb	oz.
1821	15,598,152	11·71
1831	19,533,841	12·80
1841	22,309,360	13·21
1851	28,062,978	16·87
1871	42,773,334	21·49
1881	49,820,493	22·60

The customs duty derived from imports of tobacco amounted in 1886 to £9,298,990, and there certainly is a considerable quantity of manufactured tobacco smuggled into the kingdom which comes into no official record. In the United States the production of tobacco was in 1840 219,163,319 lb, in 1850 199,752,655 lb, in 1860 434,209,461 lb, in 1870 262,735,341 lb, and in 1880 472,661,157 lb. During the ten years ending 1881 the average annual production was 472,000,000 lb, cultivated on from 600,000 to 700,000 acres, the value of the crops ranging from $40,000,000 to $45,000,000. In the same ten years 2,540,818,001 lb of leaf were exported, 1,897,606,249 lb were manufactured for home consumption, and the quantity consumed by growers was estimated to be equal to 280,000,000 lb.

For Tobacco Pipe, see PIPE.

The literature of tobacco is very extensive. The late Mr William Bragge of Birmingham published in 1880 a revised bibliography of the subject, *Bibliotheca Nicotiana*, extending to 248 quarto pages. From such a mass of authorities it would be vain here to make selections, but mention may be made of Fairholt's capital gossiping work, *Tobacco, its History and Associations* (2d ed., 1876). As modern standard works there may also be quoted Tiedemann's *Geschichte des Tabaks* (1856) and Wagner's *Tabakcultur, Tabak- und Cigarren Fabrication* (1884). In the Tenth Census Reports of the United States (1883), vol. iii., there are a series of elaborate papers on the cultivation, manufacture, and statistics of American tobacco. (J. PA.—W. D.)

TOBAGO, the most southerly of the Windward group of British West Indian Islands (11° 9′ N. lat., 60° 12′ W. long.), 20 miles north-east from Trinidad, is 26 miles in length and 7½ at its greatest breadth, with an area of 114 square miles (73,313 acres). Its formation is volcanic, and the physical aspect irregular and picturesque, with conical hills and ridges; the main ridge is 1800 feet high and 18 miles long. There are several excellent harbours. The products are sugar, rum, molasses, and fruits of various kinds, only the low ground being cultivated; production is not increasing. In 1885 the revenue was £10,826 and the expenditure £12,031, while the imports were £30,758 and the exports £26,414. The population in 1885 was 19,363 (9368 males and 9995 females), principally of African race, the whites being very few. Tobago has a small legislative council and an administrator under the Government of the Windward Islands. Its capital is Scarborough (1200 inhabitants), on the south-east coast.

Tobago was discovered by Columbus in 1498, and the British flag was first planted in 1580, the island being then occupied by Caribs. It has subsequently been held by the Dutch and the French, but ultimately was ceded to the British crown in 1814.

TOBIT, THE BOOK OF, one of the Old Testament apocrypha, relates with many marvellous circumstances the virtues, trials, and final deliverance of Tobit, a pious Israelite who was carried to Nineveh in the captivity of the ten tribes, and, after rising into favour and wealth as a trader at the royal court, was reduced to poverty because he habitually buried those of his nation whom the tyrant slew and ordered to be cast forth unburied. Besides this he lost his eyesight through an accident. Reduced almost to despair, like Job, and taunted like Job by his wife ("where are thy alms and righteous deeds?"), he yet puts his faith in God and prepares to die, but first resolves to send his son Tobias to Rhagæ (Rai), in Media, to reclaim an old loan. Now his prayers are heard and his righteousness rewarded, for Raphael, one of the seven angels that present the prayers of the saints before God, is sent in human form to conduct Tobias on his journey. Thus aided, Tobias not only recovers his father's money, but by killing a fish which attacks him as he washes his feet in the Tigris, becomes possessed of two invaluable drugs, its liver with the heart and its gall. By fumigation with the former he drives away the demon Asmodeus, who had slain the seven bridegrooms of a virtuous Jewish maiden, Sara of Ecbatana, his own kinswoman, and so wins a good wife, and with the gall he heals his father's eyes. In spite of the absurd machinery and other puerilities, the story is ingeniously constructed, and the picture of Tobit's piety is natural and touching, so that the whole is a very good exhibition of the weakness and the strength of Judaism as it was among the Israelites of the dispersion.

The date of the book cannot be precisely determined. It was written before the destruction of the temple (xiv. 5), and is cited by early Christian writers. On the other hand, it is in the highest degree probable that the Greek text is original,[1] in which case the book can hardly be earlier than the 2d century B.C. A date about the middle of this century, or a little earlier, at the time of bitter conflict with the Greeks, seems to accord best with the tone of the book. The sympathy shown for the victims of tyranny, to whom burial was denied, acquires fresh meaning when compared with such a passage as 2 Mac. v. 10, and the prominence given to eschatological hopes in the closing verses fits a time when interest in the prophecies of Israel's future glory was revived by the struggle for national independence in Judæa.

That Tobit was written by a Jew of the Eastern dispersion (so, *e.g.*, Ewald, *Gesch.*, iv. 269) will hardly be maintained by any one who accepts the Greek text as original. The book remained almost unknown to the Syriac church, a fact which tells strongly against the hypothesis of an Eastern origin; and at the period to which the work can be best referred Egypt is the only probable place for a Jewish-Greek composition. The writer knows nothing about the geography of the East beyond a few names which every Jew must have heard,—the Tigris, which, by an error common among the Greeks but hardly possible to an Oriental Jew, he regards as flowing between Nineveh and Media; Rhagæ, which was a royal residence of the Parthians; the famous city of Ecbatana; and Elymais (ii. 10), which was associated with the disaster of Antiochus Epiphanes. And in both forms of the Greek text (vi. 9 in the common text, and v. 6 in the longer) Rhagæ is falsely represented as quite near Ecbatana.[2] Nöldeke surmises, as others have done before him, that the "fish" which attacked Tobias was the Egyptian crocodile, and this conjecture is raised almost to certainty when we read in Ķazwini i. 132 that the smell of the smoke of crocodile's liver cures epilepsy and that its dung and gall cure leucoma, which was the cause of Tobit's blindness.[3] Thus the cures of Sara and Tobit are natural (*cf.* the longer Greek text, vi. 4 *sq.*); the angel's help is necessary only to secure the medicaments and explain their use.

But though the story may have been written in Egypt it contains Persian elements. There is no inconsistency in this, for the authors of Jewish Haggada generally borrowed the themes which they embellished, and that from very various quarters. In fact, at the close of our book there is a brief allusion to another story,[4] quite unknown to us, which the author evidently did not invent. The proof of a Persian element in the tale lies, not in the localities, but in the angelology and demonology. Asmodeus is the Iranian evil spirit Aeshmâ Daevâ, and Raphael, as the guardian of Tobias, has a strong resemblance to the Iranian Çraosha. Such precise adaptations of Zoroastrian ideas were hardly the common property of Judaism at so early a date; they lead us to conjecture that the writer borrowed from an Iranian story.[5] And only in this way can we explain the appearance of the dog who goes out and returns with Tobias and Raphael. This trait is so inconsistent with Jewish feelings towards the unclean animal that it is omitted in the Hebrew and Chaldee versions. But to the Iranians the dog was not only a sacred animal, the protector of herds and homes, but was the companion of the protecting spirit Çraosha (*Bundahesh*, chap. xix.), to whom Raphael in our tale corresponds.

The Greek text of Tobit is found in a shorter recension (the usual text) and in a longer form preserved in the Codex Sinaiticus (published by F. H. Reusch, 4to, Bonn, 1870). There are fragments of another form of the longer text in several cursives. All the forms are given in Fritzsche's *Libri Apocryphi*, Leipsic, 1871. The shorter text, in the judgment of Fritzsche and Nöldeke, is the earlier. The longer text is also represented by the Latin versions, the second part of the rare Syriac version (the first part is from the hexaplar Greek), and two closely allied Jewish versions, the Aramaic (published by Neubauer, from a unique Midrash in the Bodleian, Oxf., 1878) and the Hebrew, first printed in Constantinople (1516), reprinted by Münster in 1542 (whence its common name *Hebræus Munsteri*) and included in Neubauer's edition. The Aramaic seems to be a late form of the text known to Jerome, and of which he made use for the Vulgate Latin; it is certainly a translation from the Greek. There are recent commentaries on Tobit by Fritzsche (*Kurzgef. Handb. zu den Apocr.*, ii., Leipsic, 1853), Reusch (Freiburg, 1857), Sengelmann (Hamburg, 1857), and Gutberlet (Theissing, 1877). Nöldeke's paper already quoted is indispensable. For other literature, see Schürer, *NTliche Zeitgesch.*, ii. 609. (W. R. S.)

TOBOLSK, a government of Western Siberia, having the Arctic Ocean on the N., Archangel, Vologda, Perm, and Orenburg on the W., Akmolinsk and Semipalatinsk on the S., and Tomsk and Yeniseisk on the E., is one of the largest provinces of the Russian empire, occupying nearly 7 per cent. (531,980 square miles) of its total area. It borders on the Arctic Ocean, from the river Kara to the Bay of the Ghida, the broad peninsula of Yalmal projecting between the Kara Sea on the west and the Bay of the Ob; this last penetrates into the continent for more than 550 miles, with a width of from 60 to 70 miles, and receives another long and wide outlet—the bay of the Taz (Tazovskaya). Another wide bay of the Kara Sea—the Baidaratsk, or Kara Bay—runs up into the Yalmal peninsula from the north-west. The islands belonging to the government are few; Byelyi, at the extremity of Yalmal, and a few small ones along the west coast of the peninsula, as also in the Obi Bay, are for the most part ice-bound. This extensive province occupies the greater part of the lowlands of north-western Asia, which extend eastward from the Urals, and only in the far north does it include the eastern slopes of these mountains. The Pai-ho coast-ridge only touches Tobolsk with its south-eastern extremity. The Urals proper, which run south-west from the Kara Sea as far as to the Tell-pöss group (5540 feet), and thence take a southerly direction, form the boundary between Tobolsk and Vologda as far as the sources of the Petchora (61° 30′ N. lat.), but farther south their eastern slopes are included in the Russian government of Perm, and only their lowest spurs, 200 miles from the main ridge, belong to Tobolsk. The average height of the northern Urals is about 3000 feet, and several of their summits range from 3300 to 4000 and even 4370 feet (Net-yu, in 68° N. lat.). The remainder of the government is of lowland character, hardly at any point rising above the sea by more than a few hundred feet, but these lowlands vary greatly in their different parts. They assume the character of grassy steppes or prairies in the south, of immense marshes sparsely covered with forest in the north, and of treeless tundras as the shores of the Arctic Ocean are approached. The southern steppes, in their turn, may be subdivided into two distinct portions,—the Tobol and Ishim steppe in the west, and the Baraba in the east. The former, nearly 43,000 square miles in area, is one of the most fertile parts of the empire. One-third is under forest, and the remainder has a soil of very fertile black earth, which has the further advantage of being sufficiently watered. The climate, indeed, is very severe, the mean annual temperature (30° to 34° F.) being such as is found only in the north of Sweden and in Archangel; but the warm summer (65° to 68° in July) and the amount of light received from a bright sky combine to make vegetation develop with a rapidity quite unknown to western Europe. This region now has a population of more than 800,000, almost all Russians (only 14,000 aborigines), so that it may be said to be more thoroughly Russian than the Volga provinces. The area under crops every year is 3½ million acres, and the region promises to become a regular granary for Siberia and north-eastern Russia. The second portion of the southern plains, which might be called the Baraba region, being mostly occupied by the Baraba steppe, covers about 55,000 square miles. Only its western borders belong to Tobolsk. It also is perfectly flat, and covered with recent deposits; but, as there is no definite slope, the surface waters move slowly, and accumulate into a very large number of lakes and marshes. The climate is moister and the summer still shorter and less hot than in the preceding region. Forests, consisting chiefly of birch, are spread in clusters over its surface. The soil of this region also is very productive, but the fertile patches are separated by marshy grounds, and the dense clouds of mosquitoes which float over it in summer are a positive plague to both man and beast. The population numbers only 250,000, also almost all Russians (only 4000 aborigines), and the area annually under crops is about 1,350,000 acres. To the north of the regions just specified is that occupied by the administrative districts of Tura, Tobolsk, and Tara, with an area of about 110,000 square miles; this may be described as the *taiga* region. It is covered throughout with impenetrable forests and quivering marshes—the dreadful *urmans*, which are penetrated by man only for some 20 to 50 miles around the widely separated settlements. Immense cedar-trees, larches, firs, pines, birches, and maples grow very densely, and the underwood is so thick that a passage can be forced only with the aid of the hatchet, the difficulties being further increased by the layers of decayed wood and by the marshes. To cross these, which are treacherously concealed under a swaying layer of grassy vegetation, a kind of snow-shoe must be used even in the summer, and many can be crossed only in winter. Immense areas of the *urmans*, especially on the Vasyugan, have never been visited by man; but still, from time to time a Russian settlement arises in the forests, mostly founded by Nonconformists in hiding, who freely receive all sorts of fugitives. The south-western parts of this region are crossed by the Siberian highway, and to this circumstance alone is it indebted for its population of nearly 450,000 (32,000 aborigines). Only 2 per cent. of this area is under culture. Farther north extend the tundras, where the average temperature rapidly decreases from the 25° F. found in the preceding region to 15°, 10°, and 7°. The frozen soil during the hottest part of the summer thaws only for a few inches beneath the surface. The frost sets in early, and a thick envelope of snow lowers the spring temperature. Forests cover the southern parts, but the trees become poorer, shorter, and thinner, and huddle into impenetrable thickets; while, farther north, only the creeping variety of birch and the dwarf varieties of willow hold their ground. Within the Arctic Circle the last traces of arboreal vegetation disappear, their northern limit being pushed south by the double bay of the Ob and the Taz, and by the proximity of the Kara Sea.

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[1] See the arguments of Nöldeke, *Monatsb. Berl. Ak.*, 1879, p. 45 *sq.* This paper also contains the best discussion of the relation of the various texts of the book.

[2] Nöldeke shows that the same error in a less gross form appears in both texts in chap. ix. The further erroneous statement of the longer text that Ecbatana lies in a plain occurs also in Diod., ii. 13, 6, in a passage dependent on Ctesias, from whom the addition may have been taken.

[3] Very similar statements as to the medical virtues of the crocodile (aquatic or terrestrial) occur in Greek and Latin writers.

[4] The story of Nadab and Achiacharus. The names are uncertain, and one text substitutes Aman (Haman) for Nadab. But the allusion is not to the book of Esther.

[5] Compare what is said under THOUSAND AND ONE NIGHTS (p. 312) as to the probable influence of an Iranian legend on the book of Esther.

Apart from the Urals, there are no traces of hard rock anywhere in Tobolsk. Down to its southern borders it is covered with Post-Pliocene deposits, which are met with as far as the water-parting between the Irtish and the Aral-Caspian depression. This range of flat hills rises a few hundred feet above the sea-level, and it seems to mark the limit of extension of the Post-Glacial gulf of the Arctic Ocean which covered western Tobolsk during the Glacial period. Contrary to Humboldt's hypothesis, it remains, however, doubtful whether it was connected in Post-Glacial times with the Aral-Caspian Sea otherwise than by means of narrow straits, which disappeared at any rate at an early stage in that geological period.

The climate of Tobolsk is one of great extremes, the differences between the averages for the hottest and coldest months reaching as much as 70° F. The average temperatures at Berezoff, Narym, Tobolsk, and Ishim respectively are 24°, 28°, 31°·8, and 32° (January, −8°·3, −8°, −2°, and −4°; July from 62° to 67°). Only 194 days at Ishim and 153 at Berezoff have a temperature above 32°; and the Ob at Obdorsk continues ice-bound for 219 days (the Irtish 176 days at Tobolsk).

The government is watered by the Ob, which traverses it for more than 1300 miles, and is navigable throughout. It receives many tributaries, some of which are 200 to 350 miles long, but flow through quite uninhabited regions. The Irtish, a left-hand tributary of the Ob, covers all the southern part of Tobolsk with its numerous tributaries. It waters Tobolsk for 760 miles, and is navigable for the whole of its length; it receives the great Tobol, about 420 miles long, also navigable, the Ishim, and a number of less important streams; while the Tura, a tributary of the Tobol, is also a channel for navigation. The navigation lasts for nearly six months in the south. The first steamer on the Ob system was launched in 1845 and the second in 1860; since the latter date steam navigation has steadily developed.

Lakes, some of them salt, occur in great numbers on the water-parting between the Irtish and the Aral-Caspian, and everywhere in South Tobolsk. Lake Tchany, the largest, covers 1265 square miles. All are being rapidly dried up, and even within the last hundred years they have undergone great changes. Thus, in the group of lakes of Tchany, in the Baraba steppe, whole villages have arisen on ground that was under water in the earlier years of this century.[1] Immense marshes cover Tobolsk beyond 57° N. lat.,—the Vasyugan marshes in the east, the Kondinsk and Berezovsk marshes in the west, both joining farther north the tundras of the Arctic shores.

The population reached 1,283,000 in 1882. Although recent immigrants, the Russians already constitute 94 per cent. of the aggregate population, and their numbers are steadily increasing by immigration, and partly also by the arrival of exiles. No fewer than 43,750 immigrants from Russia settled at Tobolsk between 1846 and 1878, but of late this figure has greatly increased. In 1879 as many as 59,134 exiles were on the registers, but of these more than 20,000 had left their abodes and disappeared. As a rule the exiles belong to the poorest class of population. According to M. Yadrintseff,[2] the native population of Tobolsk was represented in 1879 by 29,150 Tartars and 8730 other Turkish inhabitants, chiefly in the south, 22,350 Ostiaks, chiefly on the Ob, 6920 Samoyedes in the north, and 6100 Voguls in the north-west; the total amounted to 74,220,—that is, 6·1 per cent. of the aggregate population (1,206,000 in 1879). The OSTIAKS (*q.v.*) are in a very miserable condition, having come under heavy obligations to the Russian merchants, and being compelled to hand over to them nearly all the produce of their hunting and fishing. The Tartar settlements in the south are prosperous, but not in the Tobolsk district, where their lands have been appropriated for the Russian settlers. Of the Russians nearly 85,000 are Nonconformists, according to official figures, but the number is greatly understated. Many of the Samoyedes, Ostiaks, and Voguls are nominally Christians. The Russians and the Tartars, who chiefly inhabit South Tobolsk, mostly live by agriculture. Of the total area of land regarded as suitable for cultivation (28,400,000 acres), 15,600,000 are owned by the peasant communities. Summer wheat, rye, oats, barley, and some buckwheat are raised. Flax and hemp and tobacco are cultivated in the south, where cattle-breeding also is extensively carried on. The ravages of anthrax, however (see MURRAIN, vol. xvii. p. 58), are very severe, especially in the marshy parts of the province. The indigenous inhabitants of the north had, in the same year, more than 100,000 reindeer. Dogs are used in sledges in the far north. In the forest region the chief means of existence are found in the forests. The pursuit of bears, wolves, foxes, squirrels, ermines, stags, elks, as also of sables and beavers (rapidly disappearing), is a regular occupation with the Russian peasants as well as with the indigenous inhabitants; sledges and cars, mats, sieves, wooden vessels, and pitch and tar are also manufactured to a considerable extent in the villages (valued at about £150,000). Cedar-nuts (from 5000 to 8000 cwts. every year) are gathered, partly for the sake of their oil. The fisheries of the Ob and the southern lakes are important; no fewer than 1700 Ostiaks are engaged in them on the Ob. No less than 200,000 cwts of fish are annually caught in the district of Tara alone, and Surgut exports it to the value of £10,000, while in the Narym region 10,000 cwts. of salt are used for preserving the fish

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[1] See Yadrintseff in *Izvestia Russ. Geogr. Soc.*, 1886.

[2] *Siberia as a Colony* (Russian).

The industries are insignificant (chiefly tanning, distilling, and tallow-melting); iron-works and woollen-cloth mills are still in their infancy. The export of cattle, hides, tallow, corn, flour, fish, and furs to Russia, both from Tobolsk and from the Kirghiz steppe, is of some importance. Spirits are sent farther east, to Tomsk; while all kinds of manufactured wares are imported from Russia. The fairs of Irbit and Ishim are the chief centres for trade.

The educational institutions are few. It is worthy of remark that of "secondary schools" (gymnasia and pro-gymnasia) there were in 1883 eight for girls, with 1065 scholars, and only four for boys, with 711 scholars; of primary schools there were 250, with 6844 boys and 1403 girls.

Tobolsk is divided into ten districts (*okrugs*), the chief towns (with populations in 1883) being Tobolsk (20,130), Berezoff (1990), Ishim (7100), Kurgan (8570), Surgut (1460), Tara (8640), Turinsk (4650), Tyukalinsk (3900), Tyumeñ (14,300), and Yalutorovsk (4500). Of these towns, only TOBOLSK and TYUMEÑ (*q.v.*) are really entitled to the designation, the others being mere villages, of less importance than many others on the great Siberian highway which crosses the government from Tyumeñ to Tomsk. (P. A. K.)

TOBOLSK, capital of the above government, is situated on the right bank of the Irtish, near its junction with the Tobol. It is 1535 miles from Moscow, and since the alteration of the course of the great Siberian highroad from Tyumeñ to Tomsk it has become an out-of-the-way place, and is no longer either capital of Western Siberia or even an administrative centre for exiles, as it was formerly. Viewed from the Irtish, the town has a picturesque aspect, with its kreml, or stone walls, built on a crag 200 feet high, its twenty-one churches, and several elegant buildings. The kreml, built under Peter I. by Swedish prisoners, in imitation of the kreml of Moscow, is 430 yards long by 200 yards in breadth, and contains two cathedrals erected towards the end of the 17th century. The bell of Uglitch, which rang the alarm when the czarevitch Dmitri was assassinated by order of Boris Godunoff, and therefore had its "ear torn away," and was exiled to Siberia, stands close by. The palace of the governor, the administrative offices, the seminary where the historian of Siberia, Slovtsoff, received his education, the gymnasium where Mendeléeff the chemist was trained, and the Marie school for girls, which now supplies Siberia with so many teachers, are in the upper part of the town, where broad grassy spaces separate the wide streets paved with thick planks. A monument to Yermak, the rebel Cossack who conquered Siberia, stands in a prominent place; and one of the sides of the large square on the crag is occupied by the immense prison, where more than 2000 exiles are gathered during the period of navigation. The lower part of the town stands on a sandy beach of the Irtish, and often suffers from floods. Its sanitary condition is very bad. The merchants of Tobolsk carry on a fairly brisk trade in corn from the south, salt from Semipalatinsk, timber and fish from the lower Ob. The population is almost stationary (20,130 in 1883, as against 15,500 in 1839 and 15,200 in 1772). Some 12 miles to the south-east are the ruins of the "fort of Kutchum,"—the seat of the capital of Siberia, Isker, before the Russian conquest.

Tobolsk was founded in 1587 by 500 Cossacks who left Tyumeñ under Tchulkoff, and built a wooden fort at the mouth of the Old Tobol. During the next fifteen years several other forts were erected on the territory now occupied by Tobolsk. The Ostiaks and Samoyedes soon submitted to Russian rule, but the Tartars and Bashkirs made frequent raids, so that a line of forts had to be built in the 17th century from Orenburg to Ishim. In 1752 a new line of forts was erected some 150 miles farther south, and since that time Russian settlers have been able quietly to colonize the most fertile parts to the south of Tobolsk

TOCQUEVILLE, ALEXIS HENRI CHARLES CHÉREL, COMTE DE (1805–1859), was born at Verneuil on July 29, 1805. His family on the father's side were of good descent, and distinguished both in the law and in arms, while his mother was the granddaughter of Malesherbes. Alexis de Tocqueville was brought up for the bar, or, rather, according to the division of that profession in France, for the bench, and became an assistant magistrate in 1830. A year later he obtained from the Government of July a mission to examine prisons and penitentiaries in America, and proceeded thither with his lifelong friend Gustave de Beaumont. He returned in somewhat less than two years, and published a report on the subject of his mission, but the real result of his tour was the famous *De la Démocratie en Amérique*, which appeared in 1835, and very soon made his reputation. It was at once caught up by influential members of the Liberal party in England, which country Tocqueville soon after visited, and where he married an Englishwoman. Returning to France, and beginning life as a country gentleman at Tocqueville, he thought to carry out the English ideal completely by standing for the chamber of deputies. But, with a scruple which illustrated his character, he refused Government nomination from Molé, and was defeated. Later he was successful, and sat for several years both before and after the revolution of February, becoming in 1849 vice-president of the assembly, and for a few months minister of foreign affairs He was a warm supporter of the Roman expedition, but an equally warm opponent of Louis Napoleon, and after being one of the deputies who were arrested at the *coup d'état* he retired from public life. Twenty years after his first, he produced another book, *De l'Ancien Régime*, which almost, if not quite, equalled its success. His health was never very strong, and in 1858 he broke a blood-vessel. He was ordered to the south, and, taking up his residence at Cannes, died there on the 16th of April 1859. He had published some minor pieces during his lifetime, and his complete works, including much unpublished correspondence, were produced after his death in uniform shape by De Beaumont.

During the last twenty years of his life, and for perhaps half that time after his death, Tocqueville had an increasing European fame, which for the last ten or fifteen years has been stationary if not diminishing. Both phenomena are susceptible of explanation. Although he has been accused by some of his own countrymen of having "le style triste," his manner, which is partly imitated from Montesquieu, has considerable charm; and he was the first and has remained the chief writer to put the orthodox liberal ideas which governed European politics during the first half or two-thirds of the 19th century into an orderly and attractive shape. He was, moreover, as has been said, much taken up by influential persons in England,—Senior, John Stuart Mill, and others,—and he had the great advantage of writing absolutely the first book of reasoned politics on the facts of democratic government as observed in America. Besides all this he was, if not an entirely impartial writer, neither a fanatical devotee of democracy nor a fanatical opponent of it. All this gave him a very great advantage which he has not yet wholly lost. At the same time he had defects which were certain to make themselves felt as time went on, even without the alteration of the centre of liberal opinion which has taken place of late years. The chief of these was a certain weakness which can hardly be described in English by any word more dignified than the familiar term "priggishness." His correspondence with Molé above alluded to is an instance of this, and it was also reflected on in various epigrams by countrymen and contemporaries; one of these accuses him of having unluckily "begun to think before he had begun to learn," while another, with more real than apparent inconsistency, declares that he "avait l'air de savoir de toute éternité ce qu'il venait d'apprendre." His book on America, though undoubtedly a very remarkable piece of political deduction, has the drawback of proceeding on very insufficient premisses and of trying to be too systematic. His book on the *Ancien Régime* is also wanting in solid information, and commits the great error of assuming rather than proving that the Revolution of 1789 was a proceeding of unmixed good, which delivered France from a state (not of unmixed evil, for Tocqueville was too careful a student to imagine that, but) of evil exclusively caused by the existence of monarchical and aristocratic institutions. In fact, the fault of both books is that their author is not a practical politician, a fault which is constantly illustrated and exhibited in his correspondence. He appears both in reading history and in conducting actual political business (of which, as has been seen, he had some experience) to have been constantly surprised and disgusted that men and nations did not behave as he expected them to behave. This excess of the deductive spirit explains at once both the merits and the defects of his two great works, which will probably remain to some extent political classics, though they are less and less likely to be used as practical guides.

TODAS. See NILGIRI HILLS, vol. xvii. p. 509.

TODLEBEN, or TOTLEBEN, EDUARD IVANOVICH (1818–1884), Russian general, was born at Mittau, in Courland, on May 20, 1818. His parents, who seem to have been of German descent, were of the mercantile class, and he himself was intended for commerce, but a strong instinct led him to seek the career of a military engineer. He entered the school of engineers at St Petersburg in 1835, and passed from that into the army in 1838. In 1847 and the two following years he was employed, as captain of engineers, in the campaigns against Schamyl in the Caucasus, where he directed the siege operations against the principal mountain fortresses. On the outbreak of war between Russia and the Porte in 1853, he was placed at the head of the staff of General Schilder-Schuldner, by whom Silistria was besieged. This general being wounded, Todleben acted in his place until the siege was raised. He was then transferred to the Crimea. Sebastopol, while strongly fortified toward the sea, was almost unprotected on the land side. Todleben, though still only of colonel's rank, became the animating genius of the defence. By his advice the fleet was sunk, in order to blockade the mouth of the harbour, and the deficiency of fortifications on the land side was made good before the allies could take advantage of it. The construction of earthworks and redoubts was carried on with extreme rapidity, and to these was transferred, in great part, the artillery that had belonged to the fleet. In whatever direction the besiegers drew their lines, there Todleben met them with counterworks, until, with the arrival of heavy Russian reinforcements, the besiegers almost became the besieged. It was in these improvised operations by means of earthworks that Todleben's peculiar power and originality showed itself; he was not a great military leader in the wider sense, nor was he the creator of a great permanent system of defence like Vauban. But for the special problems of Russian warfare, both in 1854 and at a later epoch, he was exactly the man wanted. Until June 1855 he conducted the operations of defence at Sebastopol in person; he was then wounded in the foot, and at the operations which immediately preceded the fall of the fortress he was not present. When he recovered from his wounds he was employed in strengthening the fortifications at the mouth of the Dnieper, and also those of Cronstadt. In 1856 he visited England, where his merits were well understood. In 1860 he was appointed assistant to the grand-duke Nicholas, and he became subsequently chief of the department of engineers. For reasons which are not known he was given no command when war with Turkey began in 1877. It was not until the disasters before Plevna had heaped discredit upon the incompetent leaders of the Russian army that the soldier of Sebastopol was called to the front. Todleben saw that Plevna could not be taken by assault, and that it would be necessary to reduce it by drawing works round Osman Pasha, and cutting him off from communication with the other Turkish commanders. In due time Plevna fell. Todleben then undertook the siege of the Bulgarian fortresses. After the conclusion of preliminaries of peace, he was placed in command of the whole Russian army, and became responsible for the government and administration of the occupied districts. In the discharge of these duties he is said to have distinguished himself by his combined firmness and good temper in dealing both with Turkish authorities and with the native population. He received the highest military honours and commands when the war was over, and became governor of Odessa. But his health was broken; and after much suffering he died at a German watering-place in June 1884. He was buried with great solemnity at Sebastopol.

TODMORDEN, a market-town of England, partly in Lancashire but chiefly in the West Riding of Yorkshire, stands on the Calder, on the Rochdale Canal, and on the Lancashire and Yorkshire Railway, 13 miles west of Halifax, 9 north of Rochdale, and 207½ north-north-west of London. It lies in three valleys amidst scenery originally romantic, and still in part retaining that characteristic. The town-hall (1875) bridges the counties boundary, the Calder, enabling the magistrates to exercise jurisdiction in both counties Of the other buildings, the Unitarian church, the market-hall, the free endowed school, and the Unitarian free school may be mentioned. A bronze statue has been erected to John Fielden, to whose energy in developing the cotton manufacture the town owes much of its prosperity. The staple industry is the spinning and weaving of cotton, and there are also foundries and machine-works. The population of the township of Todmorden and Walsden (area 7007 acres) in 1871 was 9333, and in 1881 it was 9237. In addition to this (situated wholly in Yorkshire), the urban sanitary district includes parts of Langfield and Stansfield in Yorkshire, and of Clivriger in Lancashire, the total area being 15,690 acres, with a population in 1871 of 21,764, and in 1881 of 23,862.

As early as the reign of Edward III. Todmorden was in the possession of the Radcliffes, a branch of the Radcliffes of Radcliffe Tower, but it was sold by them about the close of the 17th century. Todmorden Hall is an interesting old building of various dates.

TODY, Pennant's rendering (*Gen. Birds*, pp. 15, 61) through the French *Todier* of Brisson (*Ornithologie*, iv. p. 528) of the somewhat obscure Latin word *Todus*,[1] not unhappily applied in 1756 by Patrick Browne (*Civ. and Nat. Hist. Jamaica*, p. 476) to a little bird remarkable for its slender legs and small feet, the "Green Sparrow" or

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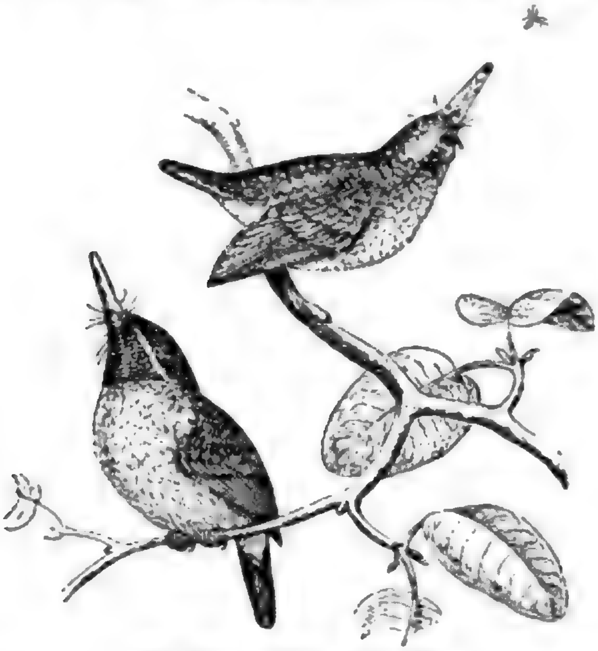
[1] In Forcellini's *Lexicon* (ed. De Vit, 1875) we find "Todus genus parvissimæ avis tibias habens perexiguas." Ducange in his *Glossarium* quotes from Festus, an ancient grammarian, "Toda est avis quæ non habet ossa in tibiis; quare semper est in motu, unde Todius (al. Todinus) dicitur ille qui velociter todet et movetur ad modum todæ, et todere, moveri et tremere ad modum todæ." The evidence that such a substantive as *Todus* or *Toda* existed seems to rest on the adjectival derivative found in a fragment of a lost play (*Syrus*) by Plautus, cited by this same Festus. It stands "cum extritis [*extortis*] talis, cum todillis [*todinis*] crusculis"; but the passage is held by scholars to be corrupt. Among naturalists Gesner in 1555 gave currency (*Hist. Animalium*, iii. p. 719) to the word as a substantive, and it is found in Levins's *Manipulus Vocabulorum* of 1570 (ed. Wheatley, 1867, col. 225) as the equivalent of the English "Titmouse." Ducange allows the existence of the adjective *todinus*. Stephanus suggests that *todi* comes from *τυτθοί*, but his view is not accepted. The verb *todere* may perhaps be Englished to "toddle"!

"Green Humming-Bird" of Sloane (*Voyage*, ii. p. 306). The name, having been taken up by Brisson (*loc. cit.*) in 1760, was adopted by Linnæus, and has since been recognized by ornithologists as that of a valid genus, though many species have been referred to it which are now known to have no affinity to the type, the *Todus viridis* of Jamaica, and accordingly have since been removed from it. The genus *Todus* was at one time placed among the *Muscicapidæ* (*cf.* FLYCATCHER, vol. ix. p. 351); but Dr Murie's investigations (*Proc. Zool. Society*, 1872, pp. 664–680, pl. lv.) have conclusively proved that it is not Passerine, and is nearly allied to the *Momotidæ* (*cf.* MOTMOT, vol. xvii. p. 3) and *Alcedinidæ* (*cf.* KINGFISHER, vol. xiv. p. 81), though it should be regarded as forming a distinct Family *Todidæ*, peculiar to the Greater Antilles, each of which islands has its own species, all of small size, the largest not exceeding four inches and a half in length.

Of the species already named, *T. viridis*, Mr Gosse (*B. Jamaica*, pp. 72–80) gives an interesting account. "Always conspicuous from its bright grass-green coat and crimson-velvet gorget, it is still a very tame bird; yet this seems rather the tameness of indifference than of confidence; it will allow a person to approach very near, and, if disturbed, alight on another twig a few yards distant . . . . commonly it is seen sitting patiently on a twig, with the head drawn in, the beak pointing upwards, the loose plumage puffed out, when it appears much larger than it is. It certainly has an air of stupidity when thus seen. But this abstraction is more apparent than real; if we watch it, we shall see that the odd-looking grey eyes are glancing hither and thither, and that ever and anon the bird sallies out upon a short feeble flight, snaps at something in the air, and returns to his twig to swallow it." Mr Gosse goes on to describe the engaging habits of one that he for a short time kept in captivity, which, when turned into a room, immediately began catching all the insects it could, at the rate of about one a minute. The birds of this Family also shew their affinity to the Kingfishers, Motmots, and Bee-eaters by burrowing holes in the ground[1] in which to make their nest, and therein laying eggs with a white translucent shell. The sexes differ little in plumage.



Tody (*Todus viridis*). (After Gosse.)

All the four species of *Todus*, as now restricted, present a general similarity of appearance, and, it may be presumed, possess very similar habits. The genus has been monographed by Mr Sharpe (*Ibis*, 1874, pp. 344–355); but he was unfortunately misled by an exceptionally bright-coloured specimen to add a fifth and bad species to those that exist—and even these, by some ornithologists, might be regarded as geographical races. The Cuban form is *T. multicolor*; that of Hispaniola is *T. subulatus* or *dominicensis*; and that of Porto Rico, originally named in error *T. mexicanus*, has since been called *hypochondriacus*. Apart from their structural peculiarities, one of the chief points of interest attaching to the *Todidæ* is their limitation, not only to the Antillean Sub-region, but, as is now believed, to its greater islands. (A. N.)

TOGA. See COSTUME, vol. vi. p. 456.

TOGO-LAND, one of the portions of the African continent under the protection of the German empire. It forms part of the territory on the west coast formerly distinguished as the Slave Coast, and is bounded on the E. by Little Popo, on the S.W. by the British Gold Coast Colony, and on the N.W. by the still independent territory of the Anlo tribes. The coast-line is only 22 miles in length, and with an area of about 500 square miles Togo-land is estimated to have a population of 40,000 souls. The great physical feature of the country is the Togo, Hakko, or Avon lagoon, which is cut off from the ocean by the narrow belt of sandy soil on which are situated Bagida, Porto Seguro, and Bay. The town of Togo lies on the east side of the Togo lagoon, where it extends eastward to Little Popo Lake. The lagoon is fed by a stream from the north, the Haho or Hakko, first discovered by John Duncan in 1846.

See Hugo Zöller, *Togoland*; *Petermann's Mittheilungen* (1886); and *Scott. Geogr. Mag.* (1886), all of which give maps.

TOKAT, a decayed provincial town of Turkey, in the vilayet of Sivas, and capital of the upper basin of the Iris (Yeschil Irmak), is a poorly-built place of about 10,000 inhabitants, in a hot, narrow valley, dominated by the ruins of a Byzantine castle, and surrounded by gardens watered by the Iris. It was once an important commercial station, and has still copper foundries. Six miles up the valley are the ruins of the Pontic COMANA (*q.v.*).

TOKAY, or TOKAJ, a small town in the county of Zemplén, in the north-east of Hungary, at the influx of the Bodrog into the Tisza, in 48° 7′ N. lat., 21° 4′ E. long. The slopes of the adjacent mountains of Hegyallya, which are of volcanic origin, produce excellent wine, several kinds of which are of perhaps the best, sweetest, and strongest quality in the world. Of these, however, none or hardly any come into the market, the wine usually sold under the name of Tokay not being a natural wine, and often not coming from the district at all. Tokay, along with about twenty-five neighbouring villages, produces annually an average of 2,200,000 gallons. The vine culture has been greatly improved of late years by a company in Budapest. The timber trade, fishing, and export of fruits are also considerable. The population was 4479 in 1880.

TOKIO, formerly called YEDO, the present capital of the empire of Japan, is situated in 35° 41′ N. lat. and 139° 46′ E. long., at the head of the bay of the same name, on the south-east coast of Hondo (mainland), the largest of the group of Japanese islands. It is connected with the seaport of Yokohama by a railway 18 miles in length. The bay of Tokio is shallow, and therefore not well suited for the navigation of large vessels. The wide river Sumida, also called Ókawa ("great river") near its mouth, runs through the town. For administrative purposes Tokio proper is divided into fifteen *ku* (districts), of which thirteen lie to the west and two to the east of the Sumida. Each ku is presided over by an official appointed by the Government, called the *ku-chio* (chief of the ku), and an assembly (Ku-Kwai) for local administrative purposes is elected every four years by the inhabitants. These ku and six *gun* (suburban districts) collectively form the Tokio-Fu, and are under the general superintendence of the *fu-chiji* (governor). Matters affecting the interests of the whole fu are discussed by an assembly (Fu-Kwai) composed of representatives from all the ku and gun. Order is maintained by a well-organized body of police (3648 men in 1885) under the command of a *keishisokan* (chief commissioner), who, like the fu-chiji, is responsible to the central Government. Since the establishment of this system crime has very materially decreased. There is also a fire brigade of 2000 men, which is connected with the police system, and renders effective service in checking the spread of the fires to which the town is peculiarly liable. Buildings of brick and stone have lately been erected in many parts of the town. The fifteen ku which form Tokio proper cover an area of 4·01 square *ri*, and the six gun 27·94 square ri, the whole fu thus extending to about 32 square ri (about 190 square miles). The greater part of the town is flat, particularly near the Sumida, and is intersected by numerous moats and canals, which, with the bridges crossing them, form a distinctive feature. There are hills varying in height from 50 to 100 feet in the six districts of Hongo, Koishikawa, Ushigome, Yotsuya, Akasaka, Azabu, and in part of Shiba. The numerous residences of the old daimios were the chief characteristics of the town, especially in the Kôjimachi-ku. Many of these have been demolished and Government offices erected on their sites; some have given place to new streets and houses; others, having survived the downfall of the shogunate, still remain surrounded by large gardens, which are celebrated for their elaborate rock-work, artificial lakes, and magnificent trees. Nearly in the centre of the Kôjimachi-ku, on an eminence, surrounded by moats, stood the residence of the shoguns, which was burnt down in 1872. An imperial palace is now in course of construction on this site. Outer moats connected with those already mentioned enclose the whole Kôjimachi-ku and a greater portion of Kanda-ku; one of the moats terminates at the Sumida. The Nihonbashi, Kiobashi, and Kanda-ku, through which the Ô-dori (main street) passes, are the business quarters of the town. The Nihonbashi (Bridge of Japan), in the ku of the same name, also in the Ô-dori, is the centre from which all distances are calculated. Nearly all the principal buildings of the city—such as the Gwaimushô (Foreign Office), the Naimushô (Home Office), the Ôkurashô (Ministry of Finance), the Monbushô (Ministry of Education), and other Government offices, &c.—are situated in those four ku. Among the parks, those of Shiba and Uyeno rank first in size and beauty, the latter containing a large sheet of water. In 1868, when the imperial army entered the city, a body of men called the shogitai, loyal to the cause of Tokugawa, here made a last stand, and during the fighting the magnificent temple of Tôyesau, on the hills of Uyeno, was burnt down. This park, as also the Mukojima (the embankment of the Sumida), and the Asukayama park, which is at some distance north-west of Uyeno, are celebrated for their sakura trees (species of cherry), which, when in full bloom, attract crowds of all classes. The famous temple of Kwannon (goddess of mercy) is in the Asakusa park, in which a continual fair is held, with the usual accompaniments of booths, shows, tea-houses, &c. The districts of Fukagawa and Honjô lie on the east bank of the river, and are connected with the rest of the town by five wooden bridges of considerable length; they are intersected by numerous canals, and the streets there are regularly laid out. The means of communication are imperfect; the streets of Tokio are in general irregular, and many are so narrow that they are unsuitable for carriages. The *jinrikisha*, a kind of chaise drawn by one or in some cases by two or more men, supplies their place to a great extent. The introduction of tramways in some parts of the town has had the good effect of diminishing the number of second-rate carriages drawn by miserable horses.

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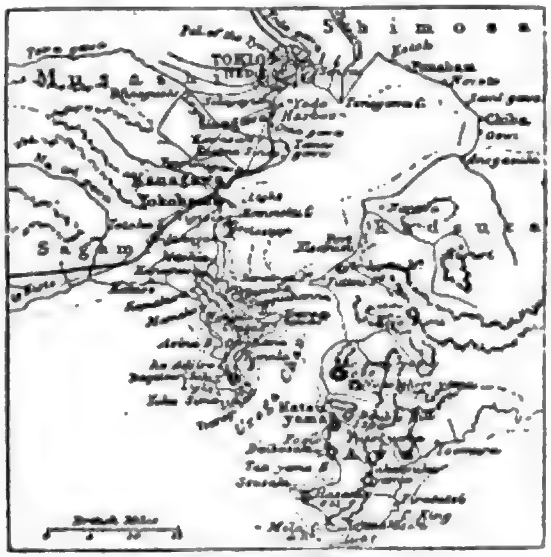
[1] This habit and their green colour has given them the French name of *Perroquet* or *Todier de terre*, by which they have been distinguished from other species wrongly assigned to the genus by some systematists; and, if we may believe certain French travellers, they must in former days have inhabited some of the Lesser Antilles; but that is hardly probable.



Environs of Tokio.

There are no reliable data as to the population of Yedo during the shogunate (see below). Owing to the influx caused by the periodical visits of the daimios with their numerous attendants, it probably exceeded one million during the early part of the present century. At the abolition of the shogunate there was a marked decrease, but the returns of recent years (1,121,560 in 1881; 1,173,603 in 1883; 1,300,073 in 1885) indicate a rapid increase. Of the 1,519,781 who constituted the population in 1886, 1,211,357 are to be classed as belonging to the town proper, and 308,424 to the six suburban districts. The sanitary condition of the city leaves much to be desired, but extensive improvements are now being carried out. The general health, however, is good, and the enforcement of vaccination has virtually stamped out the scourge of small-pox. The deaths from cholera are occasionally very numerous, especially among the lower classes.

A well-organized system of education exists, under the supervision of the ministry of education. In 1885 there were in the Tokio-Fu 658 public and private elementary schools, with 1563 teachers,—the cost of maintaining public schools being 145,152 yen (Japanese dollars). In the same year the boys and girls of school age numbered 172,653, of whom 77,001 attended schools recognized by the Government. Kindergartens on the European system have been introduced. There are also the *shihangakko* (normal schools), the *chugakko* (middle schools), and schools, both Government and private, for special branches. In the district of Hongo is the imperial university, subdivided into the four branches of law, science, medicine, and literature. Many of the students attain a high degree of proficiency.

No mention is made of Tokio in Japanese history before the end of the 12th century. It appears to have assumed no importance till about 1457, when Ôta Dokwan, a general in the service of Uyesugi Sadamasa, governor of Kamakura, built a castle there. About thirty years later the town fell into the hands of Hôjô of Odawara, and subsequently, on his overthrow by Hideyoshi and Iyeyasu, the castle was granted to the latter, who was the founder of the shogun house of Tokugawa. In 1590 Iyeyasu made his formal entry into the castle of Yedo, the extent of which he greatly enlarged. From this date the real importance of Yedo commenced. The family of the Tokugawas furnished the shoguns (or tycoons) of Japan for nearly three hundred years, and these resided during that period at Yedo. Under them the town was vastly extended, land was reclaimed from the bay, canals were constructed, and a water supply introduced. The shoguns compelled the daimios (feudal lords) to reside at Yedo with their numerous retinues during a considerable portion of their lives, and thus the prosperity of the town rapidly increased. At the restoration of the supreme authority of the emperor in 1868 the shogunate was abolished, and the population of Yedo speedily decreased. A fresh vitality was again imparted by the transfer of the court from Kioto, and the town then received its present name Tokio (eastern capital). It has since been the seat of the imperial Government, and may be considered the centre of the political, commercial, and literary activity of Japan. It is the channel through which the stream of European civilization pours into the country, and all recent progress has there taken its rise. (R. S. L.)

TOLAND, John (1670-1722), or Janus Junius, as his sponsors are said to have named him, usually described as a chief leader of the English deists, was born November 30, 1670 or 1671, in the north of Ireland, near Londonderry. He was the son, perhaps illegitimate, of Catholic parents, and was brought up in their faith. But in his fifteenth year he became a zealous Protestant, and in 1687 he passed from the school at Redcastle to Glasgow university, recommended by the magistrates of Redcastle "for his affection to the Protestant religion." Thus early in life he became "accustomed to examination and inquiry, and was taught not to captivate his understanding to any man or society." After three years at Glasgow he entered the university of Edinburgh, taking his M.A. degree there June 30, 1690. He then spent a short time in some Protestant families in England, and with their assistance went to Leyden university, to qualify him for entering the Dissenting ministry. He spent about two years in Leyden, studying ecclesiastical history especially under the famous scholar Frederick Spanheim. At the expiration of that time he took up his abode, January 7, 1694, at Oxford, having good introductions to Creech, Mill, and others. Here he made large use of the Bodleian Library, and soon acquired the reputation of being "a man of fine parts, of great learning, and of little religion," though there is no evidence to show that the last distinction was justly his due. His letters show that he then claimed to be a decided Christian, and that he was too orthodox to be classed with the Arians or the Socinians. At the same time the characteristic freedom and originality of his mind were displayed by his anticipation of subsequent doubts of the integrity of the book of Job, and the separation of the historical prologue and the speeches of Elihu from the original poem. While at Oxford he commenced the book which called him into notoriety, and became one of the standard "deistical writings"—his *Christianity not Mysterious*.[1] The book gave great offence, and several replies to it were immediately published. The author was prosecuted by the grand jury of Middlesex the year of its publication; and, when he attempted to settle in Dublin at the beginning of 1697, he was greeted with dangerous denunciations from the pulpits and elsewhere. He was soon prosecuted before the court of King's Bench, and on September 9th his book was condemned by the Irish parliament to be burned and its author to be arrested. He escaped the latter part of the sentence by flight to England. The title and the philosophical principles of Toland's book were singularly akin to those of Locke's famous work, *The Reasonableness of Christianity*, published the year before; and Locke's opponents seized the opportunity of fathering upon the philosopher the doctrines of his more heterodox and less guarded disciple. Thus Toland's work became the occasion of the celebrated controversy between Stillingfleet and Locke, in which Locke takes pains to show the difference between his position and Toland's. Toland's next work of importance was his *Life of Milton* (1698), in which, in connexion with his exposure of the fictitious authorship of the *Eikon Basilike*, he found occasion to make reflexions on "the numerous supposititious pieces under the name of Christ and His apostles and other great persons." This provoked the charge that he had called in question the genuineness of the New Testament writings, and he replied in his *Amyntor, or a Defence of Milton's Life* (1699), to which he added a remarkable list of what are now called apocryphal New Testament writings. In his remarks he really opened up the great question of the history of the canon, towards the examination of which Stephen Nye, Jeremiah Jones, and Nathanael Lardner made in reply to him the first valuable contributions. The next year his *Amyntor* and *Christianity not Mysterious* were under discussion in both Houses of Convocation, and the Upper House declined to proceed against the author. In 1701 Toland spent a few weeks at Hanover as secretary to the embassy of the earl of Macclesfield, and was received with favour by the electress Sophia in acknowledgment of his book *Anglia Libera*, a defence of the Hanoverian succession. On his return from the Continent he published a defence of himself, and of the bishops for not prosecuting him, *Vindicius Liberius* (1702), and several political pamphlets. The next year he visited Hanover and Berlin, and was again graciously received by the electress and her daughter Sophia Charlotte, queen of Prussia. On his return to England (1704) he published *Letters to Serena*, and afterwards acknowledged that the queen of Prussia was intended by the pseudonym. In these letters he anticipated some of the speculations of modern materialism. The next year appeared his *Account of Prussia and Hanover*, of which Carlyle has made use in his *Life of Frederick the Great*. From 1707 to 1710 he is again on the Continent,—at Berlin, Hanover, Düsseldorf, Vienna, Prague, and The Hague, with very varying fortunes, but generally of an adverse character. In 1709 he published *Adeisidæmon* and *Origines Judaicæ* (The Hague), in which, amongst other things, he maintained that the Jews were originally Egyptians, and that the true Mosaic institutions perished with Moses. This work provoked a number of replies from Continental theologians. In 1710 he returned to England, living chiefly in London and latterly at Putney, loving the country and his books, and subsisting precariously upon the earnings of his pen and the benevolence of his patrons. His literary projects were numerous (see the incomplete list in Mosheim); and the nobler traits of his warm Irish nature appear in his projected history of the ancient Celtic religion and his chivalrous advocacy of the naturalization of the Jews. The last of his theological works were *Nazarenus, or Jewish, Gentile, and Mahometan Christianity* (1718), and *Tetradymus* (1720), a collection of essays on various subjects, in the first of which, "Hodegus," he set the example subsequently followed by Reimarus and the rationalistic school in Germany, of interpreting the Old Testament miracles by the naturalistic method, maintaining, for instance, that the pillar of cloud and of fire of Exodus was a transported signal-fire. His last and most offensive book was his *Pantheisticon* (Cosmopoli, 1720). He died May 11, 1722, as he had lived, in great poverty, in the midst of his books, with his pen in his hand, and left behind him a characteristic Latin epitaph, in which he could justly claim to have been "veritatis propugnator, libertatis assertor."

Toland is generally classed with the deists, but at the time when he wrote his first book, *Christianity not Mysterious*, he was decidedly opposed to deism, nor does Leiand deal with that work as an exposition of deistical views. The design of the work was to show, by an appeal mainly to the tribunal of Scripture, that there are no facts or doctrines of the "gospel," or "the Scriptures," or "Christian revelation" which, when revealed, are not perfectly plain, intelligible, and reasonable, being neither contrary to reason nor incomprehensible to it. The work undoubtedly aimed a blow at some of the dogmas of later Christian times, but it claimed to be "a vindication of God's revealed will against the most unjust imputations" which occasioned "so many deists and atheists." Toland's line of argument is to show that the supposition of the doctrines of the gospel being repugnant to clear and distinct ideas and common notions leads into absurdities and inevitable scepticism; that the proof of the Divinity of Scripture is its self-evidencing power; that, though men are dependent on Divine revelation for the knowledge of the most important truths, the truths must themselves be plain and intelligible when revealed; that all the doctrines, precepts, and miracles of the New Testament are perfectly intelligible and plain; that, though reason is disordered in the case of many men, the disorder is not in the faculty itself but in the use made of it; that in the New Testament "mystery" never means anything inconceivable in itself, but things naturally intelligible enough, which are either so veiled by figurative words or rites, or so lodged in God's sole knowledge and decree, that they could not be discerned without special revelation; that no miracle of the gospel is contrary to reason, for they were all produced according to the laws of nature, though above its ordinary operations, which were therefore supernaturally assisted; that mysteries were first introduced into Christianity by the early admission into the church of Levitical ceremonies and heathen rites and mysteries, and especially by mixing up heathen philosophy with the simple religion of Christ. The work was intended to be the first of three discourses, in the second of which he was to attempt a particular and rational explanation of the reputed mysteries of the gospel, and in the third a demonstration of the verity of Divine revelation against atheists and all enemies of revealed religion. But, like so many other of his numerous projects, this failed of execution. After his *Christianity not Mysterious* and his *Amyntor*, Toland's *Nazarenus* was of chief importance, as calling attention to the right of the Ebionites to a place in the early church, though it altogether failed to establish his main argument or to put the question in the true light. His *Pantheisticon, sive Formula celebrandæ Sodalitatis Socraticæ*, of which he printed a few copies for private circulation only, gave great offence as a sort of liturgic service made up of passages from heathen authors, in imitation of the Church of England liturgy. The title also was in those days alarming, and still more so the mystery which the author threw round the question how far such societies of pantheists actually existed. Poor Toland had been outlawed by the churches of his day, and took a most imprudent delight in alarming and mystifying his persecutors. This and all his later works must be read from the point of view first suggested by Herder: "Who can refuse to see in Toland the man of wide reading and of clear intellect, and the earnest inquirer, although, as embittered by persecutions, with every fresh book he dipped his pen in a more biting acid!"

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[1] The first edition, London, 1696, was anonymous; the second, published the same year, bore on the title-page his name, and received a preface and some slight alterations; and the third appeared in 1702 with an appended *Apology for Mr Toland*.

See Mosheim's *Vindiciæ Antiquæ Christianorum Disciplinæ*, 1st ed., 1720, 2d ed., 1722 (the life of Toland prefixed to the 2d edition of this essay gives still the best and most learned account we have of his life and writings); "Memoirs of the Life and Writings of Mr John Toland," by Des Maizeaux, prefixed to *The Miscellaneous Works of Mr John Toland*, in 2 vols., London, 1747; Leland's *View of the Principal Deistical Writers*; Herder's *Adrastea*; Lechler's *Geschichte des englischen Deismus*; Isaac Disraeli's *Calamities of Authors*; *Theological Review*, November 1864; Hunt's article in *Contemporary Review*, vol. viii., and his *Religious Thought in England*; Leslie Stephen's *History of English Thought in Eighteenth Century*; Cairns's *Cunningham Lectures for 1880* On Toland's relation to the subsequent Tübingen school, as presented in his *Nazarenus*, see *Theological Review*, Oct., 1877; and on his relation to materialism, F. A. Lange's *Geschichte des Materialismus*. (J. F. S.)

TOLEDO, a province of Spain, in New Castile, is bounded on the N. by Avila and Madrid, on the E. by Cuenca, on the S. by Ciudad Real, and on the W. by Cáceres, and has an area of 5620 square miles. The surface is throughout lofty, and in a great part of its extent mountainous. Towards the centre, indeed, there are extensive plains or tablelands, but the whole of the south and east is occupied by the Montes de Toledo, which separate the waters of the Tagus on the north from those of the Guadiana on the south. These mountains are of no great height; and they were once densely covered with forests, which have now been almost entirely cut down, although there are still woods and groves of considerable extent on their lower slopes. Branches of this chain enclose the province on the east and west, and part of the range that stretches north of the Tagus approaches its north-western frontier. Toledo is well watered by the Tagus and its affluents,—the Tajuna, Jarama, Guadarrama, Alberche, and Tietar on the north, and the Algodor, Torcon, Pusa, Sangrera, and Cedron on the south. The Guadiana forms for a short distance the south-western frontier, and its tributary the Giguela waters the eastern part of the province. The country is rich in minerals, as yet almost entirely unworked, containing veins of gold, silver, lead, iron, quicksilver, copper, and tin. Coal, alum, cinnabar, &c., are also found. The soil produces corn, pulse, potatoes, oil, wine, flax, oranges, lemons, chestnuts, and melons in fair abundance, but the trade in agricultural products is almost confined to the province itself. The number of sheep and goats is few, of horses and mules still less; while the only oxen are those used in agriculture. Bees and silkworms are kept in considerable number. Manufactures once flourished, but are now in a very low state,—silk and woollen cloth, earthenware, soap, oil, chocolates, wine, rough spirit (*aguardiente*), guitar strings, and arms being almost the only articles made. The province is traversed by three lines of railway,—that of Madrid Seville-Cadiz in the east, Madrid-Toledo-Ciudad Real through the centre, and Madrid-Cáceres-Lisbon in the north. There are 12 partidos judiciales and 206 ayuntamientos, and three senators with eight deputies are returned to the cortes. The total population in 1885 was 332,000; the only towns with a population exceeding 10,000 are Toledo (20,251) and Talavera de la Reina (11,986). Some of the most brilliant fighting of the Peninsular War took place in Toledo and the neighbouring province of Cáceres, the battle of Talavera de la Reina being fought on the 27th and 28th of July 1809.

TOLEDO, the capital of the above province, and once of the whole of Spain, stands upon a circle of seven hills, 2400 feet above the sea, and washed on three sides by the Tagus. It is 37 miles west-south-west of Madrid. The river is spanned by two fine stone bridges,—the Alcántara, a Moorish bridge of a single arch, giving entrance to the city from the east, and the other, that of San Martin, from the west, while between them the river makes a sweep southwards. The place is enclosed on the land side by two walls, still in fairly perfect condition,—the inner one being built by King Wamba in the 7th century, the outer by Alfonso VI. in 1109. The gates are numerous and well preserved, the most noteworthy being the famous Puerta del Sol, the Puerta Visagra, and the Cambron. Some Roman remains (a circus, &c.) lie without the walls, on the plain to the north-west. The appearance of Toledo from a distance is imposing in the extreme, from its noble situation and the terraced lines of its buildings; but upon a nearer approach it reveals itself as dull and decayed enough, with little or no traffic in the streets, and a strange silence brooding over all its ways. The houses are large, massive, and gloomy, generally Moorish in style, of the 12th, 13th, and 14th centuries, with a great central *patio* (courtyard), and yielding abundant traces of Arabic decoration. The principal public square is the Zocodover. It forms the favourite promenade, and from it the one fairly wide street of the city leads to the cathedral. The latter is the glory of Toledo, and one of the finest monuments of art in Spain. Built upon the site of an ancient mosque, and commenced in 1227, it was completed in 1492; and, though sacked over and over again,—finally by the French under La Houssaye in 1808,—it is still, with the exception, perhaps, of the cathedral of Seville, the richest and most magnificent foundation in the Peninsula. The exterior is unfortunately hidden to a great extent by mean surrounding buildings, but the fine western façade, with its two towers, one rising 325 feet, is effective. The interior is somewhat dwarfed in appearance by the immense width. It is 404 feet long by 204 feet broad, and is divided by 84 pillars into five naves, with central lantern and choir, and a complete series of side chapels. Most of these latter are late additions, of the 15th and 16th centuries, and are very magnificent in detail. The 16th-century stained-glass windows, chiefly of Flemish work, are superb; and the treasury, reliquaries, and library, notwithstanding their repeated despoilings, are not unworthy of the see which styles itself the "first of all the Spains." In the Muzarabic chapel the ritual known by that name is still performed daily. Within the precincts of the cathedral are interred the archbishops and cardinals Tenorio, Fonseca, Mendoza, Ximenez, the great constable Alvaro de Luna, and a long array of kings and heroes. The archbishop is primate of Spain, and has for suffragans Coria, Cuenca, Siguenza, and Palencia. Besides the cathedral Toledo still possesses a great number of fine churches and other religious buildings, together with numerous Moorish and Jewish monuments. The most important church is the 15th-century florid Gothic San Juan de los Reyes, built by Ferdinand and Isabella. The best Moorish work is to be found in the old Jewish synagogues of Santa Maria la Blanca and El Tránsito, in the mosques of Cristo de la Luz and Las Tornerias, in some private houses, and in the later churches of San Roman, Santo Tomé, Santiago, and Santa Leocadia. The patio and staircase of the hospital of Santa Cruz present some of the finest Renaissance work extant. Seen from afar, the Alcazar, or royal palace, is one of the most conspicuous features of the city. It stands upon a commanding position overlooking the Tagus, and was originally built by King Wamba, but has been repeatedly altered and pulled about. It was almost entirely rebuilt by Charles V. and Philip II., under the architects Covarrubias and Herrera, and has lately been converted into a huge military academy. The city is provided with numerous elementary schools, a public library, museum, town-hall, and several large hospitals. The well-known manufactory of swords is about a mile to the north-west, beyond the Cambron gate. It is in excellent order, and produces blades as perfect as ever, but is no longer of great importance, employing only about 120 hands.

Toledo existed in the time of the Romans, who conquered it in 193 B.C. They strengthened the fortifications, and built an aqueduct to supply the place with water. By the Goths, who captured the city in 467 A.D., these works were kept up and improved; and, under the Moorish domination, from 714 to 1085, Toledo was second only to Cordova in rank and importance, with a population of 200,000 souls. Alfonso VI. of Castile and Leon recovered the stronghold in 1085; and under him and his successors it continued to flourish until the permanent establishment of the court at Madrid gave a deathblow to its prosperity. The population now is no more than 20,000.

TOLEDO, a city of the United States, the county seat of Lucas county, Ohio, is situated in 41° 40′ N. lat. and 83° 33′ W. long., chiefly upon a peninsula between the Maumee on the south and the Ottawa upon the north, just above their points of discharge into Maumee Bay, and 5 miles from Lake Erie. A small part of it, formerly known as Maumee City, lies south of the Maumee. Toledo includes an area of 21·5 square miles within its corporate limits. The bay and river form an excellent harbour and roadstead. The harbour is easily made and is well sheltered, and the bottom affords good holding ground. Besides being open to the navigation of the Great Lakes, Toledo is the terminus of the Miami and Erie Canal, connecting it with Cincinnati (184 miles distant). Seventeen railroad lines enter it, making it one of the principal railroad centres of the country. The site of Toledo and the surrounding country are very level, and only slightly elevated above Lake Erie. The soil is very productive, and is highly cultivated, being largely devoted to market gardening. There are three public parks, having a total area of 41 acres. The city is well sewered. Water is obtained by pumping. The city, which is divided into eight wards, had in 1880 a population of 50,137. The number is probably now (1887) not far from 65,000. In 1840, 1850, 1860, and 1870 respectively the population was returned at 1224, 3829, 13,768, and 31,584.

Besides its large commercial interests, as one of the principal ports upon the Great Lakes, and its importance as one of the leading railroad centres of the country, Toledo holds high rank as a manufacturing city. The capital invested in this class of industries in 1880 exceeded $5,500,000, and the products were valued at double this sum. They employed nearly 7000 persons, and paid in wages over two and a quarter millions of dollars. These industries are very varied in character, but consist largely in lumber manufactures, brewing, and iron and steel manufactures.

The first settlement within what are now the corporate limits of Toledo was made, shortly after the war of 1812, upon the south bank of the Maumee. North of the river no settlements were attempted until 1832, when the villages of Port Lawrence and Vistula were commenced in what is now the heart of the city. In the following year they were united under the present name. The city was incorporated in 1837. In 1852 it was made the county seat, and in 1874 its corporate limits were considerably enlarged.

TOLL is a sum of money paid for the use and enjoyment of a privilege. In England it is now always or almost always a sum of money; but formerly tolls in kind were not unknown. An instance is afforded by the Act of 36 Geo. III. c. 85, substituting a money payment for tolls of corn in kind taken by millers, with an exception in favour of tolls taken by custom in soke mills. Such customary tolls, if any such now exist, are apparently the only examples remaining of tolls in kind. The Weights and Measures Act, 1878, enacts that all tolls are to be charged and collected according to imperial weights and measures.

The word toll, in its earliest use, appears to have signified a franchise enjoyed by lords of manors, and is defined by Glanvill as the liberty of buying and selling in one's own land: "tol, quod nos vocamus theloneum, scilicet libertatem emendi et vendendi in terra sua." The word then became used to denote duties payable to the crown, especially on wool, generally with an inseparable epithet indicative of unpopularity. It thus took the form of "maletote" or "malum tolnetum,"[1] against which many early statutes were directed, from the Magna Carta of John till the final abandonment of the duty by Edward III. In modern English law toll is either an incident of a FRANCHISE (*q.v.*), as of a market or fair, or is independent of franchise. In the latter case it is claimed by prescription, as toll traverse or toll thorough, or is created by Act of Parliament, as in the case of turnpikes, railways, harbours, navigable rivers, and canals. Toll traverse is paid for passing over a private way, bridge, or ferry. No consideration need be proved. Toll thorough is paid for the use of a highway. In this case, if charged by a private person, some consideration, such as repair of the highway, must be shown, as such a toll is against common right. In one case, that of the Cornish custom of tin-bounding, the right to tin tolls may depend upon custom. At common law a toll must be reasonable. The same principle appears in various Acts of Parliament. The Statute of Westminster the First, 3 Edw. I. c. 31, inflicts a penalty for taking excessive toll. The Railway Clauses Consolidation Act, 1845, and most special Acts of railway companies provide, by what are known as "the Shaftesbury clauses," for the equality of tolls, that is, that all persons and classes of goods shall under like circumstances be treated alike as to charges. A right of distress is incident to the right to impose tolls, but the distress cannot be sold unless an Act of Parliament expressly authorizes the sale. Tolls are rateable for the relief of the poor where they are appurtenant to land, but not where they are extrinsic profits not arising from the possession of land. Exemption from tolls may be claimed by the prerogative, by grant or prescription, or by Act of Parliament. The king pays no toll, and may grant to another exemption from toll. The exemptions by Act of Parliament mainly affect persons in the public service, clergy on their parochial duty, and persons going to or returning from their usual place of religious worship. Most of the exceptions from turnpike tolls will be found in 3 Geo. IV. c. 126. Turnpike tolls, bridge money, and causeway mail were abolished in Scotland by the Roads and Bridges Act, 1878, as from the 1st June 1883. In England there has been no such general abolition, but the abolition of tolls has been facilitated by several recent Turnpike Acts, and their entire disappearance is only a question of time.

In the United States tolls are a subject for State legislation, except in a few instances in which Acts of Congress have dealt with tolls in rivers and harbours (see Revised Statutes, tit. lxiii.).

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[1] The same term was known in mediæval Italy. Dante, in *Inferno*, xi. 36, alludes to "tollette dannose."

The question of tolls was at one time an important one in international law. Tolls were exacted on certain straits and tidal rivers by virtue of the sovereignty of a particular state. Such tolls have mostly ceased or been redeemed. Notable instances were the Scheldt tolls and the Sound dues levied by Denmark. See Navigation Laws.

TOLUCA, or Toloccan, a city of Mexico, the capital of the state of Mexico, on the Mexican National Railway, 45 miles south-west from the federal capital. It lies on the west side of the Anahuac tableland, at the foot of Mount San Miguel de Tutucuitlalpillo, at an elevation of 8653 feet above the sea, being the highest town in the republic next to the mining station of Ameca-meca (which is 8800 feet). Toluca had in 1886 a population of about 12,000, and is usually described as a well-built flourishing town, with fine buildings and clean well-drained streets. But T. M. Brocklehurst, who visited it in 1880, gives an unfavourable impression of the place, which presented nothing attractive beyond the Portales, a fine arcade running round a large block of central buildings, with a number of good shops under the arches (*Mexico To-day*, p. 222). There is also a good theatre, and in the Plaza de los Martires a well-executed white marble monument to the patriot Miguel Hidalgo y Costilla. But the Carmen, Vera Cruz, and one or two other churches are dirty and tawdry, without presenting any striking architectural features. The city is traversed by a foul stream flowing at the bottom of a barranca or deep ravine, along whose banks are herded numerous swine in a half-wild state, which supply the hams and sausages for which the place is noted. Here also soap and wax candles are manufactured and supplied to the surrounding districts. In the south-west the Nevado de Toluca, an extinct snow-clad volcano with a flooded crater, rises to a height of 15,156 feet above sea-level.

Although Toluca appears to have been one of the earliest Toltec settlements in Anahuac, its foundation dating probably from the 6th century, it has preserved no remains of its ancient grandeur, nor have any monuments been discovered in the district in any way comparable to those of Cholula, Tula, Teotihuacan, and other ancient centres of Toltec culture. According to M. Charnay, Toluca formed one of the chief starting points of the great migrations which, after the overthrow of the Toltec empire by the Chichimec irruption in the 11th century, moved in two parallel streams southwards, converging at Copan and spreading their arts and industries over Chiapas, Yucatan, and Guatemala (*Ancient Cities of the New World*, 1887, p. 125).

TOMATO. See Horticulture, vol. xii. p. 288.

TOMPA, Mihály (= Michael) (1817-1868), one of the best and tenderest Hungarian lyric poets, was born in 1817 at Rima-Szombat, in the county of Gömör, of very humble parentage, his father being village bootmaker. He studied law and theology in Sáros-Patak, and subsequently at Budapest; but, feeling little inclination for the first-mentioned career, after many vicissitudes he, at the age of thirty, accepted the post of Protestant minister in Beje, a small village in his native county, whence, in two years, he removed to Kelemér, and four years later to Hanva, in the county of Borsod, where he remained till his death in 1868.

At the age of four-and-twenty Tompa published his first poems in the *Athenæum*, which soon procured for him a high reputation. His first volume, *Népregék és Népmondák* ("Folk-Legends and Folk-Tales"), in 1846, met with great success, and the same may be said of the first volume of his "Poems" in 1847. In 1848 he took part in the war of independence, acting as field chaplain to the volunteers of his county and seeing several battles; but the unfortunate close of that heroic struggle silenced his poetic vein for a considerable time, and, when in 1852 and 1853 he gave vent to his patriotic grief in some masterly allegories on the state of oppressed Hungary, he was twice arrested by the Austrian authorities. After being released he published his *Virágregék* ("Legends of Flowers"), a collection of poems of the highest order, showing great imagination and love of nature, and displaying the loftiest humanity and great meditative power. Soon after this he became oppressed with melancholy and abandoned this branch of poetry. Indeed from this time he produced comparatively little. He published three volumes of sermons, "which," says his biographer, Charles Szász, Protestant bishop of Budapest, "are among the best in Hungarian literature, and will favourably compare with those of Robertson, Monod, or Parker." His collected poetical works, in six volumes, were published at Budapest in 1870, and again, in four volumes, in 1885.

TOMSK, a government of Western Siberia, extending from the Chinese frontier to 60° N. lat., is bounded by Tobolsk on the N.W., by Yeniseisk on the N.E., by the Chinese province of Khobdo on the S.E., and by Semipalatinsk on the S.W. Its area, 329,040 square miles, is fully one and a half times that of France. The surface is most varied, including in the south-east the high alpine tracts of the Altai Mountains, with an elevated steppe which skirts these, and in the north-west and west the lowlands of the Irtish and the marshy tracts of the Ob.

The Altai Mountains, which cover within the limits of the Russian empire an area of 53,000 square miles, or three times that of the whole of Switzerland, although visited by many geologists, still remain very imperfectly known, even as regards their orography. The country has been mapped only along the rivers and the course of a few footpaths, and great confusion still prevails with reference to the directions of the different chains of the Altai and their mutual relations (compare Siberia). The best descriptions, however (including the most recent by M. Potanin),[1] indicate in that part of Asia the very same leading orographical features that are seen in the Tian-Shan Mountains farther south, and in the West Sayan range farther north. A plateau with an average altitude of more than 4000 feet, watered by the tributaries of the upper Yenisei, all flowing in open valleys 3000 to 4000 feet above the sea, is known to rise in that part of north-western Mongolia which is drained by the upper Yenisei and Selenga. The surface of this plateau is diversified by ridges, and by depressions like that of the Ubsa-nor—a relic of what was formerly a much larger lake. A lofty mountain chain, which has its south-east foot on the plateau and its north-west foot in the valley of the Us, fringes the plateau, and has all the characters of a border-ridge. The present writer has proposed to call this Erghik-shan. It runs from north-east to south-west along the Russo-Chinese frontier, and is pierced by a deep gorge through which flows the Yenisei. A belt, some 200 miles in width, of alpine tracts, made up of three or four chains parallel to the border ridge, fringes the outer border of the plateau, and fills up the Minusinsk region. The structure of the hilly tracts (watered by the Kemtchik) between the Yenisei and the Altai remains quite unknown, no scientific man or topographer having ever visited it. But the very same orographical features as those already described reappear in the Altai region. There is now no doubt that the backbone of the Altai is a huge and lofty border-ridge, the Sailughem, which includes the small alpine plateaus of Ukek, the upper Tchuya, and Juvlu-kul, and runs from south-west to north-east, being a continuation of the border-ridge of the West Sayan. Its flat dome-shaped summits rise to about 10,000 feet, and the small alpine plateaus just named range from 7800 to 8200 feet in elevation. It has a very steep slope towards the north-west, *i.e.*, towards the broad valleys of the upper Bukhtarma and Tchuya, and a very gentle slope towards the south-east, and its south-eastern hillfoots are on the level of the plateau of Khobdo (from 4500 to 5000 feet). A broad alpine region spreads to the north-west of the border-ridge, but in the imperfect state of our knowledge it is difficult to discriminate the real directions of its chains. Nevertheless, another lofty chain, containing the snow-clad Alps of the Katuñ (Katunskiye Byelki) and those of the Tchuya, and running also from south-west to north-east, parallel to the Sailughem border-ridge, can be distinguished in the labyrinth of confusedly scattered mountains seen on our present maps. It is one of the most picturesque chains of the region, and contains the Byelukha peak, estimated at 11,000 feet, and the Alas-tu, of nearly the same height. It is pierced, however, by so many rivers, which rise on the north-west edge of the plateau, and find their way to the lowlands by a series of gorges, that its continuity could be easily overlooked. Farther to the north-east it joins, in the opinion of the present writer, the high chain on the left bank of the Kemtchik, which is continued by the picturesque Alps on the northern bank of the Us. A third system of mountain chains, also parallel to the above, can be distinguished in the succession of the Terektinsk Mountains, those which are pierced by the Tchulyshman and those which follow the right bank of the Abakan; while traces of a fourth plication of the rocks may be discovered in the Tigeritsk Mountains, those pierced by the Biya below Lake Teletskoye, and the Kuznetskiy Alatau, on the left bank of the Abakan. A number of smaller, much lower, and shorter chains faintly appear as outer walls of this extensive alpine region. As for the Great Altai, or Altain-Nauru, our knowledge of which has been greatly increased by the recent explorations of M. Potanin,[1] it may be regarded as a south-western border-ridge of the Khobdo plateau, with its steep slope facing towards the wide Dzungarian depression, or rather to the broad trench of the Ulungur. Its direction is nearly at right angles to the above, running from north-west to south-east, like the Tarbagatai Mountains (see TURKESTAN), and it is continued farther to the south-east by the Irdyn-ula and Artsa-bogdo Mountains, which separate the eastern Gobi from the Tarim depression. It is most probable that upheavals, having the same north-western direction (which, according to M. Mushketoff, are in Central Asia more recent than the north-eastern ones), have to a certain extent modified the old north-eastern chains of the Altai, and complicated the chains of its alpine region. If so, the structure of the Altai would be very similar to that of the Turkestan mountains. A chain having a north-western direction—the Salair Mountains—shoots off from the main ranges of the Altai, between the Tom and the Tchumysh; it is about 170 miles in length, with a width of nearly 60 miles, and contains the best silver-mines of the region, as also several gold-washings. Its upheaval belongs to a more recent epoch than that of the Sailughem ridge, and (like the mountains of Turkestan, having a north-west direction) it is due to dioritic rocks. In the Kuznetsk depression it is covered with deposits of the Lower and Upper Carboniferous, containing beds of coal. The Kuznetskiy Alatau, in which Humboldt saw one of his meridional upheavals, consists of a series of ridges running south-west to north-east, with further continuations within South Yeniseisk.[2]

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[1] *Jivopisnaya Rossiya*, vol. xi.; *Sketches of N. W. Mongolia*, vols. i. and iii.; Addenda to Ritter's *Asia*.

The alpine region of the Altai is most picturesque; most of its chains, rising over 8000 and 9000 feet, are snowclad, and a great glacier descends from the hollows under the Byelukha peak; several other less known glaciers occur in the different "byelkis" (snowclad chains). A thick forest vegetation clothes the mountain slopes, while beautiful valleys, often of great length, such as that of the Bukhtarma (180 miles) or that of the Uimon and Koksu, offer on their fertile and well-sheltered floors most favourable conditions for agriculture. Several lakes are met with. some, like the Juvlu-kul and Keudykty-kul on the small alpine plateaus, at heights where only the dwarf birch grows and the polar marmot takes up its abode, while two others, Lakes Kolyvanskoye and Teletskoye, respectively 1170 and 1600 feet above the sea, from their position amidst steep and picturesque mountains, recall those of Geneva and Lucerne.

The Altai flora is very rich. Although the European flora (including the beech) which clothed the Altai at a recent period has disappeared, and the Siberian flora invades its hillfoots from the north-west, while the steppe flora is advancing from the south, still in a zone ranging from 1000 to 6000 feet above the sea the botanist has to admire a flora rich in bright flowers, tall grasses, and shrubs, several of which are now common ornamental plants in European gardens; and the zoologist discovers in the Altai the meeting-place of the northern fauna (including the reindeer) with that of the high Central-Asian plateau (including the tiger and the two-humped camel of Bactriana)

A strip of elevated plains or grassy steppes, also about 200 miles in breadth, girdles the alpine region upon the north-west. Its outer border can be roughly indicated by a line running north-east from Lake Gorkoye to Tomsk. They have an average altitude of from 700 to 1000 feet above the sea, and are covered with a luxuriant grass vegetation; the conditions for agriculture are excellent, and Russian villages are rapidly springing up. The south-west portion is known as the Kumandinsk steppe. An innumerable succession of small lakes—rivers in the process of formation—cover this steppe, where we have a system of parallel undulations, resulting in tributaries of the Ob, all flowing north-eastward with remarkable regularity.

Beyond the high plains, that is, all over north-western Tomsk, are the lowlands, which may be subdivided into two portions,—the Baraba steppe in the south-west (see TOBOLSK), and the marshy region of the Ob (the Vasyugan and Narym regions). The latter is one boundless marsh, a few settlements of native hunters occurring only along the rivers. The interior is for the most part inaccessible alike to boats and to human feet. Low hills, or rather swellings, intersect it, but even the highest points, barely 200 or 300 feet above the sea, are covered with marshy forests. The forests themselves grow on marshy ground; but where the trees disappear one sees for hundreds of miles nothing but green flowery carpets, which, when trodden on, treacherously yield under the unwary traveller. Similar in character must have been the marshes in which the Siberian mammoths and rhinoceroses of the Quaternary epoch found their graves. Only the light and broad-hoofed reindeer, but not the elk, can cross them. This inhospitable region is inhabited only by Ostiaks, who have been driven into it by stress of circumstances, and support themselves partly by fishing and partly by hunting.

The Sailughem ridge, and the high Khobdo plateau as well, consist of granites, syenites, porphyries covered only with the oldest metamorphic slates belonging to the Archaic formation (Huronian and Laurentian). The structure of the outer chains of the Altai is more complicated. Their backbone is also composed of granites, porphyries, and porphyrites covered with metamorphic slates which are intersected by layers of crystalline limestones, breccias, and veins of jade.[3] Diorites, diabases, augitic porphyries, and hypersthenites also appear, but they are of a more recent origin. Silurian clay-slates are widely spread in the southern Altai. Devonian slates and limestones are also developed in the southern Altai, and the metalliferous deposits of Zmeinogorsk, Petrovsk, Riddersk, &c., belong to that age. Carboniferous dolomitic limestones and slates are widely spread both in the southern and northern Altai. After the Carboniferous epoch the southern Altai was not again submerged, while the northern Altai was covered by the Jurassic sea, and has thick Jurassic deposits containing a copious fossil flora and rich beds of coal. Basaltic eruptions, dating from the Jurassic period, have been found in the Salair Mountains. Thick diluvial deposits cover the whole area, and in many valleys are traces of immense former glaciers; in fact, the whole of the Sailughem ridge must at one time have been clothed with an ice-cap.[4]

The southern Altai is rich in silver, copper, lead, and zinc; while in the Alatau are concealed its chief auriferous alluvial (or diluvial) deposits, iron-ores, and coal-seams. The mineral wealth of the Altai is really immense, but only a very few of the mines already known are worked. In 1881 4030 lb of gold, 14,820 lb of silver, 13,100 cwts. of lead, 6720 cwts. of copper, 240,000 cwts. of coal, 330,000 cwts. of salt, and 30,000 cwts. of bitter salt were obtained. In the same year only 3000 cwts. of iron were manufactured, and that metal is still imported from the Urals. The jade, beautiful porphyries, and the like of the district, which are cut into works of art at the crown works of Kolyvañ, are well known through the urns and vases shown at the St Petersburg Hermitage. The mineral waters of the Altai are of high quality.

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[1] *Sketches of N. W. Mongolia*, St Petersburg, 1883 (Russian).

[2] Kropotkine, "Orographical Sketch of the Districts of Minusinsk and Krasnoyarsk," in *Mem. Russ. Geogr. Soc.*, vol. v. 1875.

[3] Prof. Mushketoff in *Picturesque Russia*, vol. xi.

[4] See Potanin, *Sketches of N. W. Mongolia*, vol. iii. pp. 6, 9 sq.

Tomsk is watered mainly by the Ob and its tributaries, only its south-east corner draining into the Abakan, a tributary of the Yenisei. The Ob, formed by the union of the Biya and Katuñ, has within the government a course of more than 800 miles, and is navigated as far as Barnaul and Biysk. Its tributaries, the Tom (450 miles), the Vasyugan (530 miles), the Ket (230 miles), and the Tym (200 miles), are all navigable. The Tchulym and the Tchumysh are also great rivers. Of tributaries of the Irtish, the Bukhtarma, the Om, the Uba, and the Tara are worthy of notice. As many as 1500 lakes have been counted on the maps, but this number is exceeded by the reality. Some of them are alpine; others dot the steppes or the marshy tracts. Lake Tchany, notwithstanding its rapid desiccation, still covers 1265 square miles. Many brackish lakes, Kulundinsk, Kutchuk, &c., attain a great size, and some small salt lakes yield about 100,000 cwts. of salt.

The climate is very severe, and has, moreover, the disadvantage of being very wet in the north-west. The average yearly temperatures at Tomsk, Kainsk, and Barnaul are 30°·2, 31°, and 32°·7 (January, 4°, −6°·2, and 3°·7; July, 65°·5, 68°·5, and 62°·2). The Altai steppes, enjoying a much drier climate than the lowlands, are covered with a beautiful vegetation, and in the sheltered valleys corn is grown to heights of 3400 and 4250 feet.

The population, which is rapidly increasing, in 1882 reached 1,134,750. The Russians are in a large majority, the indigenous inhabitants numbering in 1879 only 63,600, or 6·6 per cent. of the aggregate population. They include 23,600 Altaian Tartars, 5730 Teleutes, 17,020 Mountain Kalmucks (see Tartars), 10,000 Tomsk Tartars, 2920 Samoyedes, and 4210 Ostiaks. The prevailing religion is Greek-Orthodox, but there are also some 50,000 Nonconformists, 7320 Catholics, 2600 Jews, 10,700 Mohammedans, and about 28,000 pagans.

Agriculture is the prevailing occupation. It is most productive on the elevated plains of Tomsk, Mariinsk, Barnaul, Kuznetsk, and Biysk. Cattle-breeding is much developed, especially in the Kulundinsk steppe; and bee-keeping is an important source of wealth. Fishing and hunting are extensively carried on in the forest region. Mining occupies several thousands of men in the Altai. Manufactures are insignificant, the aggregate production—chiefly from distilleries and tanneries—hardly amounting to £250,000. Trade is actively carried on at Tomsk and Barnaul, which are two great centres for the export and import trade of Siberia with Russia. The Biysk merchants carry on exchange trade with Mongolia and China. There are eight gymnasia (696 boys and 569 girls in 1883) and 225 primary schools (5650 boys, 1730 girls). The government is divided into six districts, the chief towns of which (with populations in 1884) are Tomsk (31,380), Barnaul (17,180), Biysk (13,960), Kainsk (4050), Kuznetsk (7310), and Mariinsk (13,090). Narym (1600) also has municipal institutions; it is the centre for the administration of the wide Narym region. Of the above towns only Tomsk and Barnaul have the aspect of European towns. Barnaul, capital of the mining district of the Altai, which belongs to the "Cabinet of the Emperor," is a wealthy city, with a mining school and laboratory, a botanic garden, a museum of mining and natural history, and a meteorological observatory. Kolyvañ, with a stone-cutting manufactory, has 12,250 inhabitants. Several mining villages are more important than the district towns:—Zyryanovsk (silver-mine; 4500 inhabitants), Riddersk, Zmeinogorsk (6160), Suzunsk (5400), and Salairsk (3500). (P. A. K.)

TOMSK, capital of the above government, is situated on the Tom at its confluence with the Ushaika, 27 miles above its junction with the Ob, and 2377 miles from Moscow. It is one of the chief cities of Siberia, second only to Irkutsk in population and trade importance. The great Siberian highway from Tyumeñ to Irkutsk passes through Tomsk, and it is the terminus of the navigation by steamer from the Urals to Siberia. It has, moreover, communication by steamer with Barnaul and Biysk in the Altai. The position of Tomsk determines its character, which is not that of an administrative centre, like so many Russian cities, but that of an entrepôt of wares, with many storehouses and wholesale shops. Before 1824 it was a mere village; but after the discovery of gold in the district it grew rapidly; and, although the immense wealth that accumulated suddenly in the hands of a few proprietors of gold diggings was as rapidly squandered, it continued to maintain its importance, owing to the navigation on the Irtish and the Ob, which meanwhile had grown up. It is built on two terraces on the high right bank of the Tom, and is divided into two parts by the Ushaika. The streets are rather narrow and steep; many houses of the richer merchants are of stone, but rather heavy in appearance, and altogether the aspect of the streets is not attractive. The best building is that of the future university, which is a spacious and elegant structure, with ample accommodation for library, museums, and clinical hospitals. The Government has not as yet given permission to inaugurate the building. A large cathedral, begun some five-and-twenty years ago by proprietors of gold diggings, collapsed after considerable progress had been made. The industries are almost entirely confined to tanning and the manufacture of carriages. The trade is of great importance, Tomsk being not only a centre for traffic in local produce, in which sledges (50,000 every year) and cars are prominent items, but also for the trade of Siberia with Russia. The population in 1884 was 31,380.

TONGA. See Friendly Islands.

TONG-KING, Tung-King, Tonquin, or, as it is called by the Annamese, Dong-king, consists of that portion of Annam between 18° N. lat. and the frontiers of the Chinese provinces of Kwang-se and Yun-nan, with an area of 60,000 square miles. On the W. it is bounded by the Tran-ninh range, which forms the limit of the Lao states, and on the E. by the sea. In shape it resembles, roughly speaking, an isosceles triangle, having its apex at its juncture with Annam and its base along the Chinese boundary. The name Tong king, "the eastern capital," was originally applied to Hanoi, but was eventually adopted as that of the whole country. It is the same word as Tokio (*q.v.*). See vol. xxi. Pl. IX.

Geographically Tong-king is divided into three well-defined areas. First, there is the delta of the Song-koi ("Red river") and its affluents, which, beginning at Sontay, widens out into the low lands which constitute the most fertile district in Tong-king, and within which are situated the principal cities of the country. Here is grown the rice which constitutes 39 per cent. of the total exports from Tong-king, and which is reckoned in the Hong-Kong market to be equal in quality to the rice from Siam and superior to that from Cochin-China. During the rainy season this part of the country, with the exception of the embankments, is under water, but notwithstanding this the climate is fairly healthy, and the prevalence of fever and dysentery is not so great as might be expected. From the delta northward and westward rise plateau districts, while westward of 103° E. long. there stretches a forest region about which very little is known, but which is said by the natives to be inhabited only by savages and wild beasts.

Politically the country is divided into sixteen provinces, of which the following seven are in the delta mentioned:—Bac-ninh, Sontay, Hanoi, Hai-Dzuong, Hung-yen, Nam-Dinh, and Ninh-Binh. Five provinces constitute the upland districts, viz., Cao-Banh, Lang-son, Thai-Nguyen, Tuyen-Kwan, and Kwang-yen; while the forests form the province of Hung-hoa. The main geographical feature in the country is the Song-koi, which, taking its rise near Tali Fu, in Yun-nan, enters Tong-king at Lao-kai ("the Lao boundary"), and flows thence in a south-easterly direction to the Gulf of Tong-king. It was this river which mainly in the first instance attracted the French to Tong-king, as it was believed by the explorers that, forming the shortest route by water to the rich province of Yun-nan, it would prove also to be the most convenient and expeditious means of transporting the tin, copper, silver and

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[1] Yadrintseff's *Siberia*.

gold which are known to abound there. This belief has, however, proved fallacious. The upper course of the stream is constantly impeded by rapids, the lowest being about 30 miles above Hung-hoa. Beyond this point navigation is impracticable during the dry season, and at all other times of the year goods have to be there transferred into flat-bottomed boats built for the purpose. Within the limits of Yun-nan the navigation is still more difficult. Near Sontay the Song-koi receives the waters of the Black river, the Clear river, and other streams, and from that point divides into a network of waterways which empty themselves by countless outlets into the sea.

Hanoi, the capital, is a fine city, and stands on the right bank of the Song-koi, at a distance of 80 miles from the sea. The commercial town extends along the water face for a distance of a mile and a half, while behind it stands the citadel, which encloses within its walls the palace, the treasury, the court of justice, the royal pagoda, the prison, the barracks, public offices, and official residences. Embroidery and mother-of-pearl work are the principal industries of Hanoi, which never has been and probably never will be a great commercial centre. But, notwithstanding this, the population is said formerly to have numbered 150,000, a number which has of late years probably been reduced by at least one-third.

Next in importance to Hanoi is Nam-Dinh, on one of the lower branches of the Song-koi. It is the centre of an extremely rich silk and rice district, and was before the war a great resort of Chinese merchants. But the chief place of trade is Hai-phong, on the Song-tam-bac Canal, 14 miles from the sea. This is the port of Tong-king, and its trade represents the foreign commerce of the country. In 1880, the last year of anything like normal trade, goods were imported to the value of 5,467,315 francs, and the exports amounted to 7,507,528 francs. Of the imports 34 per cent. consisted of English cotton goods and yarn, 21 per cent. of opium, 11 per cent. of Chinese medicines, 9 per cent. of Chinese water-pipe tobacco, 5 per cent. of tea, and 20 per cent. of miscellaneous goods. From 97 to 98 per cent. of these goods came from Hong-Kong. Saigon furnished about ½ per cent., and rather more than 2 per cent. represented the trade from Annam and elsewhere. The exports were in the following proportions:—rice, 39 per cent.; raw silk and silk piece goods, 21; tin, 16; lacquer oil, 6; and miscellaneous goods, 18. Of these 79 per cent. were shipped to Hong-Kong, 16 per cent. went to Saigon, and the remaining 5 per cent. were distributed among the coast ports.

The mineral wealth of the country is doubtless considerable, though so little has been done in the direction of working it that it is impossible to form any idea of its richness. According to Major-General Mesny, there are flourishing gold-fields in seventeen districts, while silver and copper mining occupies a great deal of native and Chinese labour. Only very small quantities of these minerals, however, are produced in evidence.

The population of Tong-king is estimated at about 12,000,000, and consists of Tong-kingese, Chinese, and an admixture of Lao from beyond the western frontier. The Tong-kingese belong to the Indo-Chinese stock. They are taller and a finer people than the Annamese, and they are more frivolous and excitable than their northern neighbours, the Chinese. Their intelligence is, generally speaking, of a very low order; they are dirty in their habits; and their natural timidity serves to make them deceitful. As traders they show little enterprise, and are quite unable to compete with the Chinese, into whose hands the commerce had, before the arrival of the French, entirely fallen. Their spoken language is allied to the Cambodian, while Chinese forms the medium of literary communication.

The Chinese records carry the history of Tong-king as far back as the 22d century B.C., but, as the data are neither well authenticated nor particularly interesting, we need not dwell upon them. There is, however, one mention of Tong-king, or Yueh, as it was then called, in the 12th century B.C., which acquires importance from the fact that ambassadors from that country are said to have arrived at the Chinese court, bringing with them "south-pointing chariots." These are supposed by some to have been mariner's compasses, but it is difficult to pronounce any opinion on a statement so obscure. During the reign of Che Hwang-te (218 B.C.), the emperor who made himself famous by building the Great Wall of China and burning the books, a Chinese army invaded Tong-king and captured the town of Luliang, possibly the modern Hanoi. The occupation, however, was only temporary, and it was not until the rise to power of the Han dynasty that any serious attempt was made to subjugate the country. At that time a Chinese general, Chaou T'o, who had established a principality consisting of the two modern provinces of Kwang-tung and Kwang-se, with his capital at Canton, invaded Tong-king, but was defeated and driven out of the country by the ruler, An-yang, whose victories were achieved mainly by the help of a foreign "divine mechanic." This man, whoever he may have been, seems to have been thrown aside after serving his immediate purpose; and, having thus deprived himself of his right hand, An-yang fell an easy victim when attacked by a second army sent by Chaou T'o. On the subjugation of the empire by the Han sovereign, Chaou T'o's principality was absorbed with the rest, and in 116 B.C. Tong-king became a dependency of China.

But this connexion brought no peace to the country, and for centuries rebellion followed on rebellion. A particular uprising in the 1st century is noticeable from two sisters, Chêng Tsêh and Chêng Urh, leading the rebel forces against the Chinese garrisons, with such success that the celebrated Ma Yuen had to be sent against the malcontents. After an arduous campaign Ma dispersed the rebels and captured and executed the two sisters, thus putting an end to the rebellion. The next fourteen centuries furnish a perpetual record of wars and rumours of wars, the disconnected narrative of which is generally uninteresting and sometimes unintelligible. In 1427 Li Loi acquired the throne, as so many of his predecessors had done, by violent means, but, unlike them, he established some degree of peace and order in the land. In the following century, however, the spirit of revolt broke out, and one of his successors owed the maintenance of his throne to the skill of his general Nguyen Dzo, on whom the title of hereditary viceroy was consequently conferred. This viceroy gradually assumed the supreme authority in the district under his control and virtually separated Tong-king from Annam, holding the first under his own sway and leaving the southern portion of the country to the *roi fainéant*. In this disunited condition the two countries remained during the 17th century and part of the 18th, till a successor of Nguyen invaded Annam, captured the imperial city of Hué, and dethroned the king, Gia Long, who fled to Siam. The Siamese sovereign entertained the fugitive with hospitality, but declined to help him to recover his throne. It happened, however, that at this time (1787) the Jesuit establishment of Bangkok was presided over by Bishop Pigneaux de Betaine, who thought he saw in the political condition of Annam a means of establishing the power of France in the eastern portion of Indo-China. With this object he proposed to Gia Long that he should accompany him to Paris to enlist the aid of Louis XVI. for the recovery of his throne. This the king declined to do, but as a compromise he sent his eldest son. The young prince was cordially received by Louis, before whom the bishop laid the following reasons for the interference of France on behalf of Gia Long. "The balance of political power in India appears at the present moment to be largely in favour of the English, and one may be justified in looking upon it as a matter of no little difficulty to restóre the equilibrium. In my opinion the establishment of a French colony in Cochin-China will be the surest and most efficacious means to the end. . ... The most certain way of damaging the English in India is to ruin, or at any rate to weaken, her commerce in time of peace. Being situated nearer to China, we should undoubtedly absorb much of her trade. . . . In time of war it would be still more easy to stop all commerce between China and any hostile nation. . . . From such a coign of vantage it would be easy to interfere with the designs which the English evidently have of extending their frontier more to the east."

The embassy resulted in a treaty with Gia Long, by which the French king engaged to restore that monarch to his throne on condition that he accepted the virtual protectorship of France over Annam. But even before the initial steps towards the fulfilment of this contract could be carried out, the political uprising which finally brought the French king to the scaffold made all interference in the East impossible. In these circumstances the bishop determined to raise a sufficient force from the French and other adventurers who then frequented India and the neighbouring countries, and, with an army so recruited, he landed in Annam. The Annamese resistance was of the feeblest kind; the usurper's power was broken at the first encounter, and Gia Long once again ascended his throne. As a reward for the services thus rendered to him, he extended a liberal protection to the Roman Catholic missionaries and their converts, and engaged French officers to fortify his towns and to drill his troops. He soon found, however, that his new allies had more ambitious designs than could be satisfied by doing him service. He therefore withdrew his countenance from them, and emphasized his displeasure by leaving his throne away from his eldest son, who had pleaded his cause in Paris, and by giving it to his youngest son. This change of policy told, as was natural, with greatest force on the missionaries and their converts in the interior of the country. From 1833 to 1839 eleven missionaries were put to death, and thousands, it is said, of the native Christians suffered martyrdom. Neither change of sovereign nor varying circumstances brought any relief to the persecuted Christians, until in 1859 the French Government determined to intervene on their behalf. In that year Admiral Rigault de Genouilly took Saigon by assault, and was attempting to open negotiations with the king of Annam, when the outbreak of the China war compelled him to satisfy himself with holding the captured town. So soon, however, as the Peking treaty was signed, the French resumed active operations in the neighbourhood of Saigon and took possession of the provinces of Mitto and Bienhoa in Cochin-China. These victories led to the conclusion of a treaty with the king, Tu Duc, which, however, did not prevent the French from adding the provinces of Kinh-luong, Chandoc, and Ha-tien to their acquired territory.

Having thus firmly established themselves in Annam, they began to turn their attention to Tong-king, attracted by the reported richness of its mineral wealth. They found a ready pretext for interfering in its affairs in the disturbances arising from the invasion of its northern provinces by the disbanded followers of the Tai-ping rebels. Acting on the protectorship which they professed to exercise over all the territories of Tu Duc, they proposed to him that a joint expedition composed of French and Annamese troops should be sent to quell the disturbances. On Tu Duc declining to accede, the French admiral was on the point of starting "to protect" Tong-king, when as before the outbreak of war put an end to the enterprise. The events of 1870 forbade any advance in the direction of Tong-king, but the return of peace in Europe was once more the signal for the renewal of hostilities in the East. The appearance of Garnier's work on his expedition up the Mekong aroused again an interest in Tong-king, and the reported wealth of the country added the powerful motive of self-interest to the yearnings of patriotism. Already M. Dupuis, a trader who in the pursuit of his calling had penetrated into Yun-nan, and had thus discovered that the higher waters of the Song-koi were navigable, had visited Hanoi with a small force of desperadoes, and was attempting to negotiate for the passage up the river of himself and a cargo of military stores for the Chinese authorities in Yun-nan. Meanwhile Captain Senez appeared from Saigon, having received instructions to open the route to French commerce. But to neither the trader nor the naval officer would the Tong-kingese lend a favourable ear, and in default of official permission Dupuis determined to force his way up the river. This he succeeded in doing, but arrived too late, for he found the rebellion crushed and the stores no longer wanted.

On his return to Hanoi, Dupuis found that the opposition of the authorities had gathered strength during his absence. His arrival served to restore the position of the French, and, not wishing to make an open attack upon them, the Tong-kingese general wrote to the king, begging him to induce the governor of Saigon to remove the intruder. An order was thereupon issued calling upon Dupuis to leave the country. This he declined to do, and, after some negotiations, Garnier with a detachment was sent to Hanoi to do the best he could in the difficult circumstances. Garnier threw himself heart and soul into Dupuis's projects, and, when the Tong-kingese authorities refused to treat with him except on the subject of Dupuis's expulsion, he attacked the citadel on November 20, 1873, and carried it by assault. Having thus secured his position, he sent to Saigon for reinforcements, and meanwhile sent small detachments against the five other important fortresses in the delta (Hung-yen, Phu-ly, Hai-Dzuong, Ninh-Binh, and Nam-Dinh), and captured them all. The Tong-kingese now called in the help of Liu Yung-fu, the leader of the "Black Flags," who at once marched with a large force to the scene of action. Within a few days he recaptured several villages near Hanoi, and so threatening did his attitude appear that Garnier, who had hurried back after capturing Nam-Dinh, made a sortie from the citadel. The movement proved a disastrous one, and resulted in the death of Garnier and of his second in command, Balny d'Avricourt.

Meanwhile the news of Garnier's hostilities had alarmed the governor of Saigon, who, having no desire to be plunged into a war, sent Philastre, an inspector of native affairs, to offer apologies to the king of Annam. When, however, on arriving in Tong-king Philastre heard of Garnier's death, he took command of the French forces, and at once ordered the evacuation of Nam-Dinh, Ninh-Binh, and Hai-Dzuong,—a measure which, however advantageous it may have been to the French at the moment, was most disastrous to the native Christian population, the withdrawal of the French being the signal for a general massacre of the converts. In pursuance of the same policy Philastre made a convention with the authorities (February 6, 1874), by which he bound his countrymen to withdraw from the occupation of the country, retaining only the right to trade at Hanoi and Hai-phong, and agreed to put an end to Dupuis's aggressive action. On the 15th of March a treaty was signed at Saigon.

For a time affairs remained *in statu quo*, but in 1882 Le Myre de Villers, the governor of Saigon, sent Rivière with a small force to open up the route to Yun-nan by the Song-koi. With a curious similarity the events of Garnier's campaign were repeated. Finding the authorities intractable, Rivière stormed and carried the citadel of Hanoi, and then, with very slight loss, he captured Nam-Dinh, Hai-Dzuong, and other towns in the delta. And once again these victories brought Liu Yung-fu and his Black Flags into the neighbourhood of Hanoi. As Garnier had done, so Riviere hurried back from Nam-Dinh on news of the threatened danger. Like Garnier also he headed a sortie against his enemies and like Garnier he fell a victim to his own impetuosity.

In the meantime the Annamese court had been seeking to enlist the help of the Chinese in their contest with the French. The tie which bound the tributary nation to the sovereign state had been for many generations slackened or drawn closer as circumstances determined, but never had it been entirely dissevered, and from the Annamese point of view this was one of the occasions when it was of paramount importance that it should be acknowledged and acted upon. With much more than usual regularity, therefore, the king despatched presents and letters to the court of Peking, and in 1880 he sent a special embassy, loaded with unusually costly offerings, and with a letter in which his position of a tributary was emphatically asserted. Far from ignoring the responsibility thrust upon him, the emperor of China ordered the publication of the letter in the *Peking Gazette*. The death of Rivière and the defeat of his troops had meanwhile placed the French in a position of extreme difficulty. The outlying garrisons, with the exception of Nam-Dinh and Hai-phong, were at once withdrawn to Hanoi, and that citadel was made as secure as circumstances permitted. The Black Flags swarmed round its walls, and the reinforcements brought by Admiral Courbet and General Bouet were insufficient to do more than keep them at bay. So continued was the pressure on the garrison that Bouet determined to make an advance upon Sontay to relieve the blockade. After gaining some trifling successes, he attacked Vong, a fortified village, but he met with such resistance that, after suffering considerable loss, he was obliged to retreat to Hanoi. In the lower delta fortune sided with the French, and almost without a casualty Hai-Dzuong and Phu-Binh fell into their hands. These successes led to an ultimatum being sent to the king of Annam, in which were demanded the fulfilment of the treaty of 1874 and the acceptance of the protectorate of France over the whole of Annam, including Tong-king. This document met with no favourable reception, and, as at this moment a reinforcement of 7000 men arrived from France, Courbet, determining to supersede diplomacy by arms, appeared with his fleet before Hué. He found that, though Tu Duc was dead, his policy of resistance was maintained, and he therefore stormed the city. After a feeble defence it was taken, and the admiral concluded a treaty with the king (August 25, 1883), in which the French protectorate was fully recognized, the king further binding himself to recall the Annamese troops serving in Tong-king, and to construct a road from Saigon to Hanoi.

Though this treaty was exacted from the king under pressure, the French lost no time in carrying out that part of it which gave them the authority to protect the country, and on the 1st September Bouet again advanced in the direction of Sontay. But again the resistance he met with compelled him to retreat, after capturing the fortified post of Palan. The serious nature of the opposition experienced in these expeditions induced the French commanders to await reinforcements before again taking the field. Meanwhile, on the determination to attack Sontay becoming known in Paris, the Chinese ambassador warned the ministry that, since Chinese troops formed part of the garrison, he should consider it as tantamount to a declaration of war. But his protest met with no consideration. On the arrival of reinforcements an advance was again made; and on the 16th December, after some desperate fighting, Sontay fell.

The immediate object of the French commanders was at this time to make themselves secure in the delta, and to inflict such chastisement on the Black Flags and their allies as would prevent their disturbing the peace of the garrisons. This could not be attained so long as Bac-Ninh remained in the hands of the enemy. Generals Négrier, Brière de l'Isle, and Millot accordingly marched against the town, and began to shell it. But it was already deserted, and Millot entered the gates without striking a blow. Thus, while one part of the programme was fulfilled to the letter, the other part, which was to have sealed the fate of the garrison, failed conspicuously. In these circumstances it was thought advisable to push on along the great north-eastern road to China; and Négrier advanced about 30 miles towards Lang-son, captured a village there, and then returned to Bac-Ninh.

Meanwhile Brière de l'Isle followed up that portion of the Bac-Ninh garrison which had escaped along the northern road in the direction of Thai-Nguyen. He captured the fort of Yen-Te, and marched on to Thai-Nguyen, where, as on so many occasions, there was a great display of martial ardour so long as the French were beyond firing distance, but the discharge of a few shells completely discomfited the defenders, who fled out of the north gate as the French marched in at the south. As Brière de l'Isle had positive orders not to hold the town, he burnt some of the buildings, and evacuated it. The Chinese troops immediately returned, and again were driven out a month later, only to return again on the withdrawal of the French. Once more, however, a column was sent against the city, which on this occasion was burnt to the ground.

The whole of the lower delta was thus made secure in the hands of the French. Hung-Hoa (a town about 15 miles north-east of Sontay) and Tuyen-Kwan (a fortified place about 40 miles farther north) both fell before the invaders, but from both the garrisons escaped practically unscathed.

In the meantime M. Fournier, the French consul at Tientsin, had been negotiating for peace, so far as China was concerned, with Li Hung-chang, and on May 17, 1884, had signed and sealed a memorandum by which the Chinese plenipotentiary agreed that the Chinese troops should evacuate the northern provinces of Tong-king "*immédiatement.*" This expression was undeniably vague, and the French general in Tong-king, impatient of delay, in June dispatched Colonel Dugenne at the head of a strong force to occupy Lang-son. The expedition was badly arranged; the baggage train was far too unwieldy; and the pace at which the men were made to march was too quick for that scorching time of the year. They advanced, however, within 25 miles of Lang-son, when they suddenly came upon a Chinese camp. An irregular engagement commenced, and, in the pitched battle which ensued, the Chinese broke the French lines, and drove them away in headlong flight. This brought the military operations for the season to a close.

During the rainy season fevers of all kinds became alarmingly prevalent, and the number of deaths and of men invalided was very large. In the meantime, however, an expedition, led by Colonel Donnier, against the Chinese garrison at Chu, about 10 miles south-east from Lang-kep, was completely successful; and in a battle fought near Chu the Chinese were defeated, with a loss of 3000 killed, the French loss being only 20 killed and 90 wounded. In the skirmishes which followed the French were generally victorious, but not to such a degree as to warrant any enlargement of the campaign.

The arrival in January 1885 of 10,000 men having brought up the force under Brière de l'Isle to 40,000, he ordered an advance towards Lang-son. The difficulties of transport greatly impeded his movements, still the expedition was successful. On the 6th February three forts at Dong-Song, with large supplies of stores and ammunition, fell into the hands of the French. Three days' heavy fighting made them masters of a defile on the road, and on the 13th Lang-son was taken, the garrison having evacuated the town just before the entrance of the conquerors. With his usual energy Négrier pressed on in pursuit to Ki-hea, and even captured the frontier town of Cua-ai. But Brière de l'Isle had now to hurry back to the relief of Tuyen-Kwan, which had been attacked by a Chinese force, and Négrier was left in command at Lang-son. The withdrawal of Brière de l'Isle's division gave the Chinese greater confidence, and, though for a time Négrier was able to hold his own, on the 22d and 23d of March he sustained a severe check between Lang-son and Thatke, which was finally converted into a complete rout, his troops being obliged to retreat precipitately through Lang-son to Than-moi and Dong-Song. Brière de l'Isle reached Tuyen-Kwan on the 3d of March, and found the Black Flags and Yunnan braves strongly posted on the side of an almost inaccessible pass. After having sustained a succession of attacks for eighteen days, and seven actual assaults, the delight of the garrison at seeing Brière de l'Isle's relieving force may be imagined. It was while matters were in this position that Sir Robert Hart succeeded in negotiating peace between the two countries. By the terms agreed on (April 6, 1885), it was stipulated that France was to take Tong-king under its protection and to evacuate Formosa. The Chinese undertook at the same time to expend 80,000,000 francs on the construction of roads in South China.

The future fortunes of the colony must depend greatly on the administrative ability of the governors selected to rule over it. The death of Paul Bert was in this respect a great loss to Tong-king.

See *France and Tong-King*, by J. G. Scott, 1885; *Tonkin*, by C. B. Norman, 1884; *Tungking*, by W. Mesney, 1884. (R. K. D.)

TONGUE. See ANATOMY, vol. i. p. 895, and TASTE.

TONNAGE, REGISTER TONNAGE, or INTERNATIONAL REGISTER TONNAGE, is the unit on which the assessment of dues and charges on shipping is based. The system at present in force is known as the Moorsom system. A register ton is 100 cubic feet of internal volume. Thus a vessel of 100,000 cubic feet of internal space within the points of measurements prescribed by the law is 1000 tons register. Vessels are sometimes bought and sold under this unit. The tonnage rules, which are very full and elaborate, are contained in part ii. of the Merchant Shipping Act, 1854, sections 20 to 29 inclusive, and in section 9 of the Merchant Shipping Act, 1867, the latter being a special section in reference to a deduction from the gross tonnage in respect of crew space, which space must be fit for the proper accommodation of the men who are to occupy it to entitle to such deduction. This enactment has led to great improvement in seamen's quarters.

Section 60 of the Merchant Shipping Act, 1862, provides on the point of international tonnage as follows:—"Ships belonging to foreign countries which have adopted the British system of tonnage need not be remeasured in this country." The British system has been adopted by the following countries at the dates named:—United States, 1865; Denmark, 1867; Austria-Hungary, 1871; Germany, 1873; France, 1873; Italy, 1873; Spain, 1874; Sweden, 1875; Netherlands, 1876; Norway, 1876; Greece, 1878; Russia, 1879; Finland, 1877; Hayti, 1882; Belgium, 1884; Japan, 1884. It is also under consideration by China.

There are slight differences in the rules for deduction for engine room in some of the countries, but owners or masters of foreign steamships, where this difference exists, may have the engine-rooms remeasured in the United Kingdom if they desire; in other words, their net tonnage may be reduced to exact English measure.

The British system was also mainly adopted by the International Tonnage Commission assembled at Constantinople in 1873, the rules of such commission forming the basis of dues levied on the ships of all countries passing through the Suez Canal. A special certificate is issued in the respective countries for this purpose. The main point of difference from the British system is with respect to the deduction for engine room.

There are three terms used in respect of the tonnage of ships,—namely, tonnage under decks, gross tonnage, and register tonnage.

In obtaining the gross measurement the space under the tonnage deck is first measured—sections 20 and 21 (1), (2), and (3); then the space or spaces, if any, between the tonnage deck (the tonnage deck is the second deck from below in all vessels of more than two decks and the upper deck in all other vessels) and the upper deck—section 21 (5) of Act; and finally the permanent closed-in spaces above the upper deck available for cargo, stores, passengers, or crew—section 21 (4) of Act.

The allowance for engine room is governed by the percentage the net engine room—that is, the space exclusive of the coal bunkers—bears to the gross tonnage, and varies in paddle- and screw-steamers as laid down in section 23 of the Act.

In obtaining the tonnage under tonnage deck, ships are divided in respect of their length into five classes as follows;—

Class 1.	Length	50	feet and under....................		into 4	equal parts.
,, 2.	,,	50	,, and not exceeding	120 feet,	6	,,
,, 3.	,,	120	,, ,, ,,	180 ,,	8	,,
,, 4.	,,	180	,, ,, ,,	225 ,,	10	,,
,, 5.	,,	225	,, and upwards....................		12	,,

The following is an epitome of the rule for tonnage under the tonnage deck:—

Length is taken inside on tonnage deck, from inside of plank at stern to inside of midship stern timber or plank; the length so taken, allowing for rake of bow and of stern in the thickness of the deck, and one-third of the round of beam, is to be divided into the prescribed number of equal parts (which determines the stations of the areas), according to the length of vessel, as above.

Area 1 is at the extreme limit of the bow. Area 2 is at the first point of division of the length. The rest are numbered in succession, the last being at the extreme limit of the stern.

Depths are taken at each point of division of the length, or station of each area, from the underside of the tonnage deck to ceiling at inner edge of timber strake, deducting therefrom one-third of the round of the beam. The depths so taken are to be divided into four equal parts, if midship depth should not exceed 16 feet; otherwise into six equal parts.

Breadths are taken at each point of division of the depths and also at the upper and lower points of the depths. The upper breadth of each area is to be set down in its respective column in a line with No. 1 (left-hand numerals), and the rest in succession.

The number of columns for areas will vary according to the length, as in the several classes, and will be equal to the number of parts into which the length is divided plus one.

The space or spaces between decks above the tonnage deck are dealt with by a similar formula. A mean horizontal area of the space, or each space if more than one, is found and multiplied by the mean height.

The permanent closed-in spaces above the upper deck available for cargo, stores, passengers, or crew are measured in the same manner by finding a mean area and multiplying by a mean height.

The measurement of net engine room is governed by the arrangement of the space, and is measured as a whole or in parts as may be required by its particular form.

The following is an example under class 2, depth under 16 feet, of tonnage under tonnage deck:—

<table>
<tr><td colspan="18">Length 112·75 Feet ÷ 6 = 18·791 Feet, the Common Interval between Areas.</td></tr>
<tr><td colspan="18">Depths ÷ 4, the Middle Depth being less than 16 Feet.</td></tr>
<tr><td colspan="2"></td><td>Area 1.</td><td colspan="2">Area 2.</td><td colspan="2">Area 3.</td><td colspan="2">Area 4.</td><td colspan="2">Area 5.</td><td colspan="2">Area 6.</td><td>Area 7.</td><td colspan="4" rowspan="2">Cubic Content and Register Tonnage.</td></tr>
<tr><td colspan="2">Depths ....</td><td>Feet.
...</td><td colspan="2">Feet.
12·65</td><td colspan="2">Feet.
12·3</td><td colspan="2">Feet.
11·85</td><td colspan="2">Feet.
11·4</td><td colspan="2">Feet.
10·9</td><td>Feet.
...</td></tr>
<tr><td colspan="2">Common interval between breadths ......</td><td>....</td><td colspan="2">3·162</td><td colspan="2">3·075</td><td colspan="2">2·962</td><td colspan="2">2·85</td><td colspan="2">2·725</td><td>...</td><td>No. of Areas.</td><td>Multipliers.</td><td>Areas brought up. Sq. Ft.</td><td>Products.</td></tr>
<tr><td>No. of Bdths.
1
2
3
4
5</td><td>Multipliers.
1
4
2
4
1</td><td>Being sharp at the stem no measured area.</td><td>Bdths. Feet.
19·35
18·85
16·65
11·85
1·65</td><td>Products.
19·35
75·4
33·3
47·4
1·65</td><td>Bdths. Feet.
20·2
20·4
20·15
19·6
2·0</td><td>Products.
20·2
81·6
40·3
78·4
2·0</td><td>Bdths. Feet.
20·4
20·5
20·25
19·85
6·35</td><td>Products.
20·4
82·0
40·5
79·4
6·35</td><td>Bdths. Feet.
20·2
20·35
20·0
17·8
6·35</td><td>Products.
20·2
81·4
40·0
71·2
6·35</td><td>Bdths. Feet.
19·1
18·65
14·95
8·75
1·0</td><td>Products.
19·1
74·6
29·9
35·0
1·0</td><td>Being sharp at the stern no measured area.</td><td>1
2
3
4
5
6
7</td><td>1
4
2
4
2
4
1</td><td>0
186·17
230·21
226·36
208·19
145·24
0</td><td>0
744·68
460·42
905·44
416·38
580·96
0</td></tr>
<tr><td colspan="2">⅓ common interval between breadths......</td><td>...</td><td colspan="2">177·3
1·05
8865
17730
186·165</td><td colspan="2">223·5
1·03
6705
22350
230·205</td><td colspan="2">228·65
·99
205785
205785
226·363</td><td colspan="2">219·15
·95
109575
197235
208·192</td><td colspan="2">159·6
·91
1596
14364
145·236</td><td>...</td><td colspan="4" rowspan="2">3107·88
6·26 = ⅓ common interval between areas.
1864728
621576
1864728
Tons
19455·32 ÷ 100 = 194·55 under deck.</td></tr>
<tr><td colspan="2"></td><td>Area 1.</td><td colspan="2">Area 2.</td><td colspan="2">Area 3.</td><td colspan="2">Area 4.</td><td colspan="2">Area 5.</td><td colspan="2">Area 6.</td><td>Area 7.</td></tr>
</table>

This formula is also applicable for finding displacement tonnage of ships, that is, the external displacement measured by taking transverse areas to the height of the load water-line to find the cubic content, which content divided by 35 gives the displacement in tons weight, the difference between the light and load displacement representing the carrying powers of a vessel in tons.

"The rule," says Mr Moorsom, "is founded on the purest mathematical principles. It was first published in the *Philosophical Transactions* of the Royal Society of 1798 by Attwood, in his 'Disquisition on the Stability of Ships,' who there describes it as one of those formulæ invented by Sterling for measuring spaces bounded by irregular curves, founded on Sir Isaac Newton's discovery of a theorem—a discovery which the immortal author himself considered amongst his happiest inventions—by which the areas of all curvilinear spaces not geometrically quadrible nor discoverable by any known rules of direct investigation are so closely approximated as to amount to geometrical exactness."

Mr Allan Gilmour at the middle of the present century expressed his opinion, after a careful consideration of the tonnage question, which was receiving much attention at that time owing to the law 8 and 9 Vict. cap. 89, which had been adopted in place of the old tonnage law 13 Geo. III. cap. 74, not giving satisfaction, that the "system framed by Mr Moorsom will as it were compel every one to build strong, fast-sailing, and good seagoing ships, and that, in fact, it will stand as long as the world remains." It will be admitted that great progress has been made in every way in British shipping of late years, and for this due praise must be given to the influence of the present tonnage laws. (W. M*.)

TONNAGE AND POUNDAGE were customs duties anciently imposed upon exports and imports, the former being a duty upon all wines imported in addition to prisage and butlerage, the latter a duty imposed *ad valorem* at the rate of twelvepence in the pound on all merchandise imported or exported. The duties were levied at first by agreement with merchants (poundage in 1302, tonnage in 1347), then granted by parliament in 1373, at first for a limited period only. They were considered to be imposed for the defence of the realm. From the reign of Henry VI. until that of James I. they were usually granted for life. They were not granted to Charles I., and in 1628 that king took the unconstitutional course of levying them on his own authority, a course denounced a few years later by 16 Car. I. c. 18, when the Long Parliament granted them for two months. After the Restoration they were granted to Charles II. and his two successors for life. By Acts of Anne and George I. the duties were made perpetual, and mortgaged for the public debt. In 1787 they were finally abolished, and other modes of obtaining revenue substituted, by 27 Geo. III. c. 13.

Poundage also signifies a fee paid to an officer of a court for his services, *e.g.*, to a sheriff's officer, who is entitled by 28 Eliz. c. 4 to a poundage of a shilling in the pound on an execution up to £100, and sixpence in the pound above that sum.

TONQUA BEAN. The Tonqua, Tonka, or Tonquin bean, also called the coumara nut, is the seed of *Dipterix odorata*, a Leguminous tree growing to a height of 80 feet, native of tropical South America. The drupe-like pod contains a single seed possessed of a fine sweet "new-mown hay" odour, due to the presence of a crystallizable principle called coumarin, to which also the dried stalks of *Melilotus officinalis* and the vernal grass *Anthoxanthum odoratum* owe their odour. Tonqua beans are used principally for scenting snuff and as an ingredient in perfume sachets and in perfumers' "bouquets."

TONQUIN. See Tong-king.

TONSILLITIS. See Throat Diseases.

TONSURE. The reception of the tonsure, in the Roman Catholic Church, is the initial ceremony which marks admission to orders and to the rights and privileges of clerical standing. It is administered by the bishop with an appropriate ritual. Candidates for the rite must have been confirmed, be adequately instructed in the elements of the Christian faith, and be able to read and write. Those who have received it are bound (unless in exceptional circumstances) to renew the mark, consisting of a bare circle on the crown of the head, at least once a month, otherwise they forfeit the privileges it carries. A very early origin has sometimes been claimed for the tonsure, but the earliest instance of an ecclesiastical precept on the subject occurs in can. 41 of the council of Toledo (633 A.D.): "omnes clerici, detonso superius capite toto, inferius solam circuli coronam relinquant." Can. 33 of the Quinisext council (692) requires even singers and readers to be tonsured. Since the 8th century three tonsures have been more or less in use, known respectively as the Roman, the Greek, and the Celtic. The first two are sometimes distinguished as the tonsure of Peter and the tonsure of Paul; in the latter the whole head was shaven, but when now practised in the Eastern church this tonsure is held to be adequately shown when the hair is shorn close. In the Celtic tonsure (tonsure of St John, or, in contempt, tonsure of Simon Magus) all the hair in front of a line drawn over the top of the head from ear to ear was shaven.

TONTINE. This system of life insurance owes its name to Lorenzo Tonti, an Italian banker, born at Naples early in the 17th century, who settled in France about 1650. In 1653 he proposed to Cardinal Mazarin a new scheme he had devised for promoting a public loan. His plan was to the following effect. A total of 1,025,000 livres was to be subscribed in ten portions of 102,500 livres each by ten classes of subscribers, the first class consisting of persons under 7, the second of persons above 7 and under 14, and so on to the tenth, which consisted of persons between 63 and 70. The whole annual fund of each class was to be regularly divided among the survivors of that class, and on the death of the last individual the capital was to fall to the state. This plan of operations was authorized under the name of "tontine royale" by a royal edict, but this the parlement refused to register, and the idea remained in abeyance till 1689, when it was revived by Louis XIV., who established a tontine of 1,400,000 livres divided into fourteen classes of 100,000 livres each, the subscription being 300 livres. Although the classes were not quite filled, this tontine was carried on till 1726, when the last beneficiary died,—a widow who at the time of her decease was deriving from this source an annual income of 73,500 livres. Several other Government tontines were afterwards set on foot; but in 1763 restrictions were introduced, and in 1770 all tontines at the time in existence were wound up. Private tontines continued, however, to flourish in France for some years, the "tontine Lafarge" having been opened as late as 1791.

The tontine principle has often been applied in Great Britain, chiefly to the purchase of estates or the erection of buildings for which the necessary funds could not be procured by ordinary methods. The speculative element in the system has proved an attraction. The investor stakes his money on the chance of his own life or the life of his nominee enduring for a longer period than the other lives involved in the speculation, in which case he expects to win a large prize. The only thing which will serve to distinguish this from an ordinary lottery is the assumption that some may apply greater care or skill in the selection of lives than others of the players. The tontine principle is nearly the converse of ordinary life assurance, where it is the man who dies early who obtains an advantage for his heirs at the expense of the long liver. But it has been occasionally introduced into life assurance in the distribution of profits or surplus, and so far it tends to redress the inequalities of the original contract, the profits being assigned to the longest livers to a larger extent than in the common life assurance system. The tontine principle has been brought into considerable prominence by some American life offices (see INSURANCE, vol. xiii. p. 183). All that is wanted to make the system fair is that every one should understand that in order to secure a disproportionate share of profits in the event of his surviving and keeping up his policy he must make a corresponding sacrifice if he dies early or discontinues his insurance.

TOOKE, JOHN HORNE (1736-1812), an ardent politician and an erudite philologer, was the third son of John Horne, a poulterer in Newport Market, whose business the son, when a pupil at Eton with other boys of a more aristocratic position, in early life happily veiled under the title of a "Turkey merchant." He was born in Newport Street, Long Acre, Westminster, on 25th June 1736. Some portion of his school days was passed, when he was about seven years old, in "an academy in Soho Square," and when three years older he went to a school in a Kentish village. For a time (1744-46) he was at Westminster School, but the greater part of his education was got at Eton, and then under private tuition, first at Sevenoaks in Kent (1753) and then at Ravenstone in Northamptonshire. In 1755 he was entered at St John's College, Cambridge, and took his degree of B.A. in 1758, as last but one of the senior optimes, Beadon, his life-long friend, afterwards bishop of Bath and Wells, being among the wranglers in the same year. Strange to say, the object of all this care and expense found himself doomed to the drudgery of ushership at a boarding school at Blackheath, and the pleasures of his lot were not enhanced by his father's strongly expressed desire that he should take orders in the Church of England. A strange vacillation marked his career at this period, a vacillation probably due to a constant struggle between his own inclination and the wishes of his father. He was admitted to the diaconate of the church, and almost at the same time was entered at the Inner Temple. He studied for the bar for some time, mostly in the company of Dunning and Kenyon, and then was ordained as a priest of the national church by the bishop of Salisbury. After this event his father obtained for him the next presentation to the small vicarage of New Brentford, to which Horne was duly admitted, and he retained its scanty profits until 1773. During a part of this time he was absent on a tour in France, acting as the bear-leader of a son of the miser Elwes. To his credit be it said that while he resided at Brentford he discharged with exemplary regularity all the duties of his profession, and that, reviving a practice of the previous century, he studied medicine for the benefit of his poorer parishioners. Under the excitement created by the actions of Wilkes and the blunders of his ministerial opponents, Horne plunged into politics with consuming zeal. The newspapers abounded with his productions, but his chief effort was a scathing pamphlet on Lords Bute and Mansfield, setting out the "petition of an Englishman." In 1765 he again went abroad as tutor, and on this occasion he escorted to Italy the son of a Mr Taylor, who lived near his Middlesex parish, a young man subject to fits of insanity. It was while passing through Paris on this tour that he made the personal acquaintance of Wilkes, and it was while at Montpellier, in January 1766, that a letter addressed by Horne to Wilkes laid the seeds of that personal antipathy which afterwards grew so rapidly. In the summer of 1767 the travelled parson landed again on English soil, and, in spite of his latent distrust of the so-called "patriot," his exertions quickly obtained for Wilkes that seat for the county of Middlesex which ensured his fortune. Horne was deeply concerned in all the proceedings of the corporation of London in support of the popular cause, and he advised, if he did not actually draw up, the celebrated speech which Alderman Beckford addressed to his sovereign. As an incidental act in this struggle with the court and the majority of the House of Commons, Horne involved himself in a dispute with George Onslow, the member for Surrey, which culminated in a civil action, ultimately decided in Horne's favour, and in the loss by his opponent of his seat in parliament. An influential association, called "the Society for Supporting the Bill of Rights," was founded, mainly through the exertions of Horne, in 1769, but the members were soon divided into two opposite camps of the thick and thin partisans of Wilkes and of those who refused to be labelled by the name of any combatant, and in 1770 Horne and Wilkes broke out into open warfare. Into this controversy, carried on with that unflagging zeal which always springs from personal hatred, none will now care to enter; it benefited the fortunes of neither of the combatants, and it damaged the success of the cause for which they had both laboured energetically. In 1771 Horne obtained at Cambridge, though not without some opposition from members of both the political parties, his degree of M.A., and in the same year he embarked on a more laborious and costly undertaking, that of vindicating the right of printing an account of the debates in parliament, in which, after a protracted struggle between the ministerial majority and the civic authorities, the right was definitely established. The energies of the indefatigable parson knew no bounds. In the same year (1771) he crossed swords with Junius, and ended in disarming his masked antagonist. It is a curious corollary to this controversy that more than one speculator has identified him with Junius. Horne had now passed more than half the allotted span of life, and his only fixed income consisted of those scanty emoluments attached to a position which galled him daily. He resigned his benefice, and betook himself to the study of the law and to his studies in philology. An accidental circumstance, however, occurred at this moment which largely affected his future. His friend Mr William Tooke had purchased a considerable estate south of the town of Croydon in Surrey, part of which seems to have consisted of Purley Lodge in Coulsdon. The possession of this property brought about frequent disputes with an adjoining landowner, and, after many actions in the law courts, the friends of Mr Tooke's opponent endeavoured to obtain, by a bill forced through the Houses of Parliament, the privileges which the law had not assigned to him. Horne thereupon, by a bold libel on the Speaker, drew public attention to the case, and, although he himself was placed for a time in the custody of the sergeant-at-arms, the clauses which were injurious to the interests of Mr Tooke were eliminated from the bill through the publicity which his conduct had given to the matter. Mr Tooke's gratitude knew no bounds; he declared his intention of making his friend the heir to his fortune, and, if the design was never carried into effect, Horne derived from the generous old man during his lifetime large gifts of money. No sooner had this matter been happily settled than Horne found himself involved in a more serious trouble than any that had yet befallen him. For his conduct in signing the advertisement soliciting subscriptions for the relief of the relatives of the Americans murdered by the king's troops at Lexington and Concord, he was tried at the Guildhall in July 1777 before Lord Mansfield, found guilty, and committed to the King's Bench prison in St George's Fields, from which he only emerged after a year's durance, and after a loss, in fine and costs, amounting to £1200. Soon after his deliverance, as he had thrown off, as he thought, his clerical gown, he applied to be called to the bar, but his application was negatived on the ground that his orders in the church were indelible. To return to the church was now impossible; and Horne tried his fortune, but without success, in farming some land in Huntingdonshire. Two tracts which were penned by him, one before and the other after this failure in practical life, exercised great influence in the country. One of them, criticizing the measures of Lord North's ministry, passed through numerous editions; the other set out a scheme of reform which he afterwards withdrew in favour of that advocated by Pitt. On his return from his voluntary banishment in Huntingdonshire, he became once more a frequent guest at Mr Tooke's house of Purley, and in 1782 assumed the name of Horne Tooke, which is now invariably assigned to him. In 1786 Horne Tooke conferred perpetual fame upon his benefactor's country house by adopting as a second title of his elaborate philological treatise of Ἔπεα Πτερόεντα, the more popular though misleading title of *The Diversions of Purley*. The treatise at once attracted attention in England and the Continent, was universally read by the vulgar as well as the learned, and, while its conclusions, if not always carrying conviction to the erudite, were deemed by them worthy of consideration as proceeding from a mind of extensive learning and singular acuteness, the fame given to Purley by the choice of the title gratified its owner. The first part was published in 1786, the second in 1805. The best edition is that which was published in 1829, under the editorship of Richard Taylor, with the additions written in the author's interleaved copy.

Between 1782 and 1790 Tooke gave his support to Pitt, and in the election for Westminster, a constituency in which Fox was vitally interested, he threw all his energies into the ministerial cause. With Fox he was never on terms of friendship, and Samuel Rogers, in his *Table Talk*, asserts that their antipathy was so pronounced that at a dinner party given by a prominent Whig not the slightest notice was taken by Fox of the presence of Horne Tooke. It was after the election of Westminster in 1788 that Tooke depicted the two rival statesmen in his celebrated pamphlet of *Two Pair of Portraits*. At the general election of 1790 he came forward as a candidate for that distinguished constituency, in opposition to Fox and Lord Hood, but was defeated; and, though he again sought the suffrages of its voters in 1796, and his speeches at the hustings were never exceeded in ability, he was again at the bottom of the poll. Meantime the excesses of the French republicans had unhinged the minds of all sections of society in England, and the actions of the Tory ministry faithfully represented the feelings of the country. Horne Tooke was arrested early on the morning of 16th May 1794, and conveyed to the Tower. His trial for high treason lasted for six days (October 17–23) and ended in his acquittal, the jury only requiring the short space of eight minutes to settle their verdict. The evidence which the crown could adduce in support of the charge proved to be of the slightest description, and the demeanour of the accused throughout the proceedings furnished abundant proofs of the resolution of his mind and the force of his abilities. His public life after this event was only distinguished by one act of importance. Through the influence of Lord Camelford, the fighting peer, he was returned to parliament in 1801 for the pocket borough of Old Sarum. No sooner was he returned to the House of Commons than Lord Temple endeavoured to secure his exclusion on the ground that he had taken orders in the church, and one of Gillray's caricatures delineates the two politicans, Temple and Camelford, playing at battledore and shuttlecock, with Horne Tooke as the shuttlecock. The ministry of Addington would not support this suggestion, but a bill was at once introduced by them and carried into law, which rendered all persons in holy orders ineligible to sit in the House of Commons. The parliamentary life of the member for Old Sarum was preserved through one parliament, but at its expiration he was excluded for ever.

The last years of Tooke's life were spent in retirement in a house on the west side of Wimbledon Common, and there he was visited by the leading members of the party of progress. The traditions of his Sunday parties have lasted unimpaired to this day, and the most pleasant pages penned by his biographer describe the politicians and the men of letters who gathered round his hospitable board. His conversational powers rivalled those of Dr Johnson; and, if more of his sayings have not been chronicled for the benefit of posterity, the defect is due to the absence of a Boswell. Through the liberality of his friends, his last days were freed from the pressure of poverty, and he was enabled to place his illegitimate son in a position which soon brought him wealth, and to leave a competency to his two illegitimate daughters. Illness seized him early in 1810, and for the next two years his sufferings were acute. He died in his house at Wimbledon on 18th March 1812, and his body was buried with that of his mother at Ealing, the tomb which he had prepared in the garden attached to his house at Wimbledon being found unsuitable for the interment. An altar-tomb still stands to his memory in Ealing churchyard. A catalogue of his library was printed in 1813.

The *Life of Horne Tooke*, by Alexander Stephens, is written in an unattractive style, and was the work of an admirer only admitted to his acquaintance at the close of his days. Its main facts are reproduced with more brightness in an essay by Mr J. E. Thorold Rogers in the second series of his *Historical Gleanings*. Many of Horne Tooke's wittiest sayings are preserved in the *Table Talk* of Samuel Rogers and S. T. Coleridge. (W. P. C.)

TOPAZ. It appears that the stone described by ancient writers under the name of τοπάζιος, in allusion to its occurrence on the island of Topazion in the Red Sea, was the mineral which we now know as the chrysolite or PERIDOTE (*q.v.*). The topaz of modern mineralogists was unknown to the ancients. Topaz occurs either crystallized, in association with granitic rocks, or in the form of rolled pebbles in the beds of streams. The crystals are orthorhombic prisms, with a perfect cleavage parallel to the base, or transverse to the long axis of the prism. This cleavage is recognized by the lapidary as the "grain" of the stone. It is notable that crystals of topaz are commonly hemimorphic; in other words, the prisms are terminated by dissimilar faces. This hemimorphism is associated with the property of pyroelectricity (see MINERALOGY, vol. xvi. p. 376). The chemical composition of the topaz has given rise to much discussion, but the mineral is now generally regarded as a silicate of aluminium associated with the fluorides of aluminium and silicon. When strongly heated it suffers considerable loss of weight. Brewster, examining the topaz microscopically, detected numerous fluid cavities, whence he concluded that it had been formed in the wet way. Two of the fluids obtained from these cavities have received the names of *brewsterlinite* and *cryptolinite*. Some of the finest topazes are almost colourless, and may be occasionally mistaken for diamonds. The topaz, however, is inferior in hardness; it lacks "fire"; and it becomes electric when heated—a property not possessed by the diamond. Colourless topazes are known to French jewellers as *gouttes d'eau*, and in Brazil as *pingas d'agoa*—names which refer to the limpidity of the stone—while in England they pass in trade under the curious name of *minas novas*. The beauty of the stone is best developed when in the form of a brilliant. The topaz is cut on a leaden wheel by means of emery, and is polished with tripoli. Coloured topazes are usually either yellow or blue. The pleochroism of the stone is very marked: thus the colour of the sherry-yellow crystals from Brazil is resolved by the dichroiscope into brownish yellow and rose-pink. The colour is unstable, the yellow topaz especially being liable to suffer bleaching by exposure to sunlight. Hence the fine series of crystals of Siberian topaz from the Kochscharow collection, now in the British Museum, is carefully protected from light by means of opaque pasteboard caps. In 1750 a Parisian jeweller named Dumelle discovered that the yellow topaz of Brazil, when exposed to a moderate heat, assumed a rose-pink colour. It is generally believed that all the pink topaz occurring in jewellery owes its tint to artificial treatment. Formerly it was the practice to heat the stone in a sand-bath, but the change of colour is now generally effected by wrapping the stone in German tinder, which is then ignited. This "burnt topaz" is sometimes known to jewellers as "Brazilian ruby." In like manner the blue topaz occasionally passes under the name of "Brazilian sapphire," and the pale green as "aquamarine"—a name which is strictly applicable only to the sea-green beryl. The largest known cut topaz is a fine brilliant, weighing 368 carats, and termed the "Maxwell Stuart topaz."

The topaz is occasionally found in Britain, but usually in small crystals unfit for jewellery. It occurs in granite at St Michael's Mount in Cornwall, in Lundy Island, and in Arran, but the finest British specimens are obtained from the Highlands of Scotland. Ben-a-bourd, one of the Cairngorm group, yields good blue crystals. Topaz occurs in colourless and blue crystals in the granite of the Mourne Mountains in Ireland; and microscopic crystals are not uncommon in certain other granites. The famous topaz-rock of the Schneckenstein, in Saxony, yields pale yellow crystals of great beauty as mineralogical specimens, but not suited for cutting. The yellow Saxon topaz does not seem to change colour on exposure to heat. Some of the finest topaz comes from near Odon Tchelon, in Siberia; while the well-known deep-yellow crystals of Brazil occur near Villa Rica (Ouro Preto). Fine topaz, pale blue and colourless, is found, as rolled crystals, in Tasmania and on Flinders Island in Bass's Strait. It also occurs in the tin-drifts of New South Wales; and beautifully-formed limpid crystals, of small size, accompany stream-tin at Durango, in Mexico. Fine topaz fit for jewellery has recently been worked at the Platte Mountain, near Pike's Peak, Colorado. One stone, weighing 125 carats, has been described as being "as fine a gem as America has produced of any kind" (Kunz, 1885). Topaz also occurs in cavities in rhyolite at Nathrop and Chalk Mountain, Colorado, and in trachyte near Sevier Lake, Utah. It is likewise found in Arizona, in New Mexico, and at Stoneham, Maine.

Oriental topaz is the name sometimes given to yellow corundum, a mineral which is readily distinguished from ordinary topaz by its superior hardness and density. The yellow and smoky varieties of quartz, or cairngorm, are often known in trade as *Scotch topaz*, but these are inferior to true topaz in hardness and in density. The chief differences between the three may be thus expressed:—

	Scotch Topaz.	True Topaz.	Oriental Topaz.
Hardness............	7	8	9
Specific gravity.....	2·6	3·5	4
Crystallization.......	Hexagonal.	Orthorhombic.	Hexagonal.

TOPEKA, a city of the United States, the county seat of Shawnee county and the capital of the State of Kansas, is situated (39° 3′ N. lat. and 95° 39′ W. long.) for the most part upon the south bank of the Kansas or Kaw river, upon a level prairie bench considerably elevated above the river. A small portion, known locally as North Topeka, lies upon the north side of the river. Besides the State capitol, which is an imposing building in the midst of an extensive park, the city contains the State insane asylum and the reform school. The Atchison, Topeka, and Santa Fé Railroad Company has its offices and workshops here, and the city is also intersected by a branch of the Union Pacific line. In 1860 Topeka had only 759 inhabitants; in 1870 the number had risen to 5790. In 1880 the population was 15,452 (8140 males and 7312 females); and in 1886 the number is returned at 25,005, making Topeka the second largest city in the State. The assessed valuation in 1886 was $6,547,079, and the debt of the corporation only $422,900.

TORCELLO, a small island 6 miles north-east of Venice, now almost deserted, but once a place of much importance. Torcello was one of the parent islands from which Venice was colonized, and possessed a cathedral church long before St Mark's was founded. In the 11th century Torcello had already begun rapidly to decline. The existing cathedral of S. Maria is a building of the highest ecclesiological importance, unique in Europe as a perfect example of the arrangement of the choir in the 6th or 7th century, when the original cathedral was built, and, though most of the upper structure was rebuilt by Bishop Orseolo[1] about 1008, the plan of the church and the fittings of the choir still exist as they were originally designed. The church consists of a nave, with ten bays of arches on marble monoliths, and three aisles each terminated by an apse. Round the walls of the central apse are six tiers of seats for the officiating clergy, and, in the centre, raised above the others, a marble throne for the bishop, approached by a flight of steps (see vol.

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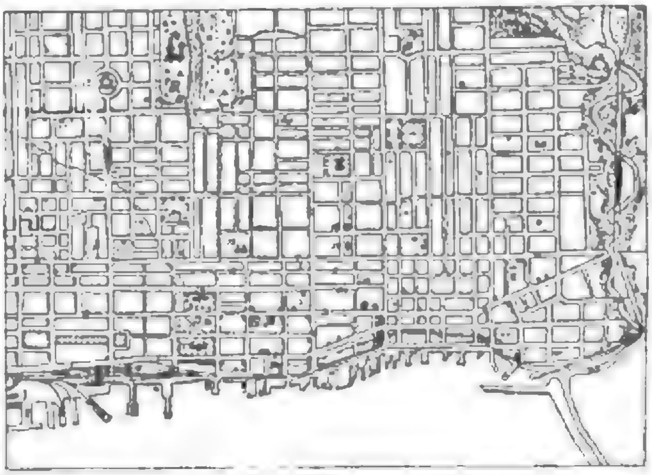
[1] Son of the Venetian doge Pietro Orseolo I.

iii. p. 418, fig. 16). The high altar stood in front of the steps, and the celebrant stood with his back to the apse, looking over the altar towards the congregation. An exactly similar arrangement still exists in many of the early Coptic churches of Old Cairo: the church of Abu Sergeh is a specially perfect example.[1] When the church was reconstructed in 1008, Bishop Orseolo did not interfere with the older and then obsolete arrangements of the choir, but added a later choir, formed by marble screens, projecting three bays into the nave, with seats along three sides of the enclosure,—an arrangement like that which still exists in the church of S. Clemente in Rome (see ROME, vol. xx. p. 833). The present choir-stalls date from the 15th century. A fine marble ambo was at the same time placed outside the cancelli, and the position of the celebrant at the high altar was reversed. The vaults of the three apses are covered with fine glass mosaics, added probably in the 12th century: in the centre is a large figure of the Virgin, with the twelve apostles below; other mosaics cover the vaults of the aisle-apses and the whole entrance wall. The latter, much restored, has scenes of the Crucifixion, the Doom, and Heaven and Hell. The sculpture of the nave capitals and on the marble cancelli is very graceful work of Byzantine style, closely resembling similar panels at Ravenna. One remarkable peculiarity of this church is the marble shutter which closes each window on the right wall; these have pivots which revolve in projecting corbels—a very early method of closing windows of which very few examples still exist. Even when the shutters were closed some dim light passed through the semitranslucent marble slabs.[2] An octagonal baptistery, also built by Bishop Orseolo, stood outside the main entrance to the church, but has been rebuilt on a smaller scale. The crypt under the central apse of the cathedral is probably part of the original church, unaltered by any later changes.[3] The small church of S. Fosca, which is connected with the cathedral by a loggia, is also a building of exceptional interest, dating from the 10th century. It is purely Oriental in plan, and much resembles that of St Mark's at Venice and S. Vitale at Ravenna, on a small scale. It has a cruciform nave, with a large dome supported on eight columns, and a projecting choir with three apses. Externally it is surrounded by a loggia, supported on marble columns with rich Byzantine capitals. S. Fosca was partially rebuilt in the 12th century, and has since been much modernized, but its original very interesting plan still remains but little changed.

TORGAU, a fortified town in the Prussian province of Saxony, is situated on the left bank of the Elbe, 30 miles north-east of Leipsic and 26 miles south-east of Wittenberg. Its most conspicuous building is the Schloss Hartenfels, on an island in the Elbe, begun in 1481 and completed in 1544 by the elector John Frederick the Magnanimous. This castle is one of the largest Renaissance buildings in Germany, and contains a chapel consecrated by Luther in 1544. The town-house is a quaint building of the middle of the 16th century, and there are several other large and fine buildings, chiefly modern. The parish church contains the tomb of Catherine von Bora, Luther's wife. The once flourishing weaving and brewing industries of Torgau have declined in modern times; but the town has manufactures of gloves and miscellaneous articles, and carries on trade in grain, &c., on the Elbe and by rail. The fortifications, begun in 1807 at Napoleon's command, are largely surrounded with water; they include a *tête-de-pont* at the end of the bridge across the Elbe. In 1885 the population was 10,988 (in 1783 4000), a large proportion of them soldiers.

Torgau is said to have existed as the capital of a distinct principality in the time of the emperor Henry I., but by 1305 it was in the possession of the margrave of Meissen. It was a frequent residence of the electors of Saxony. In Reformation times Torgau appears as the spot where John of Saxony and Philip of Hesse formed their league against the Roman Catholic imperial estates; and the Torgau Articles, drawn up here by Luther in 1530, were the basis of the Augsburg Confession. The Thirty Years' War inflicted great suffering on the town. In 1760 Frederick the Great defeated the Austrians in the neighbourhood of Torgau. The town capitulated to Tauentzien on January 10, 1814, after a siege of three months.

TORONTO, the capital of the province of Ontario and the second largest city in the Dominion of Canada, is situated on a large and finely sheltered bay on the north shore of Lake Ontario, between the rivers Don and Humber. The magnetical and meteorological observatory, in the university grounds, stands at a height of 108 feet above the lake, and approximately 342 feet above the level of the sea, in lat. 43° 39′ 35″ N., long. 79° 23′ 39″ W. Toronto is 39 miles north-east of Hamilton, at the head of Lake Ontario, and 310 miles west-south-west of Montreal. The bay is formed by a peninsula or island about 6 miles long, enclosing a fine basin of 3·44 square miles, with a narrow entrance at the west end. This forms a safe and commodious harbour. The city stands on a thick deposit of boulder clay, overlying shaly sandstones of the Cincinnati or Hudson River group, practically equivalent in position to the Caradoc horizon of British geology. These thin-bedded sandstones crop out on the lake shore, and have been quarried for flagging and building purposes at the mouth of the Humber. In the northern part of the city the boulder clay is overlaid by stratified clays of the Post-Glacial age, largely used in the manufacture of bricks, of which many of the houses are built. The site slopes gradually from the margin of the bay for a distance of 3 miles to a terrace or ancient lake margin immediately outside the northern limits of the city, which occupies an area of 12·83 square miles, or of 17·99 square miles including the harbour and island. The streets cross each other at right angles. Yonge Street, the main thorough-



Plan of Toronto.

1. Front Street.
2. King Street (West)
3. King Street.
4. King Street (East).
5. Richmond Street.
6. Queen Street (West).
7. Queen Street.
8. Queen Street (East)
9. York Street.
10. Bay Street
11. Yonge Street.
12. Parliament Buildings.
13. Government House.
14. Upper Canada College.
15. Osgoode Hall.
16. St Michael's Cathedral.
17. Metropolitan Church.
18. Free Library.
19. St James's Cathedral.
20. River Don.
21. Knox College.
22. University College.
23. Magnetic Observatory.
24. Queen's Park.
25. St James's Park.

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[1] See Middleton in *Archæologia*, vol. xlviii. p. 398.

[2] Similar marble slabs, not made to move, still exist in the apse windows of S. Miniato, near Florence, and once existed in the basilica of S. Lorenzo fuori le Mura, Rome.

[3] The cathedral of Parenzo, in Istria, a work of the 6th century, much resembles the cathedral of Torcello (see vol. iii. p. 418, fig. 17). Similar plans are also to be seen in many of the early churches of Syria (see De Vogüé, *Syrie Centrale*, Paris, 1865) as well as in the Coptic churches of Egypt.

fare running north and south, was constructed as a great military road in 1796, and extends under the same name, for upwards of 30 miles, to Lake Simcoe. It constitutes the dividing line of the city, the streets being reckoned east or west according to their relation to it.

The city is the seat of the provincial Government, with the official residence of the lieutenant-governor, the parliament buildings and Government offices, the courts of law, and the educational departmental buildings for Ontario. The provincial legislature occupies the old parliament buildings erected in 1849, when Toronto was the capital of Upper Canada; but they have long been recognized as inadequate for the purpose. Plans have accordingly been prepared, and the new buildings are now in process of erection. The site is in the centre of the Queen's Park, a finely wooded park of upwards of 30 acres, originally laid out for the provincial university, and on which the old buildings of King's College stood. The new university building occupies a fine site immediately to the west. It is an imposing structure, of great architectural beauty, in the Norman style, with a massive central tower. The buildings of the provincial school of practical science, and of the magnetical observatory, are also erected in the university grounds. The observatory is one of the meteorological stations established by the British Government, on the recommendation of the Royal Society, in 1840. It is now maintained by the Dominion Government.

The university, University College, and the school of practical science embrace in their conjoint teaching a comprehensive system of training in arts and science; and in them upwards of 500 students receive their training in arts, in the natural and applied sciences, and in engineering. There is also a medical faculty, reorganized under a recent Act, in conjunction with the department of science in the university. The university and college constitute unitedly the state institution maintained by public funds, and strictly secular. But it is surrounded with the theological and training colleges of different denominations in affiliation with it, the students of which pursue their undergraduate course in the university for a degree in arts. The affiliated colleges, some of which give degrees in divinity, include Knox College (Presbyterian), Wycliffe College (Church of England), St Michael's College (Roman Catholic), Macmaster Hall (Baptist), and Victoria College (Methodist). Besides the provincial university and its affiliated colleges, Trinity College (Church of England) gives instruction in divinity and arts, and confers degrees in all the faculties. Toronto and Trinity medical schools occupy convenient buildings in the immediate vicinity of the general hospital, the Burnside lying-in hospital, and the Mercer eye and ear infirmary. The students in medicine number nearly 500, including a small number of lady students, for whom special instruction is provided. Upper Canada College, founded in 1829, is a provincial institution analogous to one of the great English public schools. It has about 300 students. The Collegiate Institute occupies a fine building immediately to the west of the horticultural gardens. It is the higher school, forming an important feature in the provincial system of education, and is maintained, along with the free public schools, from local taxes. Its students number 443, of whom 182 are females.

Osgoode Hall, the seat of the superior courts of law and equity, is an ornate Italian building, extended at various dates. The provincial asylum for the insane affords accommodation for upwards of 700 patients; it is surrounded with recreation grounds extending to 50 acres.

The city charities are numerous and well organized. The churches include some large and handsome buildings. Among the more important public buildings are those of the educational department, including a museum and gallery of art, normal and model schools; the custom-house, a fine Renaissance building, with extensive warehouses attached; and the post-office, also of tasteful architectural design. The free city library occupies a commodious building in Church Street, in addition to branch libraries in different parts of the city. It contains upwards of 47,000 vols. There are 35 city public schools, occupying large and commodious buildings, with 262 teachers and 20,213 children. The separate (Roman Catholic) schools number 13, with 60 teachers and 3792 children.

Toronto is the seat of many flourishing industries, including foundries, tanneries, furniture, stove, shoe, and other manufactories, flour-mills, breweries, &c. The site of the city is favourable to commerce. It is the centre of a rich agricultural district; and its harbour is of easy access to the largest vessels that navigate the lakes. It lies directly opposite the mouth of the Niagara river, distant 40 miles; and throughout the season of navigation well-appointed steamers maintain communication with the principal routes of travel in the United States and Canada. By means of the Grand Trunk, the Great Western, the Northern, the Canada Pacific, and other railways, it forms an important commercial centre for distribution; and it is the seat of the head offices of most of the banks and of the chief wholesale trade of western Canada. The direct route from the lower lakes to Lake Superior and the great North-West is by the Northern Railroad to Georgian Bay, where lines of steamers maintain constant communication from Collingwood and Owen Sound to Prince Arthur's Landing and the railways to Manitoba and the North-West.

In 1861 the population numbered 44,821; in 1871 it had increased to 56,092; in 1881 to 86,415; and in 1887 it is believed to amount to 140,000. The actual number on the assessment rolls is 111,800. The estimated value of real estate in Toronto is $105,000,000. The assessed value in 1886 was $83,556,811. The annual revenue of the city is estimated for 1887 at $1,812,941. The amount of customs duties for the fiscal year ending 30th June 1887 was $4,273,038. The value of exports to the same date was $3,192,157, and of imports $21,020,528. The city returns three members to the Canadian House of Commons, and three to the provincial legislature of Ontario.

In the despatches of Canadian officials of Louis XIV. in the 17th century Toronto means the country of the Hurons, a region lying between Lake Simcoe and Lake Huron, about 40 miles north. The river Humber, which enters Lake Ontario immediately to the west of the Bay of Toronto, though navigable only for a short distance even by canoes, formed with its portages a line of communication between Lake Ontario and the Huron country. Hence the station near the mouth of the river became the common landing-place for trading and hunting parties bound for the region known of old as Toronto, and so received its name. A French trading post, built there in 1749, and originally named Fort Rouillé, after the French colonial minister Antoine Louis Rouillé, comte de Jouy, was familiarly known as Fort Toronto. The Northern Railway, the first one constructed in Upper Canada, followed the route of the old Indian trail, and established a direct line of communication, by means of steamers from Collingwood, with Lakes Huron, Michigan, and Superior. The railway passes through a fine agricultural country, and is now extended into the Muskoka and Nippitsing districts, bringing an extensive lumbering region into direct communication with Toronto.

The site for the town was surveyed in 1793 by Surveyor-General Bouchette, under the instruction of the lieutenant-governor, General Simcoe; and in his narrative of the original survey Bouchette describes the untamed aspect of the scene, with the group of wigwams of a little band of Missisanga Indians who constituted the sole occupants of the land; while the waters of the bay and the neighbouring marshes were the haunts of innumerable coveys of wildfowl. The first parliament of Upper Canada held its second session in May 1793 at the town of Newark, at the mouth of the Niagara river; but in the following August the seat of government was transferred to Toronto, to which General Simcoe gave the name of York, in honour of the duke of York, the second son of George III. Under its new name the embryo metropolis slowly progressed as the surrounding country was cleared and settled. The entrance to the harbour was guarded by two block houses; provision was made for barracks and garrison stores; buildings were erected for the legislature; and there the members of parliament, summoned by royal proclamation to "meet us in our provincial parliament in our town of York," assembled on the 1st of June 1797. Sixteen years later the population numbered only 456. The town was twice sacked in the war of 1812. General Dearborn captured it at the head of a force of upwards of 2000 drawn from the neighbouring States. On their advance to the outworks of the garrison, the magazine of the fort exploded, whether by accident or design, killing many of the invaders. The halls of legislature and other buildings were burnt, and the town pillaged. On the restoration of peace the work of creating a capital for Upper Canada had well nigh to begin anew. But the city advanced with the general progress of the country. Trade centred in the little capital; the population increased; and needful manufactures were established. The organization of Upper Canada College in 1830, with a staff of teachers nearly all graduates of Cambridge, gave a great impetus to the city and province. In 1834 the population of York numbered fully 10,000; and an Act of the provincial legislature conferred on it a charter of incorporation, giving it for the first time an efficient system of municipal government, with a mayor, aldermen, and councilmen, entrusted with the administration of its affairs. Under this charter it was constituted a city, with the name of Toronto. (D. W.)

TORPEDO. Torpedoes may be briefly described as charges of some explosive agent, enclosed in water-tight cases, and moored or propelled under water at such depths that by their explosion they may sink or seriously damage a vessel in their vicinity. The use of torpedoes in naval warfare was proposed and even attempted in the end of the last and beginning of the present century, but no successful application of them was made until the American Civil War of 1861-64. The word "submarine mine" is generally substituted for "torpedo" when speaking of defensive or stationary mines, the latter term being reserved for locomotive torpedoes, or others used in offensive operations.

1. *Submarine Mines.*—Submarine mines are divided into three classes:—(1) observation mines, fired by an electric current when the enemy is observed to be within the destructive area of the mine; (2) electro-contact mines, which, when struck, fire by automatically completing the electric circuit from the battery ashore; (3) mechanical mines, which, when struck, fire through the action of some contrivance within themselves, and are not connected with the shore. Mines of the first class are used in places where a channel has to be kept clear for screw steamers to pass, the second class in those parts of the channel where there is little traffic, and the third class in channels which it is intended to bar equally against friend or foe.

Electrical mines have the advantage over mechanical that by the removal of the firing battery the passage of a ship is rendered perfectly safe, and that the condition of the mine can be ascertained by electrical tests, but the electric cables are liable to damage, and add greatly to the expense of the defence.

Gun-cotton and dynamite are the explosives generally used in mines, the charges varying from 30 ℔ to 500 ℔, according to the description of mine. In all mines the charge is exploded by means of a detonator containing fulminate of mercury. In mines loaded with gun-cotton the detonator is inserted in a priming charge of dry gun-cotton, this priming charge being in a metal case, closely surrounded by the wet gun-cotton comprising the remainder of the charge. Where dynamite is employed the priming charge is not necessary. Experiments made to determine the horizontal distance at which an ironclad will be vitally injured by different charges have yielded the following general results:—

Charge.	Submergence.	Distance.
150 ℔ mine	10 to 15 ft.	4 ft.
250 ℔ ground mine	30 ft.	10 ft.
500 ℔ ground mine	60 ft.	15 ft.

The explosion of 500 ℔ of gun-cotton at a horizontal distance of 30 feet would seriously injure a vessel, and 30 ℔ in contact with the bottom below the armour would probably blow a hole through the outer and inner skin. The depths given above are approximately the best depths to get the fullest effect out of the charges mentioned. When the water is so deep that if the mine were placed on the bottom it could not exert its full destructive effect on the bottom of a ship, it is given enough buoyancy to allow it to float above its moorings,—a mine on the bottom being termed a "ground mine," and a mine floating above its moorings a "buoyant mine."

If mines are placed too close together the explosion of one will damage those near it, the interval which must be left between them being—for a 100 ℔ mine, 100 feet; for a 250 ℔ mine, 250 feet; and for a 500 ℔ mine, 300 feet. There is therefore always a possibility of a ship passing through a single line of mines without coming within the destructive area of any. Mines are therefore generally arranged in two or more lines, the mines of one line covering the spaces left between the mines of the next, or several mines may be laid close together, and the whole exploded simultaneously.

The electric circuit of all electrical mines is very similar. A voltaic battery ashore has one pole put permanently to earth and the other pole joined to the electric cable leading to the mine. This cable passes into the mine case through a water-tight joint, and is connected up to one pole of the electric detonator, the other pole of the detonator being connected to the mouth-piece of the mine and consequently to earth. To prevent the mine being fired until the proper moment has arrived, this circuit must be broken somewhere, and means provided for completing it when the mine is to be fired. In the case of observation mines this is done by inserting a firing key in the electric cable near the battery, and in electro-contact mines by a circuit closer in the mine.

Observation mines.

The right moment to fire an observation mine is determined by two observers ashore, who have each adjusted two sights in line with the mine, as it was lowered into position,—the stations for these observers being chosen so that their lines of sight may be as nearly as possible at right angles to each other. The electric cable from the mine is led past both observers and connected to a firing battery, one pole of which is put permanently to earth. A firing key inserted in the circuit at the station of each observer renders the simultaneous pressure of both keys necessary to explode the mine. If each observer depresses his firing key as the centre of the enemy crosses his own line of sight, both keys can only be pressed simultaneously if the enemy arrives at the intersection of the two lines of sight, and consequently over the mine. When many mines are placed in one channel, it is usual to moor them in three lines, the prolongation of each line converging to an observing station, where the direction of each line is marked by sights. The electric cables from all the mines come to another observing station, and are there connected to separate firing keys, each of which has one pole joined up to a firing battery. The observer at this station is also provided with a separate sight marking the direction of each mine in all the lines. The former station is termed the "converging" and the latter the "firing" station. The observer at the converging station telegraphs to the firing station the instant at which the centre of the enemy is on one of the lines of mines, the observer at the firing station determining by means of his sights which individual mine the enemy is over, and he can fire it by pressing the corresponding key.

Instead of separate sights for each mine, observing arcs may be used. These instruments are furnished with a telescope, which can be constantly directed on the enemy, a bar attachment automatically closing the circuit when the direction of the enemy corresponds to a mine. The camera obscura has also been used for determining the position of an enemy in the mine field.

Electro-contact mines.

Electro-contact mines are buoyant mines moored about 10 feet below the surface, and are in connexion with an electric battery ashore. They are arranged to explode on being struck by a passing ship, by means of an apparatus contained in the mine itself, called a circuit closer. Many different kinds of circuit closers are in use, but they all depend upon there being a break in the electric circuit while the circuit closer is at rest, the circuit closer completing the circuit when the mine receives a blow. That most commonly used (fig. 1) consists of a steel spindle *a* carrying a weight *b* on its upper end. This steel spindle carries an insulated brass ring *c*, to which the wire from the detonator *d* is attached, the other pole of the detonator being connected to the cable *e* leading to the electric battery. On the mine being struck the inertia of the weight causes the steel rod to vibrate sufficiently to bring the insulated ring in contact with brass springs in connexion with the earth, thus completing the circuit of the electric battery through the detonators. Another form of circuit closer is a tube of mercury, which by splashing up when the mine is struck completes the electric circuit between two previously insulated points.

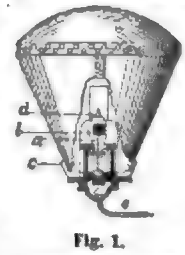


Fig. 1.

A single main cable from the battery may have several electro-contact mines attached to it; the expense of leading a separate wire from each mine to the battery is therefore avoided. If one mine was fired the broken end of its branch wire from the main cable would be left in the water, and on another mine being struck it would only receive a portion of the current, as the battery would be connected to earth through the broken branch. Each branch wire must therefore have a disconnector in circuit, clear of the explosion. The disconnector consists of a platinum wire fuse contained in a strong iron case, and the same current which fires the detonator in the mine fuses the platinum wire bridge of the disconnector, and the circuit to the broken branch remains insulated.

Mechanical mines.

Mechanical mines, of which there are many different patterns, contain the means of ignition within themselves, and are unconnected with any apparatus ashore. They may be ignited by percussion, friction, chemical action, and electricity.

A simple form of mechanical mine has a heavy top, which, on being pushed off by a passing ship, either pulls out a pin and releases a plunger, which is then forced by a powerful spring into a detonator, or a friction tube is fired when the weight falls on a line attached to it. Another form, known as Abel's mechanical exploder, consists of a glass tube containing sulphuric acid, and surrounded by chlorate of potash and sugar. The whole is contained in an india-rubber tube, which projects from the top of the mine, the lower end being in communication with the charge. When struck, the india-rubber tube bends, and, the glass tube breaking, the sulphuric acid mixes with the chlorate of potash and sugar and inflames the charge.

Electro-mechanical mines.

Electro-mechanical mines can be made by placing a voltaic battery inside the mine itself and joining it up to a fuse and circuit closer, the circuit closer completing the circuit when the mine is struck. Another form of electro-mechanical mine (fig. 2) has several projecting horns (*a*, *a*, *a*) of lead tubing. Inside each horn is a glass tube containing bichromate of potash, and immediately under it a row of small zinc and carbon plates, *b*, in a containing cell. On any one of the lead horns being bent, the glass tube is broken, and the bichromate of potash drops into the cell, converting the arrangement into a voltaic battery, which, being already connected to the electric fuse *c*, fires the mine.

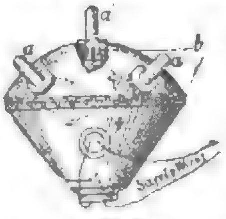


Fig. 2.

All mechanical and electro-mechanical mines are provided with some contrivance to guard against accidental explosion during the process of laying. In mechanical mines a safety pin can be withdrawn after the mine is in position, or, in the case of Abel's exploder, the projecting tube is surrounded by iron segments which fall off when the mine is in position. In electro-mechanical mines two of the wires forming part of the circuit inside the mine may be brought through to the outside and kept apart till the mine is in position, these wires being long enough to allow of the operator retiring clear of the explosion before joining them up and rendering the mine dangerous.

Mechanical mines have the advantage over electrical that they require fewer trained men for their manipulation, are cheaper, and can be placed in position very rapidly. But no really efficient method has yet been devised that will ensure a mechanical mine, after it has been placed in position, being safely taken up again for examination or removal, nor can any tests be applied to ascertain if it remains in an efficient condition.

Countermining.

All mines, especially those with electric cables attached, must be protected by gun fire or guard boats, as, if the mine field is unprotected, they can be easily destroyed by countermining or creeping. Countermining is carried out by exploding a succession of charges in an enemy's mine field. Mines containing heavy charges would be used for the purpose, several of these mines being dropped in succession from a boat towed by a fast steamer, the whole line being exploded together as soon as the last mine had been dropped. Numerous experiments have proved that the explosion of a 500 lb mine will effectually destroy any mine within a radius of 100 feet: the countermines would therefore be dropped at double this distance apart, and the channel so cleared marked by buoys. Electric cables can also be caught and raised to the surface by grapnels; or the grapnel may have a case of explosive between its arms, so that, instead of raising the wire, it may be cut by firing the charge.

3. *Locomotive Torpedoes.*—Locomotive torpedoes are a numerous class, the principal being the Whitehead, Lay, Sims, Brennan, and Ericsson. The Whitehead is the only one which can be considered a well-developed naval weapon.

Whitehead torpedo.

This torpedo (fig. 3) is made in different sizes, varying from 12 feet to 19 feet in length and from 12 to 15 inches in diameter; the cross section is circular, tapering to a point at each end. It is capable of being so adjusted that on being discharged it will travel at any depth between 5 and 15 feet below the surface, and it will maintain this depth for its entire run. The torpedo travels at a uniform speed for the whole of its range, the speed and range varying for different patterns; the latest type has a speed of 24 knots for 600 yards. The torpedo can be set so that, in the event of its not striking the ship aimed at, it will stop at the end of its range and sink. For exercise it can be set to stop at any distance within the limits of its range, rise to the surface, and float. The torpedo is divided into several compartments. The foremost A contains a charge of from 30 to 100 lb of gun-cotton, according to the size of the torpedo. This charge is fired on the torpedo striking a ship by a pistol which screws into the nose of the torpedo. On impact the point of the pistol is driven inwards and forces the point of a steel striker into a detonator. By means of powerful air-pumps air is compressed into the air-chamber B to a pressure of 1000 lb on the square inch, and actuates a three-cylinder engine, which drives two propellors revolving in opposite directions in the tail. The mechanism in the balance-chamber C works two exterior rudders on each side of the tail, which keep the torpedo at a uniform depth during its run. This device has never been patented, but is a secret; the details of it, however, have been purchased by all prominent maritime nations.

The tail F is fitted with four broad fins, which tend to keep the torpedo on a straight course and prevent it rolling. The horizontal tail fins carry four rudders, two horizontal and two vertical. The horizontal rudders worked from the balance-chamber keep the torpedo at its set depth; the vertical rudders are permanently adjusted so as to cause the torpedo to travel in a straight line.

The air-chamber of a torpedo is usually made of fluid compressed steel, the remaining compartments of thin steel plate, and the interior mechanism of phosphor-bronze. In Germany torpedoes are now made entirely of phosphor-bronze.

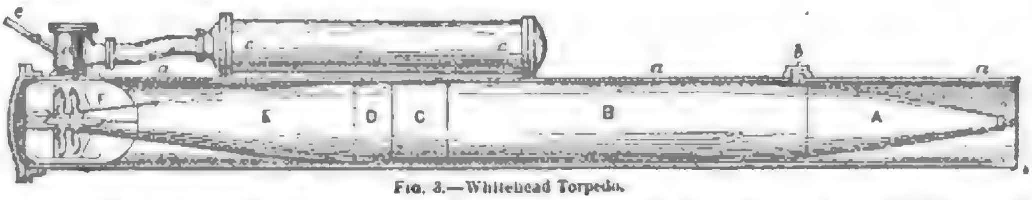


FIG. 3.—Whitehead Torpedo.

The torpedo can be discharged from above or below water. From above water it is shot out of an air-gun (fig. 3) mounted on the deck of a ship and pointing through the side. The air-gun consists of a metal tube *a*, *a*, *a*, of the same length as the torpedo, the rear end being closed by an air-tight door. The gun carries a reservoir *e* of compressed air, the contents of which, by means of a suitable firing valve *d*, can be instantaneously admitted into the gun. When the torpedo is to be discharged this firing valve is opened, and the compressed air in the reservoir forces the torpedo out at a high velocity, a tripper *b* projecting through the top of the gun throwing back the starting lever of the torpedo on its way out. From below water the torpedo is discharged through a tube, the muzzle of which forms part of the stem of the ship, the tube being fitted with an outside valve which prevents the water from entering while the torpedo is placed in the tube. Latterly powder has been used instead of compressed air for the ejecting force.

Lay torpedo.

The Lay torpedo is a boat of cylindrical form, the fore part being charged with an explosive. The motive power is carbonic acid gas generated in the usual way. As only a very small portion of the boat is visible on the surface, two guide rods, one on each end of the vessel, mark its position at any part of its run. The boat can be started, stopped, and steered by means of an electric cable, containing several insulated wires, which is paid out from the boat as it travels.

Sims torpedo.

The Sims torpedo is cigar-shaped, and is suspended to a boat-shaped float. The torpedo is propelled by screws driven by an electric motor situated in the body, the current for which is supplied from a dynamo ashore. The electric cable is coiled on a drum in the torpedo, and pays out as the torpedo advances. The torpedo is also steered from the shore by an electric current. Its speed is about 12 knots.

Brennan torpedo.

The principle of the Brennan torpedo is as follows. The torpedo contains two drums upon which a large amount of pianoforte wire is wound. One end of the wire from each drum is taken to large drums ashore, which are revolved by a steam-engine. By winding up on the large drums ashore a rotatory motion is imparted to the drums in the torpedo, which by means of gearing revolve two screw propellers, and these drive the torpedo through the water. The torpedo can be steered from the shore in any direction, by winding on one drum faster than the other, which alteration in motion moves a vertical rudder on the torpedo.

Ericsson torpedo.

The Ericsson torpedo is a long fish-shaped weapon, made of wood, and weighted so as to have little or no buoyancy. The charge is contained in a metal case at the fore end. It is propelled by a charge of gunpowder, out of a submarine gun fixed in the bows of a ship. Its range is about 300 feet, and it fires on impact.

Outrigger, drifting, and towing torpedoes.

Outrigger, Drifting, and Towing Torpedoes.—Before the introduction of the Whitehead, vessels armed with torpedoes were principally supplied with the outrigger torpedo. The explosive is contained in a metal case secured to the end of a steel or wooden pole, which lies fore and aft in the vessel carrying it. The pole can be rigged out until the torpedo is submerged a short distance ahead of the vessel, and is fired on contact with the enemy's side, either by an operator in the boat completing the electric circuit, or by the circuit being completed by a circuit closer in the torpedo. In rivers, or places with a current, drifting torpedoes can be used. They should be suspended from floats, and arranged in groups or pairs connected together by a rope, so that they may catch across the bows of a vessel at anchor. They can be fired after a given lapse of time by clockwork and other devices, or can be so arranged that the firing arrangement is released on a catch being withdrawn by the action of a propeller wheel, which remains stationary as long as the torpedo drifts with the current, but is revolved by the force of the current when the torpedo is stopped. Towing torpedoes are constructed to diverge from either side of a ship when towed, which is effected by shaping the torpedo like an otter. The torpedo tows on the surface, and, on striking a ship's side, the head containing the charge drops off, and fires as its weight tautens a line connecting it to the body.

Torpedo boats.

Torpedo Boats.—The great improvements made of late years in machine guns have rendered the outrigger and towing torpedo of little value for torpedo boats, as it would be almost impossible to approach a vessel near enough to use them before the boat would be destroyed by the storm of missiles which would be fired at her. All torpedo boats under construction, and most of those already completed, are therefore armed with the Whitehead torpedo. A modern torpedo boat is built entirely of steel, the plates often not exceeding $\frac{1}{16}$ inch in thickness, as, in order to get the necessary high speed, the minimum of weight consistent with the necessary strength is of the first importance. There are three classes of boats, known as first, second, and third. The first are capable of keeping the sea on their own account; the second are for harbour defence; and the third can be carried on board a ship.

The following table gives the dimensions and other details of a boat of each type:—

Type of Boat.	Length.	Beam.		Displacement.	Full Speed in Knots.	Indicated Horse-Power at Full Speed.	Boiler Pressure, lb per Square Inch.	Distance Boat can steam with Coal carried at	
								Full Speed.	Half Speed.
	Ft.	Ft.	In.	Tons.				Knots.	Knots.
1st class...	125	13	0	88	[illegible]	1150	140	400	2000
2d class...	86	11	0	30	20	450	125	150	400
3d class...	64	7	6	12·5	16·5	150	120	100	250

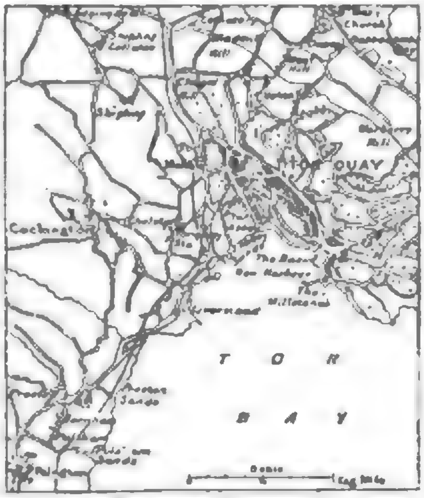
The boilers and machinery are protected by coal, and an armoured tower protects the steering gear and telegraphs for controlling the engines.

Torpedo nets.

Torpedo Nets.—The introduction of the modern torpedo boat has caused great attention to be paid to any means which will protect a ship from the torpedo. Most nations are adopting steel-wire netting, suspended from booms attached to the ship's side, the booms keeping the nets sufficiently far off to prevent any damage being done to the bottom by the explosion of the largest charge carried by a Whitehead. This netting, besides being cumbersome and heavy, cannot be used unless the ship is stationary or nearly so, so that in many cases it would be useless, but for ships at anchor it is of great value. Increased cellular subdivision is also being given to ships under construction, and special vessels, called "torpedo catchers," are being built by most nations. A torpedo catcher is a vessel of superior size and strength, but with the same high speed as a torpedo boat, the principal arm of the torpedo catcher being machine guns. (E. P. G.)

TORQUATUS. See MANLIUS.

TORQUAY, a watering-place of England, is finely situated on the northern recess of Tor Bay, Devonshire, and on the Dartmouth and Torbay branch of the Great Western Railway, 12 miles north of Dartmouth, 23 south of Exeter, and 220 west-south west of London. Owing to the beauty of its site and the equability of its climate, it is the favourite watering-place of Devon, and, being screened by lofty hills on the north, east, and west, and open to the sea breezes of the south, it has a high reputation as a winter residence. The temperature seldom rises as high as 70° in summer or falls below freezing point in winter. The lower ground is occupied by shops, hotels, and the plainer class of houses, while mansions and villas occupy the picturesque acclivities of the well-wooded limestone cliffs, commanding a great variety of fine views. There are still some remains of the original Torre abbey, founded for Præmonstratensians by William, Lord Brewer, in 1196. They stand to the north of the modern mansion, but, with the exception of a beautiful pointed-arch portal, are of comparatively small importance. On the south of the gateway is an old 13th-century building, known as the Spanish barn. On Chapel Hill are the remains of a chapel of the 12th century, dedicated to St Michael, supposed to have formerly belonged to the abbey. St Saviour's parish church of Tor-Mohun, or Tormoham, an ancient stone structure, was restored in 1874. The old church at St Mary Church, to the north of Torquay, has been rebuilt in the Early Decorated style; and in 1871 a new tower was also erected as a memorial to Dr Phillpotts, bishop of Exeter, who with his wife is buried in the churchyard. St John's church, by Street, is a very fine example of modern Gothic. Among the principal



Environs of Torquay.

secular buildings are the town-hall with square tower (1853), the post-office (1865), the museum of the natural history society (1874), the theatre and opera-house (1880), the county police court, the market, and the schools of art and science (extended in 1887). There are a number of benevolent institutions, including the Torbay infirmary and dispensary (1843), the homœopathic dispensary (1848), the Western hospital for consumption (1852), Crypt House institution for invalid ladies (1854), and the Mildmay home for incurable consumptives (1886). In 1886 the local board purchased from the lord of the manor, at a cost of £85,000, the harbours, piers, baths, assembly rooms, &c., including 60 acres of pleasure grounds and open spaces. The town is supplied with water from the Dartmoor hills, 16 miles distant, at a cost of £120,000. There is a convenient harbour, extended in 1870 at a cost of £70,000, and having a depth of over 20 feet at low water. The principal imports are coals, timber, and slates, and the principal exports are stones of the Transition limestone or Devonshire marble, which is much valued for building purposes. In the town are a number of marble-polishing works. Terra-cotta ware of very fine quality is also manufactured from a deposit of clay at Watcombe and at Hele. The population of the urban sanitary district (Tormoham with Torquay, area 1465 acres) in 1871 was 21,657, and in 1881 it was 24,767.

There was a village at Torre even before the foundation of the abbey, and in the neighbourhood of Torre are remains of Roman occupation. The manor was granted by William the Conqueror to Richard de Bruvere or de Brewere, and was subsequently known as Tor Brewer. After the defeat of the Spanish Armada, Don Pedro's galley was brought into Torbay; and William, prince of Orange, landed at Torbay 5th November 1688. The bay was a rendezvous for the British fleet during the war with France, and the first good houses at Torquay were built for the officers. Until half a century ago it was an insignificant fishing village.

See Blewitt's *Panorama of Torquay*, 1832, and White's *History of Torquay*, 1878.

TORQUEMADA, Juan de (1388–1468), or rather Johannes de Turrecremata, cardinal, was born at Valladolid in 1388, and at an early age joined the Dominican order, early distinguishing himself for learning and devotion. In 1415 he accompanied the general of his order to the council of Constance, whence he proceeded to Paris for study, and took his doctor's degree in 1423. After teaching for some time in Paris, he became prior of the Dominican house first in Valladolid and then in Toledo. In 1431 Pope Eugenius IV. called him to Rome and made him "magister sancti palatii." At the council of Basel he was one of the ablest and most prominent supporters of the view of the Roman curia, and he was rewarded with a cardinal's hat in 1439. He died in 1468.

His principal works are *In Gratiani Decretum Commentarii*, 4 vols., Venice, 1578; *Expositio Brevis et Utilis super Toto Psalterio*, Mainz, 1474; *Quæstiones Spirituales super Evangelia Totius Anni*, Brixen, 1498; *Summa Ecclesiastica*, Salamanca, 1550. The last-named work has the following topics:—(1) De Universa Ecclesia; (2) De Ecclesia Romana et Pontificis Primatu; (3) De Universalibus Conciliis; (4) De Schismaticis et Hæreticis.

TORQUEMADA, Tomas de, inquisitor-general for Castile and Leon, was born early in the 15th century, and died in 1498. When called to the work with which his name is so unenviably associated he was prior of the Dominican house in Segovia. See Inquisition.

TORRE ANNUNZIATA, a town of Italy, in the province of Naples, 12½ miles south-east from that city, on the Bay of Naples, at the southern base of Vesuvius. The inhabitants are mainly occupied in fishing and in a brisk coasting trade; there are also manufactures of arms, paper, and macaroni. The population in 1881 was 20,060.

TORRE DEL GRECO, a town of Italy, in the province of Naples, 7½ miles to the south-east of that city, lies at the south-west foot of Vesuvius, on the shore of the Bay of Naples. It is built chiefly of lava, and stands on the lava stream of 1631, which destroyed two-thirds of the older town. Great damage was done by the eruptions of 1737 and 1794, when immense streams of lava flowed through the town into the sea; the earthquake of 1857 and the eruption of December 8, 1861, were even more destructive. After each disaster the people have returned and repaired the ruin, the advantage derived from the rich land on the flanks of the volcano and the proximity to the sea and to Naples being more than enough to overcome apprehensions of danger. In the outskirts are many beautiful villas and gardens. The inhabitants are largely employed in fishing (tunny, oyster, sardine, and especially coral), and the neighbourhood is famed for its fruit and wine. The population in 1881 was 21,588.

TORREY, John (1796–1873), a distinguished American botanist, was a member of an old New England family which contributed several officers to the War of Independence. He was born at New York, and spent his school days there, save for the concluding year at Boston. When he was 15 or 16 years of age his father received a prison appointment at Greenwich, and there he made the acquaintance of Amos Eaton, one of the foremost pioneers of natural history studies and popular science teaching in America. He thus learned the elements of botany, as well as something of mineralogy and chemistry, so determining the studies of his life. In 1815 he commenced the study of medicine, meanwhile finding time to prepare his first catalogue of plants, and to establish a correspondence with American and foreign botanists, and in 1818 he commenced practice. Stimulated by Elliott's account of the flora of South Carolina and Georgia, Torrey commenced a systematic account of the botany of the Northern States, of which the first and only volume appeared in 1824. In the same year he obtained the chair of chemistry and geology at West Point military academy, whence he was translated three years later to the chemical professorship in the college of physicians, New York. He next described the collections of the first exploration of the Colorado Territory, so laying the foundation of all subsequent work upon the flora of the Rocky Mountains. In these years he also monographed the sedges, and did good service in substituting the natural for the Linnæan system. In 1836 he was appointed botanist to the State of New York, producing his *Flora* of the State in 1843; while from 1838–43 he carried on the publication of the earlier portions of *Flora of North America*, with the assistance of his pupil Asa Gray. Becoming more and more immersed in chemical labours, which from 1857 passed partly and soon completely into those of U.S. assayer, he notwithstanding continued to accumulate and work up masses of material for this vast undertaking, which still awaits completion at the hands of his colleague and successor, Prof. Gray. He evinced a continued interest in botanical teaching, and made over his valuable herbarium and library to Columbia College two or three years before his death. He will be remembered not only as the father of American systematic botany, and an accurate and faithful, if somewhat excessively cautious, investigator, but also as an eminent teacher, and for an excellence of personal character and simplicity of beliefs much resembling Faraday's. His memory is literally kept green by the beautiful Coniferous genus *Torreya*, and his labours commemorated and continued in the valuable memoirs of the Torrey Botanical Club.

See Gray, in *Silliman's Journal*, 1873.

TORRICELLI, Evangelista (1608–1647), physicist and mathematician, was born at Faenza, October 15, 1608.

Left fatherless at an early age, he was carefully educated under the care of his uncle, a Camaldolese monk, who in 1637 sent him to Rome to profit by the scientific teachings of Benedetto Castelli. The perusal of Galileo's *Dialoghi delle Nuove Scienze* (1638) inspired his fertile mind with many fresh developments of the new mechanical principles there set forth, which he embodied in a treatise *De Motu* (printed amongst his *Opera Geometrica*, 1644). Its communication by Castelli to Galileo in 1641 led to the adoption as a disciple by the Florentine sage of one who seemed not unworthy to become his successor. Torricelli accordingly, repairing to Florence, October 10, 1641, resided with Galileo, and acted as his amanuensis during the three remaining months of his life. On its close his contemplated return to Rome was anticipated by his nomination as grand-ducal mathematician and professor of mathematics in the Florentine academy. The discovery which has perpetuated his fame was made in 1643. Galileo had failed to perceive why water refuses to rise above 33 feet in a closed tube. It occurred to Torricelli to try the experiment in a more compendious form. The anticipated result ensued that the suspended column of mercury was shorter than that of water in the proportion of its greater specific gravity. He immediately concluded both to be sustained by atmospheric pressure, and constructed the "siphon-barometer" expressly for the purpose of measuring its fluctuations. By this momentous discovery the obscure notion of a *fuga vacui* was banished from physical science, and its progress most notably quickened. The mercurial barometer was long known as the "Torricellian tube," and the vacuum it includes is still designated the "Torricellian vacuum."

The publication amongst Torricelli's *Opera Geometrica* (Florence, 1644) of a tract on the properties of the cycloid involved him in a controversy with Roberval, who accused him of plagiarizing his earlier solution of the problem of its quadrature. There seems, however, no room for doubt that Torricelli's was arrived at independently. The matter was still in debate when he was seized with fever and pleurisy, and died at Florence, after twenty days' illness, October 25, 1647, at the age of 39. He was buried in San Lorenzo, and a commemorative statue of him erected at Faenza in 1864. He was of a singularly amiable disposition, and possessed qualities the most felicitous for the investigation of nature. Among the new truths detected by him was the valuable mechanical principle that if any number of bodies be so connected that, by their motion, their centre of gravity can neither ascend nor descend, then those bodies are in equilibrium. He also discovered the remarkable fact that the parabolas described (in a vacuum) by indefinitely numerous projectiles discharged from the same point with equal velocities, but in all directions, are situated within a paraboloid which is a tangent to all of them. His theorem that a fluid issues from a small orifice with the same velocity (friction and atmospheric resistance apart) which it would have acquired in falling through the depth from its surface is of fundamental importance in hydraulics. He greatly improved both the telescope and microscope, and invented the simple microscope composed of a globule of melted glass. Several large object lenses, engraven with his name, are preserved at Florence. He used and developed Cavalieri's method of indivisibles.

A selection from Torricelli's manuscripts was published by Tommaso Bonaventura in 1715, with the title *Lezioni Accademiche* (Florence). They include an address of acknowledgment on his admission to the Accademia della Crusca. His essay on the inundations of the Val di Chiana was printed in *Raccolta d'Autori che trattano del Moto dell' Acqua* (vol. iv. p. 115, Florence, 1768) and amongst *Opuscoli Idraulici* (vol. iii. p. 347, Bologna, 1822). For his life, see Fabroni, *Vitæ Italorum*, vol. i. p. 345; Ghinassi, *Lettere fin qui Inedite di Evangelista Torricelli* (Faenza, 1864); Tiraboschi, *Storia della Lett. It.*, vol. viii p. 302 (ed. 1824); Montucla, *Hist. des Math.*, vol. ii.; Marie, *Hist. des Sciences*, vol. iv. p. 133.

TORRIGIANO, Pietro (*c.* 1470-1522), a Florentine sculptor, was, according to Vasari, one of the group of talented youths who studied art under the patronage of Lorenzo the Magnificent in Florence. Ben. Cellini, reporting a conversation with Torrigiano, relates that he and Michelangelo, while both young, were copying the frescos in the Carmine chapel, when some slighting remark made by Michelangelo so enraged the violent temper of Torrigiano that he struck him on the nose, and thus caused that disfigurement which is so conspicuous in all the portraits of Michelangelo. Soon after this Torrigiano visited Rome, and helped Pinturicchio in modelling the elaborate stucco decorations in the Appartamenti Borgia for Alexander VI. After some time spent as a hired soldier in the service of different states, Torrigiano was invited to England to execute the magnificent tomb for Henry VII. and his queen which still exists in the lady chapel of Westminster Abbey. This appears to have been begun before the death of Henry VII. in 1509, but was not finished till 1517. It consists of two colossal recumbent effigies in gilt bronze on an altar-tomb of black marble, decorated with very graceful medallions of the patron saints of Henry and his wife, and other enrichments in bronze. The two effigies are well modelled, and have life-like but not too realistic portraits. After this Torrigiano received the commission for the altar, retable, and baldacchino which stood at the west, outside the screen of Henry VII.'s tomb. The altar had marble pilasters at the angles, two of which still exist, and below the *mensa* was a life-sized figure of the dead Christ in painted terra-cotta. The retable consisted of a large relief of the Resurrection. The baldacchino was of marble, with enrichments of gilt bronze; part of its frieze still exists, as do also a large number of fragments of the terra-cotta angels which surmounted the baldacchino and parts of the large figure of Christ. The whole of this work was destroyed by the Puritans in the 17th century.[1] Henry VIII. also commissioned Torrigiano to make him a magnificent tomb, somewhat similar to that of Henry VII., but one-fourth larger, to be placed in a chapel at WINDSOR (*q.v.*); it was, however, never completed, and its rich bronze was melted by the Commonwealth, together with that of Wolsey's tomb. The indentures for these various works still exist, and are printed by Neale, *Westminster Abbey*, London, 1818, vol. i. p. 54-59. These interesting documents are written in English, and in them the Florentine is called "Peter Torrysany." For Henry VII.'s tomb he contracted to receive £1500, for the altar and its fittings £1000, and £2000 for Henry VIII.'s tomb. Other works attributed from internal evidence to Torrigiano are the tomb of Margaret of Richmond, mother of Henry VII., in the south aisle of his chapel, and a terra-cotta effigy in the chapel of the Rolls.

While these royal works were going on, Torrigiano visited Florence in order to get skilled assistants. He tried to induce Ben. Cellini to come to England to help him, but Cellini refused, partly from his dislike to the brutal and swaggering manners of Torrigiano, and also because he did not wish to live among "such beasts as the English." The latter part of Torrigiano's life was spent in Spain, especially at Seville, where some terra-cotta sculpture by him still exists. His violent temper got him into difficulties with the authorities, and he ended his life in 1522 in the prisons of the Inquisition.

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[1] An old drawing still exists showing this elaborate work; it is engraved in the *Hierurgia Anglicana*, London, 1848, p. 267. Many hundreds of fragments of this terra-cotta sculpture were found a few years ago hidden under the floor of the triforium in the abbey; they are unfortunately too much broken and imperfect to be fitted together.

TORSHOK, a district town of Russia, in the government of Tver, on the river Tvertsa, 38 miles by rail to the south-west of the Ostashkovo station of the St Petersburg and Moscow railway. It dates from the 11th century, and the very name ("market-place") shows that this dependency of Novgorod was a commercial centre. It was strongly fortified with a stone wall, which, however, only partially protected it from the attacks of Mongols, Lithuanians, and Poles. Torshok is now celebrated in Russia for its embroidered leather-work and manufacture of travelling bags, and for its trade in corn and flour. The population in 1884 was 12,900.

TORT, as a word of art in the law of England and the United States, is the name of civil wrongs (not being merely breaches of contract) for which there is a remedy by action in courts of common law jurisdiction. It may be said to correspond approximately to the term "delict" in Roman law and the systems derived from it. But this is only a rough approximation. For in English usage tort includes, not only those matters which in Roman law are classed under obligations *quasi ex delicto*, but various others which Roman or modern Continental lawyers would refer to the law of ownership or real rights, and not to any such head as "delict." The truth is that the actual development of tort as a legal genus has been purely historical and to no small extent accidental. Nothing can be learnt, of course, from the word itself. It is merely the French word for "wrong," specialized into a technical meaning by a process which was completed only in the latter years of the 17th century and the earlier of the 18th.

The early common law had no theory of obligations in the Roman sense, and hardly any theory of contract. Its remedies were directed either to the restitution of something which the defendant unjustly detained from the plaintiff—were it land, goods, or money—or to the repression of violent wrongdoing. Only the former class of remedies was purely civil; the latter included a penal element of which formal traces remained long after the substance had vanished. A man who trespassed on his neighbour with force and arms offended the king as well as his neighbour, and was liable not only to pay damages to his neighbour but to make a fine to the king. Gradually the category of "force and arms" was held to include all manner of direct injuries to person, land, or goods, though the force might consist in nothing more than the bare setting foot without lawful cause on the soil possessed by one's neighbour. But this was still a long way from making room for the modern growth of the law of torts. The decisive opening was given by the Statute of Westminster, which enabled actions to be framed "on the case"—*in consimili casu*,—that is, allowed legal remedies to be extended by analogy to the forms of action already recognized. Now those forms and their incidents were archaic and inelastic: the procedure was cumbrous, and plaintiffs were liable in many ways to irrational and irreparable discomfiture. The more modern action on the case was free from these drawbacks. Hence it was the aim of ingenious pleaders to extend the action on the case as much as possible; and so successful was this movement that in the 16th century a special form of "trespass on the case" became, under the name of *assumpsit*, the common and normal method of enforcing contracts not made by deed, and remained so till the middle of the present century. It still holds its place in those American States where the old forms of action have not been abolished. Note that "assumpsit" had become a substantive title of the law, and was consciously referred to its proper genus of contract, before the genus or order of torts was formed. Meanwhile other actions on the case, framed mostly on the analogy of trespass, but partly on that of other generically similar remedies of the old law, were applied to the redress of miscellaneous injuries to person or property which for one and another reason could not be touched, or could not be conveniently dealt with, by the old action of trespass itself. Some of these actions on the case acquired fixed forms of their own and became distinct species; others did not; there remained (and there still remains in theory) an undefined region of possible new actions applying the principles of legal right and duty to new exigencies of fact.

The extension of forms of remedy grounded on trespass caused those forms which were grounded on restitution to fall into the background, with the curious result that in the modern common law nothing is left answering to the *vindicatio* of the Roman law. We have an elaborate law of property, but when it comes to the practical protection of our rights we find that we can recover our property only by complaining of a wrong done to our possession or right to possession. The law puts the actual possessor in the first line, and allows an owner definitely out of possession to sue only for "injury to the reversion," though an owner who can resume possession at will is indeed more favourably treated. Its remedies are made efficient, but at the cost of straining the theory at various points. Hence many difficulties of detail and much obscurity of principle. The distinction between *dominium* and *obligatio* exists, of course, in English law, but it is peculiarly hard for an English lawyer, with the usual unsystematic training, to grasp it with certainty or trace it with accuracy

There is also a region of considerable obscurity about the points of contact between contract and tort. The questions thus raised are too technical for discussion here. Since pleadings have ceased to be formal they are much less likely to arise; on the other hand, they are more likely, in the exceptional cases where they may still arise, to be unexpected and baffling.

For the practical purposes of modern law we may divide torts into three groups,—wrongs of a personal character, wrongs affecting property, and wrongs affecting person and property, either or both. Under the first group come the wrongs of physical violence and restraint, namely, assault and false imprisonment; then the wrong done to men's good name by libel and slander, in which kind there are sundry curious and not wholly rational distinctions; and we must here rather than elsewhere count deceit, and a somewhat ill-defined class of wrongs of a like nature, of which the generic mark is the necessary presence of a fraudulent intention, or at least reckless disregard of good faith. In one case, that of malicious prosecution, evil motive must be shown; in fact, the much-tormented word "malice" has very nearly its natural and ordinary meaning. So-called slander of title belongs to this class, being in truth a special form of deceit. Wilful interference with the exercise of public or private rights may be an actionable wrong, though the competitive exercise of like rights is none; and it is held, though not without doubt, that procuring a person to break his contract for one's own advantage (for example, a singer engaged by a rival opera manager, or a specially skilled workman in a rival factory) is on this principle a wrong to the other contracting party.

With regard to property the broad rule of the common law is that a man meddles with whatever belongs to others at his peril. This has been established and worked out only through a series of intricate formal distinctions. But the result is that, special exceptions excepted, even the most innocent assumption of dominion without a real title makes one liable to the true owner.

Wrongs of the mixed kind affecting both person and property arise from the use of one's own property, or the doing of acts lawful in themselves, in a manner inconsistent with the safety and convenience of others. The accustomed heads of such wrongs are nuisance and negligence. Generally some failure in due diligence is involved; but in some cases the law has, on grounds of general policy, imposed an absolute or all but absolute duty of avoiding harmful results. One must do certain things at one's peril, if at all, though the doing of them is not in itself unlawful; others are done not at one's peril, and yet under a wider responsibility than the common run of lawful acts. It is not wrong to make an artificial reservoir of water on one's own land; but the landowner who does so must answer for all damage, though no failure in due diligence be shown, if the water escapes by any cause which reasonable human care could possibly have provided against. Again, the occupier of a place of business must keep it in safe repair, for the benefit of customers and others lawfully coming there; and, if harm is done through the want of repair, it is no excuse for him to say that he had engaged an apparently competent person to keep things in order. These are modern principles in the law, and seem to have hardly yet reached their full development. The doctrine of negligence is also mostly modern. Questions of much interest and difficulty are raised by "contributory negligence," *i.e.*, when it is alleged by way of defence that the party complaining suffered wholly or mainly by his own want of care. The true principle appears to be that, if under the circumstances the harm suffered by the plaintiff was the natural and probable consequence of the defendant's want of care, the defendant is liable,—and this whether the plaintiff, or some third person, has or has not in any degree contributed to the final result by want of care on his own part, or even by a voluntary act, provided that the act be such as might have been foreseen and expected. But if the plaintiff has done something which, though induced by the defendant's default, was not a natural and probable consequence of it, or if the harm suffered is due to some act of a third person which could not have been reasonably foreseen or expected, then the defendant will not be liable.

A great number of special duties have been imposed on different classes of persons—public officers, undertakers of public occupations, and so forth—by modern Acts of Parliament, and are enforceable by penalties. In some cases the breach of such a duty confers a separate right of action upon a person who thereby suffers damage, in others not, according to what appears to be the intention of the enactment. No general rule can be laid down.

In practice, a large proportion of actionable injuries, especially injuries by negligence, are due to the acts or defaults of servants or workmen, from whom no substantial redress could be obtained or expected. It is held in the common law, and appears to be held in all modern systems, that a master is liable for the acts and defaults of the servants employed by him, provided those acts or defaults occur in the course of the servant's employment, that is, while the servant is about the master's business, and acting with a view to the master's interest, and not for some different private purpose of his own. But a man is not generally liable for the conduct of an "independent contractor"—a person who undertakes to do or get done certain work, but not to be under the employer's control as to the manner of doing it. One may be so liable, however, in virtue of special duties attached to particular situations by positive rules of law. When a servant is injured by the act or default of another servant working under the same employer, the general rule of liability has been largely modified in the employer's favour, on grounds which have neither been consistently expounded nor generally received as satisfactory. The Employers' Liability Act of 1880 has remedied the most obvious hardships consequent on the decisions, but only by way of particular exceptions, so that the law as a whole, if more just than it was, is much more intricate, and does not appear to rest on any intelligible principle. The Scottish courts were in a way to develop a more rational doctrine, but the House of Lords, instead of adopting it, forced the law of Scotland into conformity with judgments which were still of only recent authority in England. The subject, however, has given trouble everywhere, and legislative experiments have been tried in many Continental countries. See *Parliamentary Papers, Commercial*, No. 21, 1886.

Literature.—There are several modern English and American text-books on the law of torts:—C. G. Addison, *Wrongs and their Remedies, being a Treatise on the Law of Torts*, 6th ed., by Horace Smith, London, 1887, la. 8vo; M. M. Bigelow, *Leading Cases on the Law of Torts*, Boston, Mass., 1875, la. 8vo; Id., *Elements of the Law of Torts*, 3d ed., Boston, Mass. 1886, sm. 8vo, C. Collett, *Manual of the Law of Torts and of the Measure of Damages*, 6th ed., Madras, 1886, 8vo; T. M. Cooley, *A Treatise on the Law of Torts*, Chicago, 1880, 8vo; S. Hastings, *A Treatise on Torts*, London, 1885, la. 8vo; F. Hilliard, *The Law of Torts or Private Wrongs*, 4th ed., Boston, Mass., 1874, la. 8vo, 2 vols; F. T. Piggott, *Principles of the Law of Torts*, London, 1885, 8vo; F. Pollock, *The Law of Torts*, London, 1887, 8vo; A. Underhill, *A Summary of the Law of Torts*, 3d ed., London, 1881, 8vo. There are also well-known works of a wider scope which touch on many parts of the subject, such as that of Mayne on Damages; and monographs on special parts, such as those on Negligence by Campbell, Horace Smith, Shearman and Redfield, and Wharton, and those on Libel and Slander by Starkie (recent ed, by Folkard) and Blake Odgers. The Government of India has taken steps to codify the law of civil wrongs (Whitley Stokes, *The Anglo-Indian Codes*). The general institutional books (Blackstone and Kent, and the later adaptations of Blackstone in England) are of little use, as in almost every branch the law has been largely developed and modified by the decisions of the last fifty years. (F. PO.)

TORTOISE. Of the three names generally used for this order of reptiles, viz., Tortoise, Turtle, and Terrapin, the first is derived from the old French word *tortis*, *i.e.*, twisted, and was probably applied first to the common European species on account of its curiously bent fore-legs. Turtle is believed to be a corruption of the same word, but the origin of the name terrapin is unknown: since the time of the navigators of the 16th century it has been in general use for freshwater species of the tropics, and especially for those of the New World. The name tortoise is now generally applied to the terrestrial members of this group of animals, and that of turtle to those which live in the sea or pass a great part of their existence in fresh water.

Tortoises and turtles constitute one of the orders of Reptiles, the *Chelonia*. They are characterized by having the trunk of the body incased in a more or less ossified carapace, which consists of a dorsal more or less convex portion, and of a flat ventral one, the so-called plastron. These portions are generally more or less firmly united on the side, but leave a wide opening in front through which the head and neck and the fore-limbs protrude, and one behind for the tail and hind-limbs. The dorsal carapace is (with the exception of *Sphargis*) formed by the dorsal vertebræ, by the ribs which are so much expanded as to form sutures with each other, and by a number of lateral dermal ossifications (marginals). The plastron consists of from eight to eleven more or less dilated dermal bones, the sternal elements of higher *Vertebrata* being absent. This osseous case or shell receives in its interior the organs of the chest and abdomen, the humeral and pelvic bones, and the muscles for the humerus and femur. In many species, especially those of the family *Testudinidæ*, or tortoises proper, the neck and head and the limbs can be withdrawn within the shell, the cervical and the proximal caudal vertebræ retaining their mobility. In the majority of Chelonians the osseous shell is covered with a hard epidermoid coat, which is divided into large symmetrical plates (commonly called "tortoise-shell" in those species from which the article of commerce is obtained), which can be detached from the underlying bones. These epidermoid plates do not correspond in arrangement or extent with the bones of the carapace; they vary considerably in form, and are therefore generally noticed in the descriptions of species. Their arrangement and terminology may be learned from the accompanying illustrations (figs. 1, 2).

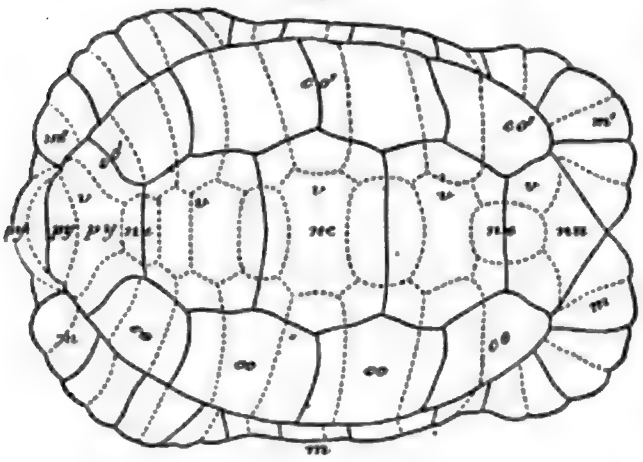
The integuments of the head, neck, tail, and limbs are either soft and smooth or tubercular or scaly, the tubercles and scales having frequently an osseous nucleus.

Other parts also of the skeleton show remarkable peculiarities, so that the sometimes very fragmentary remains of Chelonians can almost always be recognized as such. All the bones of the skull are suturally united, with the exception of the mandible and hyoid bone; the dentary portion of the mandible consists of one bone only. The pectoral arch is composed of the scapula, with which the precoracoid is united, and the coracoid. Clavicles (epiplastra) are represented by the anterior elements of the plastron. Two pairs of limbs are invariably present.

All Chelonians possess a tail, which is generally short, but sometimes elongate, and always provided with strong muscles at the base. No Chelonian possesses teeth; but their jaws are provided with horny sheaths, with hard and sharp edges, forming a beak like that of a parrot.

The number of Chelonians known at present may be estimated at about 220, the freshwater species being far the most numerous, and abundant in well-watered districts of the tropical and subtropical zones. Their number and variety decrease beyond the tropics, and in the north they disappear entirely about the 50th parallel in the western and about the 56th in the eastern hemisphere, whilst in the southern hemisphere the terrestrial forms seem to advance to 36° S. lat. only. The marine turtles, which are spread over the whole of the equatorial and subtropical seas, sometimes stray beyond those limits. As in other orders of Reptiles, the most specialized and the largest forms are restricted to the tropics (with the exception of *Macroclemmys*); but, unlike lizards or snakes, Chelonians are unable to exist in sterile districts or at great altitudes. Chelonians are strictly animals of plains, or at least of low country.

Fig. 1.



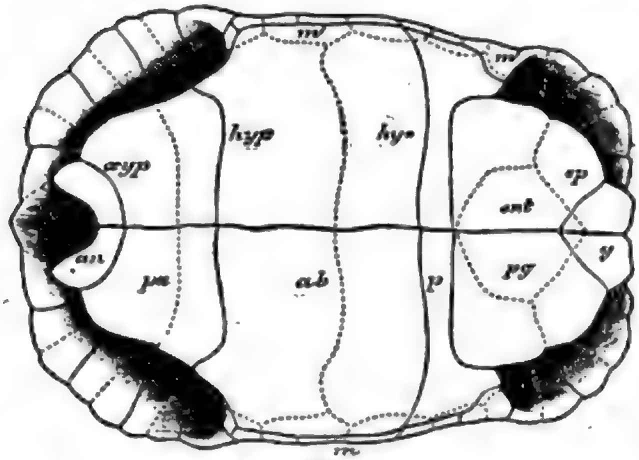


Fig. 2.

Figs. 1, 2.—Shell of *Testudo pardalis*, to show the divisions of the integument, which are marked by entire lines, and of the osseous carapace, these being marked by dotted lines. Fig 1, Upper or dorsal aspect. Fig. 2, Lower or ventral aspect.
Dermal Scutes:—*co*, costals; *v*, vertebrals; *m*, marginals; *g*, gulars; *pg*, postgulars; *p*, pectorals; *ab*, abdominals; *pa*, preanals; *an*, anals.
Bones of the Carapace:—*co'*, costals, *ne*, neurals; *nu*, nuchal; *py*, pygal; *m'*, marginals; *ent*, entoplastron, *ep*, epiplastron; *hyo*, hyoplastron; *hyp*, hypoplastron; *xyp*, xyphiplastron.

Chelonians show a great divergence in their mode of life,—some living constantly on land, others having partly terrestrial partly aquatic habits, others again rarely leaving the water or the sea. The first-mentioned, the land tortoises proper, have short club-shaped feet with blunt claws, and a very convex, heavy, completely ossified shell. In the freshwater forms the joints of the limb bones are much more mobile, the digits distinct, armed with sharp claws, and united by a membrane or web; their shell is less convex, and is flattened, and more or less extensive areas may remain cartilaginous to lessen its specific gravity. As a rule, the degree of development of the interdigital web and of convexity of the shell indicates the prevalence of aquatic or terrestrial habits of a species of terrapin. Finally, the marine turtles have paddle-shaped limbs resembling those of Cetaceans.

Land tortoises are sufficiently protected by their carapace, and therefore have no need of any special modification of structure by means of which their appearance would be assimilated to the surroundings, and thus give them additional security from their enemies. These, however, are but few in number: the large cats of South America are said to be able to tear them out of the shell with their claws; and the ancient tale of Æschylus having been killed by a tortoise carried aloft by an eagle and dropped on the head of the unfortunate poet seems to be founded on the fact that tortoises are a favourite prey of the Lämmergeyer (*Gypaetus*), which has the habit of dropping them from a height on rocks in order to break the shell. On the other hand, among the carnivorous terrapins and freshwater turtles instances of protective resemblance are not scarce, and may even attain to a high degree of specialization, as in *Chelys*; their shells offer them less protection, and their enemies (crocodiles and alligators) are more numerous; they also require this special provision to enable them to approach or seize their prey with greater ease. The colours of land tortoises are generally plain or in simple patterns, whilst those of many terrapins are singularly varied, bright, and beautiful.

Chelonians are diurnal animals; only a few are active during the night, habitually or on special occasions, as, for instance, during oviposition. Land tortoises are slow in all their movements, but all kinds living in water can execute extremely rapid motions, either to seize their prey or to escape from danger. All Chelonians are stationary, residing throughout the year in the same locality, with the exception of the marine turtles, which periodically migrate to their breeding-stations. Species inhabiting temperate regions hibernate.

Chelonians possess great tenacity of life, surviving injuries to which other Reptiles would succumb in a short time. The heart of a decapitated tortoise continues to beat for many hours after every drop of blood has been drained from the body, and the muscles of the trunk and head show signs of reflex action twenty-four hours after the severance of the spinal cord. The longevity of tortoises is likewise a well-known fact, to which reference will again be made.

Land tortoises, a few terrapins, and some of the marine turtles are herbivorous, the others carnivorous, their prey consisting chiefly of fish, frogs, and other small aquatic animals.

All Chelonians are oviparous, and the eggs are generally covered with a hard shell.

In the system[1] proposed by Duméril and Bibron, and afterwards modified by Gray and Strauch, the Chelonians are arranged according to their mode of life, and divided into terrestrial, paludine, fluviatile, and marine forms. However natural such an arrangement may appear at first, a more careful examination proves it to be (as all arrangements based solely upon the mode of life) at variance with the structural affinities, whether the recent forms alone be considered or the fossil as well. The division of the bulk of the order into *Cryptodira* and *Pleurodira*, as suggested by Agassiz, Cope, and Rütimeyer, was a decided progress, as is also the elimination of the suborders *Atheca* and *Trionychoidea* recently proposed by Cope and Baur.

The order of Chelonians may then be divided into the following suborders and families:[2]—

SUBORDER I. ATHECÆ.

Vertebræ and ribs free, separated from a bony exoskeleton.

Family 1. SPHARGIDÆ.

Limbs paddle-shaped, clawless; phalanges without condyles. Plastron reduced to an annular series of eight small bones. Exoskeleton consisting of numerous small bony plates arranged like mosaic. Pelagic.

Genus: *Dermatochelys* (*Sphargis*).
Fossil genera: *Psephophorus* (Pliocene), *Protosphargis* (Cretaceous), *Protostega* (Cretaceous), *Psephoderma?* (Triassic).

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[1] The more important works on this order of Reptiles have been enumerated in the article REPTILES, vol. xx. p. 440.

[2] Only the more important and best known of the extinct genera are admitted into this synopsis.

Suborder II. TESTUDINATA.

Dorsal vertebræ and ribs immovably united and expanded into bony plates forming a carapace, which is bordered by a complete series of marginal bones. Epiplastra (clavicles) in contact with hyoplastra; entoplastron (interclavicle), if present, oval, rhomboidal, or T-shaped. Sacral and caudal ribs articulating with the centrum and the neural arch. Digits with not more than three phalanges.

Series A. CRYPTODIRA.

Neck retractile by a sigmoid curve in a vertical plane. Pelvis not anchylosed to the carapace and plastron. Rarely one or two epidermic scutes (intergular) in addition to the normal six pairs.

Group A. Digitata.

Digits short or moderately elongate; phalanges with condyles; claws four or five. Neck completely retractile.

Family 1. Testudinidæ.

Plastral bones nine. Nuchal bone without costiform processes. Carapace with epidermic scutes. Caudal vertebræ procœlous. Tropical and temperate zones, with the exception of Australia.

Recent genera: *Dermatemys*, *Batagur*, *Clemmys*, *Pangshura*, *Geoemyda*, *Cyclemys*, *Emys*, *Cistudo*, *Manouria*, *Testudo*, *Homopus*, *Cinixys*, *Pyxis*.

Fossil genera: *Eurysternum* (Jurassic), *Chitracephalus* (Cretaceous), *Adocus* (Cretaceous), *Palæochelys* (Miocene), *Ptychogaster* (Miocene), *Colossochelys* (Pliocene).

Family 2. Platysternidæ.

Plastral bones nine. Nuchal bone without costiform processes. Carapace with epidermic scutes. Caudal vertebræ mostly opisthocœlous. Indian region.

Genus: *Platysternum*.

Family 3. Baenidæ.

Plastral bones eleven, mesoplastra being present. Nuchal bone without costiform processes. Carapace with epidermic scutes. Caudal vertebræ opisthocœlous.

Fossil genera: *Platychelys* (Jurassic); *Baena* (Eocene)

Family 4. Chelydridæ.

Plastral bones nine. Nuchal bone with long costiform processes, extending below the marginals. Carapace with epidermic scutes. Caudal vertebræ mostly opisthocœlous. Northern and tropical American regions.

Recent genera: *Chelydra*, *Macroclemmys*.

Fossil genus: *Tretosternum* (Cretaceous).

Family 5. Staurotypidæ (Boulenger).

Plastral bones nine. Nuchal bone with short costiform processes, extending below the marginals. Carapace with epidermic scutes. Caudal vertebræ procœlous. Central-American district.

Genera: *Staurotypus*, *Claudius*.

Family 6. Cinosternidæ.

Plastral bones eight, the entoplastron being absent. Nuchal bone with short costiform processes, extending below the marginals. Carapace with epidermic scutes. Caudal vertebræ procœlous. Northern and tropical American regions.

Genera: *Aromochelys*, *Cinosternum*.

Family 7. Pseudotrionychidæ (Boulenger).

Shell without epidermic scutes.

Fossil genera: *Pseudotrionyx* and *Anostira* (Eocene).

Group B. Pinnata.

Limbs paddle-shaped; phalanges without condyles; claws one or two. Neck imperfectly retractile; cervical vertebræ short, mostly articulated by amphiarthrosis.

Family 8. Chelonidæ.

Plastral bones nine. Nuchal without costiform processes. Carapace with epidermic scutes. Hyo- and hypo-plastra not meeting mesially. Pelagic.

Recent genera: *Chelone*, *Caouana*, *Caretta*.

Fossil genus: *Peppigerus* (Miocene and Eocene)

Series B. PLEURODIRA.

Neck not retractile, bending laterally. Pelvis anchylosed to the carapace and plastron. When epidermic scutes are present, one or two intergulars in addition to the normal plastral scutes.

Family 1. Chelydidæ.

Plastral bones nine. Carapace with epidermic scutes. Limbs with four or five claws. Australian and tropical American regions.

Recent genera: *Platemys*, *Chelymys*, *Elseya*, *Chelodina*, *Hydraspis*, *Hydromedusa*, *Chelys*.

Fossil genera: *Plesiochelys* (Jurassic), *Craspedochelys* (Jurassic), *Idiochelys* (Jurassic), *Notomorpha* (Eocene).

Family 2. Pelomedusidæ.

Plastral bones eleven, mesoplastra being present. Carapace with epidermic scutes. Limbs with four or five claws. African and tropical American regions.

Recent genera: *Pelomedusa*, *Sternothærus*, *Dumerilia*, *Podocnemis*, *Peltocephalus*.

Fossil genera: *Pleurosternum* (Cretaceous, Eocene), *Bothremys* (Cretaceous), *Taphrosphys* (Cretaceous).

Family 3. Carettochelydidæ.

Plastral bones nine. No epidermic scutes on the shell. Limbs paddle-shaped, with only two claws. New Guinea.

Genus: *Carettochelys*.

Family 4. Miolaniidæ (Boulenger).

Caudal vertebræ opisthocœlous; tail long and encased in a bony sheath. Australia.

Fossil genus: *Miolania* (Pleistocene).

Suborder III. TRIONYCHOIDEA.

Dorsal vertebræ and ribs immovably united, forming a carapace; no pygal plate; marginal plates absent or forming an incomplete series. Plastron formed of nine bones, epiplastra separated from the hyoplastra by the entoplastron, which is Λ-shaped, without longitudinal process. Sacral and caudal ribs attached to transverse processes of the neural arch. Fourth digit with four or five phalanges.

Family 1. Trionychidæ.

No epidermic scutes. Limbs with three claws. Indian, African, and American regions.

Genera: *Chitra*, *Heptathyra*, *Trionyx*, *Cyclanosteus*, *Emyda*.

We add a few notes on such of the genera enumerated in this synopsis as have some special interest attached to them, either from a scientific or an economic point of view.

The family *Sphargidæ* is represented in the recent fauna by a single species, *Dermatochelys* or *Sphargis coriacea*, the Leathery Turtle, the range of which extends over the tropical and subtropical seas of both hemispheres, and which occasionally strays into the northern parts of the Atlantic, its occurrence on the British coast having been recorded three or four times within the last century. It differs from all other Chelonians by its carapace being formed by ossifications of the skin only. Neither the vertebræ nor the ribs enter into its formation; the latter remain free, and are not particularly dilated. During the life of the animal the carapace is flexible like thick leather, the bony deposits being arranged like mosaic, with several longitudinal ridges of larger osseous tubercles. The limbs are, as in other marine turtles, paddle- or fin-shaped, the anterior much longer than the posterior, and all destitute of claws. This turtle is probably the largest living Chelonian, exceeding 6 feet in length. The names *Testudo lyra*, *Sphargis mercurialis*, &c., have reference to the myth that the shell of this or some other turtle was used by Mercury in his construction of the lyre.

The family *Testudinidæ* is composed of an unbroken series, from thoroughly aquatic freshwater tortoises like *Dermatemys* and *Batagur* to the tortoises which live exclusively on land and are perfectly helpless in water. In the Central-American genus *Dermatemys* the digits are very broadly webbed, the epidermic scutes are thin, and the nose is much produced,—characters which, together with the strong depression of the shell, give these terrapins somewhat the aspect of the freshwater turtles or *Trionychidæ*. They feed exclusively upon leaves, grass, and especially fruit, and are eaten by the natives. Of the freshwater tortoises of the Old World the most thoroughly aquatic are the Batagurs, which inhabit the East Indies, and attain to a length of 2 feet. Like their American representative, *Dermatemys*, they are essentially herbivorous, and their flesh is eaten. The genus *Clemmys* is extremely abundant in species, most of which are of small size, and elegantly ornamented with symmetrical markings of bright colour. The majority of the species occur in North America and Mexico, and are of amphibious habits. Only one species, *C. leprosa*, inhabits southern Europe. A second European species belongs to the genus *Emys*, *E. orbicularis*, which, towards the end of the Quaternary period appears to have been distributed over a great part of northern Europe, remains having been found in peat in England, Belgium, Denmark, and Sweden. Its habitat is now restricted to southern Europe, south-western Asia, and north-western Africa; but singularly it has survived in a few isolated northern stations, for instance, in the neighbourhood of Berlin and Konigsberg, although it is there on the verge of extinction. The mobility of the lobes of the plastron, which distinguishes *Emys* from *Clemmys*, is carried a degree further in the North-American genus *Cistudo*, the Box Tortoise; this terrapin possesses a hinge in the plastron, rendering its anterior and posterior portions movable, and converting them into lids by which the openings of the shell can be completely closed when the head and limbs are retracted. A similar protective apparatus exists in the tortoises of the genus *Cinosternum*. In the African terrestrial genus *Cinyxis* it is the posterior portion of the carapace that is movable, and separated from the anterior by a hinge. True land tortoises, *Testudo*, occur in Africa, southern Europe, southern Asia, South America, and the southern parts of North America. Those best known in Europe are *Testudo græca* and the Moorish Tortoise, *Testudo mauritanica*, large numbers of which are imported into the United Kingdom, chiefly from Morocco. But the most interesting are the gigantic tortoises which formerly inhabited in extreme abundance the Mascarene and Galapagos Islands, and are now on the verge of extinction, or have actually

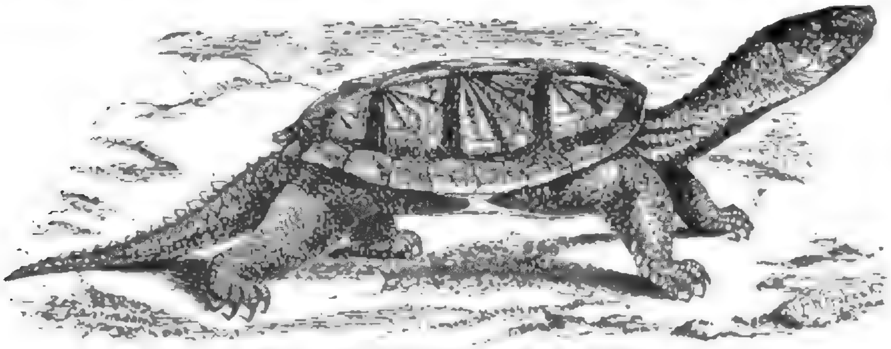

Fig. 3.—Alligator Terrapin (*Chelydra serpentina*).

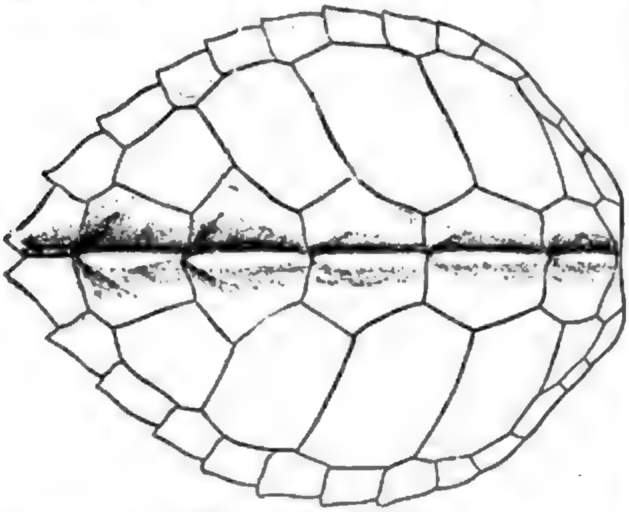

Fig. 4 Loggerhead (*Caouana caretta*)

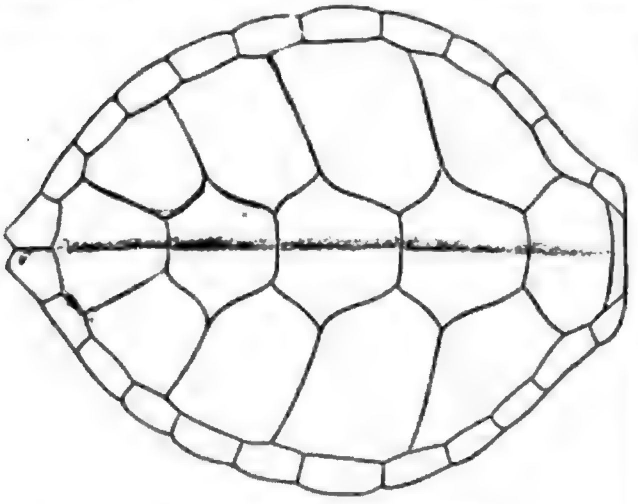

Fig. 5.—Green Turtle (*Chelone viridis*).

become extinct. At the time of their discovery those islands were uninhabited by man or any large mammal; the tortoises, therefore, enjoyed perfect security; and this, as well as their extraordinary degree of longevity, accounts for their enormous size and their large numbers. They could be captured in any quantity with the greatest ease within a few days, and proved to the ships' companies who during their long voyages had to subsist mainly on salt provisions a most welcome addition to their table. They could be carried in the hold of a ship, without food, for months, and were slaughtered as occasion required, each tortoise yielding, according to size, from 80 to 300 pounds of excellent and wholesome meat. Under these circumstances the numbers of these helpless creatures decreased so rapidly that in the beginning of this century their extermination was accomplished in the Mascarenes, and now only a few remain in a wild state in Aldabra and in some of the islands of the Galapagos group. Singularly, the majority of these islands were inhabited each by one or more peculiar forms, specifically distinct from those of the other islands. A large male specimen from Aldabra, which was imported into London some years ago, weighed 870 lb, and, although known to have been more than eighty years old, was still growing at the time of its death. There is no evidence to show that any of these tortoises were indigenous in the Seychelles; the specimens kept there in a semi-domesticated state have been either directly imported from Aldabra or are the descendants of imported individuals.

The family of *Chelydridæ* includes freshwater tortoises, which are known under the names of Snappers or Alligator Terrapins (fig. 3), on account of their ferocity and long compressed crested tail. They are now confined to North America east of the Rocky Mountains, Central America, and north-west South America, but remains of two species of *Chelydra*, closely related to their recent representative, have been found in the Oligocene and Miocene of central Europe. A second genus, closely allied to *Chelydra*, *Macroclemmys temminckii*, the shell of which attains to a length of 3 feet, and which is the largest known freshwater Chelonian, is restricted to the river-systems tributary to the Gulf of Mexico.

The family of *Cinosternidæ* contains a rather large number of small-sized species, distributed from the northern parts of the United States to the northern parts of Brazil. They are of amphibious habits. The front and hind lobes of the plastron are movable, and in certain species of *Cinosternum* the animal can completely shut itself up in its shell.

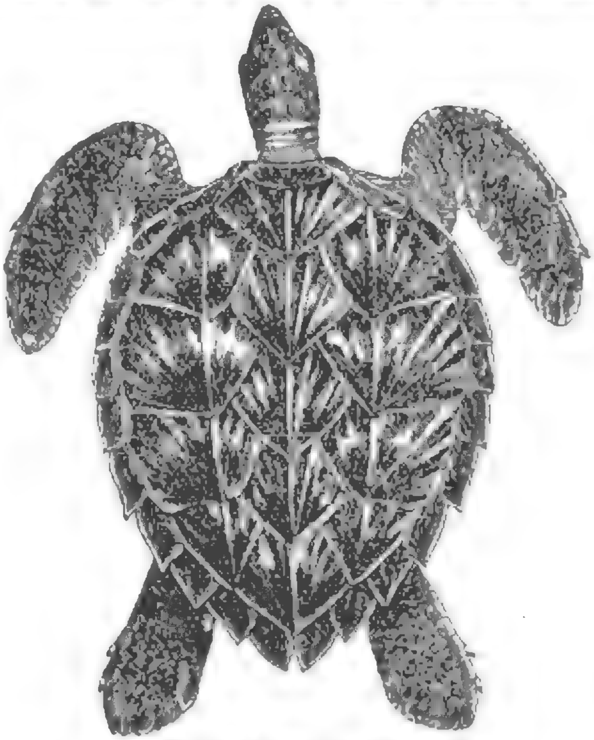

Fig. 6.—Hawksbill Turtle (*Caretta imbricata*).

The *Chelonidæ*, or marine turtles, contain but few species, which are referred to three genera,—*Caouana*, *Chelone*, and *Caretta*. Their limbs are wholly modified into paddles, by means of which they can propel themselves with extraordinary rapidity through the water, but which are entirely unfit for locomotion on land, where the progress of these animals is as awkward as that of a seal. The toes are enclosed in a common skin, out of which only one or two claws project. The carapace is broad and much depressed, so that when the turtles are surprised on shore and turned over on their back, they cannot regain their natural position. Their capture forms a regular pursuit wherever they occur in any numbers. Comparatively few are caught in the open sea, others in stake nets, but the majority are intercepted at well-known periods and localities where they go ashore to deposit their eggs. These are very numerous, from 100 to 250 being produced by one female, and buried by her in the sand; they are eagerly searched for and eaten. Some of the marine turtles are highly esteemed for the delicacy of their meat and of the gelatinous skinny parts of their neck and fins; others yield oil, and others again the tortoise-shell of commerce. Probably the largest of these marine turtles is the Loggerhead (*Caouana*), which possesses fifteen vertebral and costal shields, and occurs in the Atlantic as well as in the Indian

Ocean (fig. 4). It is carnivorous, feeding on fish, molluscs, and crustaceans, and not esteemed as food, although it is eaten by the native fishermen. A great part of the turtle-oil which finds its way into the market is obtained from the Atlantic species of this genus; also tortoiseshell of an inferior quality is obtained from it.

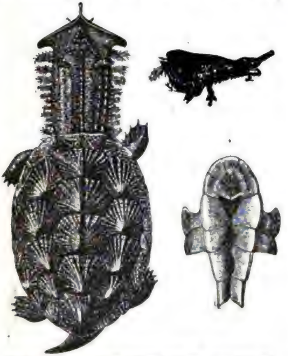

FIG. 7.—The Matamata (*Chelys fimbriata*), with side view of head, and separate view of plastron.

The Green Turtle (fig. 5), which yields the materials for the celebrated soup, belongs to the genus *Chelonia*; it is distinguished from *Caouana* by having thirteen vertebral and costal shields only, which are not imbricate. These animals are herbivorous, feeding on marine *Algæ* only; they occur in the Indo-Pacific and Atlantic; and, although several species have been distinguished, they all may possibly be referable to one only. The turtle imported into Europe comes chiefly from the West Indies. Instances are recorded of the flesh of this species having acquired poisonous qualities. The Hawksbill Turtle, *Caretta* (fig. 6), so named from its rather elongate and compressed curved upper jaw, does not reach the same size as the other turtles, and is readily recognized by the thirteen imbricate scutes of its carapace. It seems to be more abundant in the Indian than in the Atlantic Ocean, but is plentiful only in certain localities. As, however, these turtles always resort to the locality where they were born, or where they have been wont to propagate their kind, and as their capture is very profitable, they become scarcer and scarcer at places where they are known to have been abundant formerly. If the plates of tortoiseshell are detached from the animal when decomposition has set in, their colour becomes clouded and milky, and hence the cruel expedient is resorted to of suspending the turtle over fire till heat makes the shields start from the bony part of the carapace, after which the creature is permitted to escape to the water. There is no doubt that turtles thus allowed to escape to the water after such an operation may survive; but it is very improbable that the epidermal shields are ever sufficiently regenerated to be fit for use. At Celebes, whence the finest tortoiseshell is exported to China, the natives kill the turtle by blows on the head, and immerse the shell in boiling water to detach the plates; dry heat is only resorted to by the unskilful. The natives eat the flesh of this turtle, but it is unpalatable to Europeans; the eggs, however, are regarded as equal to those of the other turtles.

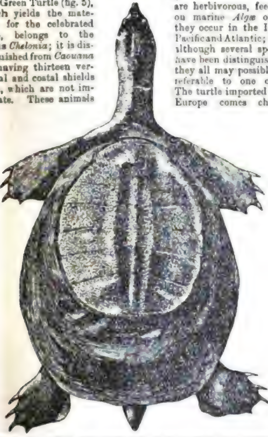

FIG. 8.—Upper View of the Turtle of the Euphrates (*Trionyx euphratica*).

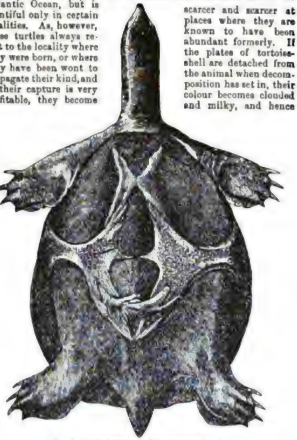

FIG. 9.—Lower View of *Trionyx euphratica*.

Of the family *Chelydidæ* the most remarkable type is the Matamata, *Chelys fimbriata*, a native of the Guianas and northern Brazil (fig. 7). In its strongly depressed and flat head, long tube-like snout, weak jaws, minute eyes, skinny tentacles, it bears a striking similarity to the Surinam toad, *Pipa americana*, which inhabits the same countries. The neck is very broad and depressed, and fringed with foliated tentacles, floating in the water like some vegetable growth, whilst the rough bossed carapace resembles a stone,—an appearance which evidently is of as great use to this creature in escaping the observation of its enemies as in alluring to it unsuspicious animals on which it feeds.

The family of *Carettochelydidæ* contains a single genus, *Carettochelys*, quite recently discovered in the Fly river, New Guinea, and exhibiting a remarkable combination of characters. Its limbs are formed very much like those of the marine turtles, whilst the shell lacks epidermic scutes, as in the *Trionychidæ*.

In the freshwater turtles, or *Trionychidæ* (figs. 8 and 9), the carapace is reduced to a flat disk, which is covered with soft skin. The neck and limbs can be lodged under the broad skinny borders of the carapace; also the plastron is very imperfectly ossified, and sometimes dilated into large flexible lobes which may cover the limbs. The latter are much flattened and broadly webbed, and only the three inner toes armed with claws. The jaws are concealed under broad, fleshy lips, the nose projecting like a short proboscis. These turtles are carnivorous, and very ferocious; when they want to bite or seize their prey they project their neck and head with lightning rapidity. They are well known on the upper Nile, Euphrates, Ganges, Yangtse-kiang, and Mississippi, and, indeed, distributed over all the large fresh waters of the geographical regions to which these rivers belong. Some of the species exceed a length of 3 feet. In the United States, where two species, *Trionyx muticus* and *Trionyx ferox*, occur, the flesh of the latter is said to be most delicate to eat, far surpassing in flavour that of the green turtle. (A. C. G.)

TORTOISESHELL. The tortoiseshell of commerce consists of the epidermic plates of the hawksbill turtle, *Caretta imbricata*. The plates of the back or carapace, technically called the head, are 13 in number, 5 occupying the centre, flanked by 4 on each side. These overlap each other to the extent of one-third of their whole size, and hence they attain a large size, reaching in the largest to 8 inches by 13 inches, and weighing as much as 9 ounces. The carapace has also 24 marginal pieces, called hoofs or claws, forming a serrated edge round it; but these, with the plates of the plastron, or belly, are of inferior value. The plates of tortoiseshell consist of horny matter, but they are harder, more brittle, and less fibrous than ordinary horn. Their value depends on the rich mottled colours they display—a warm translucent yellow, dashed and spotted with rich brown tints—and on the high polish they take and retain. The finest tortoiseshell is obtained from the Eastern Archipelago, particularly from the east coast of Celebes to New Guinea; but the creature is found and tortoiseshell obtained from all tropical coasts, large supplies coming from the West Indian Islands and Brazil.

Tortoiseshell is worked precisely as horn; but, owing to the high value of the material, care is taken to prevent any waste in its working. The plates, as separated by heat from the bony skeleton, are keeled, curved, and irregular in form. They are first flattened by heat and pressure, and superficial inequalities are rasped away. Being harder and more brittle than horn, tortoiseshell requires careful treatment in moulding it into any form, and as high heat tends to darken and obscure the material it is treated at as low a heat as practicable. For many purposes it is necessary to increase the thickness or to add to the superficial size of tortoiseshell, and this is readily done by careful cleaning and rasping of the surfaces to be united, softening the plates in boiling water or sometimes by dry heat, and then pressing them tightly together by means of heated pincers or a vice. The heat softens and liquefies a superficial film of the horny material, and that with the pressure effects a perfect union of the surfaces brought together. Heat and pressure are also employed to mould the substance into boxes and the numerous artificial forms into which it is made up.

Tortoiseshell has been a prized ornamental material from very early times. It was one of the highly esteemed treasures of the far East brought to ancient Rome by way of Egypt, and it was eagerly sought by wealthy Romans as a veneer for their rich furniture. In modern times it is most characteristically used in the elaborate inlaying of cabinet work known as buhl furniture. It is also employed as a veneer for small boxes and frames. It is cut into combs, moulded into snuffboxes and other small boxes, formed into knife-handles, and worked up into many other similar minor articles. The plates from certain other tortoises, known commercially as turtle-shell, possess a certain industrial value, but they are either opaque or soft and leathery, and cannot be mistaken for tortoiseshell. A close imitation of tortoiseshell can be made by staining translucent horn. See COMB, vol. vi. p. 175.

TORTOLA. See VIRGIN ISLANDS.

TORTONA, a town of Italy, in the province of Alessandria, on the right bank of the Scrivia, at the northern foot of the Apennines, 13 miles to the east of Alessandria, was formerly a place of strength until its fortifications were destroyed by the French after Marengo (1799); the ramparts are now turned into shady promenades. The cathedral, erected by Philip II., is architecturally uninteresting, but contains a remarkably fine Roman sarcophagus. Silk-weaving, tanning, and hat-making are the chief industries; and there is some trade in wine and grain. The population in 1881 was 9023 (commune 14,442).

Dertona is spoken of by Strabo as one of the most important towns of Liguria, and is alluded to by Pliny as a Roman colony. In the Middle Ages it was zealously attached to the Guelphic cause, on which account it was twice laid waste by Frederick Barbarossa (in 1155 and 1163).

TORTOSA, a fortified city of Spain, in the province of Tarragona, and 40 miles by rail to the south-west of that town, is picturesquely situated on the left bank of the Ebro (here crossed by a bridge of boats), 22 miles above its mouth. It is for the most part an old walled town, with narrow, crooked, and ill-paved streets; the houses are lofty, and massively built of granite. The slope on which it stands is crowned with an old ruined castle, commanding a splendid view. The cathedral is a conspicuous building near the river; it occupies the site of a mosque built in 914 by 'Abd al-Rahmân; the present structure, which dates from 1347, has its Gothic character disguised by a classical façade with Ionic pillars and much tasteless modernization. The stalls in the choir, carved by Cristobal de Salamanca in 1588–93, and the sculpture of the pulpits, as well as the ironwork of the choir-railing and some of the precious marbles with which the chapels are adorned, deserve notice. None of the other public buildings, which include an episcopal palace, a town-hall, and numerous churches, require special mention. The manufactures of Tortosa include paper, hats, leather, porcelain, majolica, soap, and spirits. There is an important fishery in the river, and an active trade is carried on through the harbour, which is accessible to vessels of 100 tons burden, corn, wine, oil, wool, silk, fruits, and liquorice (a specialty of the district) being among the leading articles of export. Near Tortosa are rich quarries of marble and alabaster, and the whole surrounding country is very fertile and beautiful. The population within the municipal boundaries in 1878 was 24,057.

Tortosa, the *Dertosa* of Strabo and the *Colonia Julia Augusta Dertosa* of numerous coins, was a city of the Ilercaones in Hispania Tarraconensis. Under the Moors it became a place of great importance as the key of the Ebro valley. It was taken by Louis the Pious in 811 (after an unsuccessful siege two years before), but was soon recaptured. Having become a haunt of pirates, and exceedingly injurious to Italian commerce, it was made the object of a crusade proclaimed by Pope Eugenius III. in 1148, and was accordingly captured by Raymond Berengar, assisted by Templars, Pisans, and Genoese. Tortosa fell into the hands of the duke of Orleans in 1708, and was again surrendered in the War of Independence in 1811 to the French under Suchet, who held it till 1814.

TORTURE. It is proposed to treat in this place not so much the innumerable modes of inflicting pain which have been from time to time devised by the perverted ingenuity of man as the subject of legal torture as it existed in the civilized nations of antiquity and of modern Europe, that is to say, torture inflicted with more or less appearance of legality by a responsible executive or judicial authority. From this point of view torture was always inflicted for one of two purposes—(1) as a means of eliciting evidence from a witness or from an accused person either before or after condemnation, (2) as a part of the punishment. Torture, as a part of the punishment, may be regarded as including every kind of bodily or mental pain beyond what is necessary for the safe custody of the offender (with or without enforced labour) or the destruction of his life,—in the language of Bentham, an *afflictive* as opposed to a *simple* punishment. Thus the unnecessary sufferings endured in English prisons before the reforms of Howard (see HOWARD and PRISON DISCIPLINE) and the drawing and quartering in the old executions for treason fall without any straining of terms under the category of torture. The whole subject is now one of only historical interest as far as Europe is concerned. It was, however, up to a comparatively recent date an integral part of the law of most countries (to which England, Aragon, and Sweden[1] formed honourable exceptions), as much a commonplace of law as trial by jury in England. One reason for its long continuance was no doubt the view taken in an age of judicial perjury[2] that truth was only to be attained by violent means, if not by torture then by ordeal or trial by battle. Speaking generally, torture may be said to have succeeded the ordeal and trial by battle (compare ORDEAL). Where these are found in full vigour, as in the capitularies of Charlemagne, there is no provision for torture. It was no doubt accepted reluctantly, but tolerated in the absence of any better means of eliciting truth, especially in cases of great gravity, on the illogical assumption that extraordinary offences must be met by extraordinary remedies.

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[1] But even in these countries, whatever the law was, torture certainly existed in fact.

[2] Hallam, *Middle Ages*, vol. i. p. 292

The opinions of the best authorities have been in theory almost unanimously against the use of torture, even in a system where it was as completely established as it was in Roman law. "Tormenta," says Cicero,[1] in words which it is almost impossible to translate satisfactorily, "gubernat dolor, regit quæsitor, flectit libido, corrumpit spes, infirmat metus, ut in tot rerum angustiis nihil veritati loci relinquatur." Seneca says bitterly, "it forces even the innocent to lie." St Augustine[2] recognizes the fallacy of torture. "If," says he, "the accused be innocent, he will undergo for an uncertain crime a certain punishment, and that not for having committed a crime, but because it is unknown whether he committed it." At the same time he regards it as excused by its necessity. The words of Ulpian, in the *Digest* of Justinian,[3] are no less impressive. "The torture (*quæstio*) is not to be regarded as wholly deserving or wholly undeserving of confidence; indeed, it is untrustworthy, perilous, and deceptive. For most men, by patience or the severity of the torture, come so to despise the torture that the truth cannot be elicited from them; others are so impatient that they will lie in any direction rather than suffer the torture; so it happens that they depose to contradictions and accuse not only themselves but others." Montaigne's[4] view of torture as a part of the punishment is a most just one:—"All that exceeds a simple death appears to me absolute cruelty; neither can our justice expect that he whom the fear of being executed by being beheaded or hanged will not restrain should be any more awed by the imagination of a languishing fire, burning pincers, or the wheel." Montesquieu[5] speaks of torture in a most guarded manner, condemning it, but without giving reasons, and eulogizing England for doing without it. The system was condemned by Bayle and Voltaire with less reserve. Among the Italians, Beccaria,[6] Verri,[7] and Manzoni[8] will be found to contain most that can be said on the subject. The influence of Beccaria in rendering the use of torture obsolete was undoubtedly greater than that of any other legal reformer. The great point that he makes is the unfair incidence of torture, as persons' minds and bodies differ in strength. Moreover, it is, says he, to confound all relations to expect that a man should be both accuser and accused, and that pain should be the test of truth; as though truth resided in the muscles and fibres of a wretch under torture. The result of the torture is simply a matter of calculation. Given the force of the muscles and the sensibility of the nerves of an innocent person, it is required to find the degree of pain necessary to make him confess himself guilty of a given crime. Bentham's[9] objection to torture is that the effect is exactly the reverse of the intention. "Upon the face of it, and probably enough in the intention of the framers, the object of this institution was the protection of innocence; the protection of guilt and the aggravation of the pressure upon innocence was the real fruit of it." The apologists of torture, even among jurists, are not numerous. In fact, theoretical objections to it are often urged by the authors of books of practice, as by Damhouder, Von Rosbach, Von Boden, and Voet. It is worthy of note, however, as illustrative of the feeling of the time, that even Bacon[10] compares experiment in nature to torture in civil matters as the best means of eliciting truth. Muyart de Vouglans[11] derives the origin of torture from the law of God. Other apologists are Simancas, bishop of Badajos,[12] Engel,[13] and in England Sir R. Wiseman.[14]

Greece.—The opinion of Aristotle was in favour of torture as a mode of proof. It is, he says, a kind of evidence, and appears to carry with it absolute credibility because a kind of constraint is applied. It is classed as one of the "artless persuasions" (ἄτεχναι πίστεις).[15] At Athens slaves, and probably at times resident aliens, were tortured, but it was never applied to free citizens,[16] such application being forbidden by a psephism passed in the archonship of Scamandrius. After the mutilation of the Hermæ in 415 B.C. a proposition was made, but not carried, that it should be applied to two senators named by an informer. In this particular case Andocides gave up all his slaves to be tortured.[17] Torture was sometimes inflicted in open court. The rack was used as a punishment even for free citizens. Antiphon was put to death by this means.[18] The torture of Nicias by the Syracusans is alluded to by Thucydides[19] as an event likely to happen, and it was only in order to avoid the possibility of inconvenient disclosures that he was put to death without torture. Isocrates and Lysias refer to torture under the generic name of *στρέβλωσις*. As might be expected, torture was frequently inflicted by the Greek despots, and both Zeno and Anaxarchus are said to have been put to it by such irresponsible authorities. At Sparta the despot Nabis was accustomed, as we learn from Polybius,[20] to put persons to death by an instrument of torture in the form of his wife Apega, a mode of torture no doubt resembling the *Jungfernkuss* once in use in Germany.

Rome.—The Roman system was the basis of all subsequent European systems which recognized torture as a part of their procedure. The law of torture was said by Cicero to rest originally on custom (*mores majorum*). There are frequent allusions to it in the classical writers[21] both of the republic and the empire. The law, as it existed under the later empire, is contained mainly in the titles *De Quæstionibus*[22] of the *Digest* and the *Code*,[23]—the former consisting largely of opinions from the *Sententiæ Receptæ* of Paulus,[24] the latter being for the most part merely a repetition of constitutions contained in the Theodosian Code.[25] Both substantive law and procedure were dealt with by these texts of Roman law, the latter, however, not as fully as in mediæval codes, a large discretion being left to the judges. Torture was used both in civil and criminal trials, but in the former only upon slaves and freedmen or infamous persons—such as gladiators—and where the truth could not be otherwise elicited, as in cases affecting the inheritance (*res hereditariæ*). Its place in the case of free citizens was taken by the reference to the oath of the party (see OATH). During the republic torture appears to have been confined to slaves in all cases, but with the empire (according to Dion Cassius under Tiberius) a free man became liable to it if accused of a crime, though not as a witness. If a Christian, of however high a condition, he was subject to torture during the period between the edict of Diocletian in 303 and the edict of toleration of Galerius in 311. This short period excepted, the liability of a free man depended upon two conditions, the nature of the accusation and the rank of the accused. On an accusation of treason every one, whatever his rank, was liable to torture, for in treason the condition of all was equal.[1] The same was the case of those accused of sorcery (*magi*), who were regarded as *humani generis inimici*.[2] A wife might be tortured (but only after her slaves had been put to the torture) if accused of poisoning her husband. In accusations of crimes other than treason or sorcery, certain persons were protected by the dignity of their position or their tender age. The main exemptions were contained in a constitution of Diocletian and Maximian, and included soldiers, nobles of a particular rank, *i.e.*, *eminentissimi* and *perfectissimi*, and their descendants to the third generation, and *decuriones* and their children to a limited extent—that is to say, they were subject to the torture of the *plumbatæ* in certain cases, such as fraud on the revenue and extortion. In addition to these, priests (but not clergy of a lower rank), children under fourteen, and pregnant women were exempt. A free man could be tortured only where he had been inconsistent in his depositions. No one was to be chained in prison before trial, nor could a prisoner be tortured while awaiting trial. The rules as to the torture of slaves were numerous and precise. It was a maxim of Roman law that torture of slaves was the most efficacious means of obtaining truth.[3] They could be tortured either as accused or as witnesses, but against their masters only in accusations of treason, adultery, frauds on the revenue, coining, and similar offences (which were regarded as a species of treason), attempts by a husband or wife on the life of the other, and in cases where a master had bought a slave for the special reason that he should not give evidence against him. The privilege from accusations by the slave extended to the master's father, mother, wife, or tutor, and also to a former master. On the same principle a freedman could not be tortured against his patron. The privilege did not apply where the slave was joint property, and one of his masters had been murdered by the other, or where he was the property of a corporation, for in such a case he could be tortured in a charge against a member of the corporation. Slaves belonging to the inheritance could be tortured in actions concerning the inheritance. The adult slaves of a deceased person could be tortured where the deceased had been murdered. In a charge of adultery against a wife, her husband's, her own, and her father's slaves could be put to the torture. A slave manumitted for the express purpose of escaping torture was regarded as still liable to it. Before putting a slave to torture without the consent of his master, security must be given to the master for his value. The master of a slave tortured on a false accusation could recover double his value from the accuser. The undergoing of torture had at one time a serious effect upon the after-life of the slave, for in the time of Gaius a slave who had been tortured could on manumission obtain no higher civil rights than those of a *dediticius*.[4] The rules of procedure were conceived in a spirit of as much fairness as such rules could be. Some of the most important were these. The amount of torture was at the discretion of the judge, but it was to be so applied as not to injure life or limb. The examination was not to begin by torture; other proofs must be exhausted first. The evidence[5] must have advanced so far that nothing but the confession of the slave was wanting to complete it. Those of weakest frame and tenderest age were to be tortured first. Except in treason, the unsupported testimony of a single witness was not a sufficient ground for torture. The voice and manner of the accused were to be carefully observed. A spontaneous confession, or the evidence of a personal enemy, was to be received with caution. Repetition of the torture could only be ordered in case of inconsistent depositions or denial in the face of strong evidence. There was no rule limiting the number of repetitions. Leading questions were not to be asked. A judge was not liable to an action for anything done during the course of the examination. An appeal from an order to torture was competent to the accused, except in the case of slaves, when an appeal could be made only by the master.[6] The appellant was not to be tortured pending the appeal, but was to remain in prison.[7] The principal forms of torture in use were the *equuleus*, or rack (mentioned as far back as Cicero), the *plumbatæ*, or leaden balls, the *ungulæ*, or barbed hooks, and the *fidiculæ*, or cord compressing the arm. Other allusions in the *Digest* and *Code*, in addition to those already cited, may be shortly noticed. The testimony of a gladiator or infamous person (such as an accomplice) was not valid without torture.[8] This was no doubt the origin of the mediæval maxims (which were, however, by no means universally recognized),—*Vilitas personæ est justa causa torquendi testem*, and *Tortura purgatur infamia*. Torture could not be inflicted during the forty days of Lent.[9] Robbers and pirates might be tortured even on Easter Day, the Divine pardon being hoped for where the safety of society was thus assured.[10] Capital punishment was not to be suffered until after conviction or confession under torture.[11] Withdrawal from prosecution (*abolitio*) was not to be allowed as a rule after the accused had undergone the torture.[12] In charges of treason the accuser was liable to torture if he did not prove his case.[13] The infliction of torture, not judicial, but at the same time countenanced by law, was at one time allowed to creditors. They were allowed to keep their debtors in private prisons, and most cruelly ill-use them, in order to extort payment.[14] Under the empire private prisons were forbidden.[15] In the time of Juvenal, if his sixth satire may be believed, the Roman ladies actually hired the public torturers to torture their domestic slaves. As a part of the punishment torture was in frequent use. Crucifixion, mutilation, exposure to wild beasts in the arena, and other cruel modes of destroying life were common, especially in the time of the persecution of the Christians under Nero.[1] Crucifixion as a punishment was abolished by Constantine in 315, in veneration of the memory of Him who was crucified for mankind. The punishment of mutilation was moderated by Justinian, who forbade amputation of both hands or feet or of any limb, and confined it in future to amputation of one hand.[2] Scourging was inflicted only on slaves; free men were exempt by the *Lex Porcia* and *Lex Valeria*, except in a few cases, such as that of adultery, the penalty for which was scourging and cutting off the nose.[3] On the other hand, where the interests of the church were concerned, the tendency was in favour of greater severity. Thus, by the Theodosian Code, a heretic was to be flogged with lead (*contusus plumbo*) before banishment,[4] and Justinian made liable to torture and exile any one insulting a bishop or priest in a church.

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[1] *Pro Sulla*, c. 23.

[2] *De Civ. Dei*, bk. xix. c. 6.

[3] *Dig.*, xlviii. 18, 23.

[4] Essay lxv. (Cotton's trans.).

[5] *Espr. des Lois*, bk. vi. c. 17.

[6] *Dei Delitti e delle Pene*, c. xvi.

[7] *Osservazioni sulla Tortura.*

[8] *Storia della Colonna Infame.*

[9] *Works*, vol. vii. p. 525.

[10] *Nov. Org.*, bk. i. aph. 98. In the *Advancement of Learning*, bk. iv. ch. 4, Bacon collects many instances of constancy under torture.

[11] *Institutis du Droit Criminel*, Paris, 1757.

[12] *De Catholicis Institutionibus Liber, ad prævacendas et extirpandas Hæreses admodum necessarius*, Rome, 1575.

[13] *De Tortura ex Foris Christianis non proscribenda*, Leipsic, 1753.

[14] *Law of Laws*, p. 122, London, 1686.

[15] *Rhet.*, i. 15, 26.

[16] The opinion of Cicero (*De Partitionibus Oratoriis*, § 34), that it was so applied at Athens and Rhodes, seems, as far as regards Athens, not to be justified by existing evidence.

[17] See Grote, *Hist. of Greece*, vol. vii. p. 274.

[18] See *Dict. of Antiq.*, s.v. Βάσανος. In the *Ranæ* of Aristophanes v. 617, there is a list of kinds of torture, and the wheel is alluded to in *Lysistrata*, v. 846.

[19] vii. 86.

[20] xiii. 7.

[21] An interesting one, illustrating the uselessness of torture in the face of courage and resolution, is the abortive result of the torture of a Spanish peasant in 25 A.D. on the charge of being the murderer of Lucius Piso (Tac., *Ann.*, iv. 45). A somewhat similar case, occurring in Sicily, is given by Valerius Maximus, bk. iii. c. iii. The horrible torture of Epicharis, a freed woman, is described by Tacitus, *Ann.*, xv. 57. In Pliny's letter to Trajan (*Epist.*, x. 97), he mentions having put to the torture two Christian deaconesses (*ministræ*).

[22] *Quæstio* included the whole process of which torture was a part. In the words of Cujacius, "quæstio est interrogatio quæ fit per tormenta, vel de reis. vel de testibus qui facto intervenisse dicuntur.

[23] *Dig.*, xlviii. 18; *Cod.*, ix. 41.

[24] v. 14, 15, 16

[25] ix. 35.

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[1] *Cod.*, ix. 8, 4.

[2] *Cod.*, ix. 18, 7.

[3] *Cod.*, i. 3, 8.

[4] Gaius, i. 13.

[5] The evidence on which the accused might be tortured was expressed in Roman law by the terms *argumentum* and *indicium*. The latter term, as will be seen, afterwards became one of the most important in the law of torture, but the analysis of *indicium* is later than Roman law. *Indicium* was not quite the same thing as *semiplena probatio*, though the terms appear to be occasionally used as synonyms. *Indicium* was rather the foundation or cause of *probatio*, whether *plena* or *semiplena*. An *indicium* or a concurrence of *indicia* might, according to circumstances, constitute a *plena* or *semiplena probatio*. The difference between the words may be illustrated by a passage from Justin, "Ad cujus rei probationem immittit indices," xxxii. 2.

[6] *Dig.*, xlix. 1, 15.

[7] *Cod.*, vii. 62, 12.

[8] *Dig.*, xxii. 5, 21, 2.

[9] *Cod.*, iii. 12, 6.

[10] *Cod.*, iii. 12, 10.

[11] *Cod.*, ix. 47, 16.

[12] *Cod.*, ix. 42, 3.

[13] *Cod.*, ix. 8, 3.

[14] See, for instance, Livy, vi. 36.

[15] *Cod.*, i. 4, 23; ix. 5.

The Church.—As far as it could the church adopted the Roman law, with the important and characteristic difference (dating from the severe edicts of Theodosius the Great in 381) that heresy took the place of treason, it being regarded as a kind of treason against God ("crimen læsæ majestatis divinæ").[6] The doctrine of confiscation for treason was so convenient and profitable that it was rapidly adopted by the church.[7] As most instances in which torture was inflicted by ecclesiastical tribunals would be accusations of heresy or Judaism—a specially revolting form of heresy to mediæval Christians—this theory practically equalized all persons for the purpose of torture, in accordance with the doctrine that in treason all were equal. The church generally secured the almost entire immunity of its clergy, at any rate of the higher ranks, from torture by civil tribunals.[8] In many instances councils of the church pronounced against torture, *e.g.*, in a synod at Rome in 384.[9] Torture even of heretics seems to have been originally left to the ordinary tribunals. Thus a bull of Innocent IV., in 1252, directed the torture of heretics by the civil power, as being robbers and murderers of souls, and thieves of the sacraments of God.[10] The church also enjoined torture for usury.[11] A characteristic division of torture, accepted by the church but not generally acknowledged by lay authorities, was into spiritual and corporal, the latter being simply the imposition of the oath of purgation, the only form originally in use in the ecclesiastical courts. The canon law contains little on the subject of torture, and that little of a comparatively humane nature. It laid down that it was no sin in the faithful to inflict torture,[12] but a priest might not do so with his own hands,[13] and charity was to be used in all punishments.[14] No confession was to be extracted by torture.[15] The principal ecclesiastical tribunal by which torture was inflicted in more recent times was of course the Inquisition (*q.v.*). The code of instructions issued by Torquemada in Spain in 1484 provided that an accused person might be put to the torture if *semiplena probatio* existed against the accused,—that is, so much evidence as to raise a grave and not merely a light presumption of guilt, often used for the evidence of one eye or ear witness of a fact. If the accused confessed during torture, and afterwards confirmed the confession, he was punished as convicted; if he retracted, he was tortured again, or subjected to extraordinary punishment. One or two inquisitors, or a commissioner of the Holy Office, were bound to be present at every examination. Owing to the occurrence of certain cases of abuse of torture, a decree of Philip II. was issued, in 1558, forbidding the administration of torture without an order from the council. But this decree does not appear to have been fully observed. By the edict of the inquisitor-general Valdés, in 1561, torture was to be left to the prudence and equity of the judges. They must consider motives and circumstances before decreeing torture, and must declare whether it is to be employed *in caput proprium*, *i.e.*, to extort a confession, or *in caput alienum*, *i.e.*, to incriminate an accomplice. The accused was not to be informed of the grounds of torture. He was not to be questioned on a particular fact, but was to be allowed to say what he pleased. Torture was not to be decreed until the termination of the process, and after defence heard, and the decree was subject to appeal, but only in doubtful cases, to the Council of the Supreme. It was also only in doubtful cases that the inquisitors were bound to consult the council; where the law was clear (and of this they were the judges) there need be no consultation, and no appeal was allowed. The judges, the registrar, and the executioners were the only persons allowed to be present at the torture. They were to be careful that the jailer suggested nothing to the accused during the torture. On ratification twenty-four hours afterwards of a confession made under torture, the accused might be reconciled, if the inquisitors believed him to be sincerely repentant. If convicted of bad faith, he might be relaxed, *i.e.*, delivered to the secular power to be burned. The inquisitors had a discretion to allow the accused to make the canonical purgation by oath instead of undergoing corporal torture, but the rule which allows this to be done at the same time discountenances it as fallacious. It is remarkable that the rules do not allow much greater efficacy to torture. They speak of it almost in the terms of Roman law as dangerous and uncertain, and depending for its effects on physical strength.[16] Torture had ceased to be inflicted before the suppression of the Inquisition, and in 1816 a papal bull decreed that torture should cease, that proceedings should be public, and that the accuser should be confronted with the accused.[17] It was still, however, customary for the fiscal, even in the latest times, to end the requisition by demanding torture as a matter of form. The rules in themselves were not so cruel as the construction put upon them by the inquisitors. For instance, by Torquemada's instructions torture could not be repeated unless in case of retractation. This led to the subtlety of calling a renewed torture a continuation, and not a repetition.[18] The rules of Torquemada and of Valdés are those of the greatest historical importance, the latter forming the code of the Holy Office until its suppression, not only in Spain, but in other countries where the Inquisition was established. But several other codes of procedure existed before the final perfection of the system by Valdés. The earliest is perhaps the instructions for inquisitors (*Directorium Inquisitorum*) compiled a century earlier than Torquemada by Nicholas Eymerico, grand inquisitor of Aragon about 1368.[1] Rules of practice were also framed two centuries later by Simancas, whose position as an apologist has been already stated. The text-book of procedure of the Italian Inquisition was the *Sacro Arsenale*.[2] In the Netherlands, Francis Van der Helst was appointed inquisitor-general in 1521, with authority to torture heretics without observing the ordinary forms of law, and without appeal.[3] In 1545 and 1550 instructions for the guidance of inquisitors were issued by Charles V.[4] The liability of a judge for exceeding the law was not always recognized by the Inquisition to the same extent as by the lay tribunals. Llorente gives an instance of a warrant by an inquisitor to a licentiate ordering the torture of an accused person, and protesting that, in case of death or fracture of limbs, the fact is not to be imputed to the licentiate.[5]

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[1] The well-known lines of Juvenal (*Sat.*, i. 155),

> "Tæda lucebis in illa,
> Qua stantes ardent qui fixo gutture fumant,"

will serve as an example of such punishments.

[2] *Nov.*, cxxxiv. 13. [3] *Cod.*, ix. 9, 37. [4] xvi. 53.

[5] *Nov.*, cxxiii. 31. On the subject of torture in Roman law reference may be made to Westphal *Die Torturer der Griechen, Römer, und Deutschen*, Leipsic, 1785; Wasserschleben, *Historia Quæstionum per Tormenta apud Romanos*, Berlin, 1836.

[6] This term, which included blasphemy and cognate offences, is used both by ecclesiastical and secular jurists, *e.g.*, by Suarez de Paz and by Jousse, *Traité de la Justice Criminelle*.

[7] See an article by Mr Lea in *The English Historical Review*, April 1887, "Confiscation for Heresy in the Middle Ages."

[8] See Escobar, *Mor. Theol.*, tract. vi. c. 2. They were to be tortured only by the clergy, where possible, and only on *indicia* of special gravity.

[9] Lea, *Superstition and Force*, p. 419, 3d ed., Philadelphia, 1878.

[10] *Leges et Constitutiones contra Hæreticos*, § 26.

[11] Lecky, *Rationalism in Europe*, vol. ii. p. 34, n.

[12] *Decr.*, pt. ii. 23, 4, 45. [13] *Decr.*, pt. i. 86, 25.

[14] *Decr.*, pt. ii. 12, 2, 11. [15] *Decr.*, pt. ii. 15, 6, 1

[16] The rules will be found in Llorente's *Hist. of the Inquisition*, cc. vi., xxii.

[17] A case of actual torture occurred in Spain in the case of Van Halen, in 1817, in spite of the papal bull. In South America, as late as 1809, power to torture was conferred on inquisitors by the dean and chapter of Santiago. See *Francisco Moyen, or the Inquisition in South America*, by B. V. Mackenna (transl. by J. W. Duffy, 1869), p. 217.

[18] Prescott, *Ferdinand and Isabella*, vol. i. p. 327.

Thus far of the law. In practice all the ingenuity of cruelty was exercised to find new modes of torment.[6] These cruelties led at times to remonstrance from the civil power. One example is the edict of Philip II. just mentioned. Another and an earlier one is an *ordonnance* of Philip the Fair, in 1302, bidding the Inquisition confine itself within the limits of the law.[7] At Venice the senate decreed that three senators should be present as inquisitors. Further details of the varieties of torture will be found, by those curious in such matters, in the works of Llorente, Herculano (*History of the Inquisition in Portugal*), Motley, Garrido and Cayley, and Picart, to which may be added works giving accounts of the sufferings of individuals under the Inquisition, such as the narrative of the sufferings of William Lithgow at Malaga in 1622 and of Van Halen in 1817, and (in the Spanish and Portuguese colonies) the cases of Francisco Moyen in Chili, and of Dellon at Goa in 1673.[8] Mental torture may be exemplified by EXCOMMUNICATION (*q.v.*), and by the secrecy and uncertainty of the proceedings of the inquisitors.

As the practice of torture, both by the civil and ecclesiastical power, became more systematized, it grew to be the subject of casuistical inquiry by churchmen, to an extent far exceeding the scanty discussion of the question in the text of the canon law. It will be sufficient here to cite as an example the treatment of it by Liguori, who incorporates the opinions of many of the Spanish casuists. On the whole, his views appear to be more humane than the prevailing practice. The object of torture he defines very neatly as being to turn *semiplena* into *plena probatio*. For this proper *indicia* are necessary. He then proceeds to decide certain questions which had arisen, the most interesting of which deal with the nature of the sin of which the accused and the judge are guilty in particular instances. A judge sins gravely if he does not attempt all milder means of discovering truth before resorting to torture. He sins in a criminal cause, or in one of notable infamy, if he binds the accused by oath to tell the truth before there is proof against him. It is the same if without oath he uses threats, terror, or exhibition of torments to confound the witness.[9] If any one, to avoid grave torments, charges himself with a capital crime, he does not sin mortally.[10] It was a doubtful question whether he sinned gravely in such a case.

England.—It is the boast of the common law of England that it never recognized torture as legal. One, perhaps the chief, reason for this position taken by the law is the difference of the nature of the procedure in criminal cases from that in general use in Continental countries. To use words more familiar in foreign jurisprudence, the English system is *accusatorial* as distinguished from *inquisitorial*. The common law of England has always shown itself averse to the inquisitorial system, and so (at least in theory) to the torture which may be regarded as an outcome of the system whose one end was to obtain a confession from the accused. The tendency of the small amount of statute law bearing on the subject is in the same direction. It was provided by Magna Charta, § 29, "that no free man . . . . . should be destroyed in any way unless by legal judgment of his equals or by the law of the land." On this Sir E. Coke comments, "No man destroyed, &c., that is, forejudged of life or limb, disinherited, or put to torture or death."[11] The Act of 27 Hen. VIII. c. 4 enacted that, owing to the frequent escape of pirates in trials by the civil law, "the nature whereof is that before any judgment of death can be given against the offenders they must plainly confess their offence (which they will never do without torture or pains)," such persons should be tried by jury before commissioners under the Great Seal. Finally, the Bill of Rights provided that cruel and unusual punishments ought not to be inflicted. The opinions of the judges have been invariably against torture in theory, however much some of them may have been led to countenance it in practice. The strongest authority is the resolution of the judges in Felton's case (1628), "that he ought not by the law to be tortured by the rack, for no such punishment is known or allowed by our law."[12] In accordance with this are the opinions of Sir John Fortescue,[13] Sir Thomas Smith,[14] and Sir E. Coke. The latter says,—"As there is no law to warrant tortures in this land, nor can they be justified by any prescription, being so lately brought in."[15] In spite of all this torture in criminal proceedings was inflicted in England with more or less frequency for some centuries, both as a means of obtaining evidence and as a part of the punishment. But it should be remarked that torture of the former kind was invariably ordered by the crown or council, or by some tribunal of extraordinary authority, such as the Star Chamber, not professing to be bound by the rules of the common law. In only two instances was a warrant to torture issued to a common law judge.[16]

A licence to torture is found as early as the Pipe Roll of 34 Hen. II.[17] The Templars (see TEMPLARS) were tortured in 1310 by royal warrant addressed to the mayor and sheriffs of London.[1] In this case it is recorded that torture was unknown in England, and that no torturer was to be found in the realm.[2] A commission was issued concerning the tortures at Newgate in 1334.[3] The rack in the Tower is said to have been introduced by the duke of Exeter in the reign of Henry VI., and to have been thence called "the duke of Exeter's daughter."[4] In this reign torture seems to have taken its place as a part of what may be called extraordinary criminal procedure, claimed, and it may be said tacitly recognized, as exercisable by virtue of the prerogative, and continued in use down to 1640.[5] The infliction of torture gradually became more common under the Tudor monarchs. Under Henry VIII. it appears to have been in frequent use. Only two cases are recorded under Edward VI., and eight under Mary.[6] The reign of Elizabeth was its culminating point. In the words of Hallam, "the rack seldom stood idle in the Tower for all the latter part of Elizabeth's reign."[7] The varieties of torture used at this period are fully described by Dr Lingard,[8] and consisted of the rack, the scavenger's daughter,[9] the iron gauntlets or bilboes, and the cell called "Little Ease." The registers of the council during the Tudor and early Stuart reigns are full of entries as to the use of torture, both for state and for ordinary offences.[10] Among notable prisoners put to the torture were Anne Ascue, the Jesuit Campion, Guy Fawkes,[11] and Peacham (who was examined by Bacon "before torture, in torture, and after torture").[12] The prevalence of torture in Elizabeth's reign led to the well-known defence attributed to Lord Burghley, "A declaration of the favourable dealing of Her Majesty's commissioners appointed for the examination of certain traitors, and of tortures unjustly reported to be done upon them for matter of religion," 1583.[13] The use of torture in England being always of an extraordinary and extra-judicial nature, it is comparatively certain that it could hardly have been applied with that observation of forms which existed in countries where it was regulated by law. There were no rules and no responsibility beyond the will of the crown or council. This irresponsibility is urged by Selden[14] as a strong objection to the use of torture.

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[1] An edition was published at Rome in 1558, and a compendium at Lisbon in 1762, and by Marchena at Montpellier in 1821.

[2] The only edition which the writer has seen is dated Genoa and Perugia, 1653.

[3] Motley, *Dutch Republic*, vol. i. p. 528.

[4] Id., p. 329.

[5] Llorente, c. xiv.

[6] Among others were the gradual pouring of water drop by drop on a particular spot of the body, the *tormento de toca*, or pouring of water into a gauze bag in the throat, which gradually forced the gauze into the stomach, and the *péndola*, or swinging pendulum, so graphically described in one of Edgar Poe's tales.

[7] *Ordonnances des Rois*, vol. i. p. 346.

[8] The history of Dellon's narrative of his experiences in the prison of the Inquisition is remarkable. It was translated into English in 1688 by the Rev. R. Wharton, a chaplain of Archbishop Sancroft, but was refused a licence, as being contrary to the king's religion, and the publisher was imprisoned.

[9] *Theol. Mor.*, bk. ix. § 202.

[10] § 274.

[11] 2 *Inst.*, 48b.

[12] 3 *State Trials*, 371.

[13] *De Laudibus Legum Angliæ*, c. 22.

[14] *Commonwealth of England*, bk. ii. c. 27. It is curious that Sir T. Smith, with all his hatred of torture, was directed by a warrant under the queen's seal alone (not through the council) to torture the duke of Norfolk's servants in 1571. In a letter to Lord Burghley he pleaded for exemption from so thankless a task.

[15] 3 *Inst.*, 35. Nevertheless, in the trial of Lords Essex and Southampton, Coke is found extolling the queen's mercy for not racking or torturing the accused, 1 *State Trials*, 1338.

[16] Jardine, *Reading on the Use of Torture in the Criminal Law of England* (1837), p. 52.

[17] Pike, *Hist. of Crime in England*, vol. i. p. 427.

So far of what may be called torture proper, to which the common law professed itself a stranger. There were, however, cases fully recognized by the common law which differed from torture only in name. The *peine forte et dure* was a notable example of this. If a prisoner stood mute of malice instead of pleading, he was condemned to the *peine*, that is, to be stretched upon his back and to have iron laid upon him as much as he could bear, and more, and so to continue, fed upon bad bread and stagnant water through alternate days until he pleaded or died.[15] It was abolished by 12 Geo. III. c. 20. 7 and 8 Geo. IV. c. 28 enacted that a plea of "not guilty" should be entered for a prisoner so standing mute. A case of *peine* occurred as lately as 1726. At times tying the thumbs with whipcord was used instead of the *peine*. This was said to be a common practice at the Old Bailey up to the last century.[16] In trials for witchcraft the legal proceedings often partook of the nature of torture, as in the throwing of the reputed witch into a pond to see whether she would sink or swim, in drawing her blood,[17] and in thrusting pins into the body to try to find the insensible spot. Confessions, too, appear to have been often extorted by actual torture, and torture of an unusual nature, as the devil was supposed to protect his votaries from the effects of ordinary torture.

Torture as a part of the punishment existed in fact, if not in name, down to a very recent period. Mutilation as a punishment appears in some of the pre-Conquest codes, such as those of Alfred, Athelstan, and Canute. Bracton, who does not notice torture as a means of obtaining evidence, divides corporal punishment into that inflicted with and without torture.[18] Later instances are the punishment of burning to death inflicted on heretics under the Six Articles (31 Hen. VIII. c. 14) and other Acts, and on women for petit treason (abolished by 30 Geo. III. c. 48), the mutilation inflicted for violence in a royal palace by 33 Hen. VIII. c. 12, the punishment for high treason, which existed nominally until 1870 (see TREASON), the pillory (abolished by 7 Will. IV. and 1 Vict. c. 23), the stocks, and the burning in the hand for felony (abolished by 19 Geo. III. c. 74). Corporal punishment now exists only in the case of juvenile offenders (see SUMMARY JURISDICTION) and of robbery with violence (see THEFT). It was abolished in the army by the Army Act, 1881.[19]

Scotland.—Torture was long a recognized part of Scottish criminal procedure, and was acknowledged as such by many Acts and warrants of the Scottish parliament, and warrants of the crown and the privy council. Some of the more important instances are the following. In 1542 the forfeiture of John, Lord Glammis, was reduced by the parliament as having proceeded on a confession extorted by threats of the "pynebankis." In 1567 four persons were ordered by the Privy Council to be tortured for complicity in Darnley's murder.[20] In 1591 a commission issued to torture certain persons accused of witchcraft.[21] James VI., in 1596, empowered the provost and bailies of Edinburgh to try rioters by torture. The torture was applied to Rhynd in 1600, on a charge of being privy to the Gowrie House conspiracy.[22] Two Acts in 1649 dealt with torture: one took the form of a warrant to examine witnesses against William Barton by any form of probation,[23] the other of a warrant to a committee to inquire as to the use of torture against persons suspected of witchcraft.[24] In 1650 the parliament ordained the committee appointed for the examination of prisoners to intimate to Colonel Sibbald that if his examination were not satisfactory the parliament would ordain him to be tortured. The judges, in 1689, were empowered by the estates to torture Chiesly of Dalrye, charged with the murder of the Lord President Lockhart, in order to discover accomplices. In the same year the use of torture without evidence or in ordinary cases was declared illegal in the Claim of Right. The careful wording of this will be noticed: it does not object to torture altogether, but reserves it for cases where a basis of evidence had already been laid, and for crimes of great gravity, thus admitting the dangerous principle, founded on Roman law, that the importance of the crime is a reason for departing from the ordinary rules of justice. However great the crime, it is no more certain than in the case of a crime of less gravity that the person accused was the person who committed it. A warrant issued in the same year to put to the torture certain persons accused of conspiring against the Government, and also certain dragoons suspected of corresponding with Lord Dundee. In 1690 an Act passed reciting the torture of William Carstares, a minister, in 1683, and re-establishing his competency as a witness.[1] The last warrant appears to be one in 1690 for torturing a man accused of rape and murder. In 1708 torture in Scotland was finally abolished by 7 Anne c. 21, § 5. Many details of the tortures inflicted will be found in Pitcairn's *Criminal Trials* and the introduction to Maclaurin's *Criminal Cases*. Among other varieties—the nature of some of them can only be guessed—were the rack, the pilniewinkis, the boot,[2] the caschie-laws, the lang irnis, the narrow-bore, and, worst of all, the waking, or artificial prevention of sleep.[3] The ingenuity of torture was exercised in a special degree on charges of witchcraft, notably in the reign of James VI., an expert both in witchcraft and in torture. The Act of 1649 already cited shows that the principle survived him. Under the government of the dukes of Lauderdale and York torture as a practice in charges of religious and political offences reached its height. "The privy council was accustomed to extort confessions by torture; that grim divan of bishops, lawyers, and peers sucking in the groans of each undaunted enthusiast, in hope that some imperfect avowal might lead to the sacrifice of other victims, or at least warrant the execution of the present."[4] With such examples before them in the law, it is scarcely to be wondered at that persons in positions of authority, especially the nobility, sometimes exceeded the law and inflicted torture at their own will and for their own purposes. There are several instances in the register of the privy council of suits against such persons, *e.g.*, against the earl of Orkney, in 1605, for putting a son of Sir Patrick Bellenden in the boots.

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[1] Rymer, *Fœdera*, vol. iii. 228, 232.

[2] Hallam, *Middle Ages*, vol. iii. p. 232.

[3] Pike, vol. i. p. 481.

[4] 3 *Inst.*, 84.

[5] This is the date of the latest warrant in Mr Jardine's work.

[6] It is to be noticed, as Mr Jardine observes, that all these are cases of an ordinary nature, and afford no ground for the assertions made by Strutt and Bishop Burnet that torture was used to heretics as heretics.

[7] *Const. Hist.*, vol. i. p. 201.

[8] *Hist. of England*, vol. viii., appendix, note v.

[9] These two were exactly opposite in principle. The rack stretched the limbs of the sufferer; the scavenger's daughter compressed him into a ball.

[10] Fifty-five of these will be found in the appendix to Mr Jardine's work. An ordinary robber of plate was threatened with torture in 1567.—Froude, *Hist. of England*, vol. viii. p. 386.

[11] It is not certain whether he was racked, but probably he was, in accordance with the king's letter:—"If he will not otherwise confess, the gentlest tortures are to be first used to him, and so on, step by step, to the most severe, and so God speed the good work."

[12] Dalrymple, *Memoirs and Letters of James I.*, p. 58; Macaulay's Essay on the Works of Bacon.

[13] Lord Somers's *Tracts*, vol. i. p. 189.

[14] *Table Talk*, "Trial."

[15] Stephen, *Hist. of the Criminal Law*, vol. i. p. 297.

[16] Stephen, vol. i. p. 300; Kelyng, *Reports*, p. 27.

[17] The superstition was that any one drawing a witch's blood was free from her power. This is alluded to in *Henry VI.*, pt. i. act i. sc. 5; "Blood will I draw on thee; thou art a witch."

[18] 104*b*.

[19] 44 Vict. c. 9, § 7.

[20] *Register of the Privy Council*, vol. i. p. 525.

[21] *Ibid.*, vol. iv. p. 680.

[22] *Ibid.*, vol. vi. p. 156.

[23] c. 333.

[24] c. 370.

Ireland seems to have enjoyed a comparative immunity from torture. It was not recognized by the common or statute law, and the cases of its infliction do not appear to be numerous. In 1566 the president and council of Munster, or any three of them, were empowered to inflict torture, "in cases necessary, upon vehement presumption of any great offence in any party committed against the Queen's Majesty."[5] In 1583 Hurley, an Irish priest, was tortured in Dublin, by "toasting his feet against the fire with hot boots."[6] In the case of Myagh, in 1581, the accused was brought over from Ireland by command of the lord deputy to be tortured in the Tower.[7] In 1615 one O'Kennan was put to the rack in Dublin by virtue of the lord deputy's commission.[8] In 1627 the lord deputy doubted whether he had authority to put a priest named O'Cullenan to the rack. An answer was returned by Lord Killultagh to the effect that "you ought to rack him if you saw cause and hang him if you found reason."[9]

British Colonies and Dependencies.—The infliction of torture in any British colony or dependency has usually been regarded as contrary to law, and ordered only by arbitrary authority. It is true that in the trial of Sir Thomas Picton in 1806, for subjecting, while governor of Trinidad, a woman named Luisa Calderon to the torture of the picquet,[10] one of the grounds of defence was that such torture was authorized by the Spanish law of the island, but the accused was convicted in spite of this defence, and the final decision of the Court of King's Bench, in 1812, decreeing a respite of the defendant's recognizances till further order, was perhaps not so much an affirmation of the legality in the particular instance as the practical expression of a wish to spare an eminent public servant.[11] As to India, the second charge against Warren Hastings was extortion from the begums of Oude by means of the torture of their servants.[12] In the present Indian Penal Code and Evidence Act there are provisions intended, as Sir James Stephen says,[13] to prevent the practice of torture by the police for the purpose of extracting confessions from persons in their custody.[14] In Ceylon torture, which had been allowed under the Dutch government, was expressly abolished by royal proclamation in 1799.

United States.—One instance of the *peine forte et dure* is known. It was inflicted in 1692 on Giles Cory of Salem, who refused to plead when arraigned for witchcraft.[15] The constitution of the United States provides, in the words of the Bill of Rights, that cruel and unusual punishments are not to be inflicted.[16] This is repeated in the constitutions of most States. The infliction of cruel and unusual punishment by the master or officer of an American vessel on the high seas, or within the maritime jurisdiction of the United States, is punishable with fine or imprisonment, or both.[17]

Continental States.—The principles of Roman law were generally adopted. Want of space unfortunately prevents a detailed examination of the law of other countries, but that of Italy may fairly be taken as the type of a system which reached at its maturity a certain revolting completeness of which it is difficult to speak with patience. The law as it existed in Italy is contained in a long line of authorities, chiefly supplied by the school of Bologna, beginning with the *glossatores* and coming down through the *post-glossatores*, until the system attained its perfection in the vast work of Farinaccius, written early in the 17th century, where every possible question that could arise is treated with elaborate minuteness. The writings of jurists were supplemented by a large body of legislative enactments in most of the Italian states, extending from the constitutions of the emperor Frederick II. down to the last century. It is not until Bartolus (1314–1357) that the law begins to assume a definite and complete form. In his commentary on book xlviii. of the *Digest* he follows Roman law closely, but introduces some further refinements: *e.g.*, though leading questions may not be asked in the main inquiry they are admissible as subsidiary. There is a beginning of classification of *indicia*. A very full discussion of the law is contained in the work on practice of Hippolytus de Marsiliis,[18] a jurist of Bologna, notorious, on his own admission, as the inventor of the torture of keeping without sleep. He defines the question as *inquisitio veritatis per tormenta et cordis dolorem*, thus recognizing the mental as well as the physical elements in torture. It was to be used only in capital cases and atrocious crimes. The works of Farinaccius and of Julius Clarus nearly a century later were of great authority from the high official positions filled by the writers. Farinaccius was procurator-general to Pope Paul V., and his discussion of torture is one of the most complete of any.[19] It occupies 251 closely printed folio pages with double columns. The length at which the subject is treated is one of the best proofs of the science to which it had been reduced. The chief feature of the work is the minute and skilful analysis of *indicia*, *fama*, *præsumptio*, and other technical terms. Many definitions of *indicium* are suggested, the best perhaps being *conjectura ex probabilibus et non necessariis orta, a quibus potest abesse veritas sed non verisimilitudo.* For every infliction of torture a distinct *indicium* is required. But this rule does not apply where it is inflicted for discovering accomplices or for discovering a crime other than that for which it was originally inflicted. Torture may be ordered in all criminal cases, except small offences, and in certain civil cases, such as denial of a *depositum*, bankruptcy, usury, treasure trove, and fiscal cases. It may be inflicted on all persons, unless specially exempted (clergy, minors, &c.), and even those exempted may be tortured by command of the sovereign. There are three kinds of torture, *levis*, *gravis*, and *gravissima*, the first and second corresponding to the ordinary torture of French writers, the last to the extraordinary. The extraordinary or *gravissima* was as much as could possibly be borne without destroying life. An immense variety of tortures is mentioned, the most usual being the tying of one hand only with the cord. The judge could not begin with torture; it was only a *subsidium*. If inflicted without due course of law, it was void as a proof. The judge was liable to penalties if he tortured without proper *indicia*, if a privileged person, or if to the extent that death or permanent illness was the result. An immense variety of tortures is mentioned, and the list tended to grow, for, as Farinaccius says, judges continually invented new modes of torture to please themselves. Numerous casuistical questions are treated at length. Could a priest reveal an acknowledgment of an intended crime made to him in confession? What kinds of reports or how much hearsay evidence constituted fame? How far was a confession allowed to be extorted by blandishments or false promises on the part of the judge? Were there three or five grades in torture? Julius Clarus of Alessandria was a member of the council of Philip II.[20] To a great extent he follows Farinaccius. He puts the questions for the consideration of the judge with great clearness. They are—whether (1) a crime has been committed, (2) the charge is one in which torture is admissible, (3) the fact can be proved otherwise, (4) the crime was secret or open, (5) the object of the torture is to elicit confession of crime or discovery of accomplices. He admits the tremendous power given to a judge of torturing a witness should he suspect that the latter knows the truth and is concealing it. An accuser may not be racked with the accused in order to test his sincerity. The clergy can be tortured only in charges of treason, poisoning, and violation of tombs. On the great question whether there are three or five grades, he decides in favour of five, viz., threats, taking to the place of torment, stripping and binding, lifting on the rack, racking. Other Italian writers of less eminence have been referred to for the purposes of this article. The burden of their writings is practically the same, but they have not attained the systematic perfection of Farinaccius. Citations from many of them are made by Manzoni (see below). Among others are Guido de Suzara, Paris de Puteo, Ægidius Bossius of Milan, Casonus of Venice, Decianus, Follerius, and Tranquillus Ambrosianus, whose works cover the period from the 13th to the end of the 17th century. The law depended mainly on the writings of the jurists as interpreters of custom. At the same time in all or nearly all the Italian states the customary law was limited, supplemented, or amended by legislation. That a check by legislative authority was necessary appears from the glimpses afforded by the writings of the jurists that the letter of the law was by no means always followed.[1] The earliest legislation after the Roman law seems to be the constitutions of the emperor Frederick II. for Sicily promulgated in 1231.

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[1] The thumbscrew with which Carstares had been tortured was afterwards presented to him as a remembrance by the Privy Council.

[2] Persons subjected to more than usual torture from the boot were said to be "extremely booted."

[3] This seems to have been used in one case in England. Lecky, *Rationalism in Europe*, vol. i. p. 122.

[4] Hallam, *Const. Hist.*, vol. iii. p. 436. See Burnet, *Hist. of Own Time*, vol. i. p. 583, and SCOTLAND, vol. xxi. p. 516.

[5] Froude, *Hist. of England*, vol. viii. p. 386.

[6] *Ibid.*, vol. xi. p. 263.

[7] Jardine, p. 29.

[8] *Cal. State Papers* (Irish series, 1615–1625), p. 78.

[9] Jardine, p. 64.

[10] In the picquet the sufferer was supported only on the great toe (which rested on a sharp stake), and by a rope attached to one arm.

[11] 30 *State Trials*, 449.

[12] See the Report of the Proceedings, vol. i., and Macaulay's Essay on Warren Hastings.

[13] Stephen, *Indian Evidence Act*, p. 126.

[14] §§ 327–331 of Code: §§ 25–27 of Act.

[15] Bouvier, *Law Dict.*, s.v. "Peine Forte et Dure."

[16] Amendments, Art. viii.

[17] *Revised Stat.*, § 5347.

[18] *Practica Criminalis quæ Averolda nuncupatur*, Venice, 1532.

[19] *Praxis et Theorica Criminalis*, bk. ii. tit. v. quæst. 30–51, Frankfort, 1622.

[20] *Practica Criminalis Finalis*, Lyons, 1637.

Several instances of the torture of eminent persons occur in Italian history. The historical case of the greatest literary interest is that of the persons accused of bringing the plague into Milan in 1630 by smearing the walls of houses with poison. An analysis of the case was undertaken by Verri[2] and Manzoni,[3] and puts in a clear light some of the abuses to which the system led in times of popular panic. Convincing arguments are urged by Manzoni, after an exhaustive review of the authorities, to prove the groundlessness of the charge on which two innocent persons underwent the torture of the *canape*, or hempen cord (the effect of which was partial or complete dislocation of the wrist), and afterwards suffered death by breaking on the wheel. The main arguments, shortly stated, are these, all based upon the evidence as recorded and the law as laid down by jurists. (1) The unsupported evidence of an accomplice was treated as an *indicium* in a case not one of those exceptional ones in which such an *indicium* was sufficient. The evidence of two witnesses or a confession by the accused was necessary to establish a remote *indicium*, such as lying. (2) Hearsay evidence was received when primary evidence was obtainable. (3) The confession made under torture was not ratified afterwards. (4) It was made in consequence of a promise of impunity. (5) It was of an impossible crime.

Much general information on the subject will be found in the works of Mr Lea and Mr Lecky, to which reference has already been made, in the *Penny Cyclopædia*, s.v. "Torture," in Zedler's *Universal Lexicon*, s.v. "Tortur," and in Meyer's *Esprit des Institutions Judiciaires*. For England, Jardine's work is the standard authority. Thirty-six kinds of torture are described in Meyer's *Konversations-Lexikon*, s.v. "Tortur." Instruments of torture are still preserved in the Tower of London and in the museums of Munich, Ratisbon, Nuremberg, The Hague, and other places. Those at the Tower are the iron collar, the bilboes, the thumbscrew, and the scavenger's daughter. There is also a model of one of the forms of the rack. (J. Wt.)

TORY. See WHIG AND TORY.

TOTEMISM. A totem is a class of material objects which a savage regards with superstitious respect, believing that there exists between him and every member of the class an intimate and altogether special relation. The name is derived from an Ojibway (Chippeway) word which was first introduced into literature, so far as appears, by J. Long, an Indian interpreter of last century, who spelt it *totam*.[4] The connexion between a man and his totem is mutually beneficent: the totem protects the man, and the man shows his respect for the totem in various ways, by not killing it if it be an animal, and not cutting or gathering it if it be a plant. As distinguished from a fetich, a totem is never an isolated individual, but always a class of objects, generally a species of animals or of plants, more rarely a class of inanimate natural objects, very rarely a class of artificial objects.

Kinds of totems.

Considered in relation to men, totems are of at least three kinds:—(1) the clan totem, common to a whole clan, and passing by inheritance from generation to generation; (2) the sex totem, common either to all the males or to all the females of a tribe, to the exclusion in either case of the other sex; (3) the individual totem, belonging to a single individual and not passing to his descendants. Other kinds of totems exist and will be noticed, but they may perhaps be regarded as varieties of the clan totem. The latter is by far the most important of all; and where we speak of totems or totemism without qualification the reference is always to the clan totem.

Clan totem.

The Clan Totem.—The clan totem is reverenced by a body of men and women who call themselves by the name of the totem, believe themselves to be of one blood, descendants of a common ancestor, and are bound together by common obligations to each other and by a common faith in the totem. Totemism is thus both a religious and a social system. In its religious aspect it consists of the relations of mutual respect and protection between a man and his totem; in its social aspect it consists of the relations of the clansmen to each other and to men of other clans. In the later history of totemism these two sides, the religious and the social, tend to part company; the social system sometimes survives the religious; and, on the other hand, religion sometimes bears traces of totemism in countries where the social system based on totemism has disappeared. We begin with the religious side.

Totemism as a religion.

Totemism as a Religion, or the Relation between a Man and his Totem.—The members of a totem clan call themselves by the name of their totem, and commonly believe themselves to be actually descended from it.

Descent from totem

Thus the Turtle clan of the Iroquois are descended from a fat turtle, which, burdened by the weight of its shell in walking, contrived by great exertions to throw it off, and thereafter gradually developed into a man.[5] The Cray-Fish clan of the Choctaws were originally cray-fish and lived underground, coming up occasionally through the mud to the surface. Once a party of Choctaws smoked them out, and, treating them kindly, taught them the Choctaw language, taught them to walk on two legs, made them cut off their toe nails and pluck the hair from their bodies, after which they adopted them into the tribe. But the rest of their kindred, the cray-fish, are still living underground.[6] The Osages are descended from a male snail and a female beaver. The snail burst his shell, developed arms, feet, and legs, and became a fine tall man; afterwards he married the beaver maid.[7] Some of the clans of western Australia are descended from ducks, swans, and other waterfowl.[8] In Senegambia each family or clan is descended from an animal (hippopotamus, scorpion, &c.) with which it counts kindred.[9]

Somewhat different are the myths in which a human ancestress is said to have given birth to an animal of the totem species. Thus the Snake clan among the Moquis of Arizona are descended from a woman who gave birth to snakes.[10] The Bakaiai in western equatorial Africa believe that their women once gave birth to the totem animals: one woman brought forth a calf, others a crocodile, hippopotamus, monkey, boa, and wild pig.[11]

Respect shown to totem.

Believing himself to be descended from, and therefore akin to, his totem, the savage naturally treats it with respect. If it is an animal he will not, as a rule, kill nor eat it. In the Mount Gambier tribe (South Australia) "a man does not kill or use as food any of the animals of the same subdivision with himself, excepting when hunger compels; and then they express sorrow for having to eat their *wingong* (friends) or *tumanang* (their flesh). When using the last word they touch their breasts, to indicate the close relationship, meaning almost a part of themselves.

To illustrate:—One day one of the blacks killed a crow. Three or four days afterwards a Boortwa (crow) named Larry died. He had been ailing for some days, but the killing of his *wingong* hastened his death.[12] The tribes about the Gulf of Carpentaria greatly reverence their totems: if any one were to kill the totem animal in presence of the man whose totem it was, the latter would say, "What for you kill that fellow? that my father!" or "That brother belonging to me you have killed: why did you do it?"[13] Sir George Grey says of the western Australian tribes that a man will never kill an animal of his *kobong* (totem) species if he finds it asleep; "indeed, he always kills it reluctantly, and never without affording it a chance to escape. This arises from the family belief that some one individual of the species is their nearest friend, to kill whom would be a great crime, and to be carefully avoided."[14] Amongst the Indians of British Columbia a man will never kill his totem animal; if he sees another do it, he will hide his face for shame, and afterwards demand compensation for the act. Whenever one of these Indians exhibits his totem badge (as by painting it on his forehead), all persons of the same totem are bound to do honour to it by casting property before it.[1] The Damaras in South Africa are divided into totem clans, called "eandas"; and according to the clan to which they belong they refuse to partake, *e.g.*, of an ox marked with black, white, or red spots, or of a sheep without horns, or of draught oxen. Some of them will not even touch vessels in which such food has been cooked, and avoid even the smoke of the fire which has been used to cook it.[2] The negroes of Senegambia do not eat their totems.[3] The Mundas (or Mundaris) and Oraons in Bengal, who are divided into exogamous totem clans, will not kill or eat the totem animals which give their names to the clans.[4] A remarkable feature of some of these Oraon totems is that they are not whole animals, but parts of animals, as the head of a tortoise, the stomach of a pig. In such cases (which are not confined to Bengal) it is of course not the whole animal, but only the special part, that the clansmen are forbidden to eat. Such totems may be distinguished as *split totems*. The Jagannáthi Kumhár in Bengal abstain from killing or injuring the totems of their respective clans, and they bow to their totems when they meet them.[5]

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[1] For instance, Paris de Puteo illustrates the extra-legal cruelties sometimes practised by asserting that he saw a judge seize an accused by the hair of the head and dash his head against a pillar in order to extort a confession.

[2] *Osservazioni sulla Tortura.*

[3] *Storia della Colonna Infame.*

[4] *Voyages and Travels of an Indian Interpreter*, p. 86, 1791.

[5] *Second Annual Report of the Bureau of Ethnology*, Washington, 1883, p. 77.

[6] Catlin, *North American Indians*, ii. p. 128.

[7] Schoolcraft, *The American Indians*, p. 95 *sq.*; Lewis and Clarke, *Travels to the Source of the Missouri River*, London, 1815, i. p. 12.

[8] Sir George Grey, *Vocabulary of Dialects of S. W. Australia.*

[9] *Revue d'Ethnographie*, iii. p. 396, v. p. 81.

[10] Bourke, *Snake Dance of the Moquis of Arizona*, p. 177.

[11] Du Chaillu, *Explorations in Equatorial Africa*, p. 308.

[12] Stewart in Fison and Howitt, *Kamilaroi and Kurnai*, p. 169.

[13] *Jour. Anthrop. Inst.*, xiii. p. 300.

[14] Grey, *Journals of Two Expeditions in North-West and Western Australia*, ii. p. 228.

Split totems.

Plant totems.

When the totem is a plant the rules are such as these. A native of western Australia, whose totem is a vegetable, "may not gather it under certain circumstances and at a particular period of the year."[6] An Oraon clan, whose totem is the kujrar tree, will not eat the oil of that tree, nor sit in its shade.[7] The Red Maize clan of the Omahas will not eat red maize. Those of the people of Ambon and Uliase who are descended from trees may not use these trees for firewood.

Totem taboos.

The rules not to kill or eat the totem are not the only taboos; the clansmen are often forbidden to touch the totem or any part of it, sometimes even to look at it.

Thus the Elk clan of the Omahas neither eat the flesh nor touch any part of the male elk.[8] The Deer-Head clan of the Omahas may not touch the skin of any animal of the deer family, nor wear moccasins of deer skin, nor use the fat of the deer for hair-oil; but they may eat the flesh of deer.[9] Of the totem clans in Bengal it is said that they "are prohibited from killing, eating, cutting, burning, carrying, using, &c.," the totem.[10] The Bechuanas in South Africa, who have a well-developed totem system, may not eat nor clothe themselves in the skin of the totem animal.[11] They even avoid, at least in some cases, to look at the totem. Thus to a man of the Bakuena (Bakwain) or Crocodile clan, it is "hateful and unlucky" to meet or gaze on a crocodile; the sight is thought to cause inflammation of the eyes.

Totem kept in captivity.

Sometimes the totem animal is fed or even kept alive in captivity. Among the mountaineers of Formosa each clan or village keeps its totem (serpent, leopard, &c.) in a cage.[12] A Samoan clan whose totem was the eel used to present the first fruits of the taro plantations to the eels.[13] Amongst the Narrinyeri in South Australia men of the Snake clan sometimes catch snakes, pull out their teeth or sew up their mouths, and keep them as pets.[14] In a Pigeon clan of Samoa a pigeon was carefully kept and fed.[15] Amongst the Kalang in Java, whose totem is the red dog, each family as a rule keeps one of these animals, which they will on no account allow to be struck or ill-used by any one.[16]

Totem buried and mourned.

The dead totem is mourned for and buried like a dead clansman. In Samoa, if a man of the Owl totem found a dead owl by the road side, he would sit down and weep over it and beat his forehead with stones till the blood flowed. The bird would then be wrapped up and buried with as much ceremony as if it had been a human being. "This, however, was not the death of the god. He was supposed to be yet alive, and incarnate in all the owls in existence."[17] The generalization here implied is characteristic of totemism; it is not merely an individual but the species that is reverenced. The Wanika in eastern Africa look on the hyæna as one of their ancestors, and the death of an hyæna is mourned by the whole people; the mourning for a chief is said to be as nothing compared to the mourning for an hyæna.[18] A tribe of southern Arabia used to bury a dead gazelle wherever they found one, and the whole tribe mourned for it seven days.[19] A Californian tribe which reverenced the buzzard held an annual festival at which the chief ceremony was the killing of a buzzard without losing a drop of its blood. It was then skinned, the feathers were preserved to make a sacred dress for the medicine-man, and the body was buried in holy ground amid the lamentations of the old women, who mourned as for the loss of a relative or friend.[20]

Totem not referred to by name.

As some totem clans avoid looking at their totem, so others are careful not to speak of it by its proper name, but use descriptive epithets instead. The three totems of the Delawares—the wolf, turtle, and turkey—were referred to respectively as "round foot," "crawler," and "not chewing," the last referring to the bird's habit of swallowing its food; and the clans called themselves, not Wolves, Turtles, and Turkeys, but "Round Feet," "Crawlers," and "Those who do not chew."[21] The Bear clan of the Ottawas called themselves not Bears but Big Feet.[22] The object of these circumlocutions is probably to give no offence to the worshipful animal.

Consequences of disrespect to totem.

The penalties supposed to be incurred by acting disrespectfully to the totem are various. The Bakalai think that if a man were to eat his totem the women of his clan would miscarry and give birth to animals of the totem kind, or die of an awful disease.[23] The Elk clan among the Omahas believe that if any clansman were to touch any part of the male elk, or eat its flesh or the flesh of the male deer, he would break out in boils and white spots in different parts of the body.[24] The Red Maize subclan of the Omahas believe that, if they were to eat of the red maize, they would have running sores all round their mouth.[25] And in general the Omahas believe that to eat of the totem, even in ignorance, would cause sickness, not only to the eater, but also to his wife and children.[26] The worshippers of the Syrian goddess, whose creed was saturated with totemism, believed that if they ate a sprat or an anchovy their whole bodies would break out in ulcers, their legs would waste away, and their liver melt, or that their belly and legs would swell up.[27]

The Samoans thought it death to injure or eat their totems. The totem was supposed to take up his abode in the sinner's body, and there to gender the very thing which he had eaten till it caused his death.[28]

Samoan mode of appeasing totem.

Thus if a Turtle man ate of a turtle he grew very ill, and the voice of the turtle was heard in his inside saying, "He ate me; I am killing him."[29] In such cases, however, the Samoans had a mode of appeasing the angry totem. The offender himself or one of his clan was wrapped in leaves and laid in an unheated oven, as if he were about to be baked. Thus if amongst the Cuttle-Fish clan a visitor had caught a cuttle-fish and cooked it, or if a Cuttle-Fish man had been present at the eating of a cuttle-fish, the Cuttle-Fish clan met and chose a man or woman who went through the pretence of being baked. Otherwise a cuttle-fish would grow in the stomach of some of the clan and be their death.[30]

Australian food taboos.

In Australia, also, the punishment for eating the totem appears to have been sickness or death.[31] But it is not merely the totem which is tabooed to the Australians; they have, besides, a very elaborate code of food prohibitions, which vary chiefly with age, being on the whole strictest and most extensive at puberty, and gradually relaxing with advancing years. Thus young men are forbidden to eat the emu; if they ate it, it is thought that they would be afflicted with sores all over their bodies.[33]

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[1] R. C. Mayne, *British Columbia*, p. 258.

[2] C. J. Anderson, *Lake Ngami*, 222 *sq.*

[3] *Rev. d'Ethn.*, iii. 396.

[4] Dalton in *Trans. Ethnolog. Soc.*, new series, vi. p. 36; Id., *Ethnol. of Bengal*, pp. 189, 254; *As. Quart. Rev.*, July 1886, p. 76.

[5] *As. Quart. Rev.*, July 1886, p. 79.

[6] Grey, *Journals*, ii. 228 *sq.*

[7] Dalton, *Ethn. of Bengal*, 254; Id., *Trans. Ethnol. Soc.*, vi. 36.

[8] E. James, *Expedition from Pittsburgh to the Rocky Mountains*, i. p. 47; *Third Rep. Bur. Ethnol.*, p. 225.

[9] James, *loc. cit.*; *Third Rep.*, 245.

[10] *As. Quart. Rev.*, July 1886.

[11] Casalis, *The Basutos*, 211.

[12] *Verhandl. der Berliner Gesell. f. Anthropologie*, 1882, p. (62).

[13] Turner, *Samoa*, p. 71.

[14] *Native Tribes of S. Australia*, p. 63.

[15] Turner, *op. cit.*, p. 64.

[16] Raffles, *Hist. of Java*, i. p. 328, ed. 1817.

[17] Turner, *op. cit.*, p. 21, *cf.* 26, 60 *sq.*

[18] Charles New, *Life, Wanderings, &c., in Eastern Africa*, p. 122.

[19] Robertson Smith, *Kinship and Marriage in Early Arabia*, p. 195.

[20] Boscano, in Alfred Robinson's *Life in California*, p. 291 *sq.*; Bancroft, *Native Races of the Pacific States*, iii. p. 168.

[21] Brinton, *The Lenape and their Legends*, p. 39; Morgan, *Anc. Soc.*, p. 171; Heckewelder, p. 247.

[22] See *Acad.*, 27th Sept. 1884, p. 203.

[23] Du Chaillu, *Equat. Afr.*, p. 309.

[24] *Third Rep.*, 225.

[25] *Ibid.*, 231.

[26] James, *Exped. to the Rocky Mountains*, ii. p. 50.

[27] Plutarch, *De Superst.*, 10; Selden, *De Dis Syris*, p. 269 *sq.*, Leipsic, 1668.

[28] Turner, *Samoa*, p. 17 *sq.*

[29] *Ibid.*, p. 50.

[30] Turner, *Samoa*, p. 31 *sq.*

[31] *J. A. I.*, xiii. p. 192.

[33] T. L. Mitchell, *Three Expeditions into the Interior of Eastern Australia*, ii. p. 341.

Totem will not injure clansman.

The relation between a man and his totem is one of mutual help and protection. If the man respects and cares for the totem, he expects that the totem will do the same by him. In Senegambia the totems, when they are dangerous animals, will not hurt their clansmen; *e.g.*, men of the Scorpion clan affirm that scorpions (of a very deadly kind) will run over their bodies without biting them.[1] A Snake clan (Ophiogenes) in Asia Minor, believing that they were descended from snakes, and that snakes were their kinsmen, submitted to a practical test the claims of any man amongst them whom they suspected of being no true clansman. They made a snake bite him; if he survived, he was a true clansman; if he died, he was not.[2] The Psylli, a Snake clan in Africa, had a similar test of kinship; they exposed their new-born children to snakes, and if the snakes left them unharmed or only bit without killing them, the children were legitimate; otherwise they were bastards.[3] In Senegambia, at the present day, a python is expected to visit every child of the Python clan within eight days after birth.[4]

Other totem clans regard a man who has been bitten by the totem, even though he survives, as disowned by the totem, and therefore they expel him from the clan. Among the Crocodile clan of the Bechuanas, if a man has been bitten by a crocodile, or merely had water splashed over him by a crocodile's tail, he is expelled the clan.[5]

Totem helps clansman.

But it is not enough that the totem should merely abstain from injuring, he must positively benefit the men who put their faith in him. The Snake clan (Ophiogenes) of Asia Minor believed that if they were bitten by an adder they had only to put a snake to the wound and their totem would suck out the poison and soothe away the inflammation and the pain.[6] Hence Omaha medicine-men, in curing the sick, imitate the action and voice of their (individual) totem.[7] Members of the Serpent clan in Senegambia profess to heal by their touch persons who have been bitten by serpents.[8] A similar profession was made in antiquity by Snake clans in Africa, Cyprus, and Italy.[9]

Totem omens.

Again, the totem gives his clansmen important information by means of omens. In the Coast Murring tribe of New South Wales each man's totem warned him of coming danger; if his totem was a kangaroo, a kangaroo would warn him against his foes.[10] The Samoan totems gave omens to their clansmen. Thus, if an owl flew before the Owl clan, as they marched to war, it was a signal to go on; but if it flew across their path, or backwards, it was a sign to retreat.[11] Some kept a tame owl on purpose to give omens in war.[12]

When the conduct of the totem is not all that his clansmen could desire, they have various ways of putting pressure on him.

Thus, in harvest time, when the birds eat the corn, the Small Bird clan of the Omahas take some corn which they chew and spit over the field. This is thought to keep the birds from the crops.[13] If worms infest the corn the Reptile clan of the Omahas catch some of them and pound them up with some grains of corn which have been heated. They make a soup of the mixture and eat it, believing that the corn will not be infested again, at least for that year.[14] During a fog the men of the Turtle subclan of the Omahas used to draw the figure of a turtle on the ground with its face to the south. On the head, tail, middle of the back, and on each leg were placed small pieces of a red breech-cloth with some tobacco. This was thought to make the fog disappear.[15]

Man assimilates himself to totem.

In order, apparently, to put himself more fully under the protection of the totem, the clansman is in the habit of assimilating himself to the totem by dressing in the skin or other part of the totem animal, arranging his hair and mutilating his body so as to resemble the totem, and representing it on his body by cicatrices, tattooing, or paint.

Among the Thlinkets on solemn occasions, such as dances, memorial festivals, and burials, individuals often appear disguised in the full form of their totem animals; and, as a rule, each clansman carries at least an easily recognizable part of his totem with him.[16] Amongst the Omahas, the smaller boys of the Black Shoulder (Buffalo) clan wear two locks of hair in imitation of horns.[17] The Small Bird clan of the Omahas "leave a little hair in front, over the forehead, for a bill, and some at the back of the head, for the bird's tail, with much over each ear for the wings."[18] The Turtle subclan of the Omahas "cut off all the hair from a boy's head, except six locks; two are left on each side, one over the forehead, and one hanging down the back in imitation of the legs, head, and tail of a turtle."[19] The practice of knocking out the upper front teeth at puberty, which prevails in Australia and elsewhere, is, or was once, probably an imitation of the totem. The Batoka in Africa who adopt this practice say that they do so in order to be like oxen, while those who retain their teeth are like zebras.[20]

Tattooing.

The Haidas of Queen Charlotte Islands are universally tattooed, the design being in all cases the totem, executed in a conventional style. When several families of different totems live together in the same large house, a Haida chief will have all their totems tattooed on his person.[21] Tribes in South America are especially distinguished by their tattoo marks, but whether these are totem marks is not said.[22] The Australians do not tattoo but raise cicatrices; in some tribes these cicatrices are arranged in patterns which serve as the tribal badges, consisting of lines, dots, circles, semicircles, &c.[23] According to one authority, these Australian tribal badges are sometimes representations of the totem.[24]

Again, the totem is sometimes painted on the person of the clansman. This, as we have seen (p. 468), is sometimes done by the Indians of British Columbia. Among the Hurons (Wyandots) each clan has a distinctive mode of painting the face; and, at least in the case of the chiefs at installation, this painting represents the totem.[25] Among the Moquis the representatives of the clans at foot-races, dances, &c., have each a conventional representation of his totem blazoned on breast or back.[26]

The clansman also affixes his totem mark as a signature to treaties and other documents,[27] and paints or carves it on his weapons, hut, canoe, &c.

The identification of a man with his totem appears further to have been the object of various ceremonies observed at birth, marriage, death, and on other occasions.

Birth ceremonies.

Birth Ceremonies.—On the fifth day after birth a child of the Deer-Head clan of the Omahas is painted with red spots on its back, in imitation of a fawn, and red stripes are painted on the child's arms and chest. All the Deer-Head men present at the ceremony make red spots on their chests.[28] When a South Slavonian woman has given birth to a child, an old woman runs out of the house and calls out, "A she-wolf has littered a he-wolf," and the child is drawn through a wolfskin, as if to simulate actual birth from a wolf. Further, a piece of the eye and heart of a wolf are sewed into the child's shirt, or hung round its neck; and, if several children of the family have died before, it is called Wolf. The reason assigned for some of these customs is that the witches who devour children will not attack a wolf.[1] In other words, the human child is disguised as a wolf to cheat its supernatural foes. The same desire for protection against supernatural danger may be the motive of similar totemic customs, if not of totemism in general.

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[1] *Revue d'Ethnographie*, iii. p. 396.

[2] Varro in Priscian, x. 32, vol. i. p. 524, ed. Keil. For the snake descent of the clan, see Strabo, xiii. 1, 14; Ælian, *N. A.*, xii. 39.

[3] Varro, *loc. cit.*; Pliny, *N. H.*, vii. § 14. Pliny has got it wrong end on. He says that if the snakes did *not* leave the children they were bastards. We may safely correct his statement by Varro's.

[4] *Revue d'Ethnographie*, iii. p. 397.

[5] Livingstone, *South Africa*, p. 255.

[6] Strabo, xiii. 1, 14.

[7] James, *Expedition to the Rocky Mountains*, i. p. 247.

[8] *Revue d'Ethnographie*, iii. p. 396.

[9] Pliny, *N. H.*, xxviii. 30.

[10] *J. A. I.*, xiii. 195 n, xvi. 46.

[11] Turner, *Samoa*, 21, 24, 60.

[12] *Ibid.*, 25 *sq.*

[13] *Third Report*, p. 238 *sq.* The idea perhaps is that the birds eat in the persons of their clansmen, and give tangible evidence that they have eaten their fill.

[14] *Third Rep.*, 248.

[15] *Third Report*, 240.

[16] Holmberg in *Acta Soc. Scient. Fennicæ*, iv. 293 *sq.*, 328; Petroff, *Report on Population, Industries, and Resources of Alaska*, p. 166.

[17] *Third Rep.*, 229.

[18] *Ibid.*, 238.

[19] *Ibid.*, 240.

[20] Livingstone, *South Africa*, p. 532.

[21] *Geolog. Surv. of Canada, Rep. for 1878–79*, pp. 108B, 135B; *Smithsonian Contrib. to Knowl.*, vol. xxi. No. 267, p. 3 *sq.*; *Nature*, 20th January 1887, p. 285; *Fourth Annual Report of the Bureau of Ethnology*, Washington, 1886, p. 67 *sq.*

[22] Martius, *Zur Ethnographie America's, zumal Brasiliens*, p. 55.

[23] Brough Smyth, *Aborigines of Victoria*, i. p. xli. *sq.*, 295, ii. 313; Eyre, *Jour.*, ii. 333, 335; Ridley, *Kamilaroi*, p. 140; *Jour. and Proc. R. Soc. N. S. Wales*, 1882, p. 201.

[24] Mr Chatfield, in Fison and Howitt, *Kamilaroi and Kurnai*, p. 66 n. On tattooing in connexion with totemism, see Haberlandt in *Mittheil. der anthrop. Gesell. in Wien*, xv. (1885) p. [53] *sq.*

[25] *First Rep.*, pp. 62, 64.

[26] Bourke, *Snake Dance*, p. 229.

[27] Heckewelder, *Indian Nations*, p. 247.

[28] *Third Rep.*, p. 245 *sq.*

Marriage ceremonies.

Marriage Ceremonies.—Among the Kalang of Java, whose totem is the red dog, bride and bridegroom before marriage are rubbed with the ashes of a red dog's bones.[2] Among the Transylvanian Gipsies, bride and bridegroom are rubbed with a weasel skin.[3] The sacred goatskin (*ægis*) which the priestess of Athene took to newly married women may have been used for this purpose.[4] At Rome bride and bridegroom sat down on the skin of the sheep which had been sacrificed on the occasion.[5] An Italian bride smeared the doorposts of her new home with wolf's fat.[6] It is difficult to separate from totemism the custom observed by totem clans in Bengal of marrying the bride and bridegroom to trees before they are married to each other. The bride touches with red lead (a common marriage ceremony) a mahwá tree, clasps it in her arms, and is tied to it. The bridegroom goes through a like ceremony with a mango tree.[7]

Death ceremonies.

Death Ceremonies.—In death, too, the clansman seeks to become one with his totem. Amongst some totem clans it is an article of faith that, as the clan sprang from the totem, so each clansman at death reassumes the totem form. Thus the Moquis, believing that the ancestors of the clans were respectively rattlesnakes, deer, bears, sand, water, tobacco, &c., think that at death each man, according to his clan, is changed into a rattlesnake, a deer, &c.[8] Amongst the Black Shoulder (Buffalo) clan of the Omahas a dying clansman was wrapped in a buffalo robe with the hair out, his face was painted with the clan mark, and his friends addressed him thus: "You are going to the animals (the buffaloes). You are going to rejoin your ancestors. You are going, or your four souls are going, to the four winds. Be strong."[9]

Ceremonies at puberty.

Ceremonies at Puberty.—The attainment of puberty is celebrated by savages with ceremonies some of which seem to be directly connected with totemism. The Australian rites of initiation at puberty include the raising of these scars on the persons of the clansmen and clanswomen which serve as tribal badges or actually depict the totem. They also include those mutilations of the person by knocking out teeth, &c., which we have seen reason to suppose are meant to assimilate the man to his totem.

At one stage of these Australian rites a number of men appear on the scene howling and running on all fours in imitation of the dingo or native Australian dog; at last the leader jumps up, clasps his hands, and shouts the totem name "wild dog."[10] The Coast Murring tribe in New South Wales had an initiatory ceremony at which the totem name "brown snake" was shouted, and a medicine-man produced a live brown snake out of his mouth.[11] As the fundamental rules of totem societies are rules regulating social intercourse, perhaps these pantomimes were intended to supply the youths with a symbolic language by means of which they might communicate with persons speaking different languages, and thus ascertain whether they belonged to clans with which marriage was allowed. The totem clans of the Bechuanas have each its special dance or pantomime, and when they wish to ascertain a stranger's clan they ask him, "What do you dance?"[12] We find elsewhere that dancing has been used as a means of sexual selection.

But in some cases these dances seem to be purely religious. At their initiatory rites the Yuin tribe in New South Wales mould figures of the totems in earth and dance before them, and a medicine-man brings up out of his inside the "magic" appropriate to the totem before which he stands: before the figure of the porcupine he brings up a stuff like chalk, before the kangaroo a stuff like glass, &c.[13]

Again, it is at initiation that the youth is solemnly forbidden to eat of certain foods; but, as the list of foods prohibited to youths at puberty both in Australia and America extends far beyond the simple totem, it would seem that we are here in contact with those unknown general ideas of the savage, whereof totemism is only a special product.

Thus the Narrinyeri youth at initiation are forbidden to eat twenty different kinds of game, besides any food belonging to women. If they eat of these forbidden foods it is thought they will grow ugly.[14] In the Mycoolon tribe, near the Gulf of Carpentaria, the youth at initiation is forbidden to eat of eagle-hawk and its young, native companion and its young, some snakes, turtles, ant-eaters, and emu eggs.[15] The Kurnai youth is not allowed to eat the female of any animal, nor the emu, nor the porcupine. He becomes free by having the fat of the animal smeared on his face.[16] On the other hand, it is said that "initiation confers many privileges on the youths, as they are now allowed to eat many articles of food which were previously forbidden to them."[17] Thus in New South Wales before initiation a boy may eat only the females of the animals which he catches; but after initiation (which, however, may not be complete for several years) he may eat whatever he finds.[18] In North America the Creek youths at puberty were forbidden for twelve months to eat of young bucks, turkey-cocks, fowls, pease, and salt.[19]

Admission to life of clan.

These ceremonies seem also to be meant to admit the youth into the life of the clan, and hence of the totem. The latter appears to be the meaning of a Carib ceremony, in which the father of the youth took a live bird of prey, of a particular species, and beat his son with it till the bird was dead and its head crushed, thus transferring the life and spirit of the martial bird to the future warrior. Further, he scarified his son all over, rubbed the juices of the bird into the wounds, and gave him the bird's heart to eat.[20] Amongst some Australian tribes the youth at initiation is smeared with blood drawn from the arms either of aged men or of all the men present, and he even receives the blood to drink. Amongst some tribes on the Darling this tribal blood is his only food for two days. Among some tribes the youths at initiation sleep on the graves of their ancestors, in order to absorb their virtues.[21] It is, however, a very notable fact that the initiation of an Australian youth is said to be conducted, not by men of the same totem, but by men of that portion of the tribe into which he may marry.[22] In some of the Victorian tribes no person related to the youth by blood can interfere or assist in his initiation.[23] Whether this is true of all tribes and of all the rites at initiation does not appear.

Resurrection.

Connected with totemism is also the Australian ceremony at initiation of pretending to recall a dead man to life by the utterance of his totem name. An old man lies down in a grave and is covered up lightly with earth; but at the mention of his totem name he starts up to life.[1] Sometimes it is believed that the youth himself is killed by a being called Thuremlui, who cuts him up, restores him to life, and knocks out a tooth.[2] Here the idea seems to be that of a second birth, or the beginning of a new life for the novice; hence he receives a new name at the time when he is circumcised, or the tooth knocked out, or the blood of the kin poured on him.[3] Amongst the Indians of Virginia and the Quojas in Africa, the youths after initiation pretended to forget the whole of their former lives (parents, language, customs, &c.), and had to learn everything over again like new-born babes.[4] A Wolf clan in Texas used to dress up in wolf skins and run about on all fours, howling and mimicking wolves; at last they scratched up a living clansman, who had been buried on purpose, and, putting a bow and arrows in his hands, bade him do as the wolves do—rob, kill, and murder.[5] This may have been an initiatory ceremony, revealing to the novice in pantomime the double origin of the clan—from wolves and from the ground. For it is a common belief with totem clans that they issued originally from the ground.

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[1] Krauss, *Sitte und Brauch der Südslaven*, p. 541 *sq.*

[2] Raffles, *Hist. of Java*, i. 328. On rubbing with ashes as a religious ceremony, *cf.* Spencer, *De Legibus Hebraeorum Ritualibus*, vol. ii. diss. iii. lib. iii. cap. 1.

[3] *Original-Mittheil. aus der ethnolog. Abtheil. der königl. Museen zu Berlin*, i. p. 156.

[4] Suidas, *s.v.* *αἰγίς*.

[5] Servius on Virgil, *Æn.*, iv. 374; Festus, *s.v.* *In pelle.*

[6] Pliny, *Nat. Hist.*, xxviii. 112.

[7] Dalton, *Ethn. of Bengal*, 194 (Mundas), 319 (Kurmis). Among the Mundas, both bride and bridegroom are sometimes married to mango trees. For Kurmi totems, see *As. Quart. Rev.*, July 1886, p. 77.

[8] Schoolcraft, *Ind. Tr.*, iv. 86.

[9] *Third Rep.*, p. 229.

[10] *J. A. I.*, xiii. 450.

[11] *Ibid.*, xvi. p. 43.

[12] Livingstone, *South Africa*, p. 13; J. Mackenzie, *Ten Years North of the Orange River*, p. 391, *cf.* p. 135 n.; *J. A. I.*, xvi. 83.

[13] *Jour. and Proc. R. Soc. N. S. Wales*, 1882, p. 206.

[14] *Nat. Tribes of S. Austral.*, p. 17.

[15] *J. A. I.*, xiii. p. 295.

[16] *Ibid.*, xiv. p. 316.

[17] *Ibid.*, 360.

[18] *Jour. and Proc. R. Soc. N. S. Wales*, 1882, pp. 208.

[19] Gatschet, *Migration Legend of the Creek Indians*, i. p. 185.

[20] Rochefort, *Hist. nat. et mor. des Îles Antilles* (Rotterdam, 1665), p. 556; Du Tertre, *Histoire générale des Antilles*, vol. ii. p. 377.

[21] *Jour. and Proc. R. Soc. N. S. Wales*, 1882, p. 172.

[22] Howitt in *J. A. I.*, xiii. 458.

[23] Dawson, *Australian Aborigines*, p. 30.

Connected with this mimic death and revival of a clansman appear to be the real death and supposed revival of the totem itself. We have seen that some Californian Indians killed the buzzard, and then buried and mourned over it like a clansman. But it was believed that, as often as the bird was killed, it was made alive again. Much the same idea appears in a Zuni ceremony described by an eyewitness, Mr Cushing. He tells how a procession of fifty men set off for the spirit-land, or (as the Zunis call it) "the home of our others," and returned after four days, each man bearing a basket full of living, squirming turtles. One turtle was brought to the house where Mr Cushing was staying, and it was welcomed with divine honours. It was addressed as, "Ah! my poor dear lost child or parent, my sister or brother to have been! Who knows which? May be my own great great grandfather or mother?" Nevertheless, next day it was killed and its flesh and bones deposited in the river, that it might "return once more to eternal life among its comrades in the dark waters of the lake of the dead." The idea that the turtle was dead was repudiated with passionate sorrow; it had only, they said, "changed houses and gone to live for ever in the home of 'our lost others.'"[6] The meaning of such ceremonies is not clear. Perhaps, as has been suggested,[7] they are piacular sacrifices, in which the god dies for his people. This is borne out by the curses with which the Egyptians loaded the head of the slain bull.[8]

Sex Totems.—In Australia (but, so far as is known at present, nowhere else) each of the sexes has, at least in some tribes, its special sacred animal, whose name each individual of the sex bears, regarding the animal as his or her brother or sister respectively, not killing it nor suffering the opposite sex to kill it. These sacred animals therefore answer strictly to the definition of totems.

Thus amongst the Kurnai all the men were called Yeerung (Emu-Wren) and all the women Djeetgun (Superb Warbler). The birds called Yeerung were the "brothers" of the men, and the birds called Djeetgun were the women's "sisters." If the men killed an emu-wren they were attacked by the women, if the women killed a superb warbler they were assailed by the men. Yeerung and Djeetgun were the mythical ancestors of the Kurnai.[9] The Kulin tribe in Victoria, in addition to sixteen clan totems, has two pairs of sex totems: one pair (the emu-wren and superb warbler) is identical with the Kurnai pair; the other pair is the bat (male totem) and the small night jar (female totem). The latter pair extends to the extreme north-western confines of Victoria as the "man's brother" and the "woman's sister."[10] The Ta-ta-thi group of tribes in New South Wales, in addition to regular clan totems, has a pair of sex totems, the bat for men and a small owl for women; men and women address each other as Owls and Bats; and there is a fight if a woman kills a bat or a man kills a small owl.[11] Of some Victorian tribes it is said that "the common bat belongs to the men, who protect it against injury, even to the half killing of their wives for its sake. The fern owl, or large goat-sucker, belongs to the women, and, although a bird of evil omen, creating terror at night by its cry, it is jealously protected by them. If a man kills one, they are as much enraged as if it was one of their children, and will strike him with their long poles."[12]

The sex totem seems to be still more sacred than the clan totem; for men who do not object to other people killing their clan totem will fiercely defend their sex totem against any attempt of the opposite sex to injure it.[13]

Individual totems.

Individual Totems.—It is not only the clans and the sexes that have totems; individuals also have their own special totems, *i.e.*, classes of objects (generally species of animals), which they regard as related to themselves by those ties of mutual respect and protection which are characteristic of totemism. This relationship, however, in the case of the individual totem, begins and ends with the individual man, and is not, like the clan totem, transmitted by inheritance. The evidence for the existence of individual totems in Australia, though conclusive, is very scanty. In North America it is abundant.

In Australia we hear of a medicine-man whose clan totem through his mother was kangaroo, but whose "secret" (*i.e.*, individual) totem was the tiger-snake. Snakes of that species, therefore, would not hurt him.[14] An Australian seems usually to get his individual totem by dreaming that he has been transformed into an animal of the species. Thus a man dreamed three times he was a kangaroo; hence he became one of the kangaroo kindred, and might not eat any part of a kangaroo on which there was blood; he might not even carry home one on which there was blood. He might eat cooked kangaroo; but, if he were to eat the meat with the blood on it, the spirits would no longer take him up aloft.[15]

In America the individual totem is usually the first animal of which a youth dreams during the long and generally solitary fasts which American Indians observe at puberty. He kills the animal or bird of which he dreams, and henceforward wears its skin or feathers, or some part of them, as an amulet, especially on the war-path and in hunting.[16] A man may even (though this seems exceptional) acquire several totems in this way; thus an Ottawa medicine-man had for his individual totems the tortoise, swan, woodpecker, and crow, because he had dreamed of them all in his fast at puberty. The respect paid to the individual totem varies in different tribes. Among the Slave, Hare, and Dogrib Indians a man may not eat, skin, nor if possible kill his individual totem, which in these tribes is said to be always a carnivorous animal. Each man carries with him a picture of his totem (bought of a trader); when he is unsuccessful in the chase, he pulls out the picture, smokes to it, and makes it a speech.[17]

The Indians of Canada changed their okki or manitoo (individual totem) if they had reason to be dissatisfied with it; their women had also their okkis or manitoos, but did not pay so much heed to them as did the men. They tattooed their individual totems on their persons.[18] Amongst the Indians of San Juan Capistrano, a figure of the individual totem, which was acquired as usual by fasting, was moulded in a paste made of crushed herbs on the right arm of the novice. Fire was then set to it, and thus the figure of the totem was burned into the flesh.[19] Sometimes the individual totem is not acquired by the individual himself at puberty, but is fixed for him independently of his will at birth. Thus among the tribes of the isthmus of Tehuantepec, when a woman was about to be confined, the relations assembled in the hut and drew on the floor figures of different animals, rubbing each one out as soon as it was finished. This went on till the child was born, and the figure that then remained sketched on the ground was the child's *tona* or totem. When he grew older the child procured his totem animal and took care of it, believing that his life was bound up with the animal's, and that when it died he too must die.[1] Similarly in Samoa, at child-birth the help of several "gods" was invoked in succession, and the one who happened to be addressed at the moment of the birth was the infant's totem. These "gods" were dogs, eels, sharks, lizards, &c. A Samoan had no objection to eat another man's "god"; but to eat his own would have been death or injury to him.[2] Sometimes the okkis or manitoos acquired by dreams are not totems but fetiches, being not classes of objects but individual objects, such as a particular tree, rock, knife, pipe, &c.[3]

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[1] *J. A. I.*, xiii. 453 *sq.*

[2] *Ib.*, xiv. 358.

[3] Angas, i. 115; Brough Smyth, i. 75 n; *J. A. I.*, xiv. 357, 359; *Nat. Tr. of S. Austr.*, pp. 232, 269.

[4] R. Beverley, *History of Virginia* (London, 1722), p. 177 *sq.*; Dapper, *Description de l'Afrique*, p. 268.

[5] Schoolcraft, *Ind. Tr.*, v. 683.

[6] Mr Cushing in *Century Magazine*, May 1883.

[7] See SACRIFICE, vol. xxi. p. 137.

[8] Herod., ii. 39.

[9] Fison and Howitt, 194, 201 *sq.*, 215, 235.

[10] *J. A. I.*, xv. p. 416; *cf.* xii. p. 507.

[11] *Ibid.*, xiv. 350.

[12] Dawson, *Australian Aborigines*, p. 52.

[13] *J. A. I.*, xiv. p. 350.

[14] *Ibid.*, xvi. p. 50.

[15] *Ibid.*, 45.

[16] Catlin, *N. Amer. Indians*, i. p. 36 *sq.*; Schoolcraft, *Ind. Tr.*, v. p. 196; Id., *Amer. Ind.*, p. 213; Sproat, *Scenes and Studies of Savage Life*, p. 173 *sq.*; Bancroft, i. 283 *sq.*: Id., iii. 156; Mayne, *Brit. Columb.*, p. 302; P. Jones, *Hist. Ojebway Ind.*, p. 87 *sq.*, &c.

[17] *Annual Report of the Smithsonian Institution for 1866*, p. 307.

[18] Charlevoix, *Hist. de la Nouv. Fr.*, vi. 67 *sq.* The word *okki* is Huron; *manitoo* is Algonkin (*ibid.*; Sagard, *Le grand Voyage du pays des Hurons*, p. 231).

[19] Boscana in A. Robinson's *Life in California*, pp. 270 *sq.*, 273; Bancroft, i. 414, iii. 167 *sq.*

Besides the clan totem, sex totem, and individual totem, there are (as has been indicated) some other kinds or varieties of totems; but the consideration of them had better be deferred till after the consideration of the social organization based on totemism.

Blood feud.

Social Aspect of Totemism, or the relation of the men of a totem to each other and to men of other totems.—(1) All the members of a totem clan regard each other as kinsmen or brothers and sisters, and are bound to help and protect each other. The totem bond is stronger than the bond of blood or family in the modern sense. This is expressly stated of the clans of western Australia and of north-western America,[4] and is probably true of all societies where totemism exists in full force. Hence in totem tribes every local group, being necessarily composed (owing to exogamy) of members of at least two totem clans, is liable to be dissolved at any moment into its totem elements by the outbreak of a blood feud, in which husband and wife must always (if the feud is between their clans) be arrayed on opposite sides, and in which the children will be arrayed against either their father or their mother, according as descent is traced through the mother or through the father.[5] In blood feud the whole clan of the aggressor is responsible for his deed, and the whole clan of the aggrieved is entitled to satisfaction.[6] Nowhere perhaps is this solidarity carried farther than among the Goajiros in Colombia, South America. The Goajiros are divided into some twenty to thirty totem clans, with descent in the female line; and amongst them, if a man happens to cut himself with his own knife, to fall off his horse, or to injure himself in any way, his family on the mother's side immediately demand payment as blood-money from him. "Being of their blood, he is not allowed to spill it without paying for it." His father's family also demands compensation, but not so much.[7]

Exogamy.

(2) *Exogamy.*—Persons of the same totem may not marry or have sexual intercourse with each other. The Navajos believe that if they married within the clan "their bones would dry up and they would die."[8] But the penalty for infringing this fundamental law is not merely natural; the clan steps in and punishes the offenders. In Australia the regular penalty for sexual intercourse with a person of a forbidden clan is death.

It matters not whether the woman be of the same local group or has been captured in war from another tribe; a man of the wrong clan who uses her as his wife is hunted down and killed by his clansmen, and so is the woman; though in some cases, if they succeed in eluding capture for a certain time, the offence may be condoned. In the Ta-ta-thi tribe, New South Wales, in the rare cases which occur, the man is killed but the woman is only beaten or speared, or both, till she is nearly dead; the reason given for not actually killing her being that she was probably coerced. Even in casual amours the clan prohibitions are strictly observed; any violations of these prohibitions "are regarded with the utmost abhorrence and are punished by death."[9] An important exception to these rules, if it is correctly reported, is that of the Port Lincoln tribe, which is divided into two clans, Mattiri and Karraru, and it is said that though persons of the same clan never marry, yet "they do not seem to consider less virtuous connexions between parties of the same class [clan] incestuous."[10] Again, of the tribes on the lower Murray, lower Darling, &c., it is said that though the slightest blood relationship is with them a bar to marriage, yet in their sexual intercourse they are perfectly free, and incest of every grade continually occurs.[11]

In America the Algonkins consider it highly criminal for a man to marry a woman of the same totem as himself, and they tell of cases where men, for breaking this rule, have been put to death by their nearest relations.[12]

Phratries.

In some tribes the marriage prohibition only extends to a man's own totem clan; he may marry a woman of any totem but his own. This is the case with the Haidas of the Queen Charlotte Islands,[13] and, so far as appears, the Narrinyeri in South Australia,[14] and the western Australian tribes described by Sir George Grey.[15] Oftener, however, the prohibition includes several clans, in none of which is a man allowed to marry. For such an exogamous group of clans within the tribe it is convenient to have a name; we shall therefore call it a phratry (L. H. Morgan), defining it as an exogamous division intermediate between the tribe and the clan. The evidence goes to show that in many cases it was originally a totem clan which has undergone subdivision.

American phratries.

The Choctaws, for example, were divided into two phratries, each of which included four clans; marriage was prohibited between members of the same phratry, but members of either phratry could marry into any clan of the other.[16] The Seneca tribe of the Iroquois was divided into two phratries, each including four clans,—the Bear, Wolf, Beaver, and Turtle clans forming one phratry, and the Deer, Snipe, Heron, and Hawk clans forming the other. Originally, as among the Choctaws, marriage was prohibited within the phratry but was permitted with any of the clans of the other phratry; the prohibition, however, has now broken down, and a Seneca may marry a woman of any clan but his own. Hence phratries, in our sense, no longer exist among the Senecas, though the organization survives for certain religious and social purposes.[17]

The phratries of the Thlinkets and the Mohegans deserve especial attention, because each phratry bears a name which is also the name of one of the clans included in it. The Thlinkets are divided as follows:—Raven phratry, with clans Raven, Frog, Goose, Sea-Lion, Owl, Salmon; Wolf phratry, with clans Wolf, Bear, Eagle, Whale, Shark, Auk. Members of the Raven phratry must marry members of the Wolf phratry, and *vice versa.*[18] Considering the prominent parts played in Thlinket mythology by the ancestors of the two phratries, and considering that the names of the phratries are also names of clans, it seems probable that the Raven and Wolf were the two original clans of the Thlinkets, which afterwards by subdivision became phratries. This was the opinion of the Russian missionary Veniaminoff, the best early authority on the tribe.[19] Still more clearly do the Mohegan phratries appear to have been formed by subdivision from clans. They are as follows:[20]—Wolf phratry, with clans Wolf, Bear, Dog, Opossum; Turtle

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[1] Bancroft, i. 661.

[2] Turner, *Samoa*, 17.

[3] Lafitau, *Mœurs des Sauvages Ameriquains*, i. 370 *sq.*; Charlevoix, *Hist. de la Nouv. Fr.*, vi. 68; Kohl, *Kitchi Gami*, i. 85 *sq.*

[4] Grey, *Jour.*, ii. 231; *Report of the Smithsonian Inst. for 1866*, p. 315; Petroff, *Rep. on Alaska*, p. 165. Other authorities speak to the superiority of the totem bond over the tribal bond (Morgan, *League of the Iroquois*, p. 82; Mayne, *Brit. Columb.*, p. 257; *American Antiquarian*, ii. p. 109).

[5] Grey, *Journals*, ii. 230, 238 *sq.*; *Smithsonian Rep.*, *loc. cit.*

[6] Fison and Howitt, 156 *sq.*, 216 *sq.* Sometimes the two clans meet and settle it by single combat between picked champions (*Jour. and Proc. R. Soc. N. S. Wales*, 1882, p. 226).

[7] Simons in *Proc. R. Geogr. Soc.*, Dec. 1885, p. 789 *sq.*

[8] Bourke, *Snake Dance of the Moquis of Arizona*, p. 279.

[9] Howitt in *Rep. of Smithsonian Inst. for 1883*, p. 804; Fison and Howitt, pp. 64–67, 289, 344 *sq.*; *J. A. I.*, xiv. p. 351 *sq.*

[10] *Nat. Tr. of S. Australia*, p. 222.

[11] *Jour. and Proc. R. Soc. N. S. Wales*, 1883, p. 24; *Transactions of the Royal Society of Victoria*, vi. p. 16.

[12] James in Tanner's *Narr.*, p. 313.

[13] *Geol. Sur. of Canada, Rep. for 1878–79*, p. 134n.

[14] *Nat. Tr. of S. Austr.*, p. 12; *J. A. I.*, xii. p. 46.

[15] Grey, *Jour.*, ii. p. 226.

[16] *Archæologia Americana, Trans. and Collect. Americ. Antiq. Soc.*, vol. ii. p. 109; Morgan, *A. S.*, pp. 99, 162.

[17] Morgan, *op. cit.*, pp. 90, 94 *sq.*

[18] A. Krause, *Die Tlinkit-Indianer*, 112, 220; Holmberg, *op. cit.*, 293, 313; Pinart in *Bull. Soc. Anthrop. Paris*, 7th Nov. 1872, p. 792 *sq.*; Petroff, *Rep. on Alaska*, p. 165 *sq.*

[19] Petroff, *op. cit.*, p. 166.

[20] Morgan, p. 174.

phratry, with clans Little Turtle, Mud Turtle, Great Turtle, Yellow Eel; Turkey phratry, with clans Turkey, Crane, Chicken. Here we are almost forced to conclude that the Turtle phratry was originally a Turtle clan which subdivided into a number of clans, each of which took the name of a particular kind of turtle, while the Yellow Eel clan may have been a later subdivision. Thus we get a probable explanation of the origin of split totems; they seem to have arisen by the segmentation of a single original clan, which had a whole animal for its totem, into a number of clans, each of which took the name either of a part of the original animal or of a subspecies of it. We may conjecture that this was the origin of the Grey Wolf and Yellow Wolf and Great Turtle and Little Turtle clans of the Tuscarora-Iroquois;[1] the Black Eagle and White Eagle and the Deer and Deer-Tail clans of the Kaws;[2] and of the Highland Turtle (striped), Highland Turtle (black), Mud Turtle, and Smooth Large Turtle clans of the Wyandots (Hurons).[3] Warren actually states that the numerous Bear clan of the Ojibways was formerly subdivided into subclans, each of which took for its totem some part of the Bear's body (head, foot, ribs, &c.), but that these have now merged into two, the Common Bear and the Grizzly Bear.[4] The subdivision of the Turtle (Tortoise) clan, which on this hypothesis has taken place among the Tuscarora-Iroquois, is nascent among the Onondaga-Iroquois, for among them "the name of this clan is Hahnowa, which is the general word for tortoise; but the clan is divided into two septs or subdivisions, the Hanyatengona, or Great Tortoise, and the Nikahnowaksa, or Little Tortoise, which together are held to constitute but one clan."[5]

On the other hand, fusion of clans is known to have taken place, as among the Haidas, where the Black Bear and Fin-Whale clans have united;[6] and the same thing has happened to some extent among the Omahas and Osages.[7]

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tries.

In Australia the phratries are still more important than in America. Messrs Howitt and Fison, who have done so much to advance our knowledge of the social system of the Australian aborigines, have given to these exogamous divisions the name of classes; but the term is objectionable, because it fails to convey (1) that these divisions are kinship divisions, and (2) that they are intermediate divisions; whereas the Greek term phratry conveys both these meanings, and is therefore appropriate.

We have seen examples of Australian tribes in which members of any clan are free to marry members of any clan but their own; but such tribes appear to be exceptional. Often an Australian tribe is divided into two (exogamous) phratries, each of which includes under it a number of totem clans; and oftener still there are subphratries interposed between the phratry and the clans, each phratry including two subphratries, and the subphratries including totem clans. We will take examples of the former and simpler organization first.

The Turra tribe in Yorke Peninsula, South Australia, is divided into two phratries, Wiltŭ (Eaglehawk) and Mūlta (Seal). The Eaglehawk phratry includes ten totem clans (Wombat, Wallaby, Kangaroo, Iguana, Wombat-Snake, Bandicoot, Black Bandicoot, Crow, Rock Wallaby, and Emu); and the Seal phratry includes six (Wild Goose, Butterfish, Mullet, Schnapper, Shark, and Salmon). The phratries are of course exogamous, but (as with the Choctaws, Mohegan, and, so far as appears, all the American phratries) any clan of the one phratry may intermarry with any clan of the other phratry.[8] But the typical Australian tribe is divided into two exogamous phratries; each of these phratries is subdivided into two subphratries; and these subphratries are subdivided into an indefinite number of totem clans. The phratries being exogamous, it follows that their subdivisions (the subphratries and clans) are so also. The well-known Kamilaroi tribe in New South Wales will serve as an example. Its subdivisions are as follows:[9]—

Phratries.	Subphratries.	Totem Clans.
Dilbi.	Muri.[10] Kubi.	Kangaroo, Opossum, Bandicoot, Padimelon, Iguana, Black Duck, Eaglehawk, Scrub Turkey, Yellow-Fish, Honey-Fish, Bream, Emu, Carpet-Snake, Black Snake, Red Kangaroo, Honey, Walleroo, Frog, Cod-Fish.
Kupathin.	Ipai. Kumbo.	

In such tribes the freedom of marriage is still more curtailed. A subphratry is not free to marry into either subphratry of the other phratry; each subphratry is restricted in its choice of partners to one subphratry of the other phratry; Muri can only marry Kumbo, and *vice versa*; Kubi can only marry Ipai, and *vice versa*. Hence (supposing the tribe to be equally distributed between the phratries and subphratries), whereas under the two phratry and clan system a man is free to choose a wife from half the women of the tribe, under the phratry, subphratry, and clan system he is restricted in his choice to one quarter of the women.

Equivalences of Australian tribal divisions.

A remarkable feature of the Australian social organization is that divisions of one tribe have their recognized equivalents in other tribes, whose languages, including the names for the tribal divisions, are quite different. A native who travelled far and wide through Australia stated that "he was furnished with temporary wives by the various tribes with whom he sojourned in his travels; that his right to these women was recognized as a matter of course; and that he could always ascertain whether they belonged to the division into which he could legally marry, 'though the places were 1000 miles apart, and the languages quite different.'"[11] Again, it is said that "in cases of distant tribes it can be shown that the class divisions correspond with each other, as for instance in the classes of the Flinders river and Mitchell river tribes; and these tribes are separated by 400 miles of country, and by many intervening tribes. But, for all that, class corresponds to class in fact and in meaning and in privileges, although the name may be quite different and the totems of each dissimilar."[12] Particular information, however, as to the equivalent divisions is very scanty.[13] This systematic correspondence between the intermarrying divisions of distinct and distant tribes, with the rights which it conveys to the members of these divisions, points to sexual communism on a scale to which there is perhaps no parallel elsewhere, certainly not in North America, where marriage is always within the tribe, though outside the clan.[14] But even in Australia a man is always bound to marry within a certain kinship group; that group may extend across the whole of Australia, but nevertheless it is exactly limited and defined. If endogamy is used in the sense of prohibition to marry outside of a certain kinship group, whether that group be exclusive of, inclusive of, or identical with the man's own group, then marriage among the totem societies of Australia, America, and India is both exogamous and endogamous; a man is forbidden to marry either within his own clan or outside of a certain kinship group.[15]

Rules of descent.

(3) *Rules of Descent.*—In a large majority of the totem tribes at present known to us in Australia and North America descent is in the female line; *i.e.*, the children belong to the totem clan of their mother, not to that of their father. In Australia the proportion of tribes with female to those with male descent is as four to one; in America it is between three and two to one.

As to the totem tribes of Africa, descent among the Damaras is in the female line,[16] and there are traces of female kin among the Bechuanas.[17] Among the Bakalai property descends in the male line, but this is not a conclusive proof that descent is so reckoned; all the clans in the neighbourhood of the Bakalai have female descent both for blood and property.[18] In Bengal, where there is a considerable body of totem tribes, Mr Risley says that after careful search he and his coadjutors have found no tribe with female descent, and only a single trace of it in one.[19] Among the totem tribes of Bengal descent is male.[1] In Assam the exogamous totem clans of the Kasias have female descent,[2] as also have the exogamous clans of the Garos, but it does not appear whether their clans are totem clans, though some of their legends point to totemism.[3]

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[1] Morgan, *op. cit.*, p. 73. [2] Morgan, p. 156. [3] *First Rep.*, p. 59.

[4] *Collections of the Minnesota Historical Society*, v. p. 49.

[5] H. Hale, *The Iroquois Book of Rites*, p. 53 *sq.*

[6] *Geol. Surv. of Canada, Rep. for 1878-79*, p. 134B.

[7] *Third Rep.*, p. 235; *American Naturalist*, xviii. p. 114.

[8] Fison and Howitt, p. 285. [9] *J. A. I.*, xii. 500.

[10] Corresponding female forms are made by adding *tha* to these male names: Muri—Matha (for Muritha), Kubi—Kubitha, &c.

[11] Fison and Howitt, p. 53 *sq.*; *cf.* Brough Smyth, i. p. 91.

[12] *J. A. I.*, xiii. p. 300.

[13] For a few particulars see Fison and Howitt, 38, 40; Brough Smyth, ii. 288; *J. A. I.*, xiii. 304, 306, 346, xiv. 348 *sq.*, 351

[14] *First Rep.*, p. 63. Between North-American tribes "there were no intermarriages, no social intercourse, no intermingling of any kind, except that of mortal strife" (Dodge, *Our Wild Indians*, p. 45).

[15] *Cf. First Rep.*, *loc. cit.*; *As. Quart. Rev.*, July 1886, p. 89 *sq.*

[16] Anderson, *Lake Ngami*, p. 221.

[17] Casalis, *The Basutos*, p. 179 *sq.*

[18] Du Chaillu, *Journey to Ashango Land*, 429; Id., *Equat. Afr.* 308 *sq.*

[19] *As. Quart. Rev.*, July 1886, p. 94.

Indirect descent.

In the Australian tribal organization of two phratries, four subphratries, and totem clans, there occurs a peculiar form of descent of which no plausible explanation has yet been offered. It seems that in all tribes thus organized the children are born into the subphratry neither of their father nor of their mother, and that descent in such cases is either female or male, according as the subphratry into which the children are born is the companion subphratry of their mother's or of their father's subphratry. In the former case we have what may be called indirect female descent; in the latter, indirect male descent. But it is only in the subphratry that descent is thus indirect. In the totem clan it is always direct; the child belongs to the clan either of its mother or of its father. Thus, in the typical Australian organization, descent, whether female or male, is direct in the phratry, indirect in the subphratry, and direct in the clan.

To take examples, the following is the scheme of descent, so far as the phratries and subphratries are concerned, in the Kamilaroi:—

Phratries.	Male.	Marries	Children are
Dilbi.	Muri.	Kumbo.	Ipai.
	Kubi.	Ipai.	Kumbo
Kupathin.	Ipai.	Kubi.	Muri.
	Kumbo.	Muri.	Kubi.

This is an example of indirect female descent, because the children belong to the companion subphratry of their mother, not to the companion subphratry of their father. But in the totems the female descent is direct; *e.g.*, if the father is Muri-Kangaroo and the mother is Kumbo-Emu, the children will be Ipai-Emu; if the mother is Kumbo-Bandicoot, the children will be Ipai-Bandicoot.[4]

The following is the scheme of descent in the Kiabara tribe:[5]—

Phratries.	Male.	Marries	Children are
Dilebi.	Baring.	Bundah.	Turowine
	Turowine.	Bulcoin.	Baring.
Cubatine.	Balcoin.	Turowine.	Bundah.
	Bundah.	Baring.	Balcoin.

This is an example of indirect male descent, because the children belong to the companion subphratry of their father, not to the companion subphratry of their mother. We have no information as to the totems, but on the analogy of indirect female descent we should expect them to be taken from the father. This at any rate is true of a large tribe or group of tribes to the south of the Gulf of Carpentaria; their rules of marriage and descent, so far as concerns the subphratries, are like those of the Kiabara, and the totems (which at the lower Leichhardt river are the names of fish) are inherited from father to son.[6]

In some Australian tribes sons take their totems from their father and daughters from their mother. Thus the Dieri in South Australia are divided into two phratries, each of which includes under it sixteen totem clans, (Caterpillar, Mullet, Dog, Rat, Kangaroo, Frog, Crow, &c.);[7] and if a Dog man marries a Rat woman, the sons of this marriage are Dogs and the daughters are Rats.[8] The Ikula (Morning Star) tribe, at the head of the Great Australian Bight, has, with certain exceptions, the same rule of descent.[9]

Transition from female to male descent.

Besides the tribes whose line of descent is definitely fixed in the female or male line, or, as with the Dieri and Ikula, half-way between the two, there are a number of tribes among whom a child may be entered in either his mother's or his father's clan. Among the Haidas, children regularly belong to the totem clan of their mother; but in very exceptional cases, when the clan of the father is reduced in numbers, the newly-born child may be given to the father's sister to suckle. It is then spoken of as belonging to the paternal aunt, and is counted to its father's clan.[10] Among the Delawares descent is regularly in the female line; but it is possible to transfer a child to its father's clan by giving it one of the names which are appropriated to the father's clan.[11] In the Hervey Islands, South Pacific, the parents settled beforehand whether the child should belong to the father's or mother's clan. The father usually had the preference; but sometimes, when the father's clan was one which was bound to furnish human victims from its ranks, the mother had it adopted into her clan by having the name of her totem pronounced over it.[12] In Samoa at the birth of a child the father's totem was usually prayed to first; but if the birth was tedious, the mother's totem was invoked; and whichever happened to be invoked at the moment of birth was the child's totem for life.[13]

Arrangement of clans on the march &c.

When a North American tribe is on the march, the members of each totem clan camp together, and the clans are arranged in a fixed order in camp, the whole tribe being arranged in a great circle or in several concentric circles.[14] When the tribe lives in settled villages or towns, each clan has its separate ward.[15] The clans of the Osages are divided into war clans and peace clans; when they are out on the buffalo hunt, they camp on opposite sides of the tribal circle; and the peace clans are not allowed to take animal life of any kind; they must therefore live on vegetables unless they can obtain meat in exchange for vegetables from the war clans.[16] Members of the same clan are buried together and apart from those of other clans; hence the remains of husband and wife, belonging as they do to separate clans, do not rest together.[17] It is remarkable that among the Thlinkets the body must always be carried to the funeral pyre and burned by men of another totem,[18] and the presents distributed on these occasions by the representatives of the deceased must always be made to men of a different clan.[19]

Phratric and subphratric totems.

Here we must revert to the religious side of totemism, in order to consider some facts which have emerged from the study of its social aspect. We have seen that some phratries, both in America and Australia, bear the names of animals;[20] and in the case of the Thlinkets and Mohegans we have seen reason to believe that the animals which give their names to the phratries were once clan totems. The same seems to hold of the names of the Australian phratries, Eaglehawk, Crow, and Seal, or at least of Eaglehawk and Crow, for these are clan totems in other tribes, and are, besides, important figures in Australian mythology. Indeed, there appears to be direct evidence that both the phratries and subphratries actually retain, at least in some tribes, their totems. Thus the Port Mackay tribe in Queensland is divided into two phratries, Yungaru and Wutaru, with subphratries Gurgela, Burbia, Wungo, and Kubera; and the Yungaru phratry has for its totem the alligator, and Wutaru the kangaroo,[21] while the subphratries have for their totems the emu (or the carpet snake), iguana, opossum, and kangaroo (or scrub turkey).[22]

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[1] *As. Quart. Rev.*, July 1886, p. 94.

[2] Dalton, *Ethn. of Beng.*, p. 56 *sq.*; W. W. Hunter, *Statistical Account of Assam*, ii. p. 217 *sq.*

[3] Dalton, *op. cit.*, 60, 63; Hunter, *op. cit.*, ii. 154 *sq.*

[4] Fison and Howitt, p. 37 *sq.*; *J. A. I.*, xiii. 335, 341, 344.

[5] *J. A. I.*, xiii. 336, 341.

[6] *Ibid.*, xii. 504.

[7] *Ibid.*, xii. 500.

[8] Letter of Mr S. Gason to the present writer.

[9] *J. A. I.*, xii. 509.

[10] *Geol. Surv. of Canada*, *Rep. for 1878–79*, p. 134B.

[11] Morgan, *A. S.*, p. 172 *sq.*

[12] Gill, *Myths and Songs of the South Pacific*, p. 36.

[13] Turner, *Samoa*, p. 78 *sq.* The child might thus be transferred to a clan which was that neither of his father nor of his mother.

[14] *First Rep.*, 64; *Third Rep.*, 219; *Amer. Naturalist*, xviii. 113.

[15] Gatschet, *Migration Legend of the Creek Indians*, 154; Bourke, *Snake Dance*, 229; *Acad.*, 27th Sept. 1884, p. 203.

[16] Rev. J. Owen Dorsey in *American Naturalist*, xviii. p. 113.

[17] Adair, *Hist. Amer. Ind.*, 183 *sq.*; Morgan, *A. S.*, 83 *sq.*; Brinton, *The Lenape and their Legends*, 54; Id., *Myths of the New World*, 87 n; A. Hodgson, *Letters from North America*, i. p. 259; Dalton, *Eth. of Beng.*, 56; *cf.* Robertson Smith, *Kinship and Marriage in Early Arabia*, 315 *sq.*

[18] Holmberg, *op. cit.*, 324.

[19] Krause, *Die Tlinkit-Indianer*, 223.

[20] As among the Chickasas, Thlinkets, and Mohegans in America, and the Turra, Ngarego, and Theddora tribes in Australia. The subphratries of the Kiabara also bear animal names.

[21] Fison and Howitt, 38 *sq.*, 40.

[22] Fison and Howitt, p. 41. The totems of the phratries and subphratries are given by different authorities, who write the native names of the subphratries differently. But they seem to be speaking of the same tribe; at least Mr Fison understands them so

As the subphratries of this tribe are said to be equivalent to the subphratries of the Kamilaroi, it seems to follow that the subphratries of the Kamilaroi (Muri, Kubi, Ipai, and Kumbo) have or once had totems also. Hence it appears that in tribes organized in phratries, subphratries, and clans each man has three totems—his phratry totem, his subphratry totem, and his clan totem. If we add a sex totem and an individual totem, each man in the typical Australian tribe has five distinct kinds of totems. What degree of allegiance he owes to his subphratry totem and phratry totem respectively we are not told; indeed, the very existence of such totems, as distinct from clan totems, appears to have been generally overlooked. But we may suppose that the totem bond diminishes in strength in proportion to its extension; that therefore the clan totem is the primary tie, of which the subphratry and phratry totems are successively weakened repetitions.

Sub-totems.

In these totems superposed on totems may perhaps be discerned a rudimentary classification of natural objects under heads which bear a certain resemblance to genera, species, &c. This classification is by some Australian tribes extended so as to include the whole of nature. Thus the Port Mackay tribe in Queensland (see above) divides all nature between the phratries; the wind belongs to one phratry and the rain to another; the sun is Wutaru and the moon is Yungaru; the stars, trees, and plants are also divided between the phratries.[1] As the totem of Wutaru is kangaroo and of Yungaru alligator, this is equivalent to making the sun a kangaroo and the moon an alligator.

The Mount Gambier tribe in South Australia is divided into two phratries (Kumi and Kroki), which again are subdivided into totem clans. Everything in nature belongs to a totem clan, thus:[2]—

Phratries.	Totem Clans.	Including
Kumi.	1. Mûla = Fish-Hawk.	Smoke, honeysuckle, trees, &c.
	2. Parangal = Pelican.	Dogs, blackwood trees, fire, frost (fem.)
	3. Wâ = Crow.	Rain, thunder, lightning, winter, hail, clouds, &c.
	4. Wila = Black Cockatoo.	Stars, moon, &c.
	5. Karato = A harmless Snake.	Fish, stringybark trees, seals, eels, &c.
Kroki.	1. Wêrto = Tea-Tree.	Ducks, wallabies, owls, cray-fish, &c
	2. Mûrna = An edible Root.	Bustards, quails, dolvich (a small kangaroo).
	3 Karâal = Black crestless Cockatoo.	Kangaroo, she-oak trees, summer, sun, autumn (fem.), wind (fem.)

With reference to this classification Mr D. S. Stewart, the authority for it, says, "I have tried in vain to find some reason for the arrangement. I asked, 'To what division does a bullock belong?' After a pause came the answer, 'It eats grass: it is Boortwerio.' I then said, 'A cray-fish does not eat grass; why is it Boortwerio?' Then came the standing reason for all puzzling questions: 'That is what our fathers said it was.'"[3] The natural objects thus classed under and sharing the respect due to the totem may be conveniently called, as Mr Howitt proposes,[4] subtotems. Again, the Wotjoballuk tribe in north-western Victoria has a system of subtotems, thus:[5]—

Phratries.	Totem Clans.	Subtotems.
Krokitch.	1. Hot Wind. 2. White crestless Cockatoo. 3. Belonging to the Sun.	Each totem has subordinate to it a number of objects, animal or vegetable, *e.g.*, kangaroo, red gum-tree, &c.
Gamutch.	4 Deaf Adder. 5. Black Cockatoo. 6. Pelican.	Do.

Of the subtotems in this tribe Mr Howitt says, "They appear to me to be totems in a state of development. Hot wind has at least five of them, white cockatoo has seventeen, and so on for the others. That these subtotems are now in process of gaining a sort of independence may be shown by the following instance: a man who is Krokitch-Wartwut (hot wind) claimed to own all the five subtotems of hot wind (three snakes and two birds), yet of these there was one which he specially claimed as 'belonging' to him, namely, Mormuk (carpet-snake). Thus his totem, hot wind, seems to have been in process of subdivision into minor totems, and this man's division might have become hot wind carpet-snake had not civilization rudely stopped the process by almost extinguishing the tribe."

Diffusion of totemism

Geographical Diffusion of Totemism.—In Australia totemism is almost universal.[6] In North America it may be roughly said to prevail, or have prevailed, among all the tribes east of the Rocky Mountains,[7] and among all the Indian (but not the Eskimo) tribes on the north-west coast as far south as the United States frontier. On the other hand, highly competent authorities have failed to find it among the tribes of western Washington, north-western Oregon, and California.[8] In Panama it exists apparently among the Guaymies; each tribe, family, and individual has a guardian animal, the most prevalent being a kind of parrot.[9] In South America totemism is found among the Goajiros on the borders of Colombia and Venezuela,[10] the Arawaks in Guiana,[11] the Bosch negroes also in Guiana,[12] and the Patagonians.[13] Finding it at such distant points of the continent, we should expect it to be widely prevalent; but, with our meagre knowledge of the South American Indians, this is merely conjecture. The aborigines of Peru and the Salivas on the Orinoco believed in the descent of their tribes from animals, plants, and natural objects, such as the sun and earth;[14] but this, though a presumption, is not a proof of totemism.

In Africa totemism prevails in Senegambia, among the Bakalai on the equator, on the Gold Coast and in Ashantee, and among the Damaras and Bechuanas in southern Africa.[15] There are traces of totemism elsewhere in Africa. In eastern Africa the Gallas are divided into two exogamous sections, and have certain forbidden foods.[16] In Abyssinia certain districts or families will not eat of certain animals or parts of animals.[17] The territory of the Hovas in Madagascar is divided and subdivided into districts, the names of the subdivisions referring "rather to clans and divisions of people than to place." One of these names is "the powerful bird," *i.e.*, either the eagle or the vulture. The same clan is found occupying separate districts.[18] One Madagascar tribe regard a species of lemur as "an embodiment of the spirit of their ancestors, and therefore they look with horror upon killing them." Other Malagasy tribes and families refrain from eating pigs and goats; others will not eat certain vegetables nor even allow them to be carried into their houses.[19] The only occasion when the Sakalava tribe in Madagascar kill a bull is at the circumcision of a child, who is placed on the bull's back during the customary invocation.[20]

In Bengal, as we have seen, there are numerous totem tribes among the non-Aryan races. In Siberia the Yakuts are divided into totem clans; the clansmen will not kill their totems (the swan, goose, raven, &c.);[1] and the clans are exogamous.[2] The Altaians, also in Siberia, are divided into twenty-four clans, which, though interfused with each other, retain strongly the clan feeling; the clans are exogamous; each has its own patron divinity and religious ceremonies; and the only two names of clans of these and kindred tribes of which the meanings are given are names of animals.[3] Totemism exists among the mountaineers of Formosa,[4] and there are traces of it in China.[5] In Polynesia it existed, as we have seen, in Samoa. In Melanesia it appears in Fiji,[6] the New Hebrides,[7] and the Solomon Islands.[8] Amongst the Dyaks there are traces of totemism in the prohibition of the flesh of certain animals to certain tribes, respect for certain plants, &c.[9] It exists in the islands of Ambon, Uliase, Leti, Moa, Lakor, Keisar (Makisar), Wetar, and the Aaru and Babar archipelagos.[10] In the Philippine Islands there are traces of it in the reverence for certain animals, the belief that the souls of ancestors dwell in trees, &c.[11]

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[1] Brough Smyth, i. 91; Fison and Howitt, 168; *cf. J. A. I.*, xiii. 300.

[2] Fison and Howitt, *loc. cit.*

[3] Fison and Howitt, 169.

[4] In *Smithson. Rep. for 1883*, p. 818.

[5] *Ibid.*

[6] Perhaps the only known exceptions are the Kurnai in eastern and the Gournditch-mora in western Victoria. For the latter see Fison and Howitt, p. 275.

[7] Gatschet, *Migration Legend of the Creek Indians*, 153; H. Hale, *The Iroquois Book of Rites*, p. 51.

[8] George Gibbs in *Contrib. to N. American Ethnol.*, i. 184; S. Powers, *Tribes of Calif.*, 5.

[9] A. Pinart in *Revue d'Ethnographie*, vi. p. 36.

[10] Simons in *Proc. R. Geog. Soc.*, Dec. 1885, pp. 786, 796.

[11] Brett, *Ind. Tribes of Guiana*, 98; Im Thurn, *Among the Indians of Guiana*, 175 sq.

[12] Crevaux, *Voyages dans l'Amérique du Sud*, p. 59.

[13] Falkner, *Descr. of Patagonia*, 114.

[14] Garcilasso de la Vega, *Royal Commentaries of the Incas*, pt. i. bk. i. chs. 9, 10, 11, 18; Gumilla, *Hist. de l'Orénoque*, i. 175 *sq.*

[15] *Revue d'Ethnologie*, iii. 396 *sq.*, v. 81; A. B. Ellis, *The Tshi speaking People of the Gold Coast*, p. 204 *sq.*; Bowdich, *Mission to Ashantee*, ed. 1873, p. 216; Du Chaillu, *Equat. Afr.*, 308 *sq.*; Id., *Journey to Ashango Land*, 427, 429; C. J. Anderson, *Lake Ngami*, 221 *sq.*; Livingstone, *Travels in S. Africa*, 13; Casalis, *The Basutos*, 211; J. Mackenzie, *Ten Years North of the Orange River*, 393; *J. A. I.*, xvi. 83 *sq.*

[16] Charles New, *Life, Wanderings, &c., in Eastern Africa*, 272, 274.

[17] Mansfield Parkyns, *Life in Abyssinia*, 293; *Tr. Ethnol. Soc.* new series, vi. 292.

[18] Ellis, *Hist. of Madagascar*, i. 87.

[19] *Folk-Lore Record*, ii. 22, 30.

[20] *Ibid.*, iv. 45.

With regard to ancient nations, totemism may be regarded as certain for the Egyptians, and highly probable for the Semites,[12] Greeks, and Latins. If proved for one Aryan people, it might be regarded as proved for all; since totemism could scarcely have been developed by any one Aryan branch after the dispersion, and there is no evidence or probability that it ever was borrowed. Prof. Sayce finds totemism among the ancient Babylonians, but his evidence is not conclusive.[13]

No satisfactory explanation of the origin of totemism has yet been given. Mr Herbert Spencer finds the origin of totemism in a "misinterpretation of nicknames": savages first named themselves after natural objects, and then, confusing these objects with their ancestors of the same names, reverenced them as they already reverenced their ancestors.[14] But this view attributes to verbal misunderstandings far more influence than, in spite of the so-called comparative mythology, they ever seem to have exercised.

Literature.—Apart from the original authorities, the literature on totemism is very scanty. The importance of totemism for the early history of society was first recognized by Mr J. F. M'Lennan in papers published in the *Fortnightly Review* (Oct. and Nov. 1869, Feb. 1870). The subject has since been treated of by E. B. Tylor, *Early History of Mankind*, p. 284 *sq.*; Sir John Lubbock, *Origin of Civilization*, 260 *sq.*; A. Lang, *Custom and Myth*, p. 260, &c.; Id., *Myth, Ritual, and Religion*, i. p. 58 *sq.*, &c.; E. Clodd, *Myths and Dreams*, p. 99 *sq.*; W. Robertson Smith, *Kinship and Marriage in Early Arabia*. See also SACRIFICE, vol. xxi. p. 135. For fuller details, see J. G. Frazer, *Totemism* (Edinburgh, 1887). (J. G. FR.)

TOTILA. See JUSTINIAN and NARSES.

TOTTENHAM, or TOTTENHAM HIGH CROSS, a suburb of London, in the county of Middlesex, is situated on the old "Great Northern" road, about 4½ miles north from Shoreditch. The cross at Tottenham is not a market-cross, and its origin is doubtful. Towards the close of the 16th century it consisted of a column of wood, capped with a square sheet of lead. The present cross of brick was erected by Dean Wood about 1600, and the ornamental work of stucco was added in 1809. In the time of Isaak Walton there stood over it a shady arbour of woodbine, sweetbriar, jessamine, and myrtle. Formerly Tottenham was noted for its "greens," in the centre of one of which stood the famous old elm trees called the "Seven Sisters"; these were removed in 1840, but the name is preserved in the Seven Sisters Road. Bruce Castle, occupying the site of the old mansion of the Bruces, but built probably by Sir William Compton in the beginning of the 16th century, is now occupied as a private boarding school. The church of All Hallows, Tottenham, was given by David, king of Scotland, probably when he visited Henry in 1126, to the canons of the church of Holy Trinity, London. It has frequently been restored and altered. The older parts are the tower, nave, and south aisle of the Perpendicular period and the south porch of the 16th century. There are a large number of monuments and brasses. Tottenham consists chiefly of an irregular line of houses for about two miles along the high road, with short side streets at intervals. There are a number of almshouses, including the Sanchez almshouses, founded in 1596 by Balthazar Sanchez, or Zanchero, confectioner to Philip of Spain; Reynardson's (1685); Pheasunt's, or "The Pound," for poor widows, originally founded by George Hynningham in 1536, and further endowed by Pheasunt and Saunders; and the sailmakers' almshouses, founded in 1869 by the Drapers' Company for forty-five inmates. The free grammar school was enlarged and endowed in 1686 by Sarah, dowager duchess of Somerset. The population of the urban sanitary district (area 4642 acres) in 1871 was 22,869, and in 1881 it was 46,456.

In the reign of the Confessor the manor of Tottenham was possessed by Earl Waltheof, who in 1070 married Judith, niece of the Conqueror, and was created in 1072 earl of Northumberland, Huntingdon, and Northampton, but joined the conspiracy against William, was betrayed by his wife, and was beheaded at Winchester. It was inherited by his daughter Maud, who was married first to Simon de St Liz and afterwards to David, son of Malcolm III., king of Scotland, who was created by Henry I. earl of Huntingdon, and received possession of all the lands formerly held by Earl Waltheof. In 1184 the manor was granted by William the Lion, king of Scotland, to his brother David, earl of Angus and Galloway, the grant being confirmed in 1199 by King John of England, who created him earl of Huntingdon. He married Maud, heiress of Hugh, earl of Chester, and his son John inherited both earldoms. The son married Helen, daughter of Llewelyn, prince of Wales, by whom he was poisoned in 1237, dying without issue. She retained possession till 1254, when the manor was divided between his coheirs Robert de Brus, John de Baliol, and Henry de Hastings, each division forming a distinct manor bearing the name of its owner. In 1429 they all came into the possession of Alderman Gedeney. William Bedwell, the Arabic scholar, was vicar of Tottenham, and published in 1632 a *Briefe Description of the Towne of Tottenham*, in which he printed for the first time the burlesque poem, the "Turnament of Tottenham."

See Robinson's *History of Tottenham*, 1840.

TOUCAN, the Brazilian name of a bird,[15] long since adopted into nearly all European languages, and apparently first given currency in England (though not then used as an English word) in 1668[16] by Charleton (*Onomasticon*, p. 115); but the bird, with its enormous beak and feather-like tongue, was described by Oviedo in his *Sumario de la Natural Historia de las Indias*, first published at Toledo in 1527 (chap. 42),[1] and, to quote the translation of part of the passage in Willughby's *Ornithology* (p. 129), "there is no bird secures her young ones better from the *Monkeys*, which are very noisom to the young of most Birds. For when she perceives the approach of those Enemies, she so settles her self in her Nest as to put her Bill out at the hole, and gives the *Monkeys* such a welcom therewith, that they presently pack away, and glad they scape so." Indeed, so remarkable a bird must have attracted the notice of the earliest European invaders of America, the more so since its gaudy plumage was used by the natives in the decoration of their persons and weapons. In 1555 Belon (*Hist. Nat. Oyseaux*, p. 184) gave a characteristic figure of its beak, and in 1558 Thevet (*Singularites de la France Antarctique*, pp. 88–90) a somewhat long description, together with a woodcut (in some respects inaccurate, but quite unmistakable) of the whole bird, under the name of "Toucan," which he was the first to publish. In 1560 Gesner (*Icones Avium*, p. 130) gave a far better figure (though still somewhat incorrect) from a drawing received from Ferrerius, and suggested that from the size of its beak the bird should be called *Burhynchus* or *Ramphestes*. This figure, with a copy of Thevet's and a detailed description, was repeated in the posthumous edition (1585) of his larger work (pp. 800, 801). By 1579 Ambroise Paré (*Œuvres*, ed. Malgaigne, iii. p. 783) had dissected a Toucan that belonged to Charles IX. of France, and about the same time Léry (*Voyage fait en la Terre du Bresil*, chap. xi.), whose chief object seems to have been to confute Thevet, confirmed that writer's account of this bird in most respects. In 1599 Aldrovandus (*Ornithologia*, i. pp. 801–803), always ready to profit by Gesner's information, and generally without acknowledgment, again described and repeated the former figures of the bird; but he corrupted his predecessor's *Ramphestes* (which was nearly right) into *Ramphastos*, and in this incorrect form the name, which should certainly be *Rhamphestes* or *Rhamphastes*, was subsequently adopted by Linnæus and has since been recognized by systematists. Into the rest of the early history of the Toucan's discovery it is needless to go.[2] Additional particulars were supplied by many succeeding writers, until in 1834 Gould completed his *Monograph* of the family[3] (with an anatomical appendix by Sir R. Owen), to which, in 1835, he added some supplementary plates; and in 1854 he finished a second and much improved edition. The latest systematic compendium on Toucans is Cassin's "Study of the Ramphastidæ," in the *Proceedings* of the Philadelphia Academy for 1867 (pp. 100–124).

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[1] Strahlenberg, *Description of the North and Eastern Parts of Europe and Asia*, London, 1738, p. 383.

[2] Middendorf, *Siber. Reise*, p. 72, quoted by Lubbock, *Origin of Civilization*, p. 135. The present writer has been unable to find the passage of Middendorf referred to.

[3] W. Radloff, *Aus Siberien*, i. 216, 258. The Ostiaks, also in Siberia, are divided into exogamous clans, and they reverence the bear (Castren, *Vorlesungen über die Altaischen Völker*, 107, 115, 117). This, however, by no means amounts to a proof of totemism.

[4] *Verhandl. d. Berl. Gesell. Anthropologie*, &c., 1882, p. (62).

[5] Morgan, *A. S.*, p. 364 *sq.* One of the aboriginal tribes of China worships the image of a dog (Gray, *China*, ii. 306).

[6] Williams, *Fiji and the Fijians*, ed. 1860, i. 219 *sq.*

[7] Turner, *Samoa*, 334.

[8] Fison and Howitt, p. 37 n.

[9] Low, *Sarawak*, 265 *sq.*, 272–274, 306; St John, *Life in the Forests of the Far East*, i. 186 *sq.*, 203; *cf.* Wilken in *Ind. Gids*, June 1884, p. 988 *sq.*; *Ausland*, 16th June 1884, p. 470.

[10] Riedel, *De sluik- en kroesharige rassen tusschen Papua en Selebes*, pp. 32, 61, 253, 334, 341, 376 *sq.*, 414, 432.

[11] Blumentritt, *Der Ahnencultus und die religiösen Anschauungen der Malaien des Philippinen-Archipel*, 159 *sq.*

[12] See W. R. Smith, *Kinship and Marriage in Early Arabia*.

[13] A. H. Sayce, *The Religion of the Ancient Babylonians*, p. 279 *sq.*

[14] Spencer, *Principles of Sociology*, i. 367.

[15] Commonly believed to be so called from its cry; but Prof. Skeat (*Proc. Philolog. Society*, 15th May 1885) adduces evidence to prove that the Guaraní *Tucă* is from *tĭ*, nose, and *cáng*, bone, *i.e.*, nose of bone.

[16] In 1656 the beak of an "Aracari of Brazil," which was a Toucan of some sort, was contained in the *Musæum Tradescantianum* (p. 2), but the word Toucan does not appear there.

By recent systematists 5 genera and from 50 to 60 species of the Family are recognized; but the characters of the former have never been satisfactorily defined, much less those of numerous subdivisions which it has pleased some writers to invent. There can be little doubt that the bird first figured and described by the earliest authors above named is the *R. toco* of nearly all ornithologists, and as such is properly regarded as the type of the genus and therefore of the Family. It is one of the largest, measuring 2 feet in length, and has a wide range throughout Guiana and a great part of Brazil. The huge beak, looking like the great claw of a lobster, more than 8 inches long and 3 high at the base, is of a deep orange colour, with a large black oval spot near the tip. The eye, with its double iris of green and yellow, has a broad blue orbit, and is surrounded by a bare space of deep orange skin. The plumage generally is black, but the throat is white, tinged with yellow and commonly edged beneath with red; the upper tail-coverts are white, and the lower scarlet. In other species of the genus, 14 to 17 in number, the bill is mostly particoloured—green, yellow, red, chestnut, blue, and black variously combining so as often to form a ready diagnosis; but some of these tints are very fleeting and often leave little or no trace after death. Alternations of the brighter colours are also displayed in the feathers of the throat, breast, and tail coverts, so as to be in like manner characteristic of the species, and in several the bare space round the eye is yellow, green, blue, or lilac. The sexes are almost alike in coloration, and externally differ chiefly in size, the males being largest. The tail is nearly square or moderately rounded. In the genus *Pteroglossus*, the "Aracaris" (pronounced Arassari), the sexes more or less differ in appearance, and the tail is graduated. The species are smaller in size, and nearly all are banded on the belly, which is generally yellow, with black and scarlet, while except in two the throat of the males at least is black. One of the most remarkable and beautiful is *P. beauharnaisi*, by some authors placed in a distinct genus and called *Beauharnaisius ulocomus*. In this the feathers of the top of the head are very singular, looking like glossy curled shavings of black horn or whalebone, the effect being due to the dilatation of the shaft and its coalescence with the consolidated barbs. Some of the feathers of the straw-coloured throat and cheeks partake of the same structure, but in a less degree, while the subterminal part of the *lamina* is of a lustrous pearly-white.[4] The beak is richly coloured, being green and crimson above and lemon below. The upper plumage generally is dark green, but the mantle and rump are crimson, as are a broad abdominal belt, the flanks, and many crescentic markings on the otherwise yellow lower parts.[5] The group or genus *Selenodera*, proposed by Gould in 1837 (*Icones Avium*, pt. 1), contains some 6 or 7 species, having the beak, which is mostly transversely striped, and tail shorter than in *Pteroglossus*. Here the sexes also differ in coloration, the males having the head and breast black, and the females the same parts chestnut; but all have a yellow nuchal crescent (whence the name of the group). The so-called Hill-Toucans have been separated as another genus, *Andigena*, and consist of some 5 or 6 species chiefly frequenting the slopes of the Andes and reaching an elevation of 10,000 feet, though one, often placed among them, but perhaps belonging rather to *Pteroglossus*, the *A. bailloni*, remarkable for its yellow-orange head, neck, and lower parts, inhabits the lowlands of southern Brazil. Another very singular form is *A. laminirostris*, which has affixed on either side of the maxilla, near the base, a quadrangular ivory-like plate, forming a feature unique in this or almost in any Family of Birds. The group *Aulacorhamphus*, or "Groove-bills," with a considerable but rather uncertain number of species, contains the rest of the Toucans.

The monstrous serrated bill that so many Toucans possess was by Buffon, after his manner, accounted a grave defect of Nature, and it must be confessed that no one has given what seems to be a satisfactory explanation of its precise use, though on evolutionary principles none will now doubt its fitness to the bird's requirements. Solid as it looks, its weight is inconsiderable, and the perfect hinge by which the maxilla is articulated adds to its efficiency as an instrument of prehension. Swainson (*Classif. Birds*, ii. p. 138) imagined it merely "to contain an infinity of nerves, disposed like net-work, all of which lead immediately to the nostrils," and add to the olfactory faculty. This notion seems to be borrowed from Trail (*Trans. Linn. Society*, xi. p. 289), who admittedly had it from Waterton, and stated that it was "an admirable contrivance of nature to increase the delicacy of the organ of smell;" but Sir R. Owen's description shews this view to be groundless, and he attributes the extraordinary development of the Toucan's beak to the need of compensating, by the additional power of mastication thus given, for the absence of any of the grinding structures that are so characteristic of the intestinal tract of vegetable-eating birds—its digestive organs possessing a general simplicity of formation. The question is one worth deciding, and would not be difficult to decide by those who have the opportunity. The nostrils are placed so as to be in most forms invisible until sought, being obscured by the frontal feathers or the backward prolongation of the horny sheath of the beak. The wings are somewhat feeble, and the legs have the toes placed in pairs, two before and two behind. The tail is capable of free vertical motion, and controlled by strong muscles, so that, at least in the true Toucans, when the bird is preparing to sleep, it is reverted and lies almost flat on the back, on which also the huge bill reposes, pointing in the opposite direction.

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[1] The writer has only been able to consult the reprint of this rare work contained in the *Biblioteca de Autores Españoles* (xxii. pp. 473–515), published at Madrid in 1852.

[2] One point of some interest may, however, be noticed. In 1705 Plot (*N. H. Oxfordshire*, p. 182) recorded a Toucan found within two miles of Oxford in 1644, the body of which was given to the repository in the medical school of that university, where, he said, "it is still to be seen." Already in 1700 Leigh in his *Lancashire* (i. p. 195, Birds, tab. 1, fig. 2) had figured another which had been found dead on the coast of that county about two years before. The bird is easily kept in captivity, and no doubt from early times many were brought alive to Europe. Besides the one dissected by Paré, as above mentioned, Joh. Faber, in his additions to Hernandez's work on the Natural History of Mexico (1651), figures (p. 697) one seen and described by Puteus (Dal Pozzo) at Fontainebleau.

[3] Of this the brothers Sturm in 1841 published at Nuremberg a German version.

[4] This curious peculiarity naturally attracted the notice of the first discoverer of the species, Poeppig, who briefly described it in a letter published in Froriep's *Notizen* (xxxii. p. 146) for December 1831.

[5] Readers of Mr Bates's *Naturalist on the River Amazons* will recollect the account (ii. p. 344) and illustration there given of his encounter with a flock of this species of Toucan. His remarks on the other species with which he met are also excellent.

As may be inferred from the foregoing, the Toucans are a Neotropical form, and by far the greater number inhabit the northern part of South America, especially Guiana and the valley of the Amazons. Some three species occur in Mexico, and several in Central America. One, *R. vitellinus*, which has its headquarters on the mainland, is said to be common in Trinidad, but none are found in the Antilles proper. The precise place of the Family in the heterogeneous group *Picariæ* cannot yet be determined. Its nearest allies perhaps exist among the *Capitonidæ*; but none of them are believed to have the long feather-like tongue which is so characteristic of the Toucans, and is, so far as known, possessed besides only by the *Momotidæ* (*cf.* MOTMOT, vol. xvii. p. 3). But of these last there is no reason to deem the Toucans close relatives, and, according to Swainson (*ut supra*, p. 141), who had opportunities of observing both, the alleged resemblance in their habits has no existence. Those of the Toucans in confinement have been well described by Broderip and Vigors (*Zool. Journal*, i. p. 484; ii. p. 478), and indeed may be partially observed in many zoological gardens. Though feeding mainly on fruits, little seems amiss to them, and they swallow grubs, reptiles, and small birds with avidity. They are said to nest in hollow trees, and to lay white eggs. (A. N.)

TOUCH may be defined as a sense of pressure, referred usually to the surface of the body. It is often understood as a sensation of contact as distinguished from pressure, but it is evident that, however gentle be the contact, a certain amount of pressure always exists between the sensitive surface and the body touched. Mere contact in such circumstances is gentle pressure; a greater amount of force causes a feeling of resistance or of pressure referred to the skin; a still greater amount causes a feeling of muscular resistance, as when a weight is supported on the palm of the hand; whilst, finally, the pressure may be so great as to cause a feeling of pain. The force may not be exerted vertically on the sensory surface, but in the opposite direction, as when a hair on a sensory surface is pulled or twisted. Touch is therefore the sense by which mechanical force is appreciated, and it presents a strong resemblance to hearing, in which the sensation is excited by intermittent pressures on the auditory organ. In addition to feelings of contact or pressure referred to the sensory surface, contact may give rise to a sensation of temperature, according as the thing touched feels hot or cold. These sensations of contact, pressure, or temperature are usually referred to the skin or integument covering the body, but they are experienced to a greater or less extent when any serous or mucous surface is touched. The skin being the chief sensory surface of touch, it is there that the sense is most highly developed, both as to delicacy in detecting minute pressures and as to the character of the surface touched. Tactile impressions, properly so called, are absent from internal mucous surfaces, as has been proved in men having gastric, intestinal, and urinary fistulæ. In these cases, touching the mucous surface caused pain, and not a sensation of touch.

Organs of Touch.—Comparative Sketch.—The organs of touch present many varieties of form, from a simple filament of sensitive protoplasm to a highly complex end-organ connected with the commencement of a sensory nerve-fibre. The bodies of the lowest organisms are formed of contractile protoplasm, and mechanical contact with any resisting substances causes a change of form. Here is the simplest kind of touch—a response on the part of any portion of the surface of the body to a mechanical stimulus. The pseudopodia of the *Rhizopoda* are also organs of touch, and probably the cilia, the flagellæ, and the short rod-like bodies seen on many *Infusoria* belong to the same class of sensory organs. Among the *Cœlentera* (hydroid polyps, tubularians, *Hydromedusæ*, *Medusæ*, *Anthozoa* or sea-anemones) tentacles are found, usually arranged in circles around the mouth or on portions of the body engaged in locomotion, as on the margins of the umbrella of *Medusæ*. These have a large amount of sensibility, and serve as organs of touch. In some also there are stiff hairs on the tentacles and around the mouth, more differentiated tactile organs. The *Vermes* show organs of touch in the form of modified cells of the integument, connected with sensory nerves. These cells often assume the form of stiff rods projected from the surface (tactile setæ). Such are often found over the whole body of *Turbellaria* and *Nemertina*, on the tentacles of *Bryozoa*, on the head segment of *Lumbricidæ*, and on the tentacles and antennæ of *Chætopoda*. In the latter group of animals tactile organs are also found in ring-like arrangements, called cirrhi, on the foot-stumps or parapodia. In some *Hirudinea* (leeches) complicated tactile rods are embedded in cup-shaped organs scattered over the body. Large prominences of the cuticle, called tactile papillæ, are also found in many of the *Vermes* near the oral and genital orifices. The *Echinodermata* have also special parts devoted to touch, and these show their highest differentiation in the tentacles of the *Holothuroida*. *Arthropoda* show tactile organs in the form usually of rod-like bodies projecting from the surface of the appendages and chiefly connected with nerves passing to ganglionic cells. In *Crustacea* such organs are found on the antennæ and other appendages, and on the antennæ in *Myriapoda* and *Insecta*. In the latter they are also found on the tarsal joints of the feet. The appearance of these rod-like bodies is seen in fig. 1.

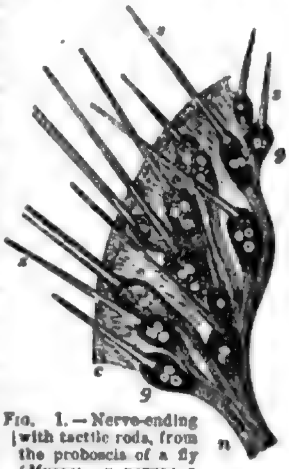


FIG. 1.—Nerve-ending with tactile rods, from the proboscis of a fly (*Musca*). *n*, nerve; *g*, ganglionic swelling; *s*, tactile rods; *c*, fine hairs of cuticle (Leydig).

Ciliated tentacular processes exist in the larva of *Brachiopoda* which are probably touch organs, but there are no definite organs of this kind in the adult form. The *Mollusca* have the sense of touch widely diffused. All the soft parts of the body are capable of feeling when touched, and in various situations there are fine hair-like prolongations from cells. These are supplied with nerves, and are touch organs. Such are found on the edge of the mantle in *Lamellibranchiata*, where they may be in rows; they also exist on the siphons, and "they serve to watch over the particles that get into the mantle cavity with the water" (Gegenbaur). Processes of a tactile kind are also found on the epipodium, the edge of the mantle, and the cephalic tentacles in many *Gasteropoda*, and on the dorsal tufts of the *Nudibranchiata*. Here and there also there are enlargements of the integument covered with cilia and supplied by a nerve which have been regarded as touch organs, but are by some supposed to be connected with smell (see SMELL). The *Tunicata* have cells with long filamentous processes in the integument, which are probably tactile in function.

In the great majority of fishes touch is limited to the lips, to parts of the fins, and to special organs called barbels. In the *Cyprinoids* there is a fold of skin bordering the mouth which is highly tactile. The lip of the sturgeon is covered with numerous papillæ; the sucking lip of the lamprey is papillose and highly sensitive. The fins are in many fishes modified to serve as organs of touch. Thus the gurnards (*Triglidæ*) have three soft flexible rays detached from the fin, and "the filiform radial appendages of the *Polynemidæ*, the prolonged ventral fins of *Osphromenus*, *Trichogaster*, and other Labyrinthibranchs, and of the *Ophidiidæ*," are examples of this class of organs (Owen). The barbels are long slender processes of skin, either single or in pairs, found in the *Siluridæ*, loaches, barbels, cods, sturgeons, and in the parasitic *Myxinidæ*. The nerves for the barbels come from the fifth pair of cranial nerves. "A cod, blind by absence or destruction of both eyeballs, has been captured in good condition, and it may be supposed to have found its food by exploring with the symphysial barbule, as well as by the sense of smell" (Owen). Bodies somewhat similar to the Pacinian corpuscles (to be afterwards described) were discovered by Savi in 1844 in the torpedo; they are arranged in linear series on the anterior part of the mouth and nostrils, and over the fore part of the electrical organs. Each is composed of two capsules, one connected with the other, and containing a granular substance in which the nerve end is embedded. Peculiar mucous glands are also found outside the electrical organs of the torpedo which are believed to minister to touch. Similar organs exist in sharks, and John Hunter dissected the snout of the spotted dog-fish (*Scyllium*) "to show the manner of the nerves ramifying as also their apparent termination in this part, each ultimate nerve appearing to terminate in the bottom of a tube or duct, the sides of which secrete and convey a thick mucus to the skin." These "nervo-mucous" organs are found in the sides and under part of the head and on the fore part of the trunk.

The *Amphibia* and *Reptilia* do not show any special organs of touch. The lips of tadpoles have tactile papillæ. Some snakes have a pair of tentacles on the snout, but the tongue is probably the chief organ of touch in most serpents and lizards. All reptiles possessing climbing powers have the sense of touch highly developed in the feet.

Birds have epithelial papillæ on the soles of the toes that are no doubt tactile. These are of great length in the capercailzie (*Tetrax urogallus*), "enabling it to grasp with more security the frosted branches of the Norwegian pine trees" (Owen). It has been suggested that the delicate "papillose" digits of the smaller birds assist them in nest-building by having the sense of touch highly developed. Around the root of the bill in many birds there are special tactile organs, assisting the bird to use it as a kind of sensitive probe for the detection in soft ground of the worms, grubs, and slugs that constitute its food. Special bodies of this kind have been detected in the beak and tongue of the duck and goose, called the tactile corpuscles of Merkel, or the corpuscles of Grandry (fig. 2). Similar bodies have been found in the epidermis of man and mammals, in the outer root-sheath of tactile hairs or feelers. They consist of small bodies composed of a capsule enclosing two or more flattened nucleated cells, piled in a row. Each corpuscle is separated from the others by a transparent protoplasmic disk. Nerve fibres terminate either in the cells (Merkel) or in the protoplasmic intercellular matter (Ranvier, Hesse, Izquierdo). Another form of end-organ has been described by Herbst as existing in the mucous membrane of the duck's tongue. These corpuscles of Herbst are like small Pacinian corpuscles with thin and very close lamellæ. Developments of integument devoid of feathers, such as the "wattles" of the cock, the "caruncles" of the vulture and turkey, are not tactile in their function.

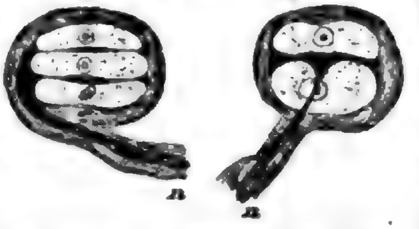


Fig. 2.—Tactile Corpuscles from duck's tongue. n, nerve.

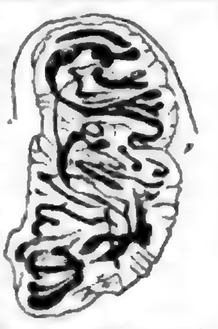


Fig. 3.—Tactile Corpuscle from the hand.

In the great majority of *Mammalia* the general surface of the skin shows sensitiveness, and this is developed to a high degree on certain parts, such as the lips, the end of a teat, and the generative organs. Where touch is highly developed, the skin, more especially the epidermis, is thin and devoid of hair. In the Monkeys tactile papillæ are found in the skin of the fingers and palms, and in the skin of the prehensile tails of various species (*Ateles*). Such papillæ also abound in the naked skin of the nose or snout, as in the shrew, mole, pig, tapir, and elephant. In the *Ornithorhynchus* the skin covering the mandibles is tactile (Owen). In many animals certain hairs acquire great size, length, and stiffness. These constitute the vibrissæ, or whiskers. Each large hair grows from a firm capsule sunk deep in the true skin, and the hair bulb is supplied with sensory nerve filaments. In the walrus the capsule is cartilaginous in texture. The marine *Carnivora* have strong vibrissæ which "act as a staff, in a way analogous to that held and applied by the hand of a blind man" (Owen). Each species has hairs of this kind developed on the eyebrows, lips, or cheeks, to suit a particular mode of existence, as, for example, the long fine whiskers of the night-prowling felines, and in the aye-aye, a monkey having nocturnal habits. In the *Ungulata* the hoofs need no delicacy of touch as regards the discrimination of minute points. Such animals, however, have broad, massive sensations of touch, enabling them to appreciate the firmness of the soil on which they tread, and under the hoof we find highly vascular and sensitive lamellæ or papillæ, contributing no doubt, not only to the growth of the hoof, but also to its sensitiveness. The *Cetacea* have numerous papillæ in the skin, regarding which John Hunter remarks: "These villi are soft and pliable; they float in water; and each is longer or shorter according to the size of the animal. In the spermaceti whale they are about a quarter of an inch long; in the grampus, bottlenose, much shorter; in all they are extremely vascular; they are sheathed in corresponding hollows of the epiderm." In some whales the skin is thrown into numerous longitudinal plaits on the under and fore part of the body (*Balænoptera*). Prof. Owen remarks regarding these: "It is peculiar to the swifter swimming whales that pursue mackerel and herring, and may serve to warn them of shoals, by appreciation of an impulse of the water rebounding therefrom, and so conveying a sense of the propinquity of sunken rocks or sand-banks. Sensitiveness to the movements of the ambient ocean is indicated by certain observed phenomena. The whale-fishers aver that when a straggler is attacked its fellows will bear down from some miles' distance, as if to its assistance; and it may be that they are attracted by perception of the vibration of the water caused by the struggles of the harpooned whale or cachalot" (Owen's *Comparative Anatomy*, vol. iii. p. 189). Bats have the sense of touch strongly developed in the wings and external ears, and in some species in the flaps of skin found near the nose. These "nose-leaves" and expanded ears frequently show vibratile movements, like the antennæ of insects, enabling the animal to detect slight atmospheric impulses. In the vampires (*Desmodi*) and fruit-eating bats (*Pteropi*) the auricular and nasal appendages are small; "such sensitive tactile guides or warners in flight are only needed in the bats of active food, which must follow in swift evolutions, like the swallows, but in gloom, the volatile insects that people the summer air at dawn or dusk" (Owen). There is little doubt that many special forms of tactile organs will be found in animals using the nose or feet for burrowing. A peculiar end-organ has been found in the nose of the mole, while there are "end-capsules" in the tongue of the elephant and "nerve rings" in the ears of the mouse.

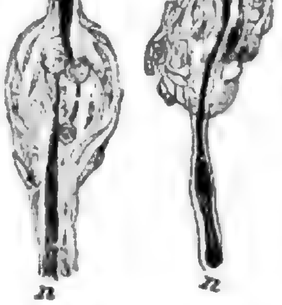


Fig. 4.—Tactile Corpuscles from clitoris of rabbit. n, nerve.

End-Organs of Touch in Man.—In man three special forms of tactile end-organs have been described, and can be readily demonstrated.

(1) *The End-Bulbs of Krause.*—These are oval or rounded bodies, from $\frac{1}{350}$ to $\frac{1}{170}$ of an inch long. Each consists of a delicate capsule, composed of nucleated connective tissue enclosing numerous minute cells. On tracing the nerve fibre, it is found that the nerve sheath is continuous with the capsule, whilst the axis cylinder of the nerve divides into branches which lose themselves among the cells. Waldeyer and Longworth state that the nerve fibrils terminate in the cells, thus making these bodies similar to the cells described by Merkel (*ut supra*). See fig. 5. These bodies are found in the deeper layers of the conjunctiva, margins of the lips, nasal mucous membrane, epiglottis, fungiform and circumvallate papillæ of the tongue, glans penis and clitoris, mucous membrane of the rectum of man, and they have also been found on the under surface of the "toes of the guinea-pig, ear and body of the mouse, and in the wing of the bat" (Landois and Stirling). In the genital organs aggregations of end-bulbs occur, known as the "genital corpuscles of Krause" (fig. 4). In the synovial membrane of the joints of the fingers there are larger end-bulbs, each connected with three or four nerve-filaments.

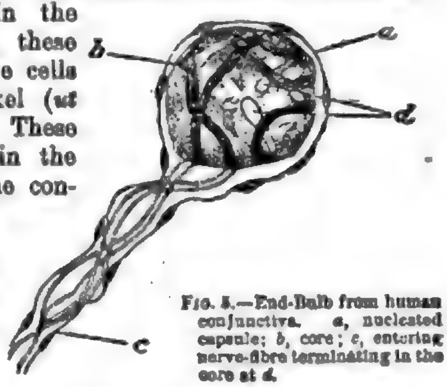


Fig. 5.—End-Bulb from human conjunctiva. a, nucleated capsule; b, core; c, entering nerve-fibre terminating in the core at d.

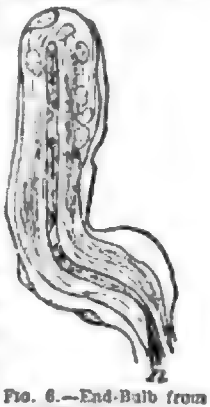


Fig. 6.—End-Bulb from conjunctiva of calf. n, nerve.

(2) *The Touch Corpuscles of Wagner and Meissner.*—These are oval bodies, about $\frac{1}{300}$ of an inch long by $\frac{1}{500}$ of an inch in breadth. Each consists of a series of layers of connective tissue arranged transversely, and containing in the centre granular matter with nuclei (fig. 7). One, two, or three nerve fibres pass to the lower end of the corpuscle, wind transversely around it, lose the

white substance of Schwann, penetrate into the corpuscle, where the axis cylinders, dividing, end in some way unknown. The corpuscles do not contain any soft core, but are apparently built up of irregular septæ of connective tissue, in the meshes of which the nerve fibrils end in expansions similar to Merkel's cells. Dr Thin describes simple and compound corpuscles according to the number of nerve fibres entering them. These bodies are found abundantly in the palm of the hand and sole of the foot, where there may be as many as 21 to every square millimetre (1 mm. = $\frac{1}{25}$ inch). They are not so numerous on the back of the hand or foot, mamma, lips, and tip of the tongue, and they are rare in the genital organs. "Kollmann describes three special tactile areas in the hand :—(1) the tips of the fingers, with 24 touch corpuscles in a length of 10 mm.; (2) the three eminences lying on the palm behind the slits between the fingers, with 5·4–2·7 touch-corpuscles in the same length; and (3) the ball of the thumb and little finger, with 3·1–3·5 touch corpuscles. The first two areas also contain many of the corpuscles of Vater or Pacini, whilst in the latter these corpuscles are fewer and scattered. In the other parts of the hand the nervous end-organs are much less developed" (Landois and Stirling).

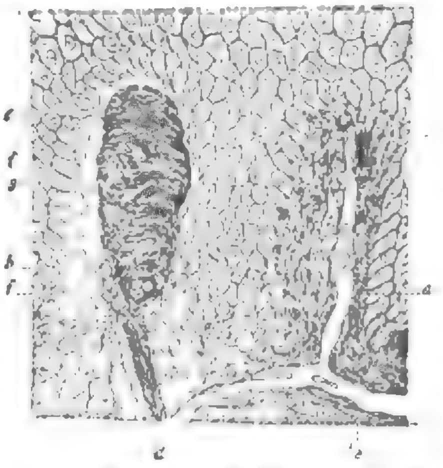


Fig. 7.—Vertical Section of the Skin of the palm of the hand. *a*, blood-vessel; *b*, papilla of the cutis vera; *c*, capillary; *d*, nerve-fibre passing to a touch-corpuscle; *e*, Wagner's touch-corpuscle; *f*, nerve-fibre, divided transversely; *g*, cells of the Malpighian layer of the skin. (From Landois and Stirling, after Biesiadecki.)

(3) *The Corpuscles of Vater or Pacini.*—These, first described by Vater so long ago as 1741, are small oval bodies, quite visible to the naked eye, from $\frac{1}{12}$ to $\frac{1}{10}$ of an inch long and $\frac{1}{25}$ to $\frac{1}{20}$ of an inch in breadth, attached to the nerves of the hands and feet. They can be readily demonstrated in the mesentery of the cat (fig. 8). Each corpuscle consists of 40 to 50 lamellæ or coats, like the folds of an onion, thinner and closer together on approaching the centre. Each lamella is formed of an elastic material mixed with delicate connective tissue fibres, and the inner surface of each is lined by a single continuous layer of endothelial cells. A double-contoured nerve fibre passes to each. The white substance of Schwann becomes continuous with the lamellæ, whilst the axis cylinder passes into the body, and ends in a small knob or in a plexus. Sometimes a blood-vessel also penetrates the Pacinian body, entering along with the nerve. Such bodies are found in the subcutaneous tissue on the nerves of the fingers and toes, near joints, attached to the nerves of the abdominal plexuses of the sympathetic, on the coccygeal gland, on the dorsum of the penis and clitoris, in the meso-colon, in the course of the intercostal and periosteal nerves, and in the capsules of lymphatic glands (William Stirling).

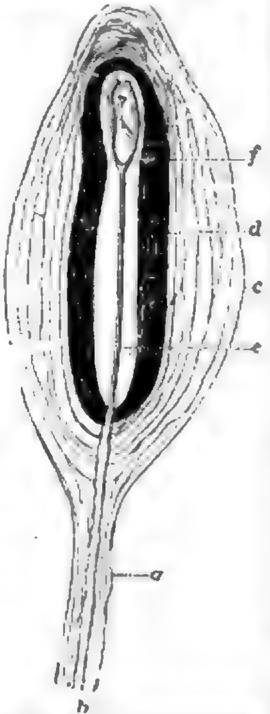


Fig. 8.—Vater's or Pacini's Corpuscle. *a*, stalk; *b*, nerve-fibre entering it; *c*, *d*, connective tissue envelope; *e*, axis cylinder, with its end divided at *f*.

Physiology of Touch in Man.—Such are the special end-organs of touch. It has also been ascertained that many sensory nerves end in a plexus of network, the ultimate fibrils being connected with the cells of the particular tissue in which they are found. Thus they exist in the cornea of the eye, and at the junctions of tendons with muscles. In the latter situation "flattened end-flakes or plates" and "elongated oval end-bulbs" have also been found (Sachs, Rollett, Golgi). A consideration of these various types of structure show that they facilitate intermittent pressure being made on the nerve endings. They are all, as it were, elastic cushions into which the nerve endings penetrate, so that the slight variation of pressure will be transmitted to the nerve. Probably also they serve to break the force of a sudden shock on the nerve endings.

Sensitiveness and Sense of Locality.—The degree of sensitiveness of the skin is determined by finding the smallest distance at which the two points of a pair of compasses can be felt. This method, first followed by Weber, is employed by physicians in the diagnosis of nervous affections involving the sensitiveness of the skin. The following table shows the sensitiveness in millimetres for an adult, whilst the corresponding numbers for a boy of 12 years of age are given within brackets (Landois and Stirling, after Weber):—

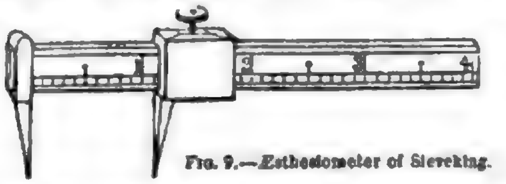


Fig. 9.—*Æsthesiometer of Sieveking.*

	Millimetres.	
Tip of tongue	1·1	[1·1]
Third phalanx of finger, volar surface	2–2·3	[1·7]
Red part of the lip	4·5	[3·9]
Second phalanx of finger, volar surface	4–4·5	[3·9]
First phalanx of finger, volar surface	5–5·5	
Third phalanx of finger, dorsal surface	6·8	[4·5]
Tip of nose	6·8	[4·5]
Head of metacarpal bone, volar	5–6·8	[4·5]
Ball of thumb	6·5–7	
Ball of little finger	5·5–6	
Centre of palm	8–9	
Dorsum and side of tongue; white of the lips; metacarpal part of the thumb	9	[6·8]
Third phalanx of the great toe, plantar surface,	11·3	[6·8]
Second phalanx of the fingers, dorsal surface	11·3	[9]
Back	11·3	[9]
Eyelid	11·3	[9]
Centre of hard palate	13·5	[11·3]
Lower third of the fore-arm, volar surface	15	
In front of the zygoma	15·8	[11·3]
Plantar surface of the great toe	15·8	[9]
Inner surface of the lip	20·3	[13·5]
Behind the zygoma	22·6	[15·8]
Forehead	22·6	[18]
Occiput	27·1	[22·6]
Back of the hand	31·6	[22·6]
Under the chin	33·8	[22·6]
Vertex	33·8	[22·6]
Knee	36·1	[31·6]
Sacrum (gluteal region)	44·6	[33·8]
Fore-arm and leg	45·1	[33·8]
Neck	54·1	[36·1]
Back of the fifth dorsal vertebra; lower dorsal and lumbar region	54·1	
Middle of the neck	67·7	
Upper arm; thigh; centre of the back	67·7	[31·6–40·6]

These investigations show not only that the skin is sensitive, but that one is able with great precision to distinguish the part touched. This latter power is usually called the *sense of locality*, and it is influenced by various conditions. The greater the number of sensory nerves in a given area of skin the greater is the degree of accuracy in distinguishing different points. Contrast in this way the tip of the finger and the back of the hand. Sensitiveness increases from the joints towards the extremities, and, as pointed out by Vierordt, sensitiveness is great in parts of the body that are actively moved. The sensibility of the limbs is finer in the transverse axis than in the long axis of the limb, to the extent of $\frac{1}{4}$ on the flexor surface of the upper limb and $\frac{1}{8}$ on the extensor surface (Landois). It is doubtful if exercise improves sensitiveness, as Francis Galton found that the performances of blind boys were not superior to those of other boys, and he says that "the guidance of the blind depends mainly on the multitude of collateral indications, to which they give much heed, and not their superiority to any one of them." When the skin is moistened with indifferent fluids sensibility is increased. Suslowa made the curious discovery that, if the area between two points distinctly felt be tickled or be stimulated by a weak electric current, the impressions are fused. Stretching the skin, and baths in water containing carbonic acid or common salt, increase the power of localizing tactile impressions. In experimenting with the compasses, it will be found that a smaller distance can be distinguished if one proceeds from greater to smaller distances than in the reverse direction. A smaller distance can also be detected when the points of the compasses are placed one after the other on the skin than when they are placed simultaneously. If the points of the compasses are unequally heated, the sensation of two contacts becomes confused. An anæmic condition, or a state of venous congestion, or the application of cold, or violent stretching of the skin, or the use of such substances as atropine, daturin, morphia, strychnine, alcohol, bromide of potassium, cannabin, and hydrate of chloral blunt sensibility. The only active substance said to increase it is caffein.

Absolute sensitiveness, as indicated by a *sense of pressure*, has been determined by various methods. Two different weights are placed on the part, and the smallest difference in weight that can be perceived is noted. Weber placed small weights directly on the skin; Aubert and Kammler loaded small plates; Dohrn made use of a balance, having a blunt point at one end of the beam, resting on the skin, whilst weights were placed on the other end of the beam to equalize the pressure; Eulenberg invented an instrument like a spiral spring paper-clip or balance (the baræsthesiometer), having an index showing the pressure in grammes; Goltz employed an india-rubber tube filled with water, and this, "to ensure a constant surface of contact, bent at one spot over a piece of cork, is touched at that spot by the cutaneous part to be examined, and, by rhythmically exerted pressure, waves analogous to those of the arterial pulse are produced in the tube" (Hermann); and Landois invented a mercurial balance, enabling him to make rapid variations in the weight without giving rise to any shock (figured in Landois and Stirling's *Physiology*, p. 1155). These methods have given the following general results. (1) The greatest acuteness is on the forehead, temples, and back of the hand and forearm, which detect a pressure of ·002 gramme; fingers detect ·005 to ·015 gramme; the chin, abdomen, and nose ·04 to ·05 gramme. (2) Goltz's method gives the same general results as Weber's experiment with the compasses, with the exception that the tip of the tongue has its sensation of pressure much lower in the scale than its sensation of touch. (3) Eulenberg found the following gradations in the fineness of the pressure sense:—the forehead, lips, back of the cheeks, and temples appreciate differences of $\frac{1}{40}$ to $\frac{1}{30}$ (200 : 205 to 300 : 310 grammes). The back of the last phalanx of the fingers, the forearm, hand, 1st and 2d phalanges, the palmar surface of the hand, forearm, and upper arm distinguish differences of $\frac{1}{10}$ to $\frac{1}{20}$ (200 : 220 to 200 : 210 grammes). The front of the leg and thigh is similar to the forearm. Then follow the back of the foot and toes, the sole of the foot, and the back of the leg and thigh. Dohrn placed a weight of 1 gramme on the skin, and then determined the least additional weight that could be detected, with this result:—3d phalanx of finger, ·499 gramme; back of the foot, ·5 gramme; 2d phalanx, ·771 gramme; 1st phalanx, ·82 gramme; leg, 1 gramme; back of hand, 1·156 grammes; palm, 1·108 grammes; patella, 1·5 grammes; forearm, 1·99 grammes; umbilicus, 3·5 grammes; and back, 3·8 grammes (Landois and Stirling). (4) In passing from light to heavier weights, the acuteness increases at once, a maximum is reached, and then with heavy weights the power of distinguishing the differences diminishes (Hering, Biedermann). (5) A sensation of pressure after the weights have been removed may be noticed (*after-pressure sensation*), especially if the weight be considerable. (6) Valentine noticed that, if the finger were held against a blunt-toothed wheel, and the wheel were rotated with a certain rapidity, he felt a *smooth* margin. This was experienced when the intervals of time between the contacts of successive teeth were less than from $\frac{1}{480}$ to $\frac{1}{640}$ of a second. The same experiment can be readily made by holding the finger over the holes in one of the outermost circles of a large syren rotating quickly: the sensations of individual holes become fused, so as to give rise to a feeling of touching a slit. (7) Vibrations of strings are detected even when the number is about 1500 per second; above this the sensation of vibration ceases. By attaching bristles to the prongs of tuning forks, and bringing these into contact with the lip or tongue, sensations of a very acute character are experienced, which are most intense when the forks vibrate from 600 to 1500 per second.

Information from Tactile Impressions.—These enable us to come to the following conclusions. (1) We note the existence of something touching the sensory surface. (2) From the intensity of the sensation we determine the weight, tension, or intensity of the pressure. This sensation is in the first instance referred to the skin, but after the pressure has reached a certain amount muscular sensations are also experienced—the so-called muscular sense. (3) The locality of the part touched is at once determined, and from this the probable position of the touching body. Like the visual field, to which all retinal impressions are referred, point for point, there is a tactile field, to which all points on the skin surface may be referred. (4) By touching a body at various points, from the difference of pressure and from a comparison of the positions of various points in the tactile field we judge of the configuration of the body. A number of "tactile pictures" are obtained by passing the skin over the touched body, and the shape of the body is further determined by a knowledge of the muscular movements necessary to bring the cutaneous surface into contact with different portions of it. If there is abnormal displacement of position, a false conception may arise as to the shape of the body. Thus, if a small marble or a pea be placed between the index and middle finger so as to touch (with the palm downwards) the outer side of the index finger and the inner side of the middle finger, a sensation of touching *one* round body is experienced; but if the fingers be crossed, so that the marble touches the inner side of the index finger and the outer side of the middle finger, there will be a feeling of *two* round bodies, because in these circumstances there is added to the feelings of contact a feeling of distortion (or of muscular action) like what would take place if the fingers, for purposes of touch, were placed in that abnormal position. Again, as showing that our knowledge of the tactile field is precise, there is the well-known fact that when a piece of skin is transplanted from the forehead to the nose, in the operation for removing a deformity of the nose arising from lupus or other ulcerative disease, the patient feels the new nasal part as if it were his forehead, and he may have the curious sensation of a nasal instead of a frontal headache. (5) From the number of points touched we judge as to the smoothness or roughness of a body. A body having a uniformly level surface, like a billiard ball, is smooth; a body having points irregular in size and number in a given area is rough; and if the points are very close together it gives rise to a sensation, like that of the pile of velvet, almost intolerable to some individuals. Again, if the pressure is so uniform as not to be felt, as when the body is immersed in water (paradoxical as this may seem, it is the case that the sensation of contact is felt only at the limit of the fluid), we experience the sensation of being in contact with a fluid. (6) Lastly, it would appear that touch is always the result of variation of pressure. No portion of the body when touching anything can be regarded as absolutely motionless, and the slight oscillations of the sensory surface, and in many cases of the body touched, produce those variations of pressure on which touch depends.

Theories as to Touch.—To explain the phenomenon of the tactile field, and more especially the remarkable variations of tactile sensibility above described, various theories have been advanced. (1) The one most generally known is that of E. H. Weber, as modified or restated by Lotze, Meissner, Czermak, and others. It assumes that, whilst we refer every tactile sensation to a certain position in the tactile field, we do not refer it merely to a point, but to a circular or oval area on the skin, called a circle of sensibility. Further, it is assumed that if two such circles touch or overlap they cannot be individually perceived, and that they can only be so individually perceived when one or more circles of sensibility intervene, or, in other words, when there is a "non-irritated sensory element" between the two points touched (figs. 10 and 11).

Each circle of sensibility may be supposed to be innervated by a distinct fibre. Thus, suppose the sensitive surface of the skin to be diagrammatically represented as in figs. 10 and 11, each square would be a "circle of sensibility." In more sensitive regions the squares would be smaller and the number of nerve terminations greater than in less sensitive regions. In fig. 10 the area contains nine "circles" and has nine nerve terminations, whilst in fig. 11, although the total area is the same, there are thirty-six "circles" and thirty-six nerve filaments. If the points of the compasses be placed at *a* and *c* in fig. 10 the sensation will be that of one point; there would also be a sensation of one point if they were placed at *c*

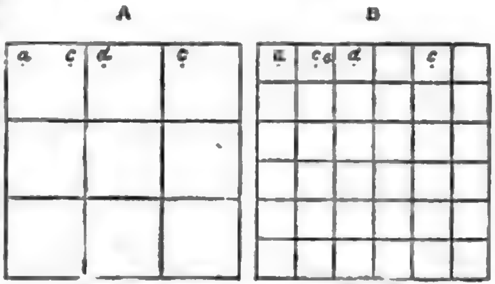


Fig. 10. Fig. 11.

Figs. 10 and 11.—Diagrams of Tactile Innervation. (From Beaunis, *Physiologie Humaine*.)

and *d*; but if the points touch *c* and *e* there will be a double sensation, because the "circle" *d* intervenes. Again, in fig. 11, where the "circles" are much smaller and more numerous, the minimum distance at which two sensations are experienced is much less than in fig. 10, for this would happen when the compasses touch *a* and *d*. It will also be observed that the same distance *d e* in fig. 10 would give a single sensation, whilst it would give a double sensation in fig. 11. But *c e* in fig. 10 gives a double sensation, and yet the same distance would give a single sensation if the points of the compasses touched adjoining "circles." A "circle of sensibility," however, cannot be regarded as an anatomical magnitude or "cutaneous sensory unit," or, in other words, the area of distribution of a single nerve-fibre. The extent of any such hypothetical circle can be altered by practice and attention, and we may therefore assume that the circles overlap, and that even the same area of skin receives numerous nerve filaments, and that consequently, when a body is touched, it excites at once many filaments. This is illustrated by fig. 12.

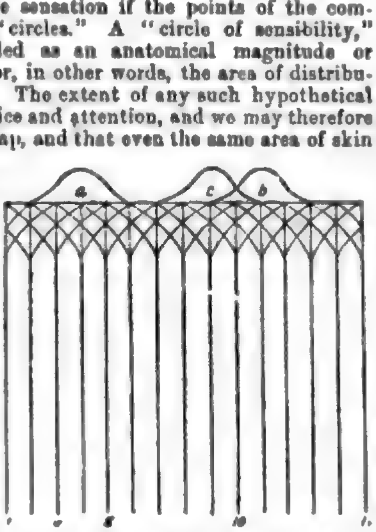


FIG. 12.—Diagram showing overlapping of "circles of sensibility." (From Beaunis.)

It will be seen that each area receives a certain number of nerve fibres and each nerve fibre supplies fibrils that cross the fibrils of adjoining nerves. If the point of the compass touch at *a*, it will irritate all the fibres from 1 to 7, but these will not be excited with equal intensity; the excitation will be at a maximum at 4, more feeble for 3 and 5, and still more feeble for 2 and 6; so that the intensity of the excitation may be represented by the curve above *a*. In this case the sensation will be that of one point, because all the fibrils have been excited. If the other point of the compass be placed at *b*, there will be an intermediary region not excited, and two points will be felt. Suppose now the second point of the compasses is moved to *c*, all the fibrils between the two points *a* and *c* are excited, and there is likely a sensation of single contact; but the excitation of the fibrils 7 and 8 is very feeble, and it is possible, by attention and practice, to leave these out, and then there will be a sensation of two contacts (Beaunis). This mechanical theory has no anatomical basis, except it be the statement made by Krause that the distance of the two points of the compasses at which two points are felt includes in the mean 12 tactile corpuscles. Whilst attention has been mainly directed to the skin as the locality where an anatomical explanation is to be sought for, it must not be forgotten that processes may be in operation in the nerve centres. It is well known that irradiation of nervous impulses occur in the nerve centres (see PHYSIOLOGY, vol. xix. p. 29), and it is not unlikely that, when a nervous impression reaches the brain from a particular area of skin, this may be diffused to neighbouring nerve-cells, exciting these, and that then the effect on these cells, in accordance with the law that sensations in nerve centres are referred to the origins in the periphery of the sensory nerve fibres reaching them, will be referred to adjoining areas of skin, or, in other words, to adjoining points in the tactile field.

Wundt has propounded a psycho-physiological theory that every part of the skin with tactile sensibility always conveys an impression of the locality of the sensation. Each area of skin has a "local colour," and this diminishes from area to area. The gradation is sudden where the sense of locality is acute and gradual where it is obtuse. "A circle of sensation is an area where the local colour changes so little that two separate impressions fuse into one" (Landois). Practice enables one to notice the changes of local colour, and thus more and more accurately to discriminate points closer and closer together. This theory does not appear to explain anything; it simply restates the phenomena for which an explanation is desired.

SENSATIONS OF TEMPERATURE.—The skin is not merely the seat of tactile impressions, but also of impressions of temperature. This depends on thermic irritation of the terminal organs, as proved by the following experiment of E. H. Weber:—"If the elbow be dipped into a very cold fluid, the cold is only felt at the immersed part of the body (where the fibres terminate); pain, however, is felt in the terminal organs of the ulnar nerve, namely, in the finger points; this pain, at the same time, deadens the local sensation of cold." If the sensation of cold were due to the irritation of a specific-nerve fibre, the sensation of cold would be referred to the tips of the fingers. When any part of the skin is above its normal mean temperature, warmth is felt; in the opposite case, cold. The normal mean temperature of a given area varies according to the distribution of hot blood in it and to the activity of nutritive changes occurring in it. When the skin is brought into contact with a good conductor of heat there is a sensation of cold. A sensation of heat is experienced when heat is carried to the skin in any way. The following are the chief facts that have been ascertained regarding the temperature sense. (1) E. H. Weber found that, with a skin temperature of from 15°·5 C. to 35° C., the tips of the fingers can distinguish a difference of ·25° C. to ·2° C. Temperatures just below that of the blood (33° C.–27° C.) are distinguished by the most sensitive parts, even to ·05° C. (2) The thermal sense varies in different regions as follows:—tip of tongue, eyelids, cheeks, lips, neck, belly. The "perceptible minimum" was found to be, in degrees C.:—breast, ·4°; back, ·9°; back of hand, ·3°; palm, ·4°; arm, ·2°; back of foot, ·4°; thigh, ·5°; leg, ·6° to ·2°; cheek, ·4°; temple, ·3°. (3) If two different temperatures are applied side by side and simultaneously, the impressions often fuse, especially if the areas are close together. (4) Practice is said to improve the thermal sense. (5) Sensations of heat and cold may curiously alternate; thus "when the skin is dipped first into water at 10° C. we feel cold, and if it be then dipped into water at 16° C. we have at first a feeling of warmth, but soon again of cold" (Landois). (6) The same temperature applied to a large area is not appreciated in the same way as when applied to a small one; thus "the whole hand when placed in water at 29°·5 C. feels warmer than when a finger is dipped into water at 32° C.

There is every reason to hold that there are different nerve fibres and different central organs for the tactile and thermal sensations, but nothing definite is known. The one sensation undoubtedly affects the other. Thus the minimum distance at which two compass points are felt is diminished when one point is warmer than the other. Again, a colder weight is felt as heavier, "so that the apparent difference of pressure becomes greater when the heavier weight is at the same time colder, and less when the lighter weight is colder, and difference of pressure is felt with equal weights of unequal temperature" (E. H. Weber). Great sensibility to differences of temperature is noticed after removal, alteration by vesicants, or destruction of the epidermis, and in the skin affection called herpes zoster. The same occurs in some cases of locomotor ataxy. Removal of the epidermis, as a rule, increases tactile sensibility and the sense of locality. Increased tactile sensibility is termed *hyperpselaphesia*, and is a rare phenomenon in nervous diseases. Paralysis of the tactile sense is called *hypopselaphesia*, whilst its entire loss is *apselaphesia*. Brown-Séquard mentions a case in which contact of two points gave rise to a sense of a third point of contact. Certain conditions of the nerve centres affect the senses both of touch and temperature. Under the influence of morphia the person may feel abnormally enlarged or diminished in size. As a rule the senses are affected simultaneously, but cases occur where one may be affected more than the other. Herzen states that "limbs which are sleeping" feel heat and not cold (Landois).

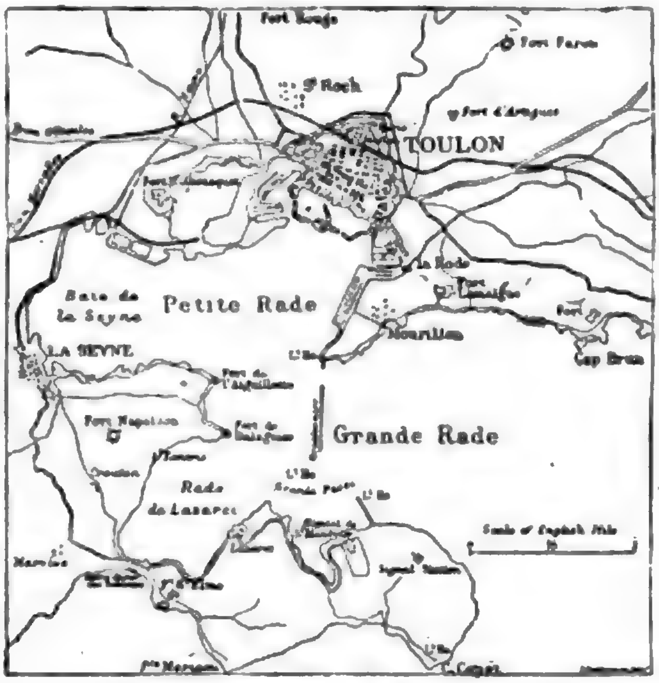
PAIN.—In addition to sensations of touch and of temperature referred to the skin, there is still a third kind of sensation unlike either, namely, pain. This sensation cannot be supposed to be excited by irritations of the end-organs of touch, or of specific thermal end-organs (if there be such), but rather to irritation of ordinary sensory nerves, and there is every reason to believe that painful impressions make their way to the brain along spinal tracks in the spinal cord. If we consider our mental condition as regards sensation at any moment, we notice numerous sensations more or less definite, not referred directly to the surface, nor to external objects, such as a feeling of general comfort, free or impeded breathing, hunger, thirst, malaise, horror, fatigue, and pain. These are all caused by the irritation of ordinary sensory nerves in different localities, and if the irritation of such nerves, by chemical, thermal, mechanical, or nutritional stimuli, passes beyond a certain maximum point of intensity the result is pain. Irritation of a nerve, in accordance with the law of "peripheral reference of sensation," will cause pain. Sometimes the irritation applied to the trunk of a sensory nerve may be so intense as to destroy its normal function, and loss of sensation or anæsthesia results. If then the stimulus be increased further, pain is excited which is referred to the end of the nerve, with the result of producing what has been called *anæsthesia dolorosa*. Pains frequently cannot be distinctly located, probably owing to the fact of irradiation in the nerve centres and subsequent reference to areas of the body which are not really the seat of irritations. The intensity of pain depends on the degree of excitability of the sensory nerves, whilst its massiveness depends on the number of nerve fibres affected. The quality of the pain is probably produced by the kind of irritation of the nerve, as affected by the structure of the part and the greater or less continuance of severe pressure. Thus there are piercing, cutting, boring, burning, throbbing, pressing, gnawing, dull, and acute varieties of pain. Sometimes the excitability of the cutaneous nerves is so great that a breath of air or a delicate touch may give rise to suffering. This *hyperalgia* is found in inflammatory affections of the skin. In *neuralgia* the pain is characterized by its character of shooting along the course of the nerve and by severe exacerbations. In many nervous diseases there are disordered sensations referred to the skin, such as alternations of heat and cold, burning, creeping, itching, and a feeling as if insects were crawling on the surface (formication). This condition is termed *paralgia*. The term *hypalgia* is applied to a diminution and *analgia* to paralysis of pain, as is produced by anæsthetics.

MUSCULAR SENSE.—The sensory impressions considered in this article are closely related to the so-called muscular sense, or that sense or feeling by which we are aware of the state of the muscles of a limb as regards contraction or relaxation. Some have held that the muscular sense is really due to greater or less stretching of the skin and therefore to irritation of the nerves of that organ. That this is not the case is evident from the fact that disordered movements indicating perversion or loss of this sense are not affected by removal of the skin (Claude Bernard). Further, cases in the human being have been noticed where there was an entire loss of cutaneous sensibility whilst the muscular sense was unimpaired. It is also known that muscles possess sensory nerves, giving rise, in certain circumstances, to fatigue, and, when strongly irritated, to the pain of cramp. Muscular sensations are really excited by irritation of sensory nerves passing from the muscles themselves. We are thus made conscious of whether or not the muscles are contracted, and of the amount of contraction necessary to overcome resistance, and this knowledge enables us to judge of the amount of voluntary impulse. Loss or diminution of the muscular sense is seen in chorea and especially in locomotor ataxy. Increase of it is rare, but it is seen in the curious affection called anxietas tibiarum, "a painful condition of unrest, which leads to a continual change in the position of the limbs" (Landois). See also PHYSIOLOGY. (J. G. M.)

TOUL, a town of France, chef-lieu of an arrondissement in the department of Meurthe-et-Moselle, on the left bank of the Moselle, 199 miles east of Paris by the railway to Nancy, at the point where the Marne Canal joins those of the Rhine and the East. The isolated hills of St Michel and Barine respectively rise 548 feet and 574 feet above the town, which is a stronghold of the first order, the centre of an entrenched camp protected by numerous forts and redoubts, and a link in the chain of fortifications which extends from Verdun to Belfort. The light and elegant church of St Étienne (formerly the cathedral) has a fine choir and transept, dating from the 13th century; the nave and aisles are of the 14th, and the beautiful recently restored façade and the towers (246 feet) of the 15th The interior (118 feet in height, 289 in length, and 89 in width) has fine glass, a remarkable organ-loft, and some interesting monuments. The bas-reliefs of the charming Gothic cloister (13th and 14th centuries) were much damaged during the Revolution. The choir and transept of St Gengoult, a fine church of the 13th century with a façade of the 15th, contain some interesting 13th-century glass; and the light groups of supporting columns, and the sculptures in the cloisters (first half of the 16th century), should also be mentioned. The old episcopal palace (18th century) is now used as the town-hall; it contains the museum and library, in which is preserved the golden bull by which the emperor Charles IV. in 1367 confirmed the liberties of the city. The population, 9632 in 1881, was 9981 in 1886 (commune 10,459).

Toul (*Tullum*) is one of the oldest towns of France; originally capital of the Leuci, in the Belgic confederation, it acquired great importance under the Romans. It was evangelized by St Mansuy in the latter half of the 4th century, and became one of the leading sees of north-east Gaul. After being sacked successively by Goths, Burgundians, Vandals, and Huns, Toul was conquered by the Franks in 450. Under the Merovingians it was governed by counts, assisted by elective officers. The bishops, who had become increasingly powerful, were invested with sovereign rights in the 10th century, holding only of the emperor, and for a period of 300 years (13th to 16th centuries) the citizens maintained a long struggle against them. The town was forced to yield for a time to the Count of Vaudemont in the 12th century, and twice to the duke of Lorraine in the 15th, and was thrice devastated by the plague in the 16th. Charles V. made a solemn entry into the town in 1544, but in the following year, at the instance of the Cardinal de Lorraine, it placed itself under the perpetual protection of the kings of France. Henry II. took possession in 1552, but the town with its territory was not officially incorporated with France till 1648. Henry IV. was received in state in 1603, and in 1637 the parlement of Metz was transferred to Toul. In 1700 Vauban reconstructed the fortifications of the town, and in 1790 the bishopric was suppressed and the diocess united to that of Nancy. Toul capitulated in 1870, after a bombardment of twelve days from heights now included in the new fortifications.

TOULON, a French fortress of the first class, chef-lieu of an arrondissement in the department of Var, of the 5th naval arrondissement, and of a military subdivision, is situated on the Mediterranean, 42 miles east-south-east of Marseilles by the railway to Nice. The bay, which opens to the east, has two divisions, the "grand rade" and the "petite rade"; it is sheltered on the north and west by high hills, closed on the south by the peninsula of Capes Sicié and Cépet, and protected on the east by a huge breakwater,—the entrance, 1300 feet wide, being defensible by torpedoes. A ship coming from the open sea must first pass the forts of St Marguerite, of Cape Brun, of La Malgue, and of St Louis to the north, and the battery of the signal station to the south; before reaching the petite rade it must further pass under the guns of the battery of Le Salut to the east, and of the forts of Balaguier and L'Éguillette to the west. The Bay of La Seyne lies west of the petite rade, and is defended by the forts of Les Six-Fours, Napoleon (formerly Fort Cairo), and Malbousquet, and the batteries of Les Arènes and Les Gaus. To the north of Toulon rise the defensive works of Mont Faron and Fort Rouge, to the east the forts of Artigues and St Catherine, to the north-east the formidable new fort of Le Coudon, and to the south-east that of La Colle Noire, respectively dominating the highway into Italy and the valley of Hyères with the Bay of Carqueyranne. The port of Toulon consists of the old dock, of which one-third is reserved for the national navy, a new dock, wholly so devoted, a harbour capable of receiving trading vessels drawing from 16 to 18 feet, but only used for cargoes of wood and wine, and the Castigneau dock. The naval arsenal (including the arsenal of Castigneau, which is contiguous with it, in the direction of La Seyne) extends over 4 miles, has an area of 667 acres, and employs from 12,000 to 13,000 men. It contains the offices connected with the administration of the port, the office of naval construction, a well-stored naval museum, and a great variety of workshops. These last include a rope-work 1050 × 66 feet, covered building yards, careening basins, forges, armourers' and joiners' shops, general magazines, reconstructed on a fireproof principle since the conflagra-

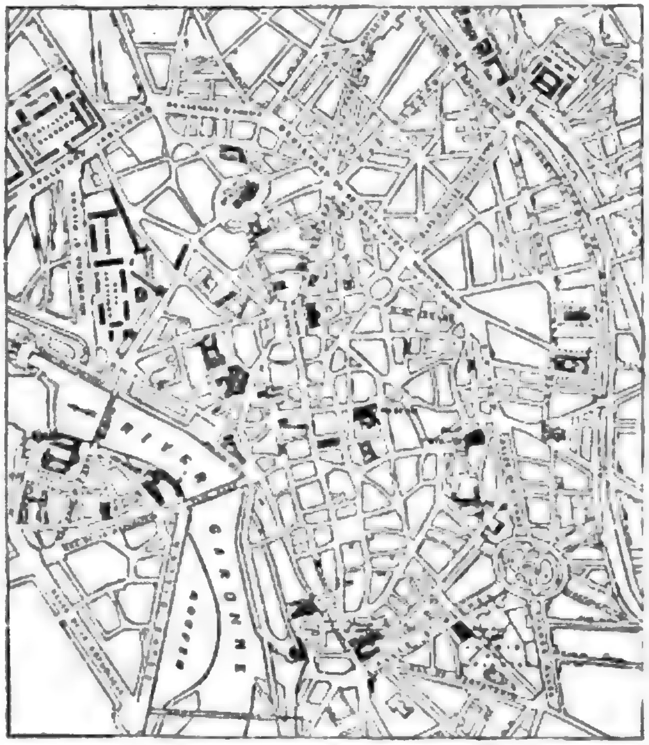


Environs of Toulon.

tion of 1793, in which are stored all materials required in the arsenal and on board ship, a park of artillery, a splendid collection of arms, and separate storehouses for various classes of rigging. The Castigneau arsenal contains the navy bakery of twenty ovens, capable of cooking 600,000 rations daily, the foundry and boiler-making works, engineers' workshops, forges, three large careening basins, a washing house, a slaughter house, stores of provisions, coals, anchors and machinery, and the like. The Mourillon arsenal, to the south-east of the town, has stores of wood, building yards, and appliances for naval construction in wood and iron. The town, enlarged to the north under the second empire, has on that side a fine new quarter; but in the old town the streets are for the most part narrow, crooked, and dirty, and to their insanitary state the cholera epidemic of 1884 has been attributed. The chief buildings are the old cathedral of St Marie Majeure, the church of St Louis, the town-hall, the theatre (seating 2000 persons), the museum, the library (18,000 volumes), the naval and military hospital, with a natural history collection and an anatomical museum attached, a naval school of medicine, a school of hydrography, and large barracks. The imports are wine (2,470,000 gallons in 1881), corn, wood, coal, hemp, iron, sugar, coffee, and fresh fish; the exports are salt, copper ore, barks for tanning, and oils. In 1882 the movement of the port was represented by 280 vessels (41,000 tons). The interesting buildings and gardens of the hospital of St Mandrier stand on the peninsula of Cape Cépet, and near them is the lazaretto. In 1881 the population of Toulon was 48,832, and in 1886 it was 53,941, exclusive of 12,487 soldiers, sailors, &c. (commune 70,122).

The Roman Telo Martius is supposed to have stood near the lazaretto. The town was successively sacked by Goths, Burgundians, Franks, and Saracens. During the early Middle Ages, and till conquered by Charles of Anjou in 1259, it was under lords of its own, and entered into alliance with the republics of Marseilles and Arles. St Louis, Louis XII., and Francis I. strengthened its fortifications. It was seized by the emperor Charles V. in 1524 and 1536. Henry IV. founded a naval arsenal at Toulon, which was further strengthened by Richelieu, and Vauban made the new dock, a new enceinte, and several forts and batteries. In 1707 the town was unsuccessfully besieged by the duke of Savoy, Prince Eugene, and an English fleet. In 1721 there was an outbreak of the plague. In 1792, after great and sanguinary disorder, the royalists of the town sought the support of the English and Spanish fleets cruising in the neighbourhood. The convention having replied by putting the town "hors la loi," the inhabitants opened their harbour to the English. The army of the republic now laid siege to the town, and it was on this occasion that Napoleon Bonaparte first made his name as a soldier. The forts commanding the town having been taken, the English ships retired after setting fire to the arsenal. The conflagration was extinguished by the prisoners, but not before 38 out of a total of 56 vessels had been destroyed. Under the Directory Toulon became the most important French military fort on the Mediterranean; it was here that Napoleon organized the Egyptian campaign, and the expedition against Algiers set out from Toulon in 1830. The fortifications have been strengthened by Napoleon I., Louis Philippe, Napoleon III., and since 1870.

TOULOUSE, chef-lieu of the French department of Haute-Garonne, 478 miles south from Paris and 160 south-east from Bordeaux, stands on the right bank of the Garonne, which here describes a bold outward curve to the east. On the left bank is the Faubourg St Cyprien. The river is spanned by three bridges,—that of St Pierre to the north, that of St Michel towards the south, and the Pont Neuf in the centre; the last-named, a fine construction of seven arches, was begun in 1543. The city is peculiarly subject to great floods, such as that of 1855, which destroyed the suspension bridge of St Pierre, or the still more disastrous one of June 1875, which, besides carrying away that of St Michel, laid the Faubourg St Cyprien under water, destroyed 7000 houses, and drowned 300 people. East and north of the city runs the great Canal du Midi (from the Mediterranean), which here joins the Garonne. Between this canal and the city proper extends the long line of boulevards (Boulevards Lacrosses, d'Arcole, du 22 Septembre, &c.) leading by the Allée St Étienne to the Boulingrin, whence a series of allées shoot out in all directions. South-west the Allee St Michel leads towards the Garonne, and south the Grande Allée towards the Faubourg St Michel. These boulevards take the place of the old city walls. Between them and the canal lie the more modern faubourgs of St Pierre, Arnaud-Bernard, Matabiau, &c.



Plan of Toulouse.

The more ancient part of the city consists of narrow irregular pebble-paved streets. Most of the houses are of brick, and none of any great architectural pretensions, except those which date back at least to the 17th century. In 1868 the municipal authorities determined to construct two entirely new streets, broad and straight, intended to cut one another at right angles near the centre of the city. Of these the first, the Rue de Metz, starts eastward from the Pont Neuf, and will ultimately intersect the Rue d'Alsace-Lorraine running from north to south. These alterations, however, go on very slowly. The Place du Capitole may be regarded as the centre, whence streets branch out in every direction. Eastward and north-east the Rue La Fayette leads across the boulevards towards the Allée La Fayette, beyond which, across the Canal du Midi, are the École Vétérinaire and the railway station, and still farther off the obelisk erected to commemorate the battle of Toulouse (April 10, 1814), and the observatory. From the north-west of the Place du Capitole the Rue du Taur runs due north past the ancient Église du Taur to the great Église St Sernin, the largest and most famous church of southern France. From the north-west corner of the same Place the Rue des Lois conducts towards the École de Droit and the arsenal. In a more westerly direction the Rue Pargaminière stretches towards the venerable church and the bridge of St Peter. From the south-west corner the Rue des Balances extends towards the Rue de Metz and the Pont Neuf. From the south the Rue St Rome, Rue des Changes, and Rue des Filatiers lead to the Place des Carmes or de la République; while from the south-east corner the Rue de la Pomme and the Rue Boulbonne lead across the Rue d'Alsace-Lorraine to the cathedral of St Stephen. In the south of the city lies the palais de justice, near which are the ancient church of the Inquisition and several of the finest houses in Toulouse. Going northwards, the traveller passes the Église de la Dalbade on his way towards the Pont Neuf, immediately to the north of which is the Église de la Daurade. North of this church, but somewhat farther from the river, is the military hospital, to the immediate east of which lie the lycée, the church of the Jacobins, and the public library. South-east from this, about halfway towards the cathedral, is the museum. North of the military hospital and beyond the Rue Pargaminière lie the arsenal and the Faubourg St Pierre. Slightly to the northwest of the Pont St Pierre the Canal de Brienne (finished 1778) cuts across the angle formed by the Garonne and Canal du Midi. Between the Canal de Brienne and the Garonne is the chief manufacturing part of the city, where the great Bazacle flour-mill stands. Along the right bank of the river run the various quays of St Pierre, &c. In the Faubourg St Cyprien, just north of the Pont Neuf, is the Hôtel Dieu St Jacques, said to have been founded before the 12th century, with its large gardens. Close to the Pont St Pierre is the hospital of St Joseph de la Grave, which makes up 1432 beds, and affords shelter to foundlings and the aged. South of the Allée St Michel is the Jardin des Plantes, founded by the ill-fated La Pérouse.

The most interesting building is the church of St Sernin or Saturninus, whom legend represents as the first preacher of the gospel in Toulouse, where he was perhaps martyred towards the middle of the 3d century. The oldest part of the present building was consecrated by Urban II. in 1096. This church is now the largest edifice of southern France, being 375 feet from east to west and 217 feet in its utmost breadth. The nave (12th and 13th centuries) is remarkable for having double aisles. Four pillars, supporting the central tower, are surrounded by heavy masonry, which somewhat spoils the general harmony of the interior. In the southern transept is the "portail des comtes," so named because near it lie the tombs of William Taillefer, Pons, and other early counts of Toulouse. The little chapel in which these tombs (ascribed to the 11th century) are found was restored by the capitols of Toulouse in 1648. Another chapel contains a Byzantine Christ of late 11th-century workmanship. The choir (11th and 12th centuries) ends in an apse, or rather chevet, surrounded by a range of columns, marking off an aisle which in its turn opens into five chapels. The stalls are of 16th-century work and very grotesquely carved. Against the northern wall is an ancient *table d'autel*, which an 11th-century inscription declares to have belonged to St Sernin. In the crypts are many relics, which, however, were robbed of their gold and silver shrines during the Revolution. The finest gate is on the south, and is surmounted by a fine representation of the Ascension in Byzantine style. The capitals of the St Sernin pillars are sometimes ornamented with leaves and sometimes with grotesque animals, &c. The belfry consists of five stories, of which the two highest are of later date, but harmonize very well with the three lower ones. The cathedral, dedicated to St Stephen, dates from three different epochs. The nave, commenced by Raymond VI. towards the beginning of the 13th century, still displays the sculptured arms of its founder, and a few years ago preserved the pulpit in which St Bernard and St Dominic are said to have preached. The choir, commenced by Bertrand de Lille (*c.* 1272), was burned in 1609, but restored in the same century. It is surrounded by seventeen chapels, which were finished by the Cardinal d'Orléans, nephew of Louis XI., towards the beginning of the 16th century. These chapels are adorned with glass dating from the 15th to the 17th century. The great western gate was constructed by Peter du Moulin, archbishop of Toulouse, from 1439 to 1451. It has been greatly battered, and presents but a poor approximation to its ancient beauty. Over this grand gate, which was once ornamented with the statues of St Sernin, St Exuperius, and the twelve apostles, as well as those of the two brother archbishops of Toulouse, Denis (1423–1439) and Peter du Moulin, there is a beautiful 13th-century rose-window, whose centre, however, is not in a perpendicular line with the point of the Gothic arch below. In the same way the choir and the nave have not the same axis.

Among other remarkable churches may be noticed those of St Pierre des Cuisines (12th century), with its beautifully sculptured capitals; of Notre Dame de la Daurade, near the Pont Neuf, built on the site of a 9th-century Benedictine abbey, but reconstructed in 1764; and of Notre Dame de la Dalbade, perhaps existing in the 11th century but in its present form dating from the 15th. The Église des Jacobins, held by Viollet le Duc to be "one of the most beautiful brick churches constructed in the Middle Ages," was built towards the end of the 13th century, and originally consisted of but one structure divided into two aisles by a range of columns. It has a beautiful octagonal belfry. Before the Revolution it contained the mausoleum of Thomas Aquinas. On the left of the Garonne stands the church of St Nicholas, also with an octagonal belfry and a spire dating from the 15th century. There are many other churches of considerable antiquity.

Of secular buildings the most noteworthy are the capitole, the museum, and the lycée. The capitole (16th–17th centuries) has a long Ionic façade constructed by Cammas (1750-60). The theatre is situated in the left wing. Running along almost the whole length of the first floor is the "salle des illustres" adorned with the busts of forty-four great natives of Toulouse; the word "native" has, however, been construed very liberally. In the capitole the Académie des Jeux Floraux holds its annual meetings. The museum (opened 1795) occupies the church and other buildings of the Augustinian convent (14th–15th cent.). It contains a splendid collection of antiquities arranged in two cloisters, and a collection of pictures. The natural history museum is at the Jardin des Plantes. The lycée occupies the group of buildings known as "Les Jacobins," the Hôtel Bernui (16th century), &c. Here is the public library (65,000 volumes).

Toulouse is singularly rich in mansions of the 16th and 17th centuries. Several of these are richly adorned by Bachelier, Michelangelo's pupil. The Hôtels d'Assezat, de St Jean, Las Bordes, Felzins, Duranti, and Maison de Pierre may be specially mentioned. A few houses are said to date from the 14th century or even earlier. Near the Allée St Michel is the palais de justice, the old meeting house of the parlement of Toulouse. Close by was the old Château Narbonnais.

Besides its university, which ranks next to those of Paris and Lyons, and has faculties of law, science, letters, and medicine, Toulouse possesses many educational and learned societies, among which may be mentioned the École des Beaux Arts et des Sciences Industrielles, the École Normale, the École de Musique, the Académies des Jeux Floraux, des Sciences et des Belles Lettres et Arts, and de Législation, the Société d'Agriculture, and the archæological Société du Midi.

The geographical position of Toulouse, on the plain of Languedoc, has made it the chief entrepôt of the district for wine, corn, and almost all the industries of the neighbourhood. Besides the grinding of flour, its leading industries are cabinetmaking, hat-making, calico printing, the manufacture of pots and pans, macaroni, and starch, leather-making (morocco), cloth and paper making, glass-blowing, saddlery, and pottery. The tobacco factory occupies 1250 hands, and manufactures 1000 tons of snuff, a corresponding quantity of tobacco, and 250 tons of cigars annually.

The population of the city, 127,196 in 1881, numbered 133,775 in 1886, that of the commune being 147,617.

Tolosa (Τολῶσσα), chief town of the Volcæ Tectosages, does not seem to have been a place of great importance during the early centuries of the Roman rule in Gaul, though one incident in its early history gave rise to the famous Latin proverb "habet aurum Tolosanum" (Aul. Gell., iii. c. 12). It was possessed of a circus and an amphitheatre, but its most remarkable remains are to be found on the heights of Old Toulouse (vetus Tolosa) some 6 or 7 miles to the east, where huge accumulations of broken pottery and fragments of an old earthen wall mark the site of an ancient settlement. The numerous coins that have been discovered on the same spot do not date back farther than the 2d century B.C., and seem to indicate the position of a Roman manufacturing centre then beginning to occupy the Gallic hill-fortress that, in earlier days, had in times of peril been the stronghold of the native tribes dwelling on the river bank. Tolosa does not seem to have been a Roman colony; but its importance must have increased greatly towards the middle of the 4th century. It is to be found entered in more than one itinerary dating from about this time; and Ausonius, in his *Ordo Nobilium Urbium*, alludes to it in terms implying that it then had a large population. In 419 it was taken by Wallia, king of the Visigoths, under whom or whose successors it became the seat of the great Teutonic kingdom of the West-Goths,—a kingdom that within fifty years had extended itself from the Loire to Gibraltar and from the Rhone to the Atlantic. On the defeat of Alaric II. (507) Toulouse fell into the hands of Clovis, who carried away the royal treasures to Angoulême. Under the Merovingian kings it seems to have remained the greatest city of southern Gaul, and is said to have been governed by dukes or counts dependent on one or other of the rival kings descended from the great founder of the Frankish monarchy. It figures prominently in the pages of Gregory of Tours and Sidonius Apollinaris. About 628 Dagobert erected South Aquitaine into a kingdom for his brother Charibert, who chose Toulouse as his capital. For the next eighty years its history is obscure, till we reach the days of Charles Martel, when it was besieged by Sema, the leader of the Saracens from Spain (*c.* 715–20), but delivered by Eudo, "princeps Aquitaniæ," in whom later writers discovered the ancestor of all the later counts of Toulouse. Modern criticism, however, has discredited this genealogy;

and the real history of Toulouse recommences in 780 or 781, when Charlemagne appointed his little son Louis king of Aquitaine, with Toulouse for his chief city.

During the minority of the young king his tutor Chorson ruled at Toulouse with the title of duke or count. Being deposed at the council of Worms (790), he was succeeded by William Courtnez, the traditional hero of southern France, who in 806 retired to his newly founded monastery at Gellone, where he died in 812. In the unhappy days of Louis the Pious and his children Toulouse suffered in common with the rest of western Europe. It was besieged by Charles the Bald in 844, and taken four years later by the Normans, who in 843 had sailed up the Garonne as far as its walls. About 852 Raymond I., count of Querci, succeeded his brother Fridolo as count of Rouergue and Toulouse; it is from this noble that all the later counts of Toulouse trace their descent. Raymond I.'s grandchildren divided their parent's estates; of these Raymond II., the elder (d. 924), became count of Toulouse, and Ermengaud, the younger, count of Rouergue, while the hereditary titles of Gothia, Querci, and Albi were shared between them. Raymond II.'s grandson, William Taillefer (d. *c.* 1037), married Emma of Provence, and handed down part of that lordship to his younger son Bertrand.[1] William's elder son Pons left two children, of whom William IV. succeeded his father in Toulouse, Albi, Querci, &c.; while the younger, Raymond IV. of St Gilles (*c.* 1066), made himself master of the vast possessions of the counts of Rouergue, married his cousin the heiress of Provence, and about 1085 began to rule the immense estates of his elder brother, who was still living.

From this time the counts of Toulouse were the greatest lords in southern France. Raymond IV., the hero of the first crusade, assumed the formal titles of marquis of Provence, duke of Narbonne, and count of Toulouse. While Raymond was away in the Holy Land, Toulouse was seized by William IX., duke of Aquitaine, who claimed the city in right of his wife Philippa, the daughter of William IV., but was unable to hold it long (1098–1100). Raymond's son and successor Bertrand followed his father's example and set out for the Holy Land in 1109, leaving his great estates at his death to his brother Alphonse-Jourdain. The rule of this prince was disturbed by the ambition of William IX. and his granddaughter Eleanor, who urged her husband Louis VII. to support her claims to Toulouse by war. On her divorce from Louis and her marriage with Henry II., Eleanor's claims passed on to this monarch, who at last forced Raymond V. to do him homage for Toulouse in 1173. Raymond V., the patron of the troubadours, died in 1194, and was succeeded by his son Raymond VI., under whose rule Languedoc was desolated by the remorseless crusaders of Simon de Montfort. Raymond VII., the son of Raymond VI. and Princess Joan of England, succeeded his father in 1222, and died in 1249, leaving an only daughter Joan, married to Alfonso the brother of Louis IX. On the death of Alfonso and Joan in 1271 the vast inheritance of the counts of Toulouse lapsed to the crown.[2]

From the middle years of the 12th century the people of Toulouse seem to have begun to free themselves from the most oppressive feudal dues. An act of Alphonse-Jourdain (1141) exempts them from the tax on salt and wine; and in 1152 we have traces of a "commune consilium Tolosæ" making police ordinances in its own name "with the advice of Lord Raymond, count of Toulouse, duke of Narbonne, and marquis of Provence." This act is witnessed by six "capitularii," four duly appointed judges (*judices constituti*), and two advocates. Twenty-three years later there are twelve capitularii or consuls, six for the city and six for its suburbs, all of them elected and sworn to do justice in whatever municipal matters were brought before them. In 1222 their number was increased to twenty-four; but they were forbidden to touch the city property, which was to remain in the charge of certain "communarii" chosen by themselves. Early in the 14th century the consuls took the name of "domini de capitulo," or, a little later, that of "capitulum nobilium." From the 13th century the consuls met in their own house, the "palatium communitatis Tolosæ" or hôtel-de-ville. In the 16th century a false derivation changed the ancient consuls (*domini de capitulo*) into the modern "capitouls" (*domini capitolii Tolosani*), a barbarous etymology which in its turn has, in the present century, transformed the old assembly house of Toulouse into the capitole.

The parlement of Toulouse was established as a permanent court in 1443. Louis XI. transferred it to Montpellier in 1467, but restored it to Toulouse before the close of the next year. This parlement was for Languedoc and southern France what the parlement of Paris was for the north. Towards the end of the 16th century, during the wars of the League, it was split up into three different sections, sitting respectively at Carcassonne or Béziers, at Castel Sarrasin, and at Toulouse. The three were reunited in 1596. Under Francis I. it began to persecute heretics, and in 1618 rendered itself notorious by burning the philosopher Vanini. The university of Toulouse owes its origin to the action of Gregory IX., who in 1229 bound Raymond VII. to maintain four masters to teach theology and eight others for canon law, grammar, and the liberal arts. Civil law and medicine were taught only a few years later. The famous "*Floral Games*" of Toulouse, in which the poets of Languedoc contended (May 1–3) for the prize of the golden violet and other gold or silver flowers, given at the expense of the city, were instituted in 1323–24.

See, besides the various guide-books, De Vic and Vaissete, *Histoire de Languedoc*, ed. 1873 sq.; Catel, *Histoire de Toulouse*, 1623; La Faille, *Histoire de Toulouse*, 1687, 1701; Du Mège, *Histoire des Institutions de Toulouse*, 4 vols., 1844-46; D'Aldeguier, *Histoire de la Ville de Toulouse*, 1833–35. (T. A. A.)

TOUNG-NGÚ, a district in the extreme north of the Tenasserim division of Burmah, with an area of 6354 square miles, and lying between 17° 37′ and 19° 28′ N. lat., and between 95° 53′ and 96° 53′ E. long. It is bounded on the N. by Upper Burmah, on the E. by a high mountain range known as the "Great Watershed," on the S. by Shwe-gyeng district, and on the W. by the Pegu Yomas. Three mountain ranges traverse the district—the Pegu Yomas, the Poung-loung, and the Nat-toung or "Great Watershed,"—all of which have a north and south direction, and are covered for the most part with dense forest. The Pegu Yomas have a general elevation of from 800 to 1200 feet, while the central range averages from 2000 to 3000 feet. The rest of Toung-ngú forms the upper portion of the valley of the Tsit-toung (Sittang) river,—the only large river in the district, the chief tributaries of which are the Tshwa, Khaboung, Hpyu, Thouk-re-gat, and Rouk-thwa-wa, all being navigable for a great portion of their course. Limestone appears in various places, and in the north-east a light grey marble is quarried for lime. The rivers form the chief means of communication during the rainy season. Of late years some good roads have been constructed, and the Burmah State Railway, when completed, will intersect the district from south to north.

In 1881 the population numbered 128,848 (males 68,484, females 60,364), of whom 93,997 were Buddhists, 17,448 Christians, 2086 Hindus, 1962 Mohammedans, and 12,612 aborigines. The only town in the district is Toung-ngú, on the Tsit-toung river in 18° 55′ 24″ N. lat. and 96° 31′ 4″ E. long., with a population of 17,199 in 1881. Of the total area only 59 square miles are actually under cultivation, owing mainly to the hilly nature of the country. Rice is the chief product; other crops include oil-seeds, sugar-cane, cotton, fruit, and vegetables. The principal manufactures are silk, saltpetre, and gunpowder. In 1885-86 the gross value of the district was £15,098, of which the land produced £5880.

TOUR, MAURICE QUENTIN DE LA (1704–1788), the renowned pastellist, was born at St Quentin on the 5th September 1704. On leaving Picardy for Paris he entered the studio of an artist named Du Pouche, and then that of Spoède,—an upright man, but a poor master, rector of the Academy of St Luke, who still continued, in the teeth of the Royal Academy, the traditions of the old guild of the master-painters of Paris. This possibly contributed to the adoption by De la Tour of a line of work foreign to that imposed by an academical training; for pastels, though occasionally used, were not a principal and distinct branch of work until 1720, when Rosalba Carriera brought them into fashion with the Parisian world. In 1737 De la Tour exhibited the first of that splendid series of a hundred and fifty portraits which formed the glory of the Salon for the succeeding thirty-seven years. In 1746 he was received by the Academy; and in 1751, the following year to that in which he received the title of painter to the king, he was promoted by that body to the grade of councillor. His work had the rare merit to satisfy at once both the taste of his fashionable models and the judgment of his brother artists. His art, consummate of its kind, achieved

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[1] About 975 there was a partition of the estates which William Taillefer and his cousin Raymond II. of Auvergne held in common,—Albi, Querci, &c., falling to William, and Gothia, &c., to Raymond.

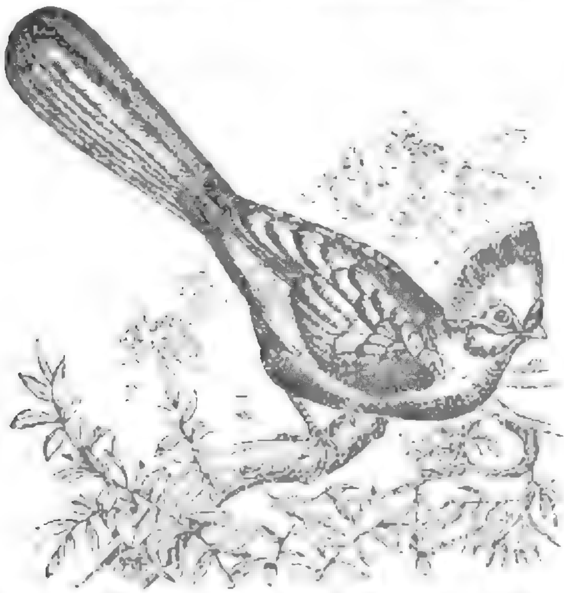
[2] List of the counts of Toulouse, mainly from De Vic and Vaissete:—

Chorson	778–790	Raymond II.	918–924	Bertrand	1096–1109
William	790–806	Raymond III.	924–*c.* 950	Alphonse-Jourdain	1109–1148
......		Garsende, for her son	*c.* 950–*c.* 975	Raymond V.	1148–1194
Berenger	817–835	William Taillefer	*c.* 975–*c.* 1037	Raymond VI.	1194–1222
Exfrid	835–845	Pons	1037–1060	Raymond VII.	1222–1249
Fridolo	845–852	William IV.	1060–*c.* 1093	Alfonso and Joan	1249–1271
Raymond I.	852–864	Raymond IV.	1093–1105		
Bernard	864–875				
Eudo	875–918				

the task of flattering his sitters, whilst hiding that flattery behind the just and striking likeness which, says Mariette, he hardly ever missed. His portraits of Rousseau, of Voltaire, of Louis XV., of his queen, of the dauphin and dauphiness, are at once documents and masterpieces unsurpassed except by his life-size portrait of Madame de Pompadour, which, exhibited at the Salon of 1755, is still the chief ornament of the cabinet of pastels in the Louvre. It is and will probably always be the most perfect model of this class of work as long as time and damp spare the fragile dust to which it owes its beauty. The museum of St Quentin, however, also possesses a magnificent collection of works which at his death were in his own hands. De la Tour retired to St Quentin at the age of 80, and there he died on 17th February 1788. The riches amassed during his long life were freely bestowed by him in great part before his death; he founded prizes at the school of fine arts in Paris and for the town of Amiens, and endowed St Quentin with a great number of useful and charitable institutions. He never married, but lived on terms of warm affection with his brother (who survived him, and left to the town the drawings now in the museum); and his relations to Mdlle. Fel, the celebrated singer, were distinguished by a strength and depth of feeling not common to the loves of the 18th century.

See, in addition to the general works on French art, Desmaze, three works, of which the most important is *Le Reliquaire de la Tour*; Guiffrey and Tourneux, *Correspondance Inédite de M. Q. de la Tour*; Champfleury, *De la Tour*, and *Peintres de Laon et de St Quentin*; and Dréolle de Nodon, *Éloge Biographique de M. Q. de la Tour.*

TOURACO, the name, evidently already in use, under which in 1743 Edwards figured a pretty African bird,[1] and presumably that applied to it in Guinea, whence it had been brought alive. It is the *Cuculus persa* of Linnæus, and *Turacus* or *Corythaix persa* of later authors, who perceived that it required generic separation. Cuvier, in 1799 or 1800, Latinized its native name (adopted in the meanwhile by both French and German writers) as above, for which barbarous term Illiger, in 1811, substituted a more classical word. In 1788 Isert described and figured (*Beobacht. Gesellsch. naturf. Freunde*, iii. pp. 16–20, pl. 1) a bird, also from Guinea, which he called *Musophaga violacea*. Its affinity to the original Touraco was soon recognized, and both forms have been joined by modern systematists in the Family *Musophagidæ*, commonly Englished Plantain-eaters or Touracos, sometimes spelt Tourakoos.



White-Crested Touraco (*Turacus albicristatus*). After Schlegel.

To take first the Plantain-eaters proper, or the genus *Musophaga*, of which only two species are known. One about the size of a Crow is comparatively common in museums, and is readily recognized by having the horny base of its fine yellow bill prolonged backwards over the forehead in a kind of shield. The top of the head, and the primaries, except their outer edge and tip, are deep crimson; a white streak extends behind the eye; and the rest of the plumage is of a rich glossy purple. The second species, *M. rossæ*, which is rare, chiefly differs by wanting the white eye-streak. Then of the Touracos—the species originally described is about the size of a Jay, and has the head, crest (which is vertically compressed and tipped with red), neck, and breast of a fine grass-green, varied by two conspicuous white streaks—one, from the gape to the upper part of the crimson orbit, separated by a black patch from the other, which runs beneath and behind the eye. The wing-coverts, lower part of the back, and tail are of a bright steel-purple, the primaries deep crimson, edged and tipped with bluish-black. Over a dozen other congeneric species, more or less resembling this, have now been described, and all inhabit some district of Africa; but there is only room here to mention that found in the Cape Colony and Natal, where it is known as the "Lory" (*cf.* vol. xv. p. 7, note 1), and, though figured by Daubenton and others, first differentiated in 1841 by Strickland (*Ann. Nat. History*, vii. p. 33) as *Turacus albicristatus*—its crest having a conspicuous white border, while the steel-purple of *T. persa* is replaced by a rich and glossy bluish-green of no less beauty. In nearly all the species of this genus the nostrils are almost completely hidden by the frontal feathers; but there are two others in which, though closely allied, this is not the case, and some systematists would place them in a separate genus *Gallirex*; while another species, the giant of the Family, has been moved into a third genus as *Corythæola cristata*. This differs from any of the foregoing by the absence of the crimson coloration of the primaries, and seems to lead to another group, *Schizorrhis*, in which the plumage is of a still plainer type, and, moreover, the nostrils here are not only exposed but in the form of a slit, instead of being oval as in all the rest. This genus contains about half a dozen species, one of which, *S. concolor*, is the Grey Touraco of the colonists in Natal, and is of an almost uniform slaty-brown. A good deal has been written about these birds, which form the subject of one of the most beautiful monographs ever published—*De Toerako's afgebeeld en beschreven*,—by Schlegel and Westerman, brought out at Amsterdam in 1860; while the latest collected information is contained in an elaborate essay by Herr Schalow (*Jour. f. Ornithologie*, 1886, pp. 1–77). Still, much remains to be made known as to their distribution throughout Africa, and their habits. They seem to be all fruit-eaters, and to frequent the highest trees, seldom coming to the ground. Very little can be confidently asserted as to their nidification, but at least one species of *Schizorrhis* is said to make a rough nest and therein lay three eggs of a pale blue colour. An extraordinary peculiarity attends the crimson coloration which adorns the primaries of so many of the *Musophagidæ*. So long ago as 1818, Jules Verreaux observed (*Proc. Zool. Society*, 1871, p. 40) that in the case of *T. albicristatus* this beautiful hue vanishes on exposure to heavy rain and reappears only after some interval of time and when the feathers are dry.[2]

The *Musophagidæ* form a very distinct Family of Prof. Huxley's *Coccygomorphæ*, having perhaps the *Coliidæ* and *Cuculidæ* as their nearest allies. Eyton pointed out (*Ann. Nat. History*, ser. 3, ii. p. 458) a feature possessed in common by the latter and the *Musophagidæ*, in the "process attached to the anterior edge of the ischium," which he likened to the so-called "marsupial" bones of Didelphian Mammals. J. T. Reinhardt has also noticed (*Vidensk. Meddels. Naturhist. Forening*, 1871, pp. 326–341) another Cuculine character offered by the *os uncinatum* affixed to the lower side of the ethmoid in the Plantain-eaters and Touracos; but too much dependence must not be placed on that, since a similar structure is presented by the FRIGATE-BIRD (vol. ix. p. 786) and the PETRELS (vol. xviii. p. 711). A corresponding process seems also to be found in TROGON (*q.v.*). The bill of nearly all the species of *Musophagidæ* is curiously serrated or denticulated along the margin, and the feet have the outer toe reversible. No member of the Family is found outside of the continental portion of the Ethiopian Region. (A. N.)

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[1] Apparently the first ornithologist to make the bird known was Albin, who figured it in 1738 from the life, yet badly, as "The Crown-bird of Mexico." He had doubtless been misinformed as to its proper country; but Touracos were called "Crown-birds" by the Europeans in West Africa, as witness Bosman's *Description of the Coast of Guinea* (1721), ed. 2, p. 251, and W. Smith's *Voyage to Guinea* (1745), p. 149, though the name was also given to the Crowned Cranes, *Balearica*.

[2] The fact of this colouring matter being soluble in water was incidentally mentioned at a meeting of the Zoological Society by Mr Tegetmeier, and brought to the notice of Prof. Church, who, after experiment, published in 1868 (*Student and Intellectual Observer*, i. pp. 161–168) an account of it as "Turacin, a new animal pigment containing copper." Further information on the subject was given by Monteiro (*Chem. News*, xxviii. p. 201; *Quart. Jour. Science*, ser. 2, iv. p. 132). The property is possessed by the crimson feathers of all the birds of the Family.

TOURCOING, a manufacturing town of France in the department of Nord, 7 miles north-east of Lille on the railway to Ghent, is rapidly becoming one with the neighbouring town of ROUBAIX (*q.v.*). Wool, cotton, linen, and silk are spun in more than 65 mills (40,000 spindles); there are upwards of 25 combing establishments (by machine and hand), 50 to 55 manufactories of velvet-pile carpets, furniture stuffs, and all kinds of woven goods, besides dye-works, soap-works, a sugar refinery, and machine workshops. The total industrial production of Tourcoing may be set down at about £6,800,000 per annum. Tourcoing possesses a chamber of commerce, a conseil de prudhommes, a consultative chamber of arts and manufactures, a wool "conditioning" bureau, schools of drawing, painting, music, and architecture, and a horticultural society. In 1866 a pyramid was erected to commemorate a battle gained by Jourdan and Moreau in the neighbourhood in 1794. The population, 34,415 in 1881, was 41,570 in 1886 (commune 58,008).

Famed since the 14th century for its woollen manufactures, Tourcoing was fortified by the Flemings when Louis XI. of France disputed the inheritance of Charles the Bold with Mary of Burgundy. The town suffered much from the French in 1477, from the Huguenots in 1556, and by fire in 1607 and 1711. The inhabitants, 18,000 in 1789, were reduced by the French Revolution to 10,000, but a new era of prosperity began in 1832. In 1801 the population of the commune was 23,493, and in 1871 it was 43,322.

TOURGUENIEFF, IVAN (1818–1883), the descendant of an old Russian family, was born at Orel, in the government of the same name, in 1818. His father, the colonel of a cavalry regiment, died when our author was sixteen years of age, leaving two sons, Nicholas and Ivan, who were brought up under the care of their mother, the heiress of the Litvinoffs, a lady who owned large estates and many serfs. Ivan studied for a year at the university of Moscow, then at St Petersburg, and was finally sent in 1843 to Berlin. His education at home had been conducted by German and French tutors, and was altogether foreign, his mother only speaking Russian to her servants, as became a great lady of the old school. For his first acquaintance with the literature of his country the future novelist was indebted to a serf of the family, who used to read to him verses from the *Rossiad* of Kheraskoff, a once-celebrated poet of last century. Tourguenieff's early attempts in literature, consisting of poems and trifling sketches, may be passed over here; they were not without indications of genius, and were favourably spoken of by Bielinski, then the leading Russian critic, for whom Tourguenieff ever cherished a warm regard. Our author first made a name by his striking sketches "The Papers of a Sportsman" (*Zapiski Okhotnika*), in which the miserable condition of the peasants was described with startling realism. The work appeared in a collected form in 1852. It was read by all classes, including the emperor himself, and it undoubtedly hurried on the great work of emancipation. Tourguenieff had always sympathized with the *muzhiks*; he had often been witness of the cruelties of his mother, a narrow-minded and vindictive woman. In some interesting papers recently contributed to the "European Messenger" (*Viestnik Evropi*) by a lady brought up in the household of Mme Tourguenieff, sad details are given illustrative of her character. Thus the dumb porter of gigantic stature, drawn with such power in *Mumu*, one of our author's later sketches, was a real person. We are, moreover, told of his mother that she could never understand how it was that her son became an author, and thought that he had degraded himself. How could a Tourguenieff submit himself to be criticized!

The next production of the novelist was "A Nest of Nobles" (*Dvorianskoe Gniezdo*), a singularly pathetic story, which greatly increased his reputation. This appeared in 1859, and was followed the next year by "On the Eve" (*Nakanune*),—a tale which contains one of his most beautiful female characters, Helen. In 1862 was published "Fathers and Children" (*Otzi i Dieti*), in which the author admirably described the nihilistic doctrines then beginning to spread in Russia, he himself inventing the word nihilism, which seems likely to become permanent. In 1867 appeared "Smoke" (*Dim*), and in 1877 his last work of any length, "Virgin Soil" (*Nov*). Besides his longer stories, many shorter ones were produced, some of great beauty and full of subtile psychological analysis, such as *Rudin*, "The Diary of a Useless Man" (*Dnevnik Lishnago Chelovieka*), and others. These were afterwards collected into three volumes. The last works of the great novelist were "Poetry in Prose" and "Clara Milich," which appeared in the pages of the "European Messenger."

Tourguenieff, during the latter part of his life, did not reside much in Russia; he lived either at Baden Baden or Paris, and chiefly with the family of the celebrated singer Viardot Garcia, to the members of which he was much attached. He occasionally visited England, and in 1879 the degree of D.C.L. was conferred upon him by the university of Oxford. He died at Bougival, near Paris, on September 4, 1883; according to his wish, his remains were taken to St Petersburg, and buried in the Volkoff cemetery, near those of the critic Bielinski.

Unquestionably Tourguenieff may be considered one of the greatest novelists of our own or any other times, and worthy to be ranked with Thackeray, Dickens, and George Eliot: with the genius of the last of those he has many affinities. His studies of human nature are profound, and he has the wide sympathies which are essential to genius of the highest order. A melancholy, almost pessimist, feeling pervades his writings, but perhaps this is always found in those who have truly listened to the "still, sad music of humanity." This morbid self-analysis seems natural to the Slavonic mind, and Tourguenieff has given abundant proof of possessing it. The closing chapter of "A Nest of Nobles" is one of the saddest and at the same time truest pages in the whole range of existing novels.

The writings of Tourguenieff have been made familiar to persons unacquainted with Russian by French translations. There are some versions in English, but the only two worthy of notice are the translation of the "Nest of Nobles" under the name of "Lisa," by Mr Ralston, and "Virgin Soil," by the late Mr Ashton Dilke.

TOURMALINE. See ELECTRICITY, vol. viii. p. 99; GEOLOGY, vol. x. p. 228; and MINERALOGY, vol. xvi. p. 409.

TOURNAI (Flem. *Doornik*), a town of Belgium, capital of an arrondissement in the province of Hainault, 53 miles by rail west-south-west from Brussels, is divided into two parts by the Scheldt, which is here spanned by seven bridges and lined with spacious tree-shaded quays. The older, which is also the busier and more important portion of the town, stands on the left bank; the new town is distinguished by its neat regular streets and modern architecture. The cathedral, which is a fine example of the Romanesque style, is a cruciform basilica, with a series of chapels and five towers. The nave was probably consecrated in 1171: the transepts date from the 13th century; and the (Gothic) choir was completed in 1338, at which time also the Romanesque façade was altered, and a porch in the Pointed style added. The sculptures in the porch range in date from the 13th to the

17th century, and deserve special notice, particularly those of later date by native artists. The general effect of the interior is harmonious and impressive. The capitals of the pillars are rich and varied; the passage round the choir contains several pictures of the Flemish school; the richly sculptured Renaissance roodloft dates from 1566; and most of the stained glass in the transept dates from about 1456. The adjacent belfry, dating originally from 1187, and partly rebuilt in 1391, was restored in 1852. In the Grande Place, not far from the cathedral, is the church of St Quentin, sometimes spoken of as "la petite cathédrale," in the Transition style, and nearly of the same date as the cathedral. The church of St Jacques dates from the 13th and 14th centuries, and that of St Brice from the 12th. The buildings of the old monastery of St Martin, on the south-west side of the town, are now used as an hôtel de ville, in connexion with which there is a small picture gallery containing some examples of Rembrandt, Rubens, and Van Dyck. The town contains courts of law, an athenæum, a theatre, a school of arts and manufactures, an episcopal palace and seminary, a natural history museum, besides other public buildings. The fortifications of Vauban, extended after the second treaty of Paris, are now demolished, and their place taken by boulevards. The leading objects of manufacture are stockings and "Brussels" carpets; the other industries include paper-making, thread-making, and the spinning of wool and flax. The trade of the place is very considerable, as vessels of 150 tons burden can ascend the river to this point, and its railway communications are good. The population in 1876 was 32,145.

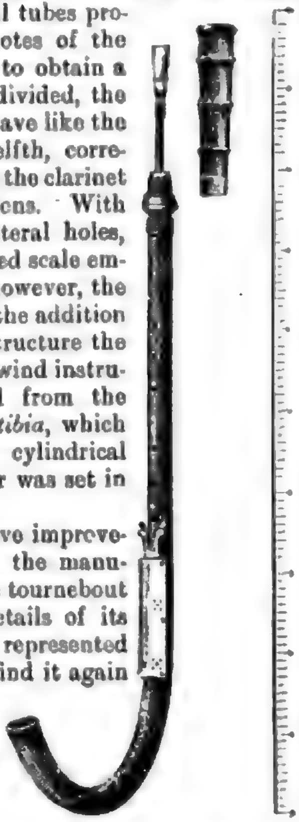
Tournay, supposed to be the *Civitas Nerviorum* of Cæsar, and afterwards known as Tournacus, was one of the first places conquered by the Franks, and Clovis made it for a time his capital. In modern times, standing as it does on the frontier between Belgium and France, it has been frequently besieged and taken. History records specially the siege by Alexander of Parma in 1581, when it was bravely but unsuccessfully defended by the princess D'Épinoy, whose statue now stands in the Grande Place. Perkin Warbeck was a native of Tournai.

TOURNAMENTS. Tournaments and jousts were the chief military exercises and displays of the age of chivalry. Besides being the appropriate sports and pastimes of a warlike era and caste, they were intended to test the skill and exhibit the prowess of the knights and squires who took part in them. Considered under their more serious aspect, apart from their association with pomp and festivity, they were, practically speaking, the equivalents of the reviews and sham-fights of later times, and were designed as a preparation for the actual manœuvres and real conflicts of the battlefield. Tournaments and jousts differed from one another principally in the circumstance that in the first several combatants on each side were engaged at once, and in the second the contention was between two combatants only. The former consisted of the mutual charges of equal troops of cavalry, while the latter consisted of a duel on horseback. Du Cange says that the French *tournoi*, English "tournament," "was a general expression which comprehended all sorts of combats that were performed by way of exercise. But it more properly meant such as were performed by companies, where many were in conflict against the same number, representing the form of a battle. When those general combats were ended, then single ones commenced; for all who were desirous of displaying their address, and attracting public notice for their valour, offered single combat with sword or lance against all who should present themselves"; and he adds that these combats were called by the old French writers "joustes," which is the same word as the English "jousts." But jousts were held far more frequently than, and quite independently of, regular tournaments throughout the period in which the customs of chivalry were observed, and, according to some authorities, the lance alone was used in them, while in the others all weapons except firearms were employed. In both cases such weapons were usually although not invariably rendered innocuous, and it was only rarely that the combatants were killed or injured by wounds, as distinguished from falls and bruises. But in one way or another tournaments and jousts were always extremely dangerous, and a long list of eminent persons met their deaths in them, from Raoul, Comte de Guines, to Henry II. of France. It may be assumed that jousts in some shape existed at all periods, in which men fought in armour and on horseback, and were in the habit of practising themselves in time of peace for the exigencies of warfare. But it is very doubtful when and where tournaments, in the proper sense of the term, were originally instituted. The older writers on the subject sought to connect them with the "Troja" or "ludus Trojæ" among the Romans. But this is a piece of archæology of the same sort as that which identified the knighthood of the Middle Ages with the ancient "ordo equestris," and will not, of course, bear examination. Much reliance again has been placed by some of them on the account of a sham-fight which was held at the celebrated interview between the emperor Louis and Charles the Bald in 841, which in certain respects bore a close resemblance to a tournament, and was no doubt the kind of exhibition out of which the tournament of a later age was developed. Others attribute the institution of tournaments to the emperor Henry the Fowler, who died in 936, or to Geoffrey de Preuilly, the ancestor of the counts of Tours, who died in 1066. However this may be, it is certain that they were in vogue on the Continent at the end of the 11th century, and that in the early part of the 12th century they were introduced into England. In the 13th and 14th centuries they were common all over Christendom, including the Eastern as well as the Western empire and the states comprised in or adjacent to it. It was not until the end of the 16th century that tilts and hastiludes passed out of fashion in Britain, and even in the earlier years of the 17th century they were occasionally celebrated under the patronage of Henry, prince of Wales, son of King James I.

The older authorities on tournaments and jousts are exceedingly numerous. But all that is material in what they have written will be found in Ste Palaye's *Memoires sur l'Ancienne Chevalerie* and Mills's *History of Chivalry*. The "Dissertations" of Du Cange at the end of Joinville's *Memoirs* and the *Chronicles* of Froissart and Monstrelet may also be consulted. Ste Palaye and Mills were both industrious compilers, and the second is much indebted to the first.

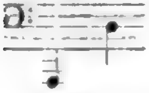
TOURNEBOUT, a wind instrument of wood, in which a cylindrical column of air is set in vibration by a reed. The lower extremity is turned up in a half circle, and from this peculiarity it has gained the French names *tournebout* and *cromorne*,—the latter a corruption of the German name *Krummhorn*. There appears to be no English equivalent. The reed of the tournebout, like that of the bassoon, is formed by two tongues of cane, adapted to the small end of a conical brass tube, the large end being inserted in the body of the instrument. It presents, however, this difference, that it is not, like that of the bassoon, in contact with the player's mouth, but is covered again by a cap pierced with a hole in the upper part, through which opening the air is introduced which sets the reed in vibration, the reed being therefore subject to no pressure of the lips. The compass of the instrument is naturally limited to the simple fundamental sounds which the successive opening of the lateral holes gives rise to. The tournebouts have not much length for the deep sounds they produce, which arises from these instruments sounding, like all tubes of cylindrical bore provided with reeds, the same as the stopped pipes of an organ. That is to say, theoretically they require only half the lengths necessary for the open pipes of an organ, or for conical tubes provided with reeds, to produce notes of the same pitch. Moreover, when, to obtain a harmonic, the column of air is divided, the tournebout will not give the octave like the oboe and bassoon, but the twelfth, corresponding in this peculiarity with the clarinet and all stopped pipes or bourdons. With the ordinary boring of eight lateral holes, the tournebout possesses a limited scale embracing a ninth. Sometimes, however, the deeper sounds are completed by the addition of one or more keys. By its structure the tournebout is one of the oldest wind instruments; it is evidently derived from the Greek *aulos* and the Roman *tibia*, which consisted equally of a simple cylindrical pipe of which the column of air was set in vibration by a double reed.

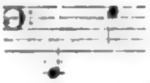
Notwithstanding the successive improvements that were introduced in the manufacture of wind instruments, the tournebout scarcely ever varied in the details of its construction. Such as we see it represented in the treatise by Virdung[1] we find it again about the epoch of its disappearance, in *L'Art du Faiseur d'Instruments de l'Encyclopédie de Diderot et d'Alembert* (Paris, 1751-80).



Bass Tournebout.

The tournebouts existed as a complete family from the 15th century. According to Virdung, it was formed of four individual instruments; Prætorius[2] cites five,—the deep bass, the bass, the tenor or alto, the cantus or soprano, and the high soprano, with compass respectively of





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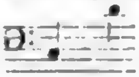

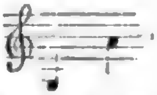

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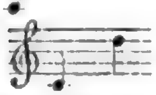
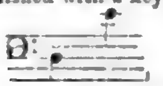
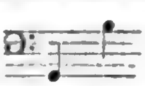


A band, or, to use the expression of Prætorius, an "accort," of tournebouts comprehended—1 deep bass, 2 bass, 3 alto-tenor, 2 cantus (soprano), 1 high soprano—9.

The tournebouts were not always an orchestra by themselves; they allied themselves also to other instruments, and notably to flutes and oboes. It was thus that the little groups of musicians in the service of princes, or those engaged by some large town on the occasion of a festival or public ceremony, were composed of several tournebout players combined with some flautists and oboe players. In 1685 the orchestra of the Neue Kirche at Strasburg comprised two tournebouts, and until the middle of the last century these instruments formed part of the music called "la grande écurie" in the service of the French kings. Tournebouts have in our days become of extreme rarity, and scarcely exist in collections. The museum of the Conservatoire Royal de Musique at Brussels has the good fortune to possess a complete family, which is regarded as having belonged to the duke of Ferrara, Alphonso II. d'Este, a prince who reigned from 1559 to 1597. The soprano (cantus or discant) has the same compass as above, while the alto, the tenor (furnished with a key), and bass have an extent respectively of





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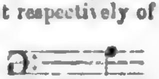

The bass (see accompanying figure), besides having two keys, is distinguished from the others by a kind of small bolt, two of which slide in grooves and close the two holes that form the lowest notes of the instrument. It is very curious to observe that the employment of these bolts, placed at the extremity of the tournebout and out of reach of the fingers of the instrumentalist, forces him to require the assistance of a person whose sole mission is to attend to these bolts during the performance.

The "Platerspil" of which Virdung gives a drawing is only a kind of tournebout. It presents especially the peculiarity that, instead of having a cap to cover over the reed, there is a spherical receiver surrounding the reed, to which the tube for insufflation is adapted. This receiver was of wood worked round, or perhaps consisted of a simple gourd. (V. M.)

TOURNEFORT, JOSEPH PITTON DE (1656-1708), a botanist of considerable reputation, was born at Aix, in Provence, in 1656. He studied in the convent of the Jesuits at Aix, and was destined for the church, but the death of his father left him free to follow his botanical inclinations. After a couple of years collecting, he studied medicine at Montpellier, but soon returned to his favourite pursuit, and was appointed professor of botany at the Jardin des Plantes in 1683. By the king's order he travelled through western Europe, where he made very extensive collections, and subsequently spent three years in Greece and Asia Minor (1700-1702). Of this journey a description in a series of letters was posthumously published in 3 vols. (*Relation d'un Voyage du Levant*, Lyons, 1717). His principal work is entitled *Institutiones Rei Herbariæ* (3 vols., Paris, 1700), and upon this rests chiefly his claims to remembrance as one of the most eminent of the systematic botanists who prepared the way for Linnæus. His exact position among these has been discussed at length by Sachs (*Geschichte d. Botanik*, Munich, 1875). He died December 28, 1708.

TOURNEUR, CYRIL, a tragic poet of the first order, has left no record of his existence beyond the respective dates of his first and last extant works (1600-1613). An allegorical poem, worthless as art and incomprehensible as allegory, is the earliest of these; an elegy on the death of Prince Henry, son of James I., is the latest. The two plays on which his fame rests, and on which it will rest for ever, were published respectively in 1607 and 1611, but all students have agreed to accept the internal evidence which assures us that the later in date of publication must be the earlier in date of composition. His only other known work is an epicede on Sir Francis Vere, of no great merit as poetry, but of some value as conveying in a straightforward and masculine style the poet's ideal conception of a perfect knight or "happy warrior," comparable by those who may think fit to compare it with the more nobly realized ideals of Chaucer and of Wordsworth. But if Tourneur had left on record no more memorable evidence of his powers than might be supplied by the survival of his elegies, he could certainly have claimed no higher place among English writers than is now occupied by the Rev. Charles Fitzgeoffrey, whose voluminous and fervent elegy on Sir Francis Drake is indeed of more actual value, historic or poetic, than either or than both of Tourneur's elegiac rhapsodies. The singular power, the singular originality, and the singular limitation of his genius are all equally obvious in *The Atheist's Tragedy*, a dramatic poem no less crude and puerile and violent in action and evolution than simple and noble and natural in expression and in style. The executive faculty of the author is in the metrical parts of his first play so imperfect as to suggest either incompetence or perversity in the workman; in *The Revenger's Tragedy* it is so magnificent, so simple, impeccable, and sublime, that the finest passages of this play can be compared only with the noblest examples of tragic dialogue or monologue now extant in English or in Greek. There is no trace of imitation or derivation from an alien source in the genius of this poet. The first editor of Webster has observed how often he imitates Shakespeare; and, in fact, essentially and radically independent as is Webster's genius also, the sovereign influence of his master may be traced not only in the general tone of his style, the general scheme of his composition, but now and then in a direct and never an unworthy or imperfect echo of Shakespeare's very phrase and accent. But the resemblance between the tragic verse of Tourneur and the tragic verse of Shakespeare is simply such as proves the natural affinity between two great dramatic poets, whose inspiration partakes now and then of the quality more proper to epic or to lyric poetry. The fiery impulse, the rolling music, the vivid illustration of thought by jets of insuppressible passion, the perpetual sustenance of passion by the implacable persistency of thought, which we recognize as the dominant and distinctive qualities of such poetry as finds vent in the utterances of Hamlet or of Timon, we recognize also in the scarcely less magnificent poetry, the scarcely less fiery sarcasm, with which Tourneur has informed the part of Vindice—a harder-headed Hamlet, a saner and more practically savage and serious Timon. He was a satirist as passionate as Juvenal or Swift, but with a finer faith in goodness, a purer hope in its ultimate security of triumph. This fervent constancy of spirit relieves the lurid gloom and widens the limited range of a tragic imagination which otherwise might be felt as oppressive rather than inspiriting. His grim and trenchant humour is as peculiar in its sardonic passion as his eloquence is original in the strenuous music of its cadences, in the roll of its rhythmic thunder. As a playwright, his method was almost crude and rude in the headlong straightforwardness of its energetic simplicity; as an artist in character, his interest was intense but narrow, his power magnificent but confined; as a dramatic poet, the force of his genius is great enough to ensure him an enduring place among the foremost of the followers of Shakespeare. (A. C. S.)

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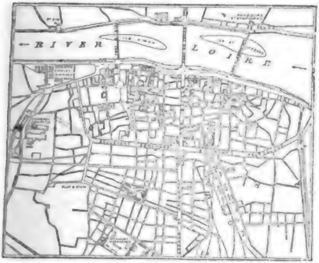
[1] *Musica getutscht und ausgezogen*, Basel, 1511.

[2] *Organographia*, Wolfenbüttel, 1618.

TOURS, a town of France, formerly the capital of Touraine, now chef-lieu of the department of Indre-et-Loire, the see of an archbishop, and the headquarters of the 9th corps d'armée, lies 145 miles (by rail) south-west of Paris, on the left bank of the Loire, a little above the junction of the Loire and Cher. Many foreigners, especially English, live at Tours, attracted by the town itself, its mild climate, its beautiful situation in "the garden of France," and the historic chateaus of the neighbourhood. The Loire is crossed by two suspension bridges, by a railway bridge, and by a fine stone bridge, but its waters too often either expose large stretches of sand, or come down in devastating flood. Many of the inhabitants belong to the leisured class, and the town possesses societies of science, art, and literature, of agriculture, of horticulture, of archæology, of medicine, and a library (50,000 volumes, and 1200 MSS., including a gospel of the 8th century, on which the kings of France took oath as honorary canons of the church of St Martin). The industrial establishments include four large silk mills, the printing and publishing works of Mame (1200 workmen), manufactories of cloth, carpets, files, white lead, stained glass, boots and shoes, and pottery. A considerable trade is carried on in wine, brandy, and dried fruits, and the sausages and confectionery of the town are well known The population, 52,209 in 1881, was 59,585 in 1886.



Plan of Tours.

Tours, under the Gauls the capital of the Turones or Turons, originally stood on the right bank of the Loire, a little above the present village of St Symphorien. At first called *Altionos*, the town was afterwards officially known as *Cæsarodunum*. The Romans removed the town from the hill where it originally stood to the plain on the left bank of the river. Behind the present cathedral. remains of the amphitheatre (443 feet in length by 394 in breadth) built towards the end of the 2d century might till lately be seen. Tours became Christian about 250 through the preaching of Gatien, who founded the bishopric. The first cathedral was built a hundred years later by St Litorius. The bishopric became an archbishopric when Gratian made Tours the capital of Lugdunensis Tertia, and about the same time the official name of Cæsarodunum was changed for that of *Civitas Turonorum*. St Martin, the great apostle of the Gauls, was bishop of Tours in the 4th century, and he was buried in a suburb which soon became as important as the town itself from the number of pilgrims who flocked to his tomb. Towards the end of the 4th century, apprehensive of barbarian invasion, the inhabitants pulled down some of their earlier buildings in order to raise a fortified wall, the course of which can still be traced in places. Their advanced fort of Larcay still overlooks the valley of the Cher. Affiliated to the Armorican confederation in 435, the town did not fall to the Visigoths till 473, and the new masters were always hated. It became part of the Frankish dominions under Clovis, who, in consideration of the help afforded by St Martin, presented the church with rich gifts out of the spoils taken from Alaric, confirmed and extended its right of sanctuary, and accepted for himself and his successors the title of canon of St Martin. The basilica, built under Bishop St Perpetuus from 472 to 477, was the largest and finest church of France, and one of the most important built in the West during the decline of the Roman empire; it is said by St Gregory of Tours to have been 160 feet long, 60 wide, and 45 high It seems to have been one of the first which had an ambulatory round the choir. Tours grew rapidly in prosperity under the Merovingians, but abuse of the right of sanctuary led to great disorder, and the church itself became a hotbed of crime. Charlemagne re-established discipline in the disorganized monastery and set over it the learned Alcuin, who established at Tours one of the oldest public schools of Christian philosophy and theology. The abbey was made into a collegiate church in the 11th century, and was for a time affiliated to Cluny, but soon came under the direct rule of Rome, and for long had bishops of its own. The suburb in which the monastery was situated became as important as Tours itself under the name of Martinopolis. The Normans, attracted by its riches, pillaged it in 853 and 903. Strong walls were erected from 906 to 910, and in the 12th century the name was changed to that of Châteauneuf. Philip Augustus abolished the disorderly commune in 1212, but the innumerable offerings of princes, lords, and pilgrims maintained the prosperity of the town all through the Middle Ages. A 13th-century writer speaks with enthusiasm of the wealth and luxury of the inhabitants, of the beauty and chastity of the women, and of the rich shrine of the saint. A third church, replacing one which had been built after the burning of that of St Perpetuus in 997, was begun in 1175, and finished in the 13th century. It was 374 feet long and 85 feet high, and had five towers, of which only two remain. The rest of the church, sold to speculators after the Revolution, disappeared under the first empire. Of the monastic buildings, only a beautiful inclosed gallery, built by Bastien François, nephew of Michel Colomb, in the time of the Renaissance, remains, but the streets which formerly belonged to Châteauneuf show many interesting relics of ecclesiastical and civil architecture. About 1130 Archbishop Hildevert built a cathedral in the old Roman town itself, on the ruins of those successively erected by Litorius and Gregory of Tours. This was burnt in 1166 during the quarrel between Louis VII. of France and Henry II. of England, the latter being lord of Tours and count of Anjou. The work was resumed in 1175, but not finished till 1547. Part of the towers belong to the 12th century; the choir to the 13th; the transept and first bays of the nave to the 14th; the remaining bays, the cloister on the north, and the fine façade to the 15th; and the two Renaissance towers (217 feet and 223 feet) to the 16th. The building is nevertheless remarkable for the harmony and regularity of its construction; specially noteworthy details are the triple western portal, the upper staircase of the north tower, a Renaissance staircase in the cloister, the old woodwork in chestnut-wood, and the splendid glass of the 13th, 14th, and 15th centuries. A pretty little mausoleum, built in 1506 by Jean Juste, is the burial-place of three young sons of Charles

VIII. The archbishop's palace is to the right of the cathedral, with an interesting chapel of the 12th century, and an outside pulpit of the 16th. During the 10th century the Benedictine abbey of St Julien was re-established by Archbishop Théotolon, and a Romanesque church built, of which the great square tower still remains. St Julien has a fine nave and double aisles; the straight terminal wall has two 16th-century apses attached. There are some paintings of the 12th century under the tower.

The magnificence of Tours declined in the 14th century; it was then united to Châteauneuf by a common wall, of which an elegant round tower (the Tour de Guise) remains near the quay, and both towns were put under the same government. The numerous and long-continued visits of Charles VII., Louis XI., and Charles VIII. in Touraine during the 15th century favoured the commerce and industry of the town, then peopled by 75,000 inhabitants. To the flourishing school of art which existed at the Renaissance are due several private houses, a fountain, and the church of Notre Dame La Riche, with splendid windows by Pinaigrier. An unimportant building, part of a modern chateau, is all that remains of the royal residence and magnificent gardens of Plessis-lès-Tours, where Louis XI. shut himself up and died, the states in 1506 proclaimed Louis XII. the father of his people, and Henry III. and Henry of Navarre united in 1589 against the League. From that year Tours was deserted by the kings of France. A fine bridge of fifteen arches was built across the Loire from 1765 to 1777 by Bayeux. The chief modern buildings are the theatre, the church of St Joseph, the railway station, and a museum with collections of antiquities, pictures, pottery, and mineralogy. There are also antiquities in the museum of the archæological society of Indre-et-Loire. The gardens and a remarkable portal of the archbishop's palace, a magnificent iron gate of the 18th century in the prefecture, once the convent of the Visitation, and the general hospital (1200 beds) should also be mentioned. In 1870 Tours was the seat of the government of the national defence. Tours is the birthplace of the heretic Berengarius, the two marshals Boucicaut, the novelist Honoré de Balzac, the poet Destouches, the painters Fouquet and Clouet, and Madame de la Vallière.

TOUSSAINT LOUVERTURE, Pierre-Dominique (1746–1803), one of the liberators of Hayti, claimed to be descended from an African chief, his father, a slave in Hayti, being the chief's second son. He was born 20th May 1746 at Breda, and was at first surnamed Breda, which was changed to Louverture in token of the results of his valour in causing a gap in the ranks of the enemy. From childhood he manifested unusual abilities, and succeeded, by making the utmost use of every opportunity, in obtaining a remarkably good education. He obtained the special confidence of his master, and was made superintendent of the other negroes on the plantation. After the insurrection of 1791 he joined the insurgents, and, having acquired some knowledge of surgery and medicine, acted as physician to the forces. His rapid rise in influence aroused, however, the jealousy of Jean François, who caused his arrest on the ground of his partiality to the whites. He was liberated by the rival insurgent chief Baisson, and a partisan war ensued, but after the death of Baisson he placed himself under the orders of Jean François. Subsequently he joined the Spaniards, but, when the French Government ratified the Act declaring the freedom of the slaves, he came to the aid of the French. In 1796 he was named commander-in-chief of the armies of St Domingo, but, having raised and disciplined a powerful army of blacks, he made himself master of the whole country, renounced the authority of France, and announced himself "the Buonaparte of St Domingo." For further details of his career see Hayti (vol. xi. p. 545). He was taken prisoner by treachery on the part of France, and died in the prison of Joux, near Besançon, 27th April 1803.

See *Mémoires* written by himself, 1853; Saint-Rémy, *Vie de Toussaint Louverture*, 1850; Gragnon-Lacoste, *Toussaint Louverture, Général en Chef de l'Armee de Saint-Domingue surnommé le Premier des Noirs*, based on private papers of the Louverture family, 1877

TOWN, TOWNSHIP. See Borough, City, Municipality, and United States, pp. 731, 827.

TOWNSHEND, Charles Townshend, Second Viscount (1674–1738), a statesman of unsullied integrity, was the eldest son of Horatio, the first viscount, and was born in 1674. He succeeded to the peerage in December 1687, and was educated at Eton and King's College, Cambridge. When he took his seat in the House of Lords his sympathies leant to Toryism, but this predilection soon faded away, and in February 1701–2 it was rumoured among the courtiers that he would hold the office of privy seal in the Whig ministry which William III. had in view. For some years after the accession of Queen Anne he remained without office, but on 29th September 1707 he was created captain of the yeomen of the guard, and in the same year he was summoned to the privy council, a distinction renewed by the queen's two successors on the throne. The command of the yeomen remained in his hands until 13th June 1711, but its responsibilities did not prevent him from acting as joint plenipotentiary with the duke of Marlborough in the peace negotiations with France which were carried on at Gertruydenberg, near Breda, or from serving as ambassador extraordinary at The Hague congress (2d May 1709–26th March 1711). Townshend was high in favour with George I., and on that king's arrival at The Hague in September 1714 he published the appointment of Townshend as secretary of state for the southern department, and entrusted to his new minister the privilege of nominating his own colleague. Horace Walpole, his brother-in-law and private secretary, recommended Stanhope for the vacant post, and Stanhope was duly appointed. Townshend did not neglect to avail himself of the advantages afforded by his attendance on the king, and before the arrival of George I. in England he had obtained complete ascendency both over his mind and the dispositions of the advisers by whom his line of conduct was generally determined. The policy of the new ministers at home and abroad lay in the promotion of peace. With this object they endeavoured to limit the charges against their predecessor Harley, Lord Oxford, to high crimes and misdemeanours. To gain this end they brought about, in 1716, an alliance between those ancient rivals in arms, France and England. In spite of their success, their influence was gradually undermined by the intrigues of Lord Sunderland and by the discontent of the Hanoverian favourites, who deemed the places and the pensions which they had gained an insufficient reward for their exertions. In October 1716 Stanhope accompanied the king on his journey to Hanover, and during this visit was seduced from his allegiance to his colleagues by the wily Sunderland, who had ingratiated himself into the royal favour. George I. was induced to believe that Townshend and Walpole were caballing with the prince of Wales, and were forming designs against the royal authority. Townshend was dismissed in December 1716 from his place of secretary of state, and was offered in lieu thereof the splendid banishment of lord-lieutenant of Ireland, a gilded sinecure which he at first contemptuously declined and only condescended ultimately to accept on the condition that he was not required to set foot on Irish soil. His latent spirit of hostility to this arrangement quickly developed into open antagonism, and in March 1717 Townshend was dismissed from his position. At the close of May 1720 a partial reconciliation took place between the opposing Whig sections of Stanhope and Townshend. The latter was readmitted into the ministry as lord president of the council (11th June 1720), and his devoted relation and colleague Sir Robert Walpole became paymaster-general. When the South Sea Bubble burst, the fortunes of the principal members of the ministry shared in the misfortune of the scheme which they had promoted. Stanhope, in a paroxysm of passion during a heated debate, broke a blood-vessel, and Sunderland, though acquitted of the charge of personal corruption, was forced to retire into private life. The withdrawal of these statesmen assigned to their rivals the chief prizes in the state: Townshend became (10th February 1721) secretary of state, and Walpole gained the position of first lord of the treasury and chancellor of the exchequer. The death of George I. threatened a change of advisers, but the dismay of the new king's favourite, Spencer Compton, at being called upon to draw up the royal speech, led to the old ministers of the crown being retained in their places. What the attacks of the opposition could not effect, the internal strife of the administration accomplished. Townshend was of a proud, impetuous disposition, born with a nature more accustomed to rule than to obey. His family had for several generations stood higher in the social life of Norfolk than Walpole's progenitors, and when he himself attained to distinction in politics his position as a member of the Upper House was greater than that enjoyed by his friend in the Commons. As the power of the Lower House increased, and as Walpole became more and more the object of the attacks of the Tories, the pre-eminence of Townshend passed from him. So long, to use the witty remark of Sir Robert Walpole, as the firm was Townshend and Walpole, things went well with them, but when the positions were reversed jealousies arose between the partners. The growing alienation was hastened by the death, in 1726, of the secretary's wife, the sister of Walpole. At the close of 1729 Townshend endeavoured to obtain the appointment of his old and attached friend, Lord Chesterfield, as his fellow secretary of state, and the failure of the attempt brought about a fierce scene between Walpole and himself. They broke out into passionate words, seized one another by their coat-collars, and would have come to blows had they not been prevented by their friends who were present. After this outbreak of passion further co-operation was impossible, and Townshend, having the good sense to recognize the position, retired into private life on 15th May 1730. The chief domestic events of his ministry were the impeachment of Bishop Atterbury, the partial restoration of Lord Bolingbroke, and the troubles in Ireland over the granting to a man called Wood of a patent for coining pence. Its concluding act was the signing of the treaty of Seville (9th November 1729). Townshend died of apoplexy 21st June 1738.

Townshend was slow in forming, but resolute in adhering to, his opinion, and, like most other men of that stamp, was impatient of contradiction. His manners have been styled "coarse, rustic, and seemingly brutal," but these defects were not visible in his domestic life. Never did minister leave office with cleaner hands; he did not add one acre to his estate nor leave large fortunes to his younger children.

TOWNSHEND, Charles (1725–1767), a politician ever to be remembered as the embodiment of wit and indiscretion, was the second son of Charles, third Viscount Townshend, who married Audrey, the daughter and heiress of Edward Harrison of Ball's Park, near Hertford, a lady who rivalled her son in brilliancy of wit and frankness of expression. Charles was born 29th August 1725, and was sent for his education to Leyden and Oxford. At the Dutch university, where he matriculated 27th October 1745, he associated with a small knot of English youths, afterwards well known in various circles of life, among whom were Askew, the book-collector, Dowdeswell, his subsequent rival in politics, Wilkes, the witty and unprincipled reformer, and Alexander Carlyle, the genial Scotchman, who devotes some of the pages of his *Autobiography* to chronicling their sayings and their doings. He represented Great Yarmouth in parliament from 1747 to 1761, when he found a seat in the treasury borough of Harwich. Public attention was first drawn to his abilities in 1753, when he delivered a lively attack, as a younger son who might hope to promote his advancement by allying himself in marriage to a wealthy heiress, against Lord Hardwicke's marriage bill. Although this measure passed into law, he attained this object in August of the following year by marrying Caroline, the eldest daughter of the second duke of Argyle and the widow of Francis, Lord Dalkeith, the eldest son of the second duke of Buccleugh. In April 1754 Townshend was transferred from the position of a member of the Board of Trade, which he had held from 1749, to that of a lord of the admiralty, but at the close of 1755 his passionate attack against the policy of the ministry, an attack which shared in popular estimation with the scathing denunciations of Pitt, the supreme success of Single-Speech Hamilton, and the hopeless failure of Lord Chesterfield's illegitimate son, caused his instant dismissal. In the administration which was formed in December 1756, and which was ruled by Pitt, the lucrative office of treasurer of the chamber was given to Townshend, and in the following spring he was summoned to the privy council. With the accession of the new monarch in 1760 this volatile politician transferred his attentions from Pitt to the young king's favourite, Bute, and when, at the latter's instance, several changes were made in the ministry, Townshend was promoted to the post of secretary of war. In this place he remained after the great commoner had withdrawn from the cabinet, but in December 1762 he threw it up. Bute, alarmed at the growth in numbers and in influence of his enemies, tried to buy back Townshend's co-operation by sundry tempting promises, and at last secured his object in March 1763 with the presidency of the Board of Trade. When Bute retired and George Grenville accepted the cares of official life, the higher post of first lord of the admiralty fell to Townshend's lot, but with his usual impetuosity he presumed to designate one of his satellites to a place under him at the board, and the refusal to accept the nomination led to his exclusion from the new administration. While in opposition his mind was swayed to and fro with conflicting emotions of dislike to the head of the ministry and of desire to share in the spoils of office. The latter feeling ultimately triumphed; he condescended to accept in the dying days of Grenville's cabinet, and to retain through the "lutestring" administration of Lord Rockingham,—"pretty summer wear," as Townshend styled it, "but it will never stand the winter,"—the highly-paid position of paymaster-general, refusing to identify himself more closely with its fortunes as chancellor of the exchequer. The position which he refused from the hands of Lord Rockingham he was forced to accept from the imperious Pitt (August 1766), and a few weeks later his urgent appeals to the great minister for increased power were favourably answered, and he was admitted to the inner circle of the cabinet. Dowdeswell, his predecessor at the exchequer, resented his removal for his brilliant rival. The new chancellor proposed the continuance of the land tax at four shillings in the pound, while he held out hopes that it might be reduced next year to three shillings, whereupon his predecessor, by the aid of the landed gentlemen, carried a motion that the reduction should take effect at once. This defeat proved a great mortification to Lord Chatham, and in his irritation against Townshend for this blow, as well as for some acts of insubordination, he meditated the removal of his showy colleague. Before this could be accomplished Chatham's mind became impaired by some mysterious malady, and Townshend, who was the most determined and influential of his colleagues, swayed the ministry as he liked. His wife was created (August 1767) Baroness Greenwich, and his brother was made lord-lieutenant of Ireland. He himself delivered in the House of Commons many speeches unrivalled in parliamentary history for wit and recklessness; and one of them still lives in history as the "champagne speech," His last act was to pass through parliament resolutions which even his colleagues deprecated in the cabinet, for taxing several articles, such as glass, paper, and tea, on their importation into America, which he estimated would produce the insignificant sum of £40,000 for the English treasury, and which shrewder observers prophesied would lead to the loss of the American colonies. Shortly after this event he retired to his wife's country seat in Oxfordshire, where he died on 4th September 1767, from a fever which he had neglected.

The universal tribute of Townshend's colleagues allows him the possession of boundless wit and ready eloquence, set off by perfect melody of intonation, but marred by an unexampled lack of judgment and discretion. He shifted his ground in politics with every new moon, and the world fastened on him the nickname, which he himself adopted in his "champagne" speech, of the Weathercock. His official knowledge was considerable; and it would be unjust to his memory to ignore the praises of his contemporaries or his profound knowledge of his country's commercial interests. The House of Commons recognized in him its spoilt child, and Burke happily said that "he never thought, did, or said anything" without judging its effect on his fellow-members. Charles Townshend is the subject of a memoir by Mr Percy Fitzgerald.

TOXICOLOGY. See Poisons.

TRACHIS, a city of ancient Greece, at the foot of Mount Œta, a little to the north-west of Thermopylæ. As commanding the approach to Thermopylæ from Thessaly, it was a place of great military importance. According to Homer, it was one of the places subject to Achilles, and was famed in legend as the scene of Hercules's death—an event which forms the subject of Sophocles's play *The Trachinian Women*. In historical times it first attained importance on the foundation of Heraclea by the Spartans in 426 B.C. The Thessalians, jealous of the establishment of a Spartan outpost on their borders, attacked Heraclea, and in 420 the Heracleots were defeated by them with heavy loss. In the winter of 409–8 Heraclea sustained another disastrous defeat. In 395 the Thebans expelled the Spartans, and restored the city to the old Trachinian and Œtæan inhabitants. In later times Heraclea was one of the mainstays of the Ætolian power in northern Greece. In 191 B.C., after the defeat of Antiochus at Thermopylæ, Heraclea was besieged and taken from the Ætolians by the Romans under the consul Acilius Glabrio. From Livy's account of the siege (xxxvi. 24), it appears that the citadel was outside the town, which lay on the low ground between the rivers Karvunaria (Asopus) and Mavra-Neria (Melas). There are still traces of the citadel on a lofty rock above.

TRACT SOCIETIES are associations for publishing or circulating religious treatises or books. The circulation of short treatises for the promotion of Christian knowledge is older than the invention of printing. Wickliffe, for instance, was a great writer and circulator of tracts, employing his Oxford friends and pupils to multiply copies. So was Luther in his day, with the help by that time of printer and bookseller. In later times John Wesley was a busy worker in this way; and Hannah More, from her own pen, produced what were known as the "Cheap Repository Tracts," highly lauded by Bishop Porteus, and widely used towards the close of the 18th century. Before this time there had been efforts of associated labour for the same object, a "book society for promoting religious knowledge among the poor" having been established in 1750. A similar society was formed at Edinburgh in 1793. But it was at the close of the century, in 1799, that there was founded in London the Religious Tract Society, an institution unparalleled in the extent and variety of its operations, and the parent of numerous societies in different parts of the empire as well as in the United States and on the continent of Europe. There are other associations with kindred objects, but in connexion with particular ecclesiastical systems. Thus the tract department of the Christian Knowledge Society is specially connected with the Church of England; and the Wesleyans, Baptists, and other denominations have their own tract societies. The Church of Rome also has now similar associations. The Religious Tract Society is alone in being confined to the diffusion of religious truth common to all Protestant Christians, to the exclusion of topics touched by ecclesiastical divisions. This catholicity is secured by the fundamental rules of the society, and by its managing committee being composed half of Churchmen and half of Nonconformists of all denominations.

A brief statement of the proceedings of the Religious Tract Society, as presented in its latest annual *Report*, will best serve to show the general objects and operations of all such organizations,—any special or varied action elsewhere adopted being noted as we proceed. The main object of the society is the preparation and publication of religious literature. At first this consisted mostly of tracts and small treatises. After a time larger books were published, including series of reprinted works of the early Reformers and English Protestant theologians and Biblical expositors, and also books on common subjects treated in a religious spirit. The society also issues magazines for all classes. Four of these periodicals, the *Leisure Hour*, the *Sunday at Home*, the *Boys' Own Paper*, and the *Girls' Own Paper*, have a united circulation, including monthly parts and yearly volumes, of nearly 600,000 numbers weekly, or above 30 millions in the year. The total annual issue, including books, tracts, &c., at home and abroad, is nearly 86 millions.

The distribution of this is chiefly through the ordinary channels of trade, with the exception of the tracts, which are circulated by home and foreign missionary societies, and various agencies public and private. Almost every missionary agency is indebted to the Religious Tract Society for the work carried on through the press. Grants are made, either free or as nearly as possible at cost price; and, when it is advisable to produce publications at foreign stations, grants of paper and other material, as well as money payments, are voted. The publications are in almost every tongue, the list containing works in 174 languages and dialects.

The funds for this large and varied work come partly from donations, subscriptions, and legacies, but chiefly from the profits of the sales of the society's publications. The total missionary and evangelistic expenditure in the year ending March 31, 1886, amounted to £47,722, of which £19,019 was supplied from the trade funds, which have also borne the entire cost of management, both of the business and missionary departments. The total amount received from sales, subscriptions, and all other sources was £212,731, 11s. 8d.

The American Tract Society and some of the Continental societies undertake the distribution as well as the production of tracts and books, by means of paid colporteurs and other agents. The Continental societies produce most of their own books and tracts, aided largely by grants of money and paper from the Religious Tract Society.

TRACTION, Electric The driving of vehicles by electricity was made commercially practicable by the invention of the dynamo-electric machine, which gave a ready means of producing electrical energy by the expenditure of mechanical work, and by the further discovery that the function of the dynamo could be reversed,—that it was capable of acting efficiently as a motor to do mechanical work when supplied with energy in the electrical form. Experiment has shown that when a dynamo is used to produce an electric current, which, in its turn, drives another dynamo serving as a motor, the double conversion of energy may be performed with no very serious loss. In favourable cases, when the dynamo and motor are close together, the motor will yield more than 80 per cent. of the work which is spent in driving the dynamo. When they are far apart there is an additional loss, due to the resistance of the conductor which connects them, and a further loss due to its imperfect insulation. The use of high electromotive force, which reduces the first of these, tends to increase the second; it is, however, practicable to keep both within reasonable limits. Early attempts to apply electricity to traction were made by Robert Davidson, who placed an electromagnetic locomotive on the Edinburgh and Glasgow Railway in 1837, and by Jacobi of St Petersburg, who propelled a boat on the Neva in 1839 by an electromagnetic engine driven by a battery of Grove's cells. The inefficiency and bulkiness of early electromotors, and the cost of producing electric energy when a galvanic battery was the source, made it impossible for electricity under such conditions as these to compete with other methods of traction. A good battery using zinc as the active metal consumes from 1 to 2 ℔ of zinc per hour per horse-power developed; a good steam-engine consumes from 2 to 3 ℔ of coal in doing the same amount of work, and the cost of zinc is about fifty times that of coal. Hence, notwithstanding modern improvements in electromotors, the cost of producing mechanical power by means of electricity, when a zinc-consuming battery is the source, is still prohibitive.

The earliest practical electric railway was constructed at the Berlin exhibition of 1879 by Dr Werner Siemens. At one station was a dynamo driven by a steam-engine. The current was conducted to the moving car through a special rail placed between the ordinary rails and insulated from the ground by blocks of wood. From this rail it passed through a motor-dynamo on the car, and the ordinary rails completed the circuit. Electrical contact with the ordinary rails was made by the wheels, and with the central rail by a pair of brushes made of copper wire which rubbed against its sides. Spur-wheels were used to connect the motor shaft with the wheels and to effect a suitable reduction of speed. The line was half a mile long and of 2-feet gauge. The motor developed about 3½ horse-power, and was carried by a separate truck, forming a locomotive which drew a car with 20 passengers at a speed of from 4 to 7 miles an hour.

The success of the Berlin experiment was complete, and Messrs Siemens followed it up in 1881 by the construction of a permanent electric tramway, 1½ miles in length, at Lichterfelde, which has now (1887) been in continuous operation for six years. At Lichterfelde the ordinary rails, insulated by wooden sleepers, are the only conductors. Where roads cross the line the rails are cut out of circuit, and the current is carried past the gap by underground cables, but switches are provided by which the current can be sent into the insulated sections if required. Each car takes 24 passengers, and runs at a speed of 12 miles an hour. There is no separate locomotive, the motor-dynamo being on the car itself. In 1882 Messrs Siemens constructed an electric tramway in the mines of Zankerode, in Saxony, and built for it a locomotive able to draw 8 tons at a speed of 7½ miles an hour. Overhead conductors were employed, consisting of a pair of insulated I-shaped rails fixed to the roof of the workings; the current was conveyed to and from the locomotive by means of a pair of contact carriages sliding on these conductors, and connected with the car by short flexible cables. A similar line was opened in 1883 at the Hohenzollern colliery in Upper Silesia.

The same year witnessed the completion of another pioneer undertaking of the first importance, an electric tramway 6 miles long connecting Portrush and Bushmills, in the north of Ireland. Here the insulated conductor is a special rail, carried alongside of the line on wooden posts at a height of 1½ feet above the ground. Contact is made by springs shaped like carriage-springs, which project from one side of the car at both ends, so that the length of the car enables continuous contact to be maintained at cross-roads, where there are gaps in the conducting rail, past which the current is taken by underground cables. The ordinary rails serve as return conductors. The dynamos are driven by turbines at a station nearly a mile distant from the line; they supply a current of 100 amperes with an electromotive force of 250 volts. The motors are placed on passenger cars; their speed is regulated by means of resistance coils, which the driver of the car switches into the circuit. A similar tramway, 3 miles long, connecting Bessbrook and Newry, was opened in 1885; there also water-power is made use of to drive the generating dynamos. On these lines the train usually consists of a motor car with passengers, followed by two or three goods waggons, and the whole working expenses are from 3d. to 4d. per train-mile. The speed is 10 miles an hour.

Amongst early electrical railways Mr Volk's short line on the beach at Brighton deserves mention. There the rails themselves act as conductors, and are insulated only by wooden sleepers lying on the shingle. The line has been in operation since 1883, with a working expense of only 2d. per car-mile.

Other English and Continental lines will be referred to later; it is, however, in America that electrical traction has hitherto found its widest development. In 1880 Mr Edison ran an electric locomotive on an experimental track near his laboratory at Menlo Park. Soon after the Chicago exhibition of 1883, at which an electric railway was shown in action, a large number of permanent lines were established. There are now more than twenty electrical tramways at work in the United States, under the patents of Edison, Field, Daft, Van Depoele, Sprague, and others. Many more lines are projected, and experiments are in progress on the application of electrical traction on a large scale to the elevated railways of New York.

Electric traction by storage batteries.

In all the instances which have been referred to above, electricity is employed as a means of transmitting power as it is wanted from a generating station to the cars, through a conductor extending along the track. Another method of effecting electric traction is to carry a store of energy on the car or on a special locomotive, by using secondary batteries which are charged from time to time at the generating station. This system, which was introduced in England by Mr Reckenzaun and on the Continent by M. Julien, has been successfully employed on several lines.

The system of storage, by means of secondary batteries, has the great advantage over the system of transmission through a conductor that it makes each car independent and that it is applicable to ordinary tramway lines. As regards economy of power, we have in the storage system a more complex series of transformation of energy, and therefore a larger number of items of loss. In both systems alike we have a certain loss of energy at the dynamo and at the motor. A secondary battery yields in the electrical form only about 70 per cent. of the energy given to it. In comparing the two methods, the loss which this involves has to be set off against that which occurs in the transmission system in the process of conduction, an item which may be very small in favourable cases, but which becomes large when there are many cars to be driven, when the line is long, and when, owing to the use of an exposed conductor, the electromotive force has to be kept low. Under average conditions it is probable that the conductor system has a slight advantage over the other in this respect, but the difference is not material, especially as the cost of power is a comparatively small part of the whole working expense of a line. The difference is slightly affected by the fact that in the storage system there is an extra weight to be carried—namely, the batteries—amounting to about ⅓ or ¼ of the whole weight, and the tractive force required to overcome friction is increased in a corresponding degree. A serious objection to the storage system is the probable cost of renewing batteries. In respect, however, both of durability and of power (in relation to weight) secondary batteries have of late undergone a marked improvement: and it is likely that the storage system will prove the most applicable to tramways in city streets, where conductors on the level of the road are impracticable and overhead conductors would not be permitted.

Classification of systems.

The existing methods of electrical traction as applied to tramways may be classified as follows:—

I. Motor driven by storage batteries, the batteries and motor being carried either (*a*) in the car itself or (*b*) on a separate truck forming a locomotive. Reckenzaun's and Julien's cars, in which the batteries are under the seats, are examples of the first plan, which is in operation on lines at Antwerp, Hamburg, Brussels, and New York. Mr Elieson's tramway locomotive working in London on the North Metropolitan tramways is an example of the second plan. It is obviously preferable, when space can be found on the car itself for the motor and batteries, to place them there rather than on a separate truck. When a separate locomotive is used it must be heavy enough to grip the rails, and the whole weight to be drawn is then considerably greater.[1]

II. Conductor systems, which may be classified thus:—

(*a*) Those using the ordinary rails as the only conductors. The lines at Lichterfelde and Brighton, already mentioned, are examples of this plan, which is quite inapplicable where the rails are laid flush with the roadway as in city streets.

(*b*) Those using a third (insulated) rail, above ground. To this class belong the Portrush, the Bessbrook, and several American lines. This plan, like the last, is not applicable to city streets.

(*c*) Those using one (or in some cases two) overhead conductors. A line of this type has been successfully worked between Mödling and Hinterbrühl, near Vienna, and another between Frankfort and Offenbach, both since 1884, at a cost of about 3½d. per car-mile. The conductors consist of slotted tubes 1 inch in bore supported on posts 18 feet high and stayed by wires at intermediate points to keep them from sagging. The contact carriages are pistons sliding in the tubes.[2] The Daft lines at Baltimore and other places in America, and the Van Depoele lines, of which some 30 miles are in operation, are mostly worked by means of overhead conductors.

(*d*) Those using underground conductors in a slotted channel or conduit. This system, which has the obvious advantage that the conductor is placed entirely out of the way of street traffic, has been introduced at Blackpool by Mr Holroyd Smith, and, in America, at Cleveland by Messrs Bentley and Knight and at Philadelphia by Mr Schlesinger. In the Blackpool line the conductor is split into two parts which run parallel to each other within the conduit on its two sides, and are touched by a contact arm which reaches down through a narrow central slot at the level of the street; an electromotive force of 200 volts is employed. The conduit is placed midway between the rails, but it may be questioned whether, in view of the conditions of ordinary street traffic, a better place for it would not be at one side. Mr Field has proposed a tramway with two conduits, one beside each rail, containing two conductors, one to be charged positively and the other negatively, so that a comparatively high resultant difference of potential is available for the motor although the potential of neither conductor differs to a dangerous degree from that of the earth.

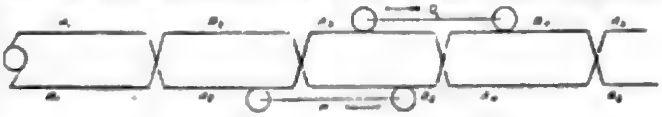
(*e*) One system remains to be described, which was proposed in 1881 by Messrs Ayrton and Perry as specially applicable to electric railways of considerable length, in which an exposed conductor would give rise to much loss through leakage. Their plan is to use a well-insulated conductor in a closed channel underground. The line is divided into short sections; each of these has an exposed conductor, which may be one of the rails, and this is placed in temporary contact with the insulated conductor as the train passes, by the pressure of the wheels on a flexible rail or stud, or by means of automatic electromagnetic switches. Leakage is thus restricted to the continuous and well-insulated conductor, together with that section of the surface conductor which is in contact with the former at any one time; and the system has the further advantage that it gives the means of providing an automatic block by which successive trains are kept from overtaking one another.

The form and disposition of the motor-dynamo and the mode by which it is connected with the driving-axle of the car are matters in which much variety of practice exists. The question of gearing is complicated by the fact that the frame of the car oscillates vertically with respect to the axles. Spur-wheels, worm-gear, friction-gear, belts, multiple-band gear, and chain-gear are or have been used. Mr Reckenzaun's car is carried by two bogie trucks, one under each end, and each bogie carries a motor whose axle, placed longitudinally, drives a central spur-wheel on one axle of the bogie by means of a worm. An advantage possessed by two motors is that, by coupling them in series or parallel, or by using one only, the driver is able to command different grades of power without the use of resistance coils. In cars driven by storage batteries the same object may be secured by various groupings of the cells.

Telpherage.

Telpherage.—In all the methods of electrical traction to which reference has been made the road on which the cars run is essentially a railway or tramway of the kind used in horse traction and steam traction. In 1881 the late Prof. Fleeming Jenkin devised a system of electric locomotion in which the vehicles are hung upon what resembles an exaggerated telegraph line. To this he gave the name of *telpherage*. As developed by the inventor, in conjunction with Messrs Ayrton and Perry, the system is especially adapted to the transport of goods at a slow speed, in localities where the traffic would be insufficient to support an ordinary railway.

The telpher line is a steel rod or cable, suspended from brackets on posts about 70 feet apart; it serves at once as carrier of weights and conductor of electricity. The line may be made rigid, and in that case a high speed of transit may be attained; but in general the line is flexible and the trains travel slowly in what may be, if the volume of traffic requires it, a nearly continuous stream. Each train consists of a series of buckets or skeps which hang each from a single running wheel or pair of wheels, and are spaced by wooden connecting bars. A small electric motor, which hangs below the line and is geared by spur and chain gearing to a pair of driving-wheels, forms the locomotive. In general, the line is electrically divided into equal sections, which have the same length as a single train, so that the front carriage is always on the section in advance of the rear carriage. The train is furnished with a continuous conductor from end to end, through which it makes electric contact between the section in front and the section behind, and the motor is included in the circuit of this conductor. Two systems of working are used, which enable trains to be run either in electrical series or "parallel." In the series system the successive sections of the line are electrically connected, so long as no train is on them, by means of switches at the joints between the sections, so that the whole forms one continuous conductor. When a train comes on any one section it breaks contact at the joint between that section and the one behind it; the circuit, however, remains closed through the conductor on the train itself, and in this way the motor receives the current which is passing through the line. Other trains at other places in the line receive the same current, each by breaking for the time the ordinary contact between the two sections it touches, and substituting a contact through its own conductor and motor. When a train leaves a section it replaces the switch that makes contact with the section behind. If, however, there are more than one train on the line, an automatic block system is added to prevent one from overtaking another by letting the section which a train leaves stand insulated for a time. No control is exercised from the vehicles themselves; in fact, the trains run without attendants. In the simplest parallel system of telpherage a continuous conductor distinct from the line is stretched alongside of it; the trains make contact between the two. The figure shows another plan, known as the cross-over parallel system, which is suitable where a double line of trains is desired. There A_1, B_2, A_3 . . . form successive sections of one line, and B_1, A_2, B_3 . . . of another. A_1, A_2, A_3 . . . are electrically continuous, and are connected to one pole of the dynamo. B_1, B_2, B_3 . . . are also continuous, and are connected to the other pole. Thus the sections of each line are alternately positive and negative. Any train, such as P or Q, bridges the gap between two sections and receives a current which suffers reversal as the train passes from one section to the next. It is to be regretted that space does not admit of any description of the details of telpherage, many of which present the utmost ingenuity. The system was shown to be practicable by experiments on an experimental line at Weston. The first telpher line on a commercial basis was erected in 1885 at Glynde, in Sussex, and has been maintained in operation notwithstanding many difficulties inseparable from so completely novel an undertaking.



Cross-over Parallel System of Telpherage.

Propulsion of boats.

The electrical propulsion of boats, by means of storage batteries, has been the subject of several successful experiments, but has not found systematic application. In this connexion reference should be made to a scheme proposed by Ayrton and Perry for the haulage of boats on canals or of waggons upon roads. Their proposal was to have a conductor ranged along the towing path, or along the side of the road. A motor running on this was to pull itself along and drag the boat or waggon after it.

Aerial navigation.

In aerial navigation, storage batteries working an electric motor have been used to drive the propeller of a "dirigible" balloon.

Theory of motors.

Space does not admit of more than the briefest reference to the theory of electric motors. A motor may be regarded as a dynamo acting to produce an electromotive force e which is opposite in direction to the externally impressed electromotive force E. The resultant electromotive force is $E-e$, and on this, together with the resistance of the circuit, the strength of the current C depends. The electrical power supplied is CE, and of this the motor utilizes Ce. The efficiency is e/E. It is easily seen, as was first shown by Jacobi, that the power developed by the motor (Ce) is a maximum when $e = \frac{1}{2}E$. But this condition of maximum power involves that half the energy supplied is wasted; to secure higher efficiency, motors are in practice run at much less than their maximum power, so that e may approach more nearly to equality with E. The field magnets of motors, like those of dynamos, may be wound with coils in series with the armature coil, or with coils forming a shunt to the armature, or with a combination of both. A very important part of the theory deals with the automatic regulation of speed by the use of compound winding. In a paper of fundamental importance with regard to this part of the subject, Messrs Ayrton and Perry[3] have shown that a motor may be made to run at constant speed under varying loads when the external electromotive force is constant, provided that a differential combination of direct shunt and reverse series winding be employed,—the shunt coil serving to energize the magnets and the series coil to reduce their magnetism to a certain extent when the current in the armature is increased. The proportion of series to shunt winding necessary for this result depends on the relation of the resistance of the armature to that of the shunt coil, and it is an easy deduction from the theory that, when the resistance of the armature is negligibly small, the speed of a simple shunt-wound motor driven by means of a constant external electromotive force is sensibly constant, a result which has been experimentally demonstrated by Mr Mordey (*Phil. Mag.*, Jan. 1886). It is shown in the same paper that a similar means of governing may be used when the current passing through the motor is kept constant, instead of the external electromotive force. The principle of differential compound winding to secure automatic regulation of speed has been applied in several American motors, notably by Mr Sprague.

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[1] For a comparison of the weights to be drawn and the tractive force required in different systems, see a paper by Mr Reckenzaun, *Elect. Rev.*, May 21, 1886.

[2] For details of the construction and working expenses of these and other lines, see the valuable paper by Mr Reckenzaun, *Jour. Soc. of Arts*, April 20, 1887. Statistics of American lines will be found in a paper by T. C. Martin, read before the American Institute of Electrical Engineers, May 18, 1887.

[3] "Electromotors and their Government," *Jour. Soc. Tel. Eng.*, 1883.

Details of most of the electrical tramways and railways mentioned in the text will be found in the journals *Electrical Review*, *Electrician*, and *Electrical World* (New York) of the dates referred to. See also *The Electric Motor and its Applications*, by T. C. Martin and J. Wetzler (New York, 1887). The Portrush line is described by E. Hopkinson and A. Siemens in a paper read before the Society of Arts, April 1883. For telpherage, in addition to articles in the journals named, see Fleeming Jenkin, "On Telpherage," *Jour. Soc. Arts*, May 1884; also *Professional Papers* of the Corps of Royal Engineers, Chatham, vol. x., 1884. (J. A. E.)

TRACY, ANTOINE LOUIS CLAUDE DESTUTT, COMTE DE (1754–1836), was born in Bourbonnais on July 20, 1754. The noble family to which he belonged was of Scottish descent, tracing its origin to Walter Stutt, a gentleman who in 1420 accompanied the earls of Buchan and Douglas to the court of France, and whose family afterwards rose to be counts of Tracy. The father of Destutt de Tracy (as he is usually called) was a soldier, and died a field-marshal. Destutt de Tracy began his studies under the superintendence of his mother, and afterwards prosecuted them at the university of Strasburg. During his student days, however, he was chiefly noted for his skill in every kind of manly exercise. On leaving the university he embraced a military career, in which his advance was rapid. When the Revolution broke, Tracy, who was then thirty-five years of age, took an active part in the provincial assembly of Bourbonnais. He was elected a deputy of the nobility to the states-general, where he sat alongside of his friend La Fayette. In the spring of 1792 he received the rank of field-marshal, along with the sole command of the cavalry in the army of the North; but, as the conduct of affairs fell more and more into the hands of the extremists, he took an indefinite leave of absence, and settled with his family at Auteuil. Here, in the society of Condorcet and Cabanis, he devoted himself to scientific studies. Under the Reign of Terror he was arrested and imprisoned for nearly a year. It was his solitary meditations at this period, we are told, which discovered to him his true bent. Under the influence of Locke and Condillac he abandoned the natural sciences for the study of mind. On the motion of Cabanis he was named associate of the Institute in the class of the moral and political sciences. He soon began to attract attention by the *mémoires* which he read before his colleagues—papers which formed the first draft of his comprehensive work on ideology. The society of "ideologists" at Auteuil embraced, besides Cabanis and Tracy, who have been called respectively the physiologist and the metaphysician of the school, Volney, who has been called its moralist, and Garat, its professor in the National Institute. Under the empire he was a member of the senate, but took little part in its deliberations. Under the Restoration he became a peer of France, but protested against the reactionary spirit of the Government, and remained in opposition. In 1808 he was elected a member of the French Academy in room of Cabanis, and in 1832 he was also named a member of the Academy of Moral Sciences on its reorganization. He appeared, however, only once at its conferences. He was old and nearly blind, and filled with sadness, it is said, by the loss of his friends and the discredit into which his most firmly cherished opinions had fallen. "His only distraction was to have Voltaire read aloud to him." He died at Paris on the 9th of March 1836.

Destutt de Tracy was the last eminent representative of the sensualistic school which Condillac founded in France upon a one-sided interpretation of the doctrines of Locke. He pushed the sensualistic principles of Condillac to their last consequences, being in full agreement with the materialistic views of his friend Cabanis, though the attention of the latter was devoted more to the physiological, that of Tracy to the psychological or "ideological" side of man. His ideology, he frankly stated, formed "a part of zoology," or, as we should say, of biology. To think is to feel. The four faculties into which he divides the conscious life—perception, memory, judgment, will—are all varieties of sensation. Perception is sensation caused by a present affection of the external extremities of the nerves; memory is sensation caused, in the absence of present excitation, by dispositions of the nerves which are the result of past experiences; judgment is the perception of relations between sensations, and is itself a species of sensation, because if we are aware of the sensations we must also be aware of the relations between them; will he identifies with the feeling of desire, and therefore includes it as a variety of sensation. It is easy to see that such conclusions ignore important distinctions, and are, indeed, to a large extent an abuse of language. As a psychologist Destutt de Tracy deserves credit for his distinction between active and passive touch, which has developed into the modern theory of the muscular sense. His account of the notion of external existence, as derived, not from pure sensation, but from the experience of action on the one hand and resistance on the other, may be compared with the account of Bain and later psychologists. Tracy worked up his separate monographs extending over a number of years into the *Éléments d'Idéologie* (1817–18 and 1824–5), which presents his complete doctrine. He also wrote in 1806 a *Commentaire sur l'Esprit des Lois de Montesquieu*, in which he argues ably in support of a free constitution on grounds which hardly admit of being harmonized with his general philosophical principles. The book was translated in America by his friend President Jefferson, who recommended it for use in the colleges. The first French edition appeared in 1817, and it was several times reprinted.

TRADE, BOARD OF. The greater part of such supervision of commerce and industry as exists in the United Kingdom is exercised by the "Committee of Privy Council for Trade" (see PRIVY COUNCIL), or, as it is usually called, the Board of Trade. As early as the 14th century councils and commissions had been formed from time to time to advise parliament in matters of trade, but it was not till the middle of the 17th century, under the Commonwealth, that any department of a permanent character was attempted. Cromwell's policy in this respect was continued under the Restoration, and in 1660 a committee of the privy council was appointed for the purpose of obtaining information as to the imports and exports of the country, and improving trade. A few years later another committee of the council was appointed to act as intermediaries between the crown and the colonies, or foreign plantations, as they were then called. This joint commission of trade and plantations was abolished in 1675, and it was not until twenty years later that the Board of Trade was revived under William III. Among the chief objects set before this board were the inquiry into trade obstacles and the employment of the poor; the state of the silver currency was also a subject on which John Locke, its secretary, lost no time in making representations to the Government. Locke's retirement in 1700 removed any chance of the Board of Trade advocating more enlightened opinions on commercial subjects than those generally held at that time. It had only a small share in making the constitutions of the colonies, as all the American ones except Georgia and Nova Scotia were formed before the reign of Charles II.; and in 1760 a secretary of state for the colonies was appointed, to whom the control drifted away. In 1780 Burke made his celebrated attack on the public offices, which resulted in the abolition of the board. In 1786, however, another permanent committee of the privy council was formed by order in council, and with one or two small exceptions the legal constitution of the Board of Trade is still regulated by that order. Under it all the principal officers of state, including the first lords of the treasury and admiralty, the secretaries of state, and certain members of the privy council, among whom was the archbishop of Canterbury, obtained seats at the board *ex officio*; and ten unofficial members, including several eminent statesmen, were also placed on the committee. The duties of the revived board were made the same as they were in the beginning of the century, but, in addition, the regulation of the food supply of the country, by restricting or relaxing the export and import of corn, was brought into prominence owing to a larger population requiring to be fed. New duties were thrown on the board by the growth of joint-stock companies, the development of railways, and the increase in shipping, and it was necessary to break it up into departments charged with the administration of the various Acts of Parliament. The Board of Trade thus became a mere name, the president being practically the secretary of state for trade, and the vice-president became, in 1867, a parliamentary secretary, with similar duties to those of a parliamentary under-secretary of state. At present, besides the president, who has usually a seat in the cabinet, the parliamentary secretary, and a permanent secretary, there are six assistant secretaries, each in charge of a department.

1. *The Commercial Department* is the real remains of the original Board of Trade, as it combines the charge of the trade statistics with the general consultative duties with which King Charles II.'s board was originally entrusted. The statistical work includes compiling the abstracts relating to the United Kingdom, the colonies, and foreign countries, the supervision of the trade accounts, and the preparation of shipping, railway, emigration, and fishery statistics. A record of the prices of corn has been obtained from actual sales in the chief market towns for about a hundred years, the original object being the sliding scale of corn duties, but these are now continued to govern the tithe payments, and form an unbroken series of prices based on actual transactions, and not mere market quotations. Foreign and colonial customs tariffs and regulations are also matters on which information is published, and labour statistics are for the future to have special attention. In 1872 one of the most important functions of the commercial department, viz., the negotiation of commercial treaties, was transferred to the Foreign Office, but the Board of Trade is still consulted on these matters by the Foreign Office, as well as by the Colonial Office on colonial commercial matters, and by the other public departments. The Bankruptcy Act of 1883 added a new branch of work, but for this there is now a separate establishment under an inspector-general. The last new work undertaken by the department is the publication (begun August 1886) of a *Monthly Journal* of commercial information, chiefly from official sources.

2. *The Railway Department* was originally constituted in 1840, and performs multifarious duties under various Railway Acts, including the inspection of railways before they are open, inquiries into accidents, reports on proposed railways, approval of bye-laws, appointment of arbitrators in disputes, as well as many duties under private Railway Acts. The inspection of tramways, their bye-laws and "provisional orders," are all dealt with here, as are similar orders relating to gas and water schemes and to electric lighting. Patents, designs, and trade marks are now dealt with by the Patent Office, which is subordinate to the railway department, and copyright, art unions, and industrial exhibitions are also among the matters dealt with by the department.

3. *The Marine Department* was created a separate branch of the Board of Trade in 1850, about which time many new and important marine questions came under the Board of Trade, such, for example, as the survey of passenger steamers, the compulsory examination of masters and mates, the establishment of shipping offices for the engagement and discharge of seamen. Further work fell to the marine department by the Act of 1853, which gave it the control of lighthouse funds, and to a certain extent of pilotage. The consolidating Merchant Shipping Act of 1854 and subsequent legislation so much increased the department that in 1866 it was divided into three, viz., the present marine department, which deals with ships and seamen, the harbour department, and the finance department.

4. *The Harbour Department* was, as stated above, a branch of the marine department until 1866, so far as it is connected with the physical adjuncts of navigation, but various other matters have since been added, *e.g.*, the charge of the foreshores belonging to the crown, formerly managed by the commissioners of woods and forests, and the protection of navigable harbours and channels, long under the control of the Admiralty. Lighthouse funds, provisional orders for oyster and mussel fisheries, the management of Holyhead and Ramsgate harbours and of Dover pier, wreck, and quarantine are all among the matters dealt with by this department, which also has charge of the standards department for weights and measures.

5. *The Finance Department* was, like the harbour department, separated in 1866 from the marine department. The accounts of all the branches of the Board of Trade are in its charge, including the subordinate offices. It also deals with the accounts of harbours, lighthouses, and mercantile marine offices, and of the merchant seamen's fund, and with the consuls' accounts for disabled seamen abroad. Savings banks and seamen's money orders are also among the accounts and payments with which it is charged, and outside these marine matters it has to prepare for parliament the life insurance companies' accounts and to take charge of the bankruptcy estate accounts

6. *The Fisheries Department.*—By a recent Act the powers of the Home Office over salmon and other fisheries have been transferred to the Board of Trade, and a small department has consequently been created charged with the care of those industries.

TRADE-MARKS. There seems no reason to doubt that the practice of employing a mark to denote the goods of a particular trader (not necessarily the manufacturer) grew out of the use of signs, which, first affixed to the dealer's shop, were afterwards represented on his tokens, and eventually placed on the goods themselves. Trade-marks proper appear to have been in use in England in the reign of Elizabeth. The first reported case was in 1783, when Lord Mansfield decided that the sale by the defendants of a certain medicine under the name or mark of the plaintiff was a fraud. By other decisions it was affirmed that the use of another's trade-mark was actionable, even without the intent to defraud. The law, however, remained in an unsatisfactory condition till, by the Merchandise Marks Act in 1862, it was made a misdemeanour to forge or counterfeit a trade-mark, while penalties were inflicted for the sale of articles bearing a forged mark.

In 1875 the Trade Marks Registration Act established for the first time a registry of trade-marks in Britain, greatly facilitating the proof of title. A more precise definition of a trade-mark was also provided. In 1883 this Act was repealed by the Patents, Designs, and Trade Marks Act, in which its principal provisions were incorporated. All proceedings for the registration of trade-marks are now regulated by the Patents Act. A trade-mark may be a name printed or otherwise delineated in some particular or distinctive manner, or a signature, or a device, mark, brand, &c. Registration is compulsory, at least in the sense that the owner cannot prevent infringement or sue for damages for infringement unless he has registered, though it would appear that this disability exists only in the case of a mark capable of being registered under the Act. There are certain *indicia* which cannot be registered because they do not fall within the definition of a trade-mark, but which may yet be protected at equity. Registration is deemed equivalent to public use of the mark, and, after the expiration of five years, is conclusive evidence of right to exclusive use. Applications for registration have to be addressed to the comptroller of patents; should he refuse to register, there is an appeal to the Board of Trade. If there is opposition, the matter goes to the High Court of Justice. Registration holds good for fourteen years, at the end of which time it has to be renewed. Special provision is made in the Act for the retention of certain of the ancient privileges of the Cutlers Company of Sheffield. The total number of marks now upon the register is nearly 50,000.

The Customs Consolidation Act, 1876, forbids the importation of articles of foreign manufacture bearing any mark purporting to be the mark of manufacturers resident in the United Kingdom, or stating or implying that such articles were manufactured in the United Kingdom. The Merchandise Marks Act, 1887, consolidated and amended the law of offences relating to trade-marks and trade descriptions. It repealed the Act of 1862 and replaced it by fuller provisions. It is now an offence to forge a trade-mark, to falsely apply to goods any trade-mark or any mark so nearly resembling a trade-mark as to deceive, to make any die, &c., for the purpose of forging or for being used for forging a trade-mark, to apply any false trade description to goods, to dispose of or have in possession any die, &c., for the purpose of forging a trade-mark, or to cause any of the above-mentioned things to be done. There are special sections in the Act dealing with its application to watches and watch-cases. Where a watch-case is of foreign manufacture it must, if stamped at an assay office in the United Kingdom, bear a mark differing from the mark placed upon watches manufactured in the United Kingdom. A warranty is implied in the sale of goods bearing a trade-mark or trade description. See WARRANTY.

In most foreign countries provisions have long existed for the registration of trade-marks; and they also form one of the classes of "industrial property" for the protection of which an international convention was formed in 1883. This convention now includes sixteen states,—the more important being Belgium, France, Great Britain, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United States. The subjects of all the contracting states enjoy in each state the same rights and privileges as that state grants to its own subjects for the protection of trade-marks. Registration also in one of the states confers certain rights of priority in the others.

United States.—The legislation of the different States and Territories varies considerably, some providing for the registration of trade-marks either with or without protection for unregistered trade-marks, while others provide only for protection without registration. On March 3, 1881, Congress passed an Act "to authorize the registration of trade-marks and to protect the same," which provides that owners of trade-marks used in commerce with foreign nations or with the Indian tribes, provided such owners be domiciled in the United States or located in any foreign country or tribe which affords similar privileges to citizens of the United States, may obtain registration of trade-marks under the Act. Registration is not compulsory; failure to register a trade-mark, or to renew registration, does not deprive the owner of any remedy he might have at law or in equity; and the courts will, generally speaking, protect the unregistered equally with the registered.

For fuller information see L. B. Sebastian's *Law of Trade Marks*, or R. W. Wallace's edition of the Patents, Designs, and Trade Marks Act; and in America Rowland Cox's *American Trade-Mark Cases*, Cox's *Manual of Trade-Mark Cases*, and William Henry Brown's *Treatise on the Law of Trade Marks*

TRADE UNIONS are combinations for regulating the relations between workmen and masters, workmen and workmen, or masters and masters, or for imposing restrictive conditions on the conduct of any industry or business. By the common law all such combinations were, with certain rare and unimportant exceptions, regarded as illegal. They were considered to be contrary to public policy, and were treated as conspiracies in restraint of trade. Those who were engaged or concerned in them were liable to be criminally prosecuted by indictment or information, and to be punished on conviction by fine and imprisonment. The offence was precisely the same whether it was committed by masters or by workmen. But, although the provisions of the common law applied *mutatis mutandis* to both of them alike, it was, practically speaking, in reference rather to the latter than to the former that their effects were developed and ascertained. While it was held to be perfectly lawful for workmen, as individuals, to consent or to refuse to labour for any remuneration or for any time they pleased, when two or more of them joined together, and agreed to labour only on certain stipulated terms with respect either to the payment or the duration of their labour, they were guilty *ipso facto* of a misdemeanour. It was immaterial whether the end they had in view was to determine wages or to limit work; or whether the means they adopted for promoting its attainment was a simultaneous withdrawal from employment, an endeavour to prevent other workmen from resuming or taking employment, or an attempt to control the masters in the management of their trade, the engagement of journeymen or apprentices, or the use of machinery or industrial processes; or whether in seeking to enforce their demands they relied merely on advice and solicitation, or resorted to reproach and menace, or proceeded to actual violence. In any event their combination in itself constituted a criminal conspiracy, and rendered them amenable to prosecution and punishment. From the reign of Edward I. to the reign of George IV. the operation of the common law was enforced and enlarged by between thirty and forty Acts of Parliament, all of which were more or less distinctly and explicitly designed to prohibit and prevent what we have learned to describe and recognize as the "organization of labour." But the rise of the manufacturing system towards the end of the last century, and the revolution which accompanied it in the industrial arrangements of the country, were attended by a vast and unexpected extension of the movement which the legislature had for so long and with so much assiduity essayed to suppress. Among the multitudes of workmen who then began to be employed in single factories or in neighbouring factories in the same towns, trade unions in the form of secret societies speedily became numerous and active, and to meet the novel requirements of the situation a more summary method of procedure than that which had hitherto been available was provided by the 40th Geo. III. cap. 106. By this statute, passed in 1800, it was enacted that all persons combining with others to advance their wages or decrease the quantity of their work, or in any way to affect or control those who carried on any manufacture or trade in the conduct and management thereof, might be convicted before one justice of the peace, and might be committed to the common jail for any time not exceeding three calendar months, or be kept to hard labour in the house of correction for a term of two calendar months. The discontent and disorder of which, in conjunction with a state of commercial depression and national distress, the introduction of steam and improved appliances generally into British manufactures was productive in the first quarter of the current century led to the nomination of a select committee by the House of Commons, to inquire into the whole question of what were popularly and comprehensively designated the "combination laws," in the session of 1824. After taking evidence, the committee reported to the House that "those laws had not only not been efficient to prevent combinations either of masters or workmen, but on the contrary had, in the opinion of many of both parties, had a tendency to produce mutual irritation and distrust, and to give a violent character to the combinations, and to render them highly dangerous to the peace of the community." They further reported that in their judgment "masters and workmen should be freed from such restrictions as regards the rate of wages and the hours of working, and be left at perfect liberty to make such agreements as they mutually think proper." They therefore recommended that "the statute laws which interfered in these particulars between masters and workmen should be repealed," and also that "the common law under which a peaceable meeting of masters or workmen might be prosecuted should be altered." In pursuance of their report, the 4th Geo. IV. cap. 95 was at once drafted, brought in, and passed. But the immediate results of the change which it effected were regarded as so inconvenient, formidable, and alarming that in the session of 1825 the House of Commons appointed another select committee to re-examine the various problems, and review and reconsider the evidence which had been submitted to their predecessors in the previous year. They reported without delay in favour of the total repeal of the 4th Geo. IV. cap. 95, and the restoration of those provisions of the combination laws, whether statutory or customary, which it had been more particularly intended to abrogate. The consequence was the enactment of the 6th Geo. IV. cap. 129, of which the preamble declares that the 4th Geo. IV. cap. 95 had not been found effectual, and that combinations such as it had legalized were "injurious to trade and commerce, dangerous to the tranquillity of the country, and especially prejudicial to the interests of all who were concerned in them." The effect of the 6th Geo. IV. cap. 129 was to leave the common law of conspiracy in full force against all combinations in restraint of trade, except such as it expressly exempted from its operation as it had been before the 4th Geo. IV. cap. 95 was passed. It comprised, however, within itself the whole of the statute law relating to the subject, and under it no persons were liable to punishment for meeting together for the sole purpose of consulting upon and determining the rate of wages or prices which they, being present, would require for their work or pay to their workmen, or the hours for which they would work or require work in any trade or business, or for entering into any agreement, verbal or written, for the purpose of fixing the rate of wages or prices which the parties to it should so receive or pay. But all persons were subjected to a maximum punishment of three months' imprisonment with hard labour who should by violence, threats or intimidation, molestation, or obstruction do, or endeavour to do, or aid, abet, or assist in doing or endeavouring to do, any of a series of things inconsistent with freedom of contract which the Act enumerated and defined. Afterwards, in order to remove certain doubts which had arisen as to the true import and meaning of the words "molestation" and "obstruction," it was provided by the 22d Vict. cap. 34 that "no person, by reason merely of his endeavouring peaceably and in a reasonable manner, and without threat or intimidation direct or indirect, to persuade others to cease or abstain from work, in order to obtain the rate of wages or the altered hours of labour agreed to by him and others, should be deemed to have been guilty of 'molestation' or 'obstruction.'" In spite of the partial recognition which trade unions had thus received, they continued to be unlawful, although not necessarily criminal, associations. In certain cases, they were by statute exempted from penal consequences, and their members were empowered to combine for specified purposes, and to collect funds by voluntary contributions for carrying them into effect. But in the estimation of the common law the special privileges which had been accorded to them under particular circumstances did not confer any general character of legality upon them, and where their rules were held to be in restraint of trade, as in the prohibition of piece-work or the limitation of the number of apprentices, they were still regarded as conspiracies. Hence they were practically excluded from the advantages in regard to the security of their property and the settlement of their disputes which, under the Friendly Societies Act, 18th and 19th Vict. cap. 63, had been granted to all associations established for any purposes which were not illegal. In this condition the law was when what became notorious as the "Sheffield and Manchester outrages" suggested the appointment of the royal commission on trade unions, which investigated the subject from 1867 to 1869. The outcome was, first, a temporary measure for the more effectual protection of the funds of trade unions, passed in 1869, and, secondly, the two measures which, as amended and amending, are cited together as the "Trade Union Acts 1871 and 1876"—the 34th and 35th Vict. cap. 22 and the 39th and 40th Vict. cap. 31.

By these statutes, construed with the Conspiracy and Protection of Property Act, 1875, the 38 and 39 Vict. cap. 86, the law relating to combinations, whether of workmen or of masters, assumed the shape in which it exists at the present time. In connexion with trade disputes no person can now be prosecuted for conspiracy to commit an act which would not be criminal if committed by him singly, and consequently employers and employed alike may lawfully do in combination all that they would be entitled to do as individuals. The purposes of a trade union are not to be deemed illegal merely because they are in restraint of trade, and the circumstance that they are in restraint of trade is not to render any member of it liable to prosecution, nor is it to avoid or make voidable any agreement or trust relating to it. No court, however, can entertain legal proceedings with the object of directly enforcing or recovering damages for the breach of an agreement between the members of a trade union as such, concerning the conditions on which the members for the time being shall or shall not sell their goods, transact their business, employ or be employed, or the payment by any person of any subscription or penalty to a trade union, or for the application of the funds of a trade union to provide benefits or to furnish contributions to any employer or workman not a member of such trade union in consideration of such employer or workman acting in conformity with the rules or resolutions of such trade union, or to discharge any fine imposed upon any person by any court of justice or any agreement made between one trade union and another, or any bond to secure such agreements. But such incapacity to sue on such agreements is not to be taken as constituting any of them illegal. Every person, however, commits a misdemeanour, and on conviction is liable to a maximum fine of £20, or to a maximum imprisonment of three months with hard labour, who wilfully and maliciously breaks a contract of service or hiring, knowing, or having reasonable cause to believe, that the probable consequence of his so doing, either alone or in combination with others, will be to endanger human life or cause serious bodily injury, or to expose valuable property, whether real or personal, to destruction or serious injury; or who, being employed by a municipal authority or by any company or contractor on whom is imposed by Act of Parliament, or who have otherwise assumed, the duty of supplying any place with gas or water, wilfully and maliciously breaks a contract of service or hiring, knowing, or having reasonable cause to believe, that the probable consequence of his so doing, alone or in combination with others, will be to deprive the inhabitants of that place, wholly or in part, of their supply of gas or water; or who, with a view to compel any other person to do or to abstain from doing any act which such other person has a right to abstain from doing or to do, wrongfully and without legal authority uses violence to or intimidates such other person or his wife or children, or injures his property; or who persistently follows such person about from place to place; or who hides any tools, clothes, or other property owned or used by such other person, or deprives him of or hinders him in the use thereof; or who watches or besets the house or other place where such person resides or works or carries on business or happens to be, or the approach to such house or place; or who follows such other person with two or more other persons in a disorderly manner in or through any street or road. But attending at or near the house or place where a person resides or works or carries on business in order merely to obtain or communicate information is not watching or besetting within the statute. In regard to registration, trade unions are placed on a similar footing with friendly and provident and industrial societies, and they enjoy all the privileges, advantages, and facilities which those associations possess and command. On their side, however, they have to comply with the same conditions, are subject to the same liabilities, and are compelled to make the same periodical returns.

Although there are several large and influential societies among the employers of labour which come within the legal definition of trade unions, what are commonly as well as more accurately meant by trade unions are societies exclusively composed of the employed,—the suppliers of labour whether skilled or unskilled. Of trade unions in this sense,—those of which the members are all artisans or labourers,—the organization is everywhere pretty much the same, although the rules and regulations of various associations differ in detail more or less distinctly and widely from one another. Their ordinary constitution is that of a society divided into districts, and again into smaller local bodies. The seat of the governing authority—the general or executive council—is usually fixed at some large centre of industry or commerce, as London, Manchester, or Birmingham, and it is often changed at stated intervals by a vote of the society at large. It is the policy of the trade unions, by this method of organization, to extend the area of their influence, and so to increase their power in dealing with the masters or in controlling their own members in any emergency. Each of the branches has a separate government for special purposes. But for general purposes all the branches are under the command of the executive council or central committee, which is constituted of members or officers who are elected by the whole society. The terms on which members are admitted are different in different associations. But in all of them there are certain limits as to age and the number of years during which the candidate has been apprenticed to or has worked in the trade. The revenue and reserve of all the societies are derived from admission fees and weekly or monthly subscriptions, together with the amount of the fines which are imposed for neglect of duty and breaches of the rules and regulations. These sources of income are sufficient for ordinary purposes; and extraordinary charges, such as are entailed by a "strike" or a "lock-out," are nearly always, if not invariably, met by means of "levies" made on the members by order of the executive council or central committee. The following account of the Amalgamated Society of Engineers may be accepted as furnishing a typical example of the organization and management of a large and flourishing trade union.

According to the thirty-third annual *Report* of that society, it appears that in 1883 the union consisted of 424 branches, chiefly in towns in the British Isles, but with a fair sprinkling in Canada, the United States, Australia, India, and other parts of the globe. The number of members was 50,418. A branch must consist of not fewer than seven members or more than three hundred. The constitution is pre-eminently democratic. Each branch is itself a completely organized body. It selects and elects its own officers; it collects, holds, and spends its own funds; and it manages the whole of the business which affects itself alone. The officers of the branch are elected at general meetings at which every member must be present under the penalty of a fine. Members who refuse to be nominated for office, or who refuse to serve if elected, are also subject to fines, and officers who neglect their business either by coming late to meetings or absenting themselves altogether are similarly punished. A meeting of the members of each branch is held every fortnight for the transaction of ordinary business, such as receiving subscriptions and deciding upon propositions for new members. These meetings begin at half-past 7 in the evening, and close at half-past 9 or 10 o'clock, but the hours are altered when it is convenient to alter them. The duties of the secretary are onerous, and his responsibility is great. No one therefore is eligible who has not been in the society two years successively, and "no member shall be elected as secretary who keeps a public or beer house." He has charge of the accounts of his branch, and conducts its correspondence. He has to see to the payment of members who are entitled to travelling relief donation, sick, superannuation, or funeral benefit. He has to summon meetings, keep minutes, report to the general secretary as to the state of trade in the district, the number of men out of work, or on the other hand he has to state what men are wanted, and he has also "to transact any other business that belongs to his office." The president, vice-president, and assistant secretary of a branch are elected quarterly, while the secretary and referee are elected annually. Members are exempt if they are fifty years of age, or if they reside more than 3 miles from the club house; and they are disqualified if they are 10s. in arrear with their contributions. There are also bookkeepers, money stewards, doorkeepers, treasurers, and auditors, the nature of whose work is evident from their titles. There are also sick stewards, whose duties are to visit the sick twice a week, to report their visits to the meetings of the branch, and to carry the invalid his sick benefit. None of the offices are honorary. In branches numbering fewer than fifty members every officer is allowed 4d., and in branches numbering fifty and upwards 6d., for his attendance on branch meeting nights. The secretary is paid annually and according to the size of the branch. The lowest amount is £1, 5s. for a branch of ten members, the highest £10, 4s. for a branch of three hundred. The auditors are paid at a lower rate, which varies from 9d. to 4s. 8d., while the treasurer is paid 10 per cent. on the sum set apart for use. Each branch has also a committee, which has power to determine anything whereon the society's rules are silent. The books of the branch are open to their inspection; they can summon meetings, and they have various other duties. Each member of this committee receives 6d. for each meeting he attends, and is fined 6d. for each meeting from which he is absent. In any district in which there are more branches than one, a local district committee must be formed, consisting of seven members, each branch as nearly as practicable selecting an equal number. Where there are seven branches, each one sends a representative. The duties of this committee are to "watch over the interests of the trade, and transact such business as affects the district generally." It must not, however, interfere with the business of any particular branch of the society. The central authority is vested in a general or executive council, consisting of thirty-seven members, of whom eleven represent metropolitan branches, the others being from the provinces, including Scotland and Ireland. As the country councillors cannot conveniently attend frequent meetings in London, the ordinary management is entrusted to the eleven London members, who are called the local council, and the council is also further broken up into various committees for managing the details of the society. This council hears appeals from branches, advises, forbids, initiates, and terminates strikes. The general secretary receives a salary of £4 a week and lives rent free. He also receives 1s. 6d. each time he attends a council meeting, and is paid for any special journeys undertaken or extra work done. His assistants receive £2, 10s. a week each, and have to give the whole of their time to the association. They have to compile and issue a monthly report as well as quarterly and yearly reports. The last-named is quite a formidable volume, consisting of nearly 400 pages of large post octavo, and those of other societies are similar. The general secretary's hours of business are fixed from 9 A.M. to 6 P.M. He has power to authorize members who are on donation to be removed from one branch to another where there is a probability of employment, and he has to keep a register of all the members of the society, stating when and where admitted, age, married or single, and whether a member has received any part of the financial money. In the Amalgamated Society of Engineers the contribution of each member is generally 1s. a week, and if a man be in arrears he is suspended from the benefits of the society, unless indeed he is out of work or in distressed circumstances. At the end of 1883 the union had a balance in hand of £178,128, or upwards of £3, 10s. a man.

In some trade unions—for example, those of the compositors—there is a special body ("fathers of chapels") whose business it is to see that the rules and regulations of the societies they belong to are faithfully observed in the establishments where they are employed. In others again—for instance, in the National Agricultural Labourers Union, as distinguished from the Federal Union of Agricultural Labourers—the system of management is completely centralized, the secretary or the executive committee having entire control of the funds and business of the whole association. In all large towns there are trade councils formed of delegates from the different trade unions within their area, whose function it is to discuss and supervise the general interests of the unionists in the several trades of which they are representative. Moreover, an annual trade unions congress is held in some great centre of industry and population in one of the three kingdoms, at which delegates from almost all the trade unions throughout the realm are present and take part in debating questions, whether social or political, which are of special interest to the working classes. At these assemblies, which have now been held for twenty consecutive years, a parliamentary committee, which remains in existence for the ensuing twelvemonth, is chosen, to whom the whole body of trade unionists looks for counsel and assistance with respect to legislation intended or desired on their behalf. To the action of the trade unions congress and their parliamentary committee much of the legislation which has been recently effected on questions affecting the welfare of the order of the community to which they belong is to be attributed,—notably the Employers' Liability Act and the amended Factory and Mines Acts. (See *Trade Unions*, &c., by William Trant.)

The objects of trade unions are twofold,—first, those of a friendly or benefit society, and, secondly, those of a trade society or guild. In the former capacity they afford relief to their members when they are out of work from any cause, including sickness or accident; they occasionally provide them with superannuation allowances, and they almost always make burial allowances on account of deceased members and their wives. In the latter capacity it is their special business to promote what they conceive to be the interests of the trade with which they are connected by placing the workmen, so far as combination will fulfil that purpose, on a footing approaching to equality with the capitalists by whom they are employed in the disposal of their labour. Of course this is the great object for which the unions really exist. But, as the commissioners on trade unions have pointed out, it is found desirable to conjoin the objects of a friendly or benefit society with it, because by that means additional members and funds are obtained, and the authority which the union as a trade society has over its members is thus augmented. The leading aims of all trade unionism are to increase wages and to diminish the labour by which it is needful to earn them, and further to secure a more equal distribution of work among the workmen in any given trade than would be the case under a régime of unrestricted competition. Hence their rules prescribe a minimum amount of wages to be accepted and a maximum amount of work to be done by their members, and prohibit piece work or working overtime. The methods by which the unionists endeavour to accomplish their end, which is in a sense the monopoly of the labour market, are either direct or indirect. The direct method is a "strike," or simultaneous cessation of labour on the part of the workmen. It is the ultimate sanction as between the employed and their employers of the demands made by the union. But, where the unionists are strong, the mere threat of a strike is often sufficient to fulfil the intended purpose, and arbitration is still more frequently found effectual for bringing about a settlement or compromise. The indirect methods to which the trade unionists resort for reaching their aims are by limiting the number of workmen to be employed in any trade and by repressing or discountenancing competition among those who are actually employed in it. Most of them forbid the admission of more than a stipulated proportion of apprentices, and some of them prohibit the engagement of women to do work which can be done by men. Nearly all of them resist the common employment of unionists and non-unionists, and do their best to exclude non-unionists from employment altogether. But the amount expended by trade unions in the conduct of trade disputes is very much less than is generally imagined. Mr George Howell, for instance, showed conclusively in the *Contemporary Review* that such was the case three or four years ago, and Mr Murchie, the chairman of the parliamentary committee, stated at the trade unions congress at Stockport in the autumn of 1885 that Mr Howell's contentions had been signally confirmed by more recent experience. Taking the seven largest trade unions, those whose statistics had been relied on by Mr Howell—namely, the Amalgamated Engineers, the Ironfounders, the Boiler Makers and Iron Shipbuilders, the Steam-Engine Makers, Ironmoulders of Scotland, Amalgamated Tailors, and Amalgamated Carpenters and Joiners—he affirmed that, while in the nine years preceding 1884 their receipts were £2,818,548, their expenditure was £2,963,186, of which amount £1,207,180 was spent in unemployed benefit, £592,273 in sick benefit, £975,052 in compensation for loss of tools, superannuations, accidents, funerals, minor grants and benefits, and expense of management, only £188,680 had been spent in connexion with "trade movements," or about 6¼ per cent. of the whole sum expended.

There are no really trustworthy means of arriving at anything approaching to an accurate estimate of the actual numerical strength of the trade unions in the United Kingdom. According to the last *Report* of the registrar general of friendly societies, there were in the year 1883 registered in his office 195 trade unions with 253,088 members and £431,495 funds, of which 12 returned over £10,000 funds, 9 over 10,000 members, and 6 over £10,000 income. But this of course conveys a very inadequate notion of the dimensions to which trade unionism has attained, since many of the largest and most influential societies are still unregistered.

The following table shows the number of delegates and the aggregate membership of the societies represented by them at the trade unions congresses in the years from 1880 to 1886, both inclusive:—

	Number of Delegates.	Number of Bodies represented.	Trade Councils represented.	Trade Unions represented directly.	Total Number of Persons represented.	Number represented by Trade Councils.	Unionists represented directly (approximate).
1880	122	105	17	88	474,213	92,511	381,702
1881	154	122	18	104	460,797	86,376	374,421
1882	153	126	23	103	506,337	102,972	405,365
1883	173	125	21	114	561,091	94,166	466,925
1884	142	116	21	95	597,636	109,984	487,652
1885	162	136	27	109	631,606	131,368	500,238
1886	143	121	24	97	635,380	122,207	513,173

We shall not be far wrong, perhaps, if we set down the number of trade unionists in all the three kingdoms at about 800,000. (F. DR.)

TRAGEDY. See DRAMA.

TRAJAN (*c.* 53–117 A.D.). MARCUS ULPIUS TRAIANUS, the fourteenth Roman emperor, was a native of Italica, in Spain. The family to which he belonged was probably Italian and not Iberian by blood. His father began life as a common legionary soldier, and fought his way up to the consulship and the governorship of Asia. He was one of the hardest fighters in Judæa under Vespasian and Titus; he served too against the Parthians, and won the highest military distinction open to a subject, the grant of the triumphal insignia. Thus he acquired a prominent place among the brand new patricians created by the Flavians as substitutes for the nobles of old descent who had succumbed to the cruelty and rapacity of the emperors from Tiberius to Nero. The younger Trajan was rigorously trained by his father, and deeply imbued with the same principles and tastes. He was a soldier born and bred. No better representative of the true old hardy Roman type, little softened either by luxury or education, had come to the head of affairs since the days of Marius. The date of his birth was probably 53 A.D. His training was almost exclusively military, but his experience as an officer gave him an acquaintance with almost every important province of the empire which was of priceless value to him when he came to the throne. For ten years he held a commission as military tribune, which took him to many lands far asunder; then he filled important posts in Syria and Spain. How much actual warfare Trajan saw in those days we can hardly tell; he certainly went through some severe service under his father's command against the Parthians. By the year 89 he had achieved a considerable reputation. At that time L. Antonius Saturninus headed a rebellion in Germany, which threatened seriously to bring Domitian's rule to an end. Trajan was ordered in hot haste from Further Spain to the Rhine. Although he carried his troops over that long and arduous march with almost unexampled rapidity, he only arrived after the insurrection had been put down. But his promptitude raised him higher in the favour of Domitian, and he was advanced to the consulship in 91 Of the next five years of his life we know nothing positively. It is not unlikely that they were spent at Rome or in Italy in the fulfilment of some official duties. When the revolution of 96 came, and Nerva replaced the murdered Domitian, Trajan had conferred upon him one of the most important posts in the empire, that of consular legate of Upper Germany. An officer whose nature, as the event showed, was interpenetrated with the spirit of legality was a fitting servant of a revolution whose aim it was to substitute legality for personal caprice as the dominant principle of affairs. The short reign of Nerva really did start the empire on a new career, which lasted more than three quarters of a century. But it also demonstrated how impossible it was for any one to govern at all who had no claim, either personal or inherited, to the respect of the legions. Nerva saw that if he could not find an Augustus to control the army, the army would find another Domitian to trample the senate under foot. In his difficulties he took counsel with L. Licinius Sura, a lifelong friend of Trajan, and in October 97 he ascended the Capitol, and with all due solemnity proclaimed that he adopted Trajan as his son. The senate confirmed the choice, and acknowledged the emperor's adopted son as his successor. In a letter which Nerva sent at once to Trajan he quoted most significantly a line from the beginning of the Iliad, where Chryses, insulted by Achilles, prays to Apollo: "May thy shafts afford me vengeance on the Greeks for my tears." After a little hesitation Trajan accepted the position, which was marked by the titles of imperator, Cæsar, and Germanicus, and by the tribunician authority. He immediately proceeded to Lower Germany, to assure himself of the fidelity of the troops in that province, and while at Cologne he received news of Nerva's death (January 98). The authority of the new emperor was recognized at once all the empire over. The novel fact that a master of the Romans should have been born on Spanish soil seems to have passed with little remark, and this very absence of notice is significant. Trajan's first care as emperor was to write to the senate an assurance like that which had been given by Nerva, that he would neither kill nor degrade any senator. He ordered the establishment of a temple and cult in honour of his adoptive father, but he did not present himself at Rome for nearly two years after his accession. Possibly he had taken measures before Nerva's death to secure the revenge which Nerva craved, but probably did not live to see. In his dealings with the mutinous prætorians the strength of the new emperor's hand was shown at once. He ordered a portion of the force to Germany. They did not venture to disobey, and were distributed among the legions there. Those who remained at Rome were easily overawed and reformed. It is still more surprising that the soldiers should have quietly submitted to a reduction in the amount of the donative or gift which it was customary for them to receive from a new emperor, though the civil population of the capital were paid their largess (*congiarium*) in full. By politic management Trajan was able to represent the diminution as a sort of discount for immediate payment, while the civilians had to wait a considerable time before their full due was handed to them.

The secret of Trajan's power lay in his close personal relations with the officers and men of the army and in the soldierly qualities which commanded their esteem. He possessed courage, justice, and frankness to a high degree. Having a good title to military distinction himself, he could afford, as the unwarlike emperors could not, to be generous to his officers. The common soldiers, on the other hand, were fascinated by his personal prowess and his somewhat ostentatious camaraderie. His features were firm and clearly cut; his figure was tall and soldierly, and exhibited the sinewy hard health of a veteran campaigner. His hair was already grey before he came to the throne, though he was not more than forty-four years old. The stoutness of the emperor's arm had been proved in the face of his men in many a hard fight. When on service he used the mean fare of the common private, dining on salt pork, cheese, and sour wine. Nothing pleased him better than to take part with the centurion or the soldier in fencing or other military exercise, and he would applaud any shrewd blow which fell upon his own helmet. He loved to display his acquaintance with the career of distinguished veterans, and to talk with them of their battles and their wounds. Probably he lost nothing of his popularity with the army by occasional free indulgence in sensual pleasures, with which, as Bacon remarks, the soldier is apt to pay himself for the perils he encounters. Yet every man felt and knew that no detail of military duty, however minute, escaped the emperor's eye, and that any relaxation of discipline would be rigidly punished, yet with unwavering justice. Trajan emphasized at once his personal control and the constitutionality of his sway by bearing on his campaigns the actual title of "proconsul," which no other emperor had done. All things considered, it is not surprising that he was able, without serious opposition from the army, to remodel the whole military institutions of the empire, and to bring them into a shape from which there was comparatively little departure so long as the army lasted. In disciplinary matters no emperor since Augustus had been able to keep so strong a control over the troops. Pliny rightly praises Trajan as the lawgiver and the founder of discipline, and Vegetius classes Augustus, Trajan, and Hadrian together as restorers of the morale of the army. The confidence which existed between Trajan and his army finds expression in some of the coins of his reign.

For nearly two years after his election Trajan did not appear in Rome. He had decided already what the great task of his reign should be—the establishment of security upon the dangerous north-eastern frontier. Before visiting the capital he determined to put affairs in train for the attainment of this great object. He made a thorough inspection of the great lines of defence between the Danube and the Rhine, and framed and partly carried out a vast scheme for strengthening and securing them. The policy of opposing uncivilized tribes by the construction of the *limes*, a raised embankment of earth or other material, intersected here and there by fortifications, was not his invention, but it owed in great measure its development to him. It is probable that the northernmost part of the great *limes Germaniæ*, from the Rhine at Rheinbrohl, nearly midway between Coblenz and Bonn, to a point on the Main east of Frankfort, where that river suddenly changes its course from north to west, was begun by Domitian. The extension of this great barrier southwards was undertaken by Trajan, though we cannot say how far he carried the work, which was not entirely completed till long after his time. The *limes* leaves the Main at Miltenberg, a point at which the north and south course of the river is broken by a great angle, and then follows a line generally parallel to the stream of the Neckar, till it reaches Lorch, a place between Stuttgart and Aalen. Here it meets the so-called *limes Rætiæ*, which trends eastward till it cuts the Danube at Kelheim, a place some distance short of Ratisbon, the ancient *Castra Regina*. This grand work, which would have excited the envy of Augustus, is traceable in its main extent at the present day. We may without hesitation follow the opinion of Mommsen, who maintains that the *limes* was not intended, like Hadrian's wall between the Tyne and the Solway, and like the great wall of China, to oppose an absolute barrier against incursions from the outside. It was useful as marking definitely the boundary of the Roman sway, and as assuring the Romans that no inroad could be made without intelligence being had of it beforehand, while the *limes* itself and the system of roads behind it enabled troops to be directed rapidly to any threatened point, and the fortified positions could be held against large numbers till reinforcements arrived. Great importance was no doubt attached to the perfection of the lines of communication bearing on the *limes*. Among a people of roadmakers, Trajan was one of the greatest, and we have definite evidence from inscriptions that some of the military roads in this region were constructed by him. The more secure control which the Romans now maintained over the territory within the *limes* tended to its rapid civilization, and the Roman influence, if not the Roman arms, soon began to affect powerfully the regions beyond.

After his careful survey of the Rhine end of the great defensive barrier, Trajan proceeded to consider it and plan it from the Danube. From the age of Tiberius onwards the Romans possessed the whole southern bank of the river from its source to the Euxine. But the precarious tenure of their possession had been deeply impressed on them by the disasters and humiliations they had undergone in these districts during the reign of Domitian. A prince had arisen among the Dacians, Decebalus by name, worthy to be placed at the head of all the great barbarian antagonists of Rome. Like Maroboduus, he was able to combine the forces of tribes commonly hostile to each other, and his military ability almost went the length of genius. After he had swept the province of Mœsia bare, he was defeated by one of Domitian's lieutenants, but the position of affairs on the Danubio-Rhenish border was still so threatening that the emperor was glad to conclude a treaty which conferred extraordinary advantages on his foe. Not only did the Romans stipulate to pay to Decebalus an annual subsidy, which he must have regarded as a tribute, but they agreed to supply him with engineers and craftsmen skilled in all kinds of construction, but particularly in the erection of fortifications and defensive works. During the nine or ten years which had elapsed since the conclusion of this remarkable treaty, the Dacian prince had immensely strengthened the approaches to his kingdom from the Roman side. He had also equipped and drilled his formidable army after the Roman fashion. It was impossible for a soldier like Trajan to endure the conditions laid down by Domitian; but the conquest of Dacia had become one of the most formidable tasks that had ever confronted the empire. Trajan no doubt planned a war before he left the Danube for Rome late in 99.

The arrival of the emperor had been awaited in the capital with an impatience which is expressed by Pliny and by Martial.[1] All that had happened since Trajan's elevation to the throne had raised high at Rome the hope of a prosperous and glorious reign. As he entered the city and went on foot to the Capitol, the plaudits of the people were unmistakably genuine. During his stay in the city he riveted more firmly still the affections both of the senate and of the people. The reconciliation of the empire with liberty, inaugurated, as Tacitus says, by Nerva, seemed now to be securely achieved. Trajan was absolutely open and simple, and lived with men at Rome as he had lived with his soldiers while on service. He realized the senate's ideal of the citizen ruler. The assurance that no senator should suffer was renewed by oath. All the old republican formalities were most punctiliously observed—even those attendant on the emperor's election to the consulate, so far as they did not involve a restoration of the old order of voting at the comitia. The veneration for republican tradition is curiously attested by the reproduction of many republican types of coin struck by senatorial officers. Trajan seized every opportunity for emphasizing his view that the *princeps* was merely the greatest of the magistrates, and so was not above but under the laws. He was determined, he said, to be to his subjects such a ruler as he had desired for himself when a subject. There is a pretty story to the effect that he handed the commander of the prætorians his sword, and said, "Use it for me if I do well, but against me if I do ill." Martial, who had called Domitian his lord and his god, now cried, "In him we have no lord, but an imperator!" Real power and influence were accorded to the senate, which had now, by the incorporation of members whose origin was provincial, become in a manner representative of the whole empire. Trajan associated with the senators on equal terms, and enjoyed in their company every kind of recreation. All pomp was distasteful to him, and discarded by him. There was practically no court, and no intrigues of any kind were possible. The approach to his house was free, and he loved to pass through the city unattended, and to pay unexpected visits to his friends. He thirsted for no senator's blood, and used severity against the *delatores* alone. There was but one insignificant conspiracy against him during his whole reign. Though not literary himself, Trajan conciliated the literary men, who at all times had close relations with the senate. His intimate, M. Licinius, played an excellent Mæcenas to his Augustus. In his efforts to win the affections of Roman society, Trajan was excellently aided by his wife Plotina, who was as simple as her husband, benevolent, pure in character, and entirely unambitious. The hold which Trajan acquired over the people was no less firm than that which he maintained upon the army and the senate. His largesses, his distributions of food, his public works, and his spectacles were all on a generous scale. The exhibitions in the arena were perhaps at their zenith during his tenure of power. Though, for some unexplained reason, he abolished the mimes, so beloved of the populace, at the outset of his reign, he availed himself of the occasion of his first triumph to restore them again. The people were delighted by the removal of the imperial *exedra* in the circus, whereby five thousand additional places were provided. Taxation was in many directions reduced, and the financial exactions of the imperial officers controlled by the erection of a special court. Elaborate precautions were taken to save Italy from famine; it is said that corn for seven years' consumption at the capital was retained in the granaries. Special encouragement was given to merchants to import articles of food. The corporation of bakers was organized, and made more effective for the service of the public. The internal trade of Italy was powerfully stimulated by the careful maintenance and extension of the different lines of road. But the most striking evidence of Trajan's solicitude for his people's welfare is found in his institution of the *alimenta*, whereby means were provided for the rearing of poor and orphan children in Italy. The method had been sketched out by Nerva, but its great development was due to Trajan. The moneys allotted by the emperor were in many cases supplemented by private benevolence. As a soldier, Trajan realized the need of men for the maintenance of the empire against the outer barbarians, and he preferred that these men should be of Italian birth. He was only carrying a step farther the policy of Augustus, who by a system of rewards and penalties had tried to encourage marriage and the nurture of children. The actual effect of Trajan's regulations is hard to measure; they were probably more effectual for their object than those of Augustus. The foundations were confiscated by Pertinax, after they had existed less than a century.

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[1] It has been conjectured, not improbably, that the *Germania* of Tacitus, written at this period, had for one of its aims the enlightenment of the Romans concerning the formidable character of the Germans, so that they might at once bear more readily with the emperor's prolonged absence and be prepared for the necessity of decisive action on the frontier.

During the year 100, when Trajan was consul for the third time, Pliny, who had been designated consul for a part of it, was appointed to deliver the "Panegyric" which has come down to us, and which forms the most important source of our knowledge concerning this emperor. Pliny's eulogy of Trajan and his denunciation of Domitian are alike couched in extravagant phrases, but the former perhaps rests more uniformly on a basis of truth and justice than the latter. The tone of the "Panegyric" certainly lends itself to the supposition of some historians that Trajan was inordinately vain. That the emperor had an honest and soldierly satisfaction in his own well-doing is clear; but, if he had had anything like the vanity of a Domitian, the senate, ever eager to outrun a ruler's taste for flattery, would never have kept within such moderate bounds.

Towards the end of 100, or early in 101, Trajan left Rome for the Danube. Pretexts for a Dacian war were not difficult to find. Although there was no lack of hard fighting, victory in this war depended largely on the work of the engineer. The great military road connecting the posts in Upper Germany with those on the Danube, which had been begun by Tiberius, was now extended along the right bank of the river as far as the modern Orsova. The year 101 was spent mainly in road-making and fortification. In the following campaign, after desperate fighting to the north of the Danube in the mountainous region of Transylvania, such as Cæsar never encountered in all his Gaulish wars, the capital of Decebalus was taken, and he was forced to terms. He agreed to raze all fortresses, to surrender all weapons, prisoners, and Roman deserters, and to become a dependent prince under the suzerainty of Rome. Trajan came back to Italy with Dacian envoys, who in ancient style begged the senate to confirm the conditions granted by the commander in the field. The emperor now enjoyed his first Dacian triumph, and assumed the title of Dacicus. At the same time he royally entertained the people, and no less royally rewarded his brave officers. But the Dacian chief could not school his high spirit to endure the conditions of the treaty, and Trajan soon found it necessary to prepare for another war. A massive stone bridge was built across the Danube, near the modern Turn Severin, by Apollodorus, the gifted architect who afterwards designed the forum of Trajan. In 105 began the new struggle, which on the side of Decebalus could now only lead to victory or to destruction. The Dacians fought their ground inch by inch, and their army as a whole may be said to have bled to death. The prince put an end to his own life. His kingdom became an imperial province; in it many colonies were founded, and peopled by settlers drawn from different parts of the empire. The work done by Trajan in the Danubian regions left a lasting mark upon their history. The emperor returned to the capital in 106, laden with captured treasure. His triumph outdid in splendour all those that went before it. Games are said to have been held continuously for four months. Ten thousand gladiators contended in the arena, and eleven thousand beasts were killed in the contests. Congratulatory embassies came from all lands, even from India. The grand and enduring monument of the Dacian wars is the noble pillar which still stands on the site of Trajan's forum at Rome.

The end of the Dacian wars was followed by seven years of peace. During part of that time Pliny was imperial legate in the provinces of Bithynia and Pontus, and in constant communication with Trajan. The correspondence is extant, and gives us the means of observing the principles and tendencies of the emperor as a civil governor.

The provinces (hitherto senatorial) were in considerable disorder, which Pliny was sent to cure. It is clear from the emperor's letters that in regard to nine out of ten of the matters which his anxious and deferential legate referred to him for his decision he would have been better pleased if the legate had decided them for himself. Trajan's notions of civil government were, like those of the duke of Wellington, strongly tinged with military prepossessions. He regarded the provincial ruler as a kind of officer in command, who ought to be able to discipline his province for himself, and only to appeal to the commander-in-chief in a difficult case. In advising Pliny about the different free communities in the provinces, Trajan showed the same regard for traditional rights and privileges which he had exhibited in face of the senate at Rome. At the same time, these letters bring home to us his conviction that, particularly in financial affairs, it was necessary that local self-government should be carried on under the vigilant supervision of imperial officers. The control which he began in this way to exercise, both in Italy and in the provinces, over the "municipia" and "liberæ civitates," by means of agents entitled (then or later) "correctores civitatium liberarum," was carried continually farther and farther by his successors, and at last ended in the complete centralization of the government. On this account the reign of Trajan constitutes a turning point in civil as in military history. In other directions, though we find many salutary civil measures, yet there were no far-reaching schemes of reform. Many details in the administration of the law, and particularly of the criminal law, were improved. To cure corruption in the senate the ballot was introduced at elections to magistracies. The finances of the state were economically managed, and taxpayers were most carefully guarded from oppression. Trajan never lacked money to expend on great works of public utility; as a builder, he may fairly be compared with Augustus. His forum and its numerous appendages were constructed on a magnificent scale. Many regions of Italy and the provinces besides the city itself benefited by the care and munificence which the emperor bestowed on such public improvements. His attitude towards religion was, like that of Augustus, moderate and conservative. The famous letter to Pliny about the Christians is, according to Roman ideas, merciful and considerate. It was impossible, however, for a Roman magistrate of the time to rid himself of the idea that all forms of religion must do homage to the civil power. Hence the conflict which made Trajan appear in the eyes of Christians like Tertullian the most infamous of monsters. On the whole, Trajan's civil administration was sound, careful, and sensible, rather than brilliant or epoch-making.

In 113 or 114 Trajan left Italy to make war in the East. The never-ending Parthian problem confronted him, and with it were more or less connected a number of minor difficulties. Already by 106 the position of Rome in the East had been materially improved by the peaceful annexation of districts bordering on the province of Syria. The district of Damascus, hitherto a dependency, and the last remaining fragment of the Jewish kingdom, were incorporated with Syria; Bostra and Petra were permanently occupied, and a great portion of the Nabathæan kingdom was constituted the Roman province of Arabia. Rome thus obtained mastery of the most important positions lying on the great trade routes from East to West. These changes could not but affect the relations of the Roman with the Parthian empire, and the affairs of Armenia became in 114 the occasion of a war which has been described under PERSIA, vol. xviii. p. 603. Trajan's campaigns in the East ended in complete though brilliant failure. In the retreat from Ctesiphon (117) the old emperor tasted for almost the first time the bitterness of defeat in the field. He attacked the desert city of Hatra, westward of the Tigris, whose importance is still attested by grand ruins. The want of water made it impossible to maintain a large force near the city, and the brave Arabs routed the Roman cavalry. Trajan, who narrowly escaped being killed, was forced to withdraw. A more alarming difficulty lay before him. Taking advantage of the absence of the emperor in the far East, and possibly by an understanding with the leaders of the rising in Armenia and the annexed portions of Parthia, the Jews all over the East had taken up arms at the same moment, and at a given signal. The massacres they committed were portentous. In Cyprus 240,000 men are said to have been put to death, and at Cyrene 220,000. At Alexandria, on the other hand, many Jews were killed. The Romans punished massacre by massacre, and the complete suppression of the insurrection was long delayed, but the Jews made no great stand against disciplined troops. Trajan still thought of returning to Mesopotamia, and of avenging his defeat at Hatra, but he was stricken with sickness and compelled to take ship for Italy. His illness increasing, he landed in Cilicia, and died at Selinus in that country about the end of July 117. Trajan, who had no children, had continually delayed to settle the succession to the throne, though Pliny in the "Panegyric" had pointedly drawn his attention to the matter, and it must have caused the senate much anxiety. Whether Hadrian, the cousin of Trajan, was actually adopted by him or not is impossible to determine; certainly Hadrian had not been advanced to any great honours by Trajan. Even his military service had not been distinguished. Plotina asserted the adoption, and it was readily and most fortunately accepted, if not believed, as a fact.

The senate had decreed to Trajan as many triumphs as he chose to celebrate. For the first time a dead general triumphed. When Trajan was deified, he appropriately retained, alone among the emperors, a title he had won for himself in the field, that of "Parthicus." He was a patient organizer of victory rather than a strategic genius. He laboriously perfected the military machine, which when once set in motion went on to victory. Much of the work he did was great and enduring, but the last year of his life forbade the Romans to attribute to him that *felicitas* which they regarded as an inborn quality of the highest generals. Each succeeding emperor was saluted with the wish that he might be "better than Trajan and more fortunate than Augustus." Yet the breach made in Trajan's *felicitas* by the failure in the East was no greater than that made in the *felicitas* of Augustus by his retirement from the right bank of the Rhine. The question whether Trajan's Oriental policy was wise is answered emphatically by Mommsen in the affirmative. It was certainly wise if the means existed which were necessary to carry it out and sustain it. But succeeding history proved that those means did not exist. The assertion of Mommsen that the Tigris was a more defensible frontier than the desert line which separated the Parthian from the Roman empire can hardly be accepted. The change would certainly have created a demand for more legions, which the resources of the Romans were not sufficient to meet without danger to their possessions on other frontiers.

The records of Trajan's reign are miserably deficient. Our best authority is the 68th book of Dio Cassius; then comes the "Panegyric" of Pliny, with his correspondence. The facts to be gathered from other ancient writers are scattered and scanty. Fortunately the inscriptions of the time are abundant and important. Of modern histories which comprise the reign of Trajan the best in English is that of Merivale; but that in German by H. Schiller (*Geschichte der römischen Kaiserzeit*, Gotha, 1883) is more on a level with recent inquiries. There are special works on Trajan by H. Francke (Güstrow, 1837), De la Berge (Paris, 1877), and Dierauer (in M. Büdinger's *Untersuchungen zur römischen Kaisergeschichte*, Leipsic, 1868). A paper by Mommsen in *Hermes*, iii. pp. 30 *sq.*, entitled "Zur Lebensgeschichte des jüngeren Plinius," is important for the chronology of Trajan's reign. (J. S. R.)

TRALEE, a market-town and seaport, and the chief town of Kerry, Ireland, is situated on the Ballymullen or Leigh river, about a mile from where it discharges itself into Tralee Bay, and on the Great Southern and Western Railway, 21 miles north-west of Killarney and 18 south-west of Listowel. It is a neat, well-built, and comparatively prosperous town. The principal public buildings are the court-house, the town-hall, the corn exchange, the chamber of commerce, the workhouse, the infantry barracks, the county hospital, and the fever hospital. A ship canal, permitting the passage of ships of 200 tons burden, and constructed at an expense of £30,000, connects it with Tralee Bay. Coal, iron, and timber are imported, and there is a considerable export of grain. There is a large trade in butter. The population of the town in 1871 was 9506 and in 1881 it was 9396.

Tralee, anciently Traleigh, the "strand of the Leigh," owes its origin to the foundation of a Dominican monastery in 1213 by John Fitz-Thomas, of the Geraldine family. During the reign of Elizabeth it was in the possession of Earl Desmond, on whose forfeiture it came into possession of the Dennys. At the time of the rebellion in 1641 the English families in the neighbourhood asked to be placed in the castle under the charge of Sir Edward Denny, but during his absence a surrender was made. The town was incorporated by a charter in the 10th of James I., and had the privilege of sending two members to the Irish parliament. Though disfranchised at the Union, it obtained the privilege of returning one member in 1832, but in 1885 it was merged in the county.

TRAMWAY. Originally a tramway signified a wheel track laid with timbers, and afterwards with iron plates, having a flange on the inner edge by which wheels of the ordinary sort were kept in the track (see RAILWAY). The introduction of the flanged wheel and edge rail caused tramways to be superseded by railways, but not until many miles of tramroads had been laid and successfully worked in various parts of the United Kingdom. Although the name is sometimes given to a light railway, by a tramway is now generally understood a street railway, constructed so as to interfere but little with the ordinary traffic, on which vehicles having flanged wheels are propelled by animal or mechanical power. Tramways in this sense originated in the United States.

A street railway for passengers was laid in New York in 1832, but it was soon removed on account of the accidents caused by it. In 1852 a French engineer, Loubât, revived tramways in New York, and they were soon afterwards laid in other American cities. A short line was also laid in Paris in 1853. The rails used were of wrought-iron, 5 inches wide, having a groove for the flanged wheels of the cars 1¾ to 2¼ inches wide and 1 to 1½ inches deep (fig. 1). To lessen the inconvenience to ordinary traffic occasioned by this rail, the "step rail" (fig. 2) was introduced, consisting of a flat surface 3 to 5 inches wide, which can be used by ordinary wheels, and a raised tread on the outer side 1 inch higher and 1¾ inch wide, on which the flanged wheels of the cars run. This form of rail is still very general in America, and is a good one for the tramways, though not for the general public. In 1858–9 Train, an American, endeavoured to obtain an Act of Parliament authorizing tramways in London; failing in that, he laid tramways, by consent of the road authority, first in 1860 at Birkenhead, and soon afterwards in London. The rail laid at Birkenhead had a step of ¾ inch between flat surfaces 3 inches and 1½ inches wide. That laid in London was narrower, with a step of half an inch, but the slippery flat surface and the step of the rail caused serious inconvenience and numerous accidents to carriages, and the tramways were removed in a few months, after one of them had been successfully indicted as a nuisance. In Birkenhead, in spite of complaints of the inconvenience caused to the general traffic, the original rails remained until 1864, when, after a short length had been laid as an experiment with a rail of the grooved section now in general use (fig. 3), the whole of the tramway, several miles in length, was relaid with it. The tramway was subsequently indicted as a nuisance, but the trial resulted in a verdict in favour of the grooved rail. In 1868 an Act of Parliament authorizing the construction of about 6¾ miles of tramways in Liverpool was obtained; and in 1869–71 Acts for 61 miles of tramways in London were passed, and were soon followed by other Acts for tramways in Glasgow, Dublin, Edinburgh, and other provincial towns.

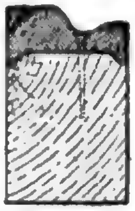
Fig. 1.

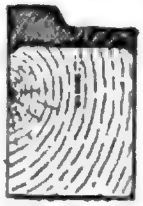
Fig. 2.

Tramways Act.

In 1870 the Tramways Act was passed, enabling the Board of Trade to make provisional orders authorizing the construction of tramways in Great Britain, with the consent of the local authorities, and giving considerable powers for regulating their construction and working. By the Act the gauge, unless otherwise prescribed by special Act, is to be such as will admit of the use of carriages constructed for use on railways of a gauge of 4 feet 8½ inches. Tramways for which Acts had been previously obtained were of 4 feet 8½ inches gauge, to comply with a standing order intended for railways, and not to make them available for railway rolling stock, which the narrow groove of an ordinary tramway rail will not admit. There is reason to think that a narrower gauge, such as 3 feet 6 inches, is often sufficient and preferable to the 4 feet 8½ inches gauge.

Tramways in towns, authorized by provisional order, are to be constructed in the middle of the road, and are not to be so laid that for 30 feet and upwards a less space than 9 feet 6 inches shall be left between the outside of the footpath and the rail, if one-third of the owners or occupiers of premises abutting upon that part of the road object. Vehicles are thus enabled to stop at the road side without hindrance from the tramcars. To leave 9 feet 6 inches on each side of a single line of tramway of 4 feet 8½ inches gauge a street must be upwards of 24 feet wide. No carriage used on a tramway must extend more than 11 inches beyond the outer edge of the wheels, and there must be a space of at least 15 inches between the sides of the widest carriages or engines to be used, when passing one another. A width of not less than 3 feet 2 inches between double lines and at passing places is thus necessary, and a double line of tramway, leaving 9 feet 6 inches space on each side, requires a street at least 32 feet 6 inches wide between the footways. In narrow roads there is a convenience in having the tramway at the side, and it is sometimes provided for in special Acts. The space between the rails, and for 18 inches beyond them, is repairable as part of the tramway. Power is given to local authorities to purchase tramways at the expiration of twenty-one years, and they may be removed under certain circumstances.

It appears from a parliamentary return that in 1886 there were 779 miles of street tramways open for traffic in Great Britain, on which a capital of £11,503,438 had been expended, the net receipts for the year being £563,735, and the working expenses 79 per cent. of the gross receipts.

Construction.

The grooved rail first laid in England was 4½ inches wide and an inch thick, having a tread or rolling surface for the wheel 1¾ inches wide, and a groove ¾ inch deep, ⅞ inch wide at the bottom, and 1¼ inches wide at the top (fig. 3). The rail was spiked through to a longitudinal timber laid on cross sleepers, and secured to them by angle brackets and spikes. This rail and method of laying were generally adopted, but it was found that the heads of the spikes wore off, and the rails required re-spiking, and split and worked loose at the joints. A rail known as the box-rail was introduced, having flanges below on each side, through holes in which clips are driven to fasten the rail to the tim

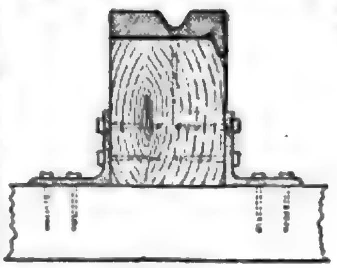
Fig. 3.

ber. This constitutes a good fastening, and the flanges give stiffness to the rail, but the clips cause gaps between the rail and the paving stones, which lead to the formation of ruts alongside the rails. The longitudinal timbers, instead of being laid on cross sleepers, on which the paving does not bed well, are often fixed in cast-iron chairs connected by transverse tie-bars. A bed of concrete is always laid under the longitudinal timbers, and should extend to the whole width of the paving. The rails first laid weighed 40 ℔ per yard, but it was soon found desirable to increase the weight to 60 ℔ per yard. It is, however, impossible to fish the joints of rails like the above, and it was found that the working of the joints under the passage of the cars loosened the ends of the rails, dislocated the paving, and damaged both the tramway cars and ordinary vehicles. Tramways proved hardly able to withstand heavy street traffic; and to provide for steam traction a stronger form of rail and a better system of permanent way became necessary. Many forms of iron bearings have been devised, the rail being either supported continuously or on chairs at intervals. In the best of these the tram rail can be replaced when worn without disturbing the foundation. In the system used in Liverpool cast-iron longitudinal sleepers weighing 80 and 90 ℔ a yard carry steel rails of a T section (fig. 4) weighing 40 ℔ a yard, both sleepers and rails being held down by bolts to jaws anchored in the concrete foundation. The rails can be renewed and the sleepers can be taken up with very little disturbance of the paving.

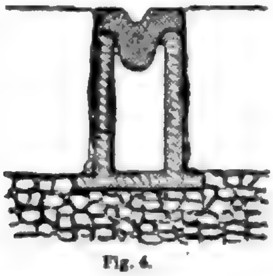

Fig. 4.

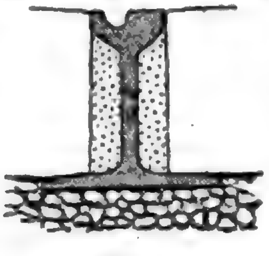

Fig. 5

Steel rails of a flatfooted or a bridge section, and of such a depth as to constitute both rail and sleeper, are also used. In some of the latest and best examples the rail is of a flatfooted section (fig. 5), 6 or 7 inches deep, and 6 or 7 inches wide at the base, weighing 65 to 93 ℔ per yard. The head has a groove either planed out or rolled in it, giving the usual profile to the upper surface. The joints are fished in the ordinary way, and are as strong as the rail itself. Cross ties are sometimes used, but when the rail is slightly bedded in the concrete foundation they are dispensed with. The paving is set in cement close against the rail, and is bedded directly or in sand on the base of the rail, upon which there is a bearing of 1½ or 2 inches. Such a tramway will stand steam traction and the heaviest street traffic, but the rail, which is of an expensive section, requires entire renewal when the head is worn out. Iron or steel continuous bearings are less elastic, and therefore more jarring and noisy than timber sleepers.

The profile of the upper surface of tram rails has been little altered since the first grooved rail was devised for Birkenhead in 1863, though slight modifications have been made in the form of the groove with the object of lessening tractive resistance. For the sake of the ordinary traffic the groove should not exceed 1 inch in width, and a rounded section with sides splaying outwards facilitates the forcing out of the mud and dirt. A nearly upright side next the tread or rolling surface with a splay on the inner side throws the mud away from the wheel. The upper corners of the rail should be angular, to make as thin a joint as possible between the rail and the paving. There has been a tendency to diminish the width, and a rail as narrow as 3 inches has been laid. A deviation from the usual profile has been adopted in Liverpool, where the groove is in the middle of a rail 3½ inches wide.

Paving.

A tramway must not only afford a good rolling surface capable of bearing the weights running on it, but it must also be able to resist the shocks of heavy vehicles crossing the rails in all directions. The space between the rails, and for 18 inches beyond them, which is repairable with the tramway, is always paved, sometimes in provincial towns and in the suburbs of London with wood, but generally with stone sets in the best manner on a concrete foundation. The sets alongside the rail should be carefully dressed and fitted to make a thin joint. There is much extra wear, and a tendency to form a rut alongside the rail, arising from ordinary wheels using the tram rail, and unless the surface of the paving is kept to the level of the rail the wheels of carriages are caught by the rail, and damage and accidents are caused. To resist the wear near the rails, chilled cast-iron blocks have been used where the traffic is great. On a macadamized road there is the same tendency to form a rut along the outer edge of the tramway paving, which is to some extent prevented by giving a serrated edge to the paving. There is always great difficulty in keeping the road surface to the level of the paving, and it is better to pave the entire width of a street in which a tramway is laid.

Curves.

Although cars can be drawn round very sharp curves, the latter should be as easy as possible. A radius of 150 to 200 feet is the least that should be used when there is any choice, but necessity may compel the use of curves of 50 or even 30 feet radius. On such curves, however, the cars are liable to be strained, and the resistance to traction is greatly increased.

Passing places.

A single line of tramway must have passing places for the cars, consisting of pieces of double line of length sufficient to hold two cars at least, with connecting curves and the necessary points and crossings. Where steam or other mechanical power is to be used the passing loops should be at least 200 feet in length. There is inevitable delay and interference with the street traffic at passing places, and where cars are to be run at frequent intervals it is better to lay down a double line if the street is wide enough. It is a great advantage to the ordinary traffic to have the cars moving always in the same direction on the same line of rails.

Points and crossings.

For horse traction fixed points of chilled cast-iron or steel are sufficient, as the driver can turn his horses and direct the car on to and either line of rails. When mechanical power is used, drop points or movable points are required. In the former the groove leading into the road to be taken is of the full depth, and the other groove shallow, so that the engine and cars naturally take the former. On coming out of the shallower groove to the deeper there is, however, a drop encountered which is damaging to the rolling stock, and especially to the engines. Movable points require setting by hand, or they are actuated by a spring or balance weight. In one form of spring point one groove is filled up by a tongue which is pressed down by wheels passing out of a loop, but which forms the side of the groove for wheels running the opposite direction. A spring point of steel, which is forced aside by the flange of the wheel passing out, and shuts close again by its own elasticity, is also successfully used. A movable point on one side of the way is sufficient. Crossings are either built up from rails cut to the required angle, or they are cast solid in steel or chilled iron. Filling pieces of the same material, roughened on the surface for foothold, are inserted between the rails at the angles of points and crossings. Both points and crossings wear rapidly, and are troublesome to maintain in good condition, and when not so maintained are dangerous to ordinary traffic.

Cars.

The tramcars generally in use in the United Kingdom are constructed to carry 22 persons inside and 24 outside. They are 16 feet long in the body, or 24 feet including the platforms at each end, and weigh 2½ to 2¾ tons when empty and about 5¼ tons when fully loaded. Smaller cars to carry 20 or 14 persons inside, drawn by one horse, are useful to run at short intervals when the traffic is not great, a frequent service of cars being a great element of success. The car wheels are usually of steel or chilled iron, with a flange half an inch deep, and are fitted with powerful brakes. The axles are about 6 feet apart, giving a short wheel-base to enable the cars to pass sharp curves, but with the disadvantage of overhanging ends. Cars to be drawn by mechanical power, especially if outside passengers are to be carried, should have a flexible wheel-base, either by means of bogie frames or radiating axles. In Hamburg and Copenhagen tramcars have wheels without flanges, and a small guiding wheel running in the groove, which can be raised to allow the car to leave the track.

Traction.

The tractive force required on a straight and level tramway is found to vary from $\frac{1}{180}$ to $\frac{1}{70}$ of the load, according to the condition of the rails. On a tramway in average condition it is about $\frac{1}{100}$. The resistance is thus at the best nearly double that on a railway, and sometimes as much as on a good pavement. This is due to the friction of the flange of the wheel in the grooved rail, and to the circumstance that the latter is always more or less clogged with dirt. The clearance between the flange and the groove is necessarily small, as the former must have sufficient strength, and the latter must be narrow. The least inaccuracy of gauge, therefore, causes extra friction, which is greatly increased on curves. By removing the flanges from two of the four wheels of a tramway car Tresca found that the resistance was reduced from $\frac{1}{100}$ to $\frac{1}{143}$ of the load. The resistance due to gravity is of course not lessened on a tramway; and, if $\frac{1}{100}$ of the load be the tractive force required on the level, twice as much, or $\frac{1}{50}$ of the load, will be required on a gradient of 1 in 100 and three times as much on a gradient of 1 in 50. To start a tramcar, four or five times as great a pull is required as will keep it in motion afterwards, and the constant starting after stoppages, especially on inclines, is very destructive to horses. Horses employed on tramways are worked only a few hours a day, a day's work being a journey of 10 or 12 miles, or much less on steep gradients. In London a tramcar horse bought at the age of five years has to be sold at a low price after about four years' work. On the Edinburgh tramways, in consequence of the steep gradients, the horses last a less time, and they have to be constantly shifted from steep to easier gradients. The cost of traction by horses is generally 6d. or 7d. per mile for two horses, and more when the gradients are steep.

Steam traction.

The application of steam as a motive power on street tramways is attended with special difficulties, arising from the conditions under which the engines have to work. A tramway engine must be able to draw its load up steep gradients, demanding perhaps seven or eight times the power required on a level, and it must have the necessary adhesion without being too heavy for the permanent way. It must be capable of traversing sharp curves, of going backwards or forwards with safety, and of stopping and starting quickly. For the safety and convenience of the public the Board of Trade require that tramway engines shall have brakes to each wheel, to be applied by hand and by steam, a governor so arranged as to shut off the steam and apply the brakes when the engine exceeds the speed of 10 miles an hour or other stated speed, an indicator to show the speed, a whistle or bell to be sounded as a warning, and a fender to push aside obstructions; the engine must be free from noise produced by blast, and from clatter of machinery such as to constitute a reasonable ground of complaint; and the machinery and fire must be concealed from view; no smoke or steam must be emitted so as to constitute any reasonable ground of complaint to passengers or the public.

The first attempt to use steam on a modern tramway was with Grantham's combined engine and car. It was about 25 feet long, having a vertical boiler in a central compartment, with the steam cylinders below, driving one pair of wheels 2 feet 6 inches in diameter. It carried 20 passengers inside and 24 outside, weighing 6½ tons empty and 12 tons when fully loaded. In a later car the boiler and machinery were at one end, and the body of the car was carried on a bogie frame. In a combined engine and car the weight of the car and passengers is utilized for adhesion of the driving wheels, and this is conveniently effected in Rowan's car, in which there are two four-wheel bogies, the leading one carrying the engine and boiler, and half the body of the car and passengers. The engine can be detached from the car for repair and another engine can be substituted in a few minutes. Economy of rolling stock, and the advantage of being able to use cars intended for horses, are in favour of independent engines. They are usually in general construction similar to locomotives, but are enclosed so as to resemble in outward appearance a short tramcar. The cylinders are 6 to 9 inches in diameter, with a stroke of 10 to 12 inches. The wheels are coupled, 2 to 3 feet in diameter, and the engines weigh 4 to 6 tons with fuel and water. The governor to shut off steam and apply the brakes when any determined speed is attained is actuated either by the engine wheels or by an independent wheel to prevent the possibility of the brakes being put on when the driving-wheels slip. An effectual way of rendering the exhaust steam invisible is to condense it by passing it through water in a tank, or through a shower of water let off at each blast, but when the water gets hot it must be changed, and in streets it is difficult to get rid of the hot water. Several methods of superheating by passing the exhaust steam through the fire have been adopted, but they are all attended with an increased consumption of fuel, which in cold damp weather is considerable. It is now preferred to pass the steam into tubes exposed to the air on the top of the engine car, from which the condensed water is returned to the feed-tank, to be again pumped into the boiler at a high temperature. Any steam remaining uncondensed passes into the smoke-box. Compound cylinders have been applied to tramway engines, giving a greater range of power, economizing fuel, and rendering the exhaust steam easier to deal with. The extra complication of a compound engine is, however, a drawback.

The cost of steam traction with engines of ordinary size is generally 3d. to 4d. per mile run by the engine, and more on lines with steep gradients. To this must be added for depreciation 10 per cent., or, according to some authorities, 15 per cent. on the original cost of the engines, making altogether 4d. to 6d. per mile run on a tramway with average gradients.

Fireless engines.

Fireless engines were first tried in New Orleans, and have been in successful use on tramways in France for some years. The motive power is obtained from water heated under pressure to a very high temperature in stationary boilers and carried in a reservoir, where it gives off steam as the pressure and temperature are reduced. Two tons of water heated to give a steam-pressure of 250 ℔ to the square inch serves for a run of 8 or 10 miles, leaving more than $\frac{1}{10}$ of the water and a pressure of 20 to 25 ℔ above the atmosphere on returning to the boiler. Large boiler-power is required to reheat the engine reservoirs quickly, and this cannot be afforded for only a few engines, but, when worked on a sufficient scale, the fireless engines are claimed to be economical, the economy resulting from the generation of the steam in large stationary boilers.

Compressed air.

Compressed air as a motive power offers the advantage of having neither steam nor the products of combustion to be got rid of. In Scott Moncrieff's engine, which was tried on the Vale of Clyde tramways in 1876, air was compressed to 310 ℔ on the square inch, and expanded in the cylinders from a uniform working pressure to that of the atmosphere. There is a considerable loss of heat during the expansion of the air which is attended with a serious loss of pressure, and in Mékarski's system, which has been in use for the propulsion of tramcars at Nantes for seven years, the loss of pressure is considerably lessened by heating the air during expansion. The air, at a pressure of 426 ℔ per square inch, is stored in cylindrical reservoirs beneath the car, and before use is passed through a vessel three quarters full of water heated to 300° F., by which it is heated and mixed with steam. The heat of the latter is absorbed by the air during its expansion, first to a working pressure which can be regulated by the driver, and then to atmospheric pressure in the cylinders. At Nantes the average cost for three years for propelling a car holding 34 persons was about 6d. per mile.

In San Francisco a main charged with air at a pressure of about 120 ℔ per square inch has been laid along the tram route, from which reservoirs on the cars are charged by means of standpipes and flexible connexions at convenient points, the operation taking a very short time. The inventor claims to utilize 30 per cent. of the power applied to the compressor.

Cable tramways.

Street tramways worked by means of a wire rope have been in successful operation in San Francisco since 1873. There are now upwards of 24 miles of double line in San Francisco, and 10 miles in Chicago, and the system is being adopted in other American and colonial cities. It has also been in operation in England at Highgate Hill for several years, and is about to be adopted in other localities. The motive power is transmitted from a stationary engine by a rope of steel wire running always in one direction up one track and down the other, in a tube midway between the rails, on pulleys which are arranged so as to suit curves and changes of gradient as well as straight and level lines. Over the rope is a slot ⅝ inch wide, in which travels a flat arm of steel connecting the dummy car with the gripper which grasps the cable. The flat arm is in three pieces, the two outer ones constituting a frame which carries the lower jaw of the gripper, with grooved rollers at each end of it, over which the cable runs when the gripper is not in action. The upper jaw is carried by the middle piece, which slides within the outer frame, and can be depressed by a lever or screw, pressing the cable first on the rollers, and then on the lower jaw until it is firmly held. The speed of the cable, which is generally 6 to 8 miles an hour, is thus imparted to the car gradually and without jerk. The arrangements for passing the pulleys, for changing the dummy and cars from one line to the other at the end of the road, for keeping the cable uniformly taut, and for crossings and junctions with other lines are of considerable ingenuity. When the cars are cast off from the cable they must be stopped by hand brakes, which on steep gradients especially must be of great power.

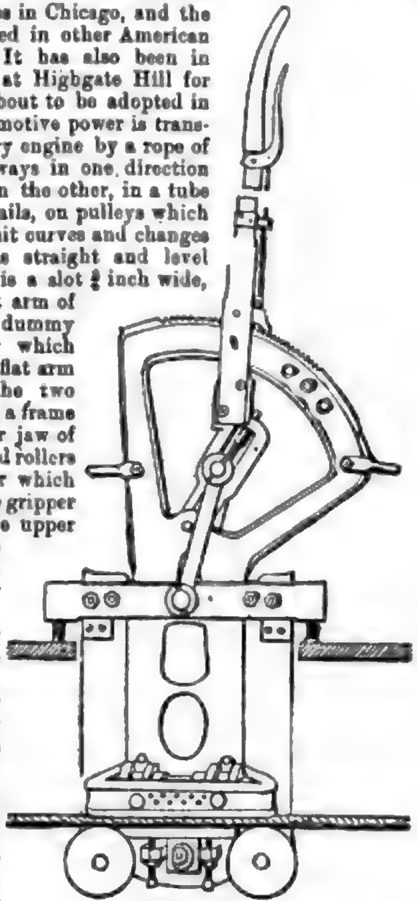

FIG. 6.—Gripper.

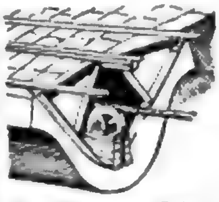

FIG. 7.—Carrying Pulley.

The system has advantages on double lines with few and easy curves when the gradients are long and steep, and it can be employed on gradients too steep for steam traction. On level lines it is doubtful if it could compete in economy with steam, or even with horse traction, unless with a very frequent service of cars, though then it presents the advantages of being comparatively quiet, and free from smoke and steam, and of admitting a frequent service of cars with little extra cost. On the cable roads of San Francisco it has been found that, of the average daily power employed, 68 per cent. is expended in moving the cables, &c., 28 per cent. for the cars, and 4 per cent. for passengers. It is considered that it is practicable to utilize in moving cars and passengers as much as 50 per cent. of the power, provided the cars are fully loaded and run at short intervals.

Electric motors.

Electricity has been applied as a motive power on a tramway about 2 miles long at Blackpool. The current is conveyed by two copper conductors in a central channel beneath the roadway, and is communicated to the motors in the car by a collector running upon the conductors and passing through a narrow slit in the channel. The return current passes through the rails. The cars carry as many as 56 passengers on a level line. Tramways have also been worked by accumulators at Antwerp and Brussels, but the weight of them appears to be at present prohibitory to this method of applying electricity, except for short trips. See TRACTION.

For fuller information, see D. K. Clark, *Tramways, their Construction and Maintenance*; F. Sérafon, *Les Tramways et les Chemins de Fer sur Routes*; "Street Tramways," *Proc. Inst. C. E.*, vol. l.–vol. lxvii.; "The Working of Tramways by Steam," *Ibid.*, vol. lxxix.; and F. B. Smith, *Cable Tramways*. (T. C.)

TRANCE. See SLEEP; also MAGNETISM (ANIMAL).

TRANI, a seaport of Italy, on the Adriatic, in the province of Bari, and 26 miles by rail west-north-west of that town, still retains its old walls and bastions, with the citadel, now used as a prison. Some of the streets remain much as they were in the mediæval period, and many of the houses display more or less of Norman decoration. The cathedral, on a raised open site near the sea, dating from about the year 1100, is a basilica with three apses, a large crypt, and a lofty tower. The arches of the Romanesque portal are beautifully ornamented, in a manner suggestive of Arab influence; the bronze doors, executed by Barisanus of Trani in 1175, rank among the best of their period in southern Italy. The capitals of the pillars in the crypt are fine examples of the Romanesque. The interior of the cathedral has been barbarously modernized. The vicinity of Trani produces an excellent wine (Moscado di Trani); and its figs, oil, almonds, and corn are also profitable articles of trade. The harbour was once deep and good, but latterly has got silted up. The population of the town in 1881 was 25,173 (commune 25,647).

Trani is the *Turenum* of the itineraries. It first became a flourishing place under the Normans and during the crusades, but attained the acme of its prosperity as a seat of trade with the East under the Angevine princes. Several synagogues continue to afford an indication of its former commercial prosperity.

TRANQUEBAR, a seaport town in the Tanjore district of Madras presidency, India, in 11° 1′ 37″ N. lat. and 79° 55′ E. long. In the 17th century it belonged to the Danes; it was taken by the British with other Danish settlements in 1807, but restored in 1814, and finally purchased in 1845 for a sum of £20,000. In Danish times Tranquebar was a busy port, but its prosperity has fluctuated considerably of late years, and is now at a very low ebb. It was the first settlement of Protestant missionaries in India, founded by Ziegenbalg and Plutschau (Lutherans) in 1706; and as a mission station it still retains its importance.

See vol. xxii. Plate I.

TRANSBAIKALIA (*Zabaikalskaya Oblast*), a province of Eastern Siberia, to the east of Lake Baikal, has Irkutsk on the west, Yakutsk on the north, the province of Amur on the east, and Mongolia on the south. Its area (240,780 square miles) is about as great as that of Austria-Hungary, but its population is under half a million. With regions of a purely Siberian character on the one hand, and including on the other the outer borders of the Mongolian steppes and the upper basin of the Amur, Transbaikalia forms an intermediate link between Siberia, Mongolia, and the northern Pacific littoral. The mountains of the Yablonovoi Khrebet, which run in a north-easterly direction from the sources of the Kerulen to the bend of the Olekma in 56° N. lat., divide the province into two quite distinct parts: to the west the upper terrace of the high East Asian plateau continued from the upper Selenga and Yenisei (from 4000 to 5000 feet high) towards the plateau of the Vitim (3500 to 4000 feet); and to the east the lower terrace of the same plateau (about 2800 feet high), which appears as a continuation of the eastern Gobi. The continuity of the high plateau extending from the upper Selenga to the upper Vitim was for a long time overlooked in consequence of a broad and deep valley by which it is intersected. Beginning at Lake Baikal, it pierces the huge north-western border-ridge of the plateau, and runs eastward up the Uda, with an imperceptible gradient, like a gigantic railway cutting enclosed between two steep slopes, sending another branch south towards Kiakhta. After having served, through a succession of geological periods, as an outlet for the water and ice which accumulated on the plateau, it is now utilized for the two highways which lead from Lake Baikal over the plateau (3500–4000 feet) to the Amur in the east and the Chinese depression in the south. Elsewhere, the high and massive border-ridge on the north-western edge of the plateau can be crossed only by difficult footpaths. The border-ridge just mentioned, pierced by the wide opening of the Selenga, runs from south-west to north-east under different names, being known as Khamar-daban to the south of Lake Baikal (the Khamar-daban peak raising its bald summit to a height of 6900 feet above the sea), and as the Barguzin Mountains (7000 to 8000 feet) along the eastern bank of the Barguzin river, while farther to the north-east it has been described by the present writer under the names of the South Muya and Tchara Mountains (6000 to 7000 feet). Resting its south-east base on the plateau, it descends steeply on the north-west to the lake, or to the broad picturesque valleys of the Barguzin, the Muya, and the Tchara. Larch, fir, and cedar forests thickly clothe the ridge, whose dome-shaped rounded summits (*goltsy*) rise above the limits of tree vegetation, but do not reach the snow-line (here above 10,000 feet). The high plateau itself has the aspect of an undulating table-land, intersected by low ranges, which rise some 1500 or 2000 feet above its surface, and are separated by broad, flat, and marshy valleys, which the rivers languidly traverse till they find their way across the border-ridges. Those of the valleys which are better drained have fine meadow lands, but as a whole the plateau has the appearance, especially in the north, of a wet or marshy prairie in the hollows, while the hills are thickly clothed with forests (almost exclusively of larch and birch). Numberless lakes and ponds occur along the river courses. Tungus hunters find a livelihood in the forests and on the meadows, but permanent agricultural settlements are impossible, corn seldom ripening on account of the early frosts. The lower parts of the broad and flat valley of the Djida have, however, a few Cossack settlements, and on the upper Selenga and Yenisei Mongolian shepherds (Uryankhes and Darkhates) inhabit the high grassy valleys about Lake Kossogol (5560 feet above the sea). Quite different is the lower terrace of the plateau, occupied by the eastern Gobi and the Nertchinsk region of Transbaikalia, and separated from the above by the Yablonovoi ridge. This last is the south-eastern border ridge of the higher terrace. It rises to 8250 feet in the Sokhondo peak, but elsewhere its dome-shaped summits do not exceed 5000 or 6000 feet. When crossing it from the north-west, about Tchita, the traveller hardly perceives that he is approaching the great water-parting between the Arctic and the Pacific oceans. Numberless lakes, with flat undefined borders, feed streams which flow lazily amidst marshes, some of them to join the great northward rivers, others to find their way to the Amur and the Pacific. Low hills rise gently above the edge of the plateau, but an abrupt slope descends towards the south-east, where the hill-foots of the Yablonovoi are nearly 1500 and 2000 feet lower than on the north-west. Climate, flora, and fauna suddenly change as soon as the Yablonovoi has been crossed; the steppes of Dauria (continuations of those of the Gobi), covered with a bright luxuriant vegetation, meet the view of the spectator. The Siberian flora gives way to the much richer Daurian flora, which in turn is exchanged for the Pacific littoral flora as soon as the traveller descends from the lower terrace of the plateau towards the Manchurian plains and lowlands.

The lower terrace, occupied in Transbaikalia by the Nertchinsk district, has the character of a steppe, but is also intersected by a number of ranges, all running south-west to north-east, and all being plications of Silurian and Devonian rocks, containing silver, lead, and copper, and also auriferous sands. Agriculture can be easily carried on in the broad prairies, the only drawbacks being droughts, and also frosts in the settlements in the higher close valleys of the Nertchinsk or Gazimur Mountains. The lower terrace is in its turn fringed by a border-ridge—the Great Khingan—which has, with reference to the lower terrace, the same characters as the Yablonovoi in relation to the upper, and separates Siberia from northern Manchuria. This important ridge, as shown elsewhere (vol. xxii. pp. 3, 4), does not run from south to north, as represented on the old maps, but from south-west to north-east; it is pierced by the Amur near Albazin, and joins the Okhotsk ridge, which in its turn does not join the Yablonovoi Mountains. The mountains drawn west and east on older maps to connect the Yablonovoi with the Okhotsk ridge have no actual existence.

The rivers belong to three different systems,—the affluents of Lake Baikal, of the Lena, and of the Amur. Of the first the Selenga (800 miles long) rises in the Hanghai Mountains of north-western Mongolia, one of its great tributaries (the Ehin-gol) being an emissary of Lake Kessogol. It flows past Selenghinsk and enters Lake Baikal from the south-east, forming a wide delta. The Tchikoi, the Khilok, and the Uda are its chief tributaries in Transbaikalia.[1] The Barguzin and the Upper Angara are two large tributaries of Lake Baikal from the north-east. Of the tributaries of the Lena, the Vitim with its affluents (Karenga, Taipa, Muya, Kalar, Kalakan) flows on the high plateau through uninhabited regions, as also does the Olekma. The tributaries of the Amur, which is formed by the junction of the Shilka and the Arguñ, are much more important. The Arguñ, which at a quite recent epoch received the waters of the Dalai-nor, and thus had the Keruleñ for its source, is no longer in communication with the rapidly drying Mongolian lake, and has its sources in the Gañ, which flows from the Great Khingan. It is not navigable, but receives the Gazimur and several other streams which water the Nertchinsk mining district. The Shilka is formed by the union of the Onon and the Tchita rivers, and is navigable from the town of Tchita, thus being an important channel of transit to the Amur.

Lake Baikal, with an area of 12,430 square miles (nearly equal to that of Switzerland), extends in a half crescent from south-west to north-east; it has a length of over 400 miles and a width of from 20 to 53 miles. Its level is 1561 feet above the sea.[2] About the middle it is divided into two parts, the Great Lake and the Little Lake, by the island Olkhon and the peninsula of Svyatoi Nos, which closely approach one another. Between the two there is a submerged ridge, which must be considered as a continuation of the Barguzin Alps. The wide delta of the Selenga narrows the Great Lake in its middle part, and renders it more shallow in the east than in the west—the greatest depth (4186 feet) having been reached by Dr Godlevski in the south-west. The depth of the Little Lake does not exceed 210 feet. According to Tchersky, the trough now occupied by the base had its origin in three separate synclinal valleys, which date from the Azoic epoch, and were gulfs of the ocean during the Silurian or Huronian period. They coalesced at a much later epoch.[3] Of other lakes, the Gusinoye and Lake Baunt on the Vitim plateau, and Oron at its base, are worthy of notice. Many lakes yield common salt or sulphate of natron.

The high plateau consists of granites, gneisses, and syenites, covered with Laurentian schists. Silurian and Devonian marine deposits occur only on the lower terrace. Since that time the region has not been under the sea, and only freshwater Jurassic deposits and coal-beds are met with in the depressions. During the Glacial period most of the high terrace of the plateau and its border ridges were undoubtedly covered with vast glaciers. Volcanic rocks of more recent origin (Mesozoic ?) are met with in the north-western border ridge and on its slopes, as well as on the Vitim plateau. During the Glacial period the fauna of the lowest parts of Transbaikalia was decidedly arctic; while during the Lacustrine or Post-Glacial period it was covered with numberless lakes, the shores of which were inhabited by Neolithic man. Only few traces of these have remained, and they are rapidly drying up. Earthquakes are very frequent on the shores of Lake Baikal, especially at the mouth of the Selenga, extending as far as Irkutsk, Barguzin, and Selenghinsk; in 1862 an extensive area was submerged by the lake. Numerous mineral springs, some of them of high repute, are spread all over Transbaikalia. The chief of them are the hot alkaline springs (130° F.) at Turka, at the mouth of the Barguzin, whither hundreds of patients resort annually, those of Pogromna on the Uda (very similar to the Seltzer springs), those of Molokova near Tchita, and those of Darasun in the Nertchinsk district (very rich in carbonic acid and phosphate of iron).

The flora and fauna of Transbaikalia, owing to their intermediate character between a purely Siberian flora and fauna and those characteristic of the Mongolian and Manchurian regions, have been the subject of many careful investigations since the time of Pallas down to those of Turczaninoff, Middendorff, Schrenck, Radde, and Polyakoff. Their various characters in different parts of this extensive territory could not be described without entering too largely into details. The reader may consult the works of the authors just named (see vol. xxii. p. 12).

The climate is, as a whole, exceedingly dry and extreme. The winter is cold and dry; snow is so trifling that the horses of the Buriats find their food throughout the winter on the steppes, and in the very middle of the winter wheeled vehicles are used all over the west. To the east of the Yablonovoi ridge the Nertchinsk district feels the influence of the North Pacific monsoon region, and snow falls more thickly, especially in the valleys, but the summer continues to be hot and dry. On the high plateau, even the summer is cold, owing to the altitude and the humidity arising from the marshes, and the soil is frozen to a great depth. In the vicinity of Lake Baikal the moderating influence of the great water-basin is felt to some extent, and there is a cooler summer; in winter exceedingly deep snow covers the *goltsys* and valleys of the mountains around the lake.[4]

The population (497,760 in 1882) is exceedingly sparse, unless the immense uninhabitable spaces of the plateaus be left out of account. Even on the lower terrace nearly the whole of the region on the left bank of the Shilka is unsuited for agriculture, as also are the Gazimur Mountains, where only a few settlers gain a livelihood in some of the valleys, struggling against an unhealthy climate and the influence of goitre. The Russian population there gathers around the crown mines of the Nertchinsk district, while the steppes are occupied by Buriats. A succession of villages, supported partly by agriculture and partly by hunting and trade with Mongolia, are settled along the Shilka between Tchita and Sryetensk, while farther down the river flows in such a wild mountain region that only a few families are settled, at distances some 20 miles apart, to maintain communication. The same is true with regard to the lower Arguñ. The valleys of the Uda, the lower Selenga, and especially the Tchikoi and the Khilok have been occupied since the beginning of the century by Raskolniks, who have received the name of *Semeiskiye* on account of their large (compound) families, and there one finds, in a condition of prosperity such as is unknown in Russia proper, some of the finest representatives of the Russian race. The remainder of the steppe of the Uda is occupied by Buriats, while the forests and marshes of the plateau are the hunting grounds of the nomad Tunguses. Only the valley of the Djida in the south of the Khamar-daban is settled in its lower parts.

The Russians of Transbaikalia present a great variety of ethnological types. Mainly owing to the difficulties of communication, many Great Russian Raskolniks and Little Russian settlers have preserved their ethnographical features pure from any admixture; while there are, on the other hand, villages in the Nertchinsk district, chiefly composed of the earliest Russian settlers, where a great admixture of Tungusian or Mongolian blood is observable. On the upper Arguñ the Cossacks are in features, character, language, and manners largely Mongolian. The Russians along the Chinese frontier constitute a separate *voisko* of the Transbaikalian Cossacks. There is great uncertainty as to the numbers of the Buriats; they are estimated at about 150,000. The Tunguses number only a very few thousands.

Agriculture is carried on to a limited extent by the Buriats and in all Russian settlements; but it prospers only in the valleys of west Transbaikalia, and partly in the Nertchinsk region, while in the steppes of the Arguñ and Onon even the Russians resort chiefly to cattle-breeding and trade, or to hunting. On the whole, corn has to be imported; summer wheat and summer rye, oats, and barley are the chief crops in the east, winter rye not being sown in consequence of the want of snow. Cattle-rearing is extensively carried on, especially by the Buriats, but their herds and flocks, which wander freely over the steppes throughout the winter, are often destroyed in great numbers by the snow-storms of spring. Hunting is an important occupation, even with the Russians, many of whom leave their homes in October to spend six weeks in the *taiga* (forest-region). The fisheries of Lake Baikal and the lower parts of its affluents are important. Enormous quantities of *Salmo omul* are taken every year; and, although the curing is most primitive, the annual yield is valued at £20,000. The *Salmo thymalus*, *S. oxyrhynchus*, and *S. fluviatilis* are also taken largely.

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[1] Steamers have ascended the lower Selenga and the Uda up to Verkneudinsk.

[2] According to the levelling made in 1875-76 from Zverinogolovsk, in Orenburg, to Lake Baikal. There is uncertainty as to the absolute altitude, that of Zverinogolovsk, 318 feet, having still to be verified. See *Mem. Russ. Geogr. Soc.: Phys. Geogr.*, vol. xv., 1885.

[3] I. Tchersky, "Results of the Exploration of Lake Baikal," in *Mem. Russ. Geogr. Soc.*, *Phys. Geogr.*, vol. xv., 1886, with a geological map on a scale of 7 miles to an inch; Fr. Schmidt's report in the yearly *Report* of the Russian Geographical Society for 1866 (both Russian).

[4] "Das Klima von Ost-Sibirien," by A. Woyeikoff, in *Meteor. Zeitsch.*, 1884.

The possibilities of discoveries of gold are absorbing all the industrial forces of Transbaikalia. Gold-diggings occur chiefly in the basins of the Shilka and the upper Vitim, also on the Tchikoi and the Khilok. No less than 25,400 ℔ is extracted annually by private enterprise, and about 3200 ℔ by the crown, at the Kara gold-diggings, where nearly 1400 convicts are employed. The silver mining formerly carried on at several crown works is now on the decrease (see NERTCHINSK); the quantity extracted in 1884 was only 241 ℔. Every kind of manufactured ware has to be imported from Russia; and even petty trades are almost unknown in the villages.

The trade of the provinces is chiefly represented by that of Kiakhta. The Cossacks on the frontier carry on some trade in brick-tea, cattle, and hides with Mongolia. The export of furs is of considerable value.

The communications of Transbaikalia are limited to the great Amur highway, which fringes the south coast of Lake Baikal and passes through Verkhneudinsk, Tchita, and Nertchinsk to Sryetensk, whence steamers ply down to the mouth of the Amur; in winter, further communication with the Amur beyond Sryetensk is maintained on sledges on the ice of the Shilka, but in the autumn and spring a horseback journey as far as Kumara is the only possible method of reaching the middle Amur. Steamer communication is also maintained for six or seven months across Lake Baikal, from Posolskoye, at the mouth of the Selenga, to Listvenichnaya, 40 miles from Irkutsk. A highway connects Verkhneudinsk with Selenghinsk and Kiakhta, and communication on the steppes of the Arguñ and the Onon as well as up the Barguzin is easy. The rest of Transbaikalia can be visited only on horseback.

Transbaikalia is divided into five districts, the chief towns of which (with populations in 1880) are Tchita, capital of the province (12,600 inhabitants), Barguzin (800), Nertchinsk (4070), Selenghinsk (1150), and Verkhneudinsk (4150). Kiakhta has 4290 inhabitants, and Sryetensk, being at the head of the navigation, is a rising town. (P. A. K.)

See vol. ii. Plate XXVI. **TRANSCASPIAN REGION** (*Zakaspiyskaya Oblast*), an extensive territory to the east of the Caspian, annexed by Russia within the last fifteen years, is bounded on the S. by the highlands of Khorasan and Afghanistan, on the N. by Uralsk (from which it is divided by a line drawn from the Mortvyi Kultuk Bay of the Caspian to the south extremity of Lake Aral), on the N.E. by Khiva and Bokhara, and on the S.E. (where it penetrates towards Herat on the slopes of the Paropamisus, and includes the Badhyz plateau) by Afghan Turkestan. So defined, it has an area of 220,000 square miles.

Although nine-tenths of this territory consists of uninhabitable desert, an interest attaches to it on account of the great physical changes it has undergone during the Post-Glacial period. Since Pallas visited its borders, and still more since Humboldt discussed its history, it has never ceased to attract the attention of geographers. In fact, some of the most interesting problems of geography, such as those relating to the changes in the course of the Jaxartes and the Oxus, the bifurcation and the oscillation of a great river, and the supposed periodical disappearance of Lake Aral, are connected with the Transcaspian deserts; and it is here that we must look for a clue to the great physical changes which transformed the Mediterranean of Western Asia—the Aral-Caspian and Pontic basin—into a series of separate seas, and desiccated them, powerfully influencing the distribution of floras and faunas, and compelling the inhabitants of Western and Central Asia to enter upon their great migrations. But down to a very recent date the dry and barren deserts, peopled only by wandering Turcoman bands, remained almost a *terra incognita*, and only now are we beginning to make the very first steps towards their really scientific exploration.

A mountain chain, in length comparable to the Alps, separates the deserts of the Transcaspian from the highlands of Khorasan. It runs from north-west to south-east, and appears as a continuation of the Caucasus. It begins in the Krasnodovsk peninsula of the Caspian, under the names of Kuryanin-kara and Great Balkans, whose masses of granite and other crystalline rock reach a height of more than 5000 feet. Farther to the south-east these are continued in the much lower Little Balkans and Kyuren-dagh (2000 feet), the Kopepet-dagh, Kosty-dagh, Asilma, and Zaryn-kul,—the name of Kopepet-dagh or Kopet-dagh being often now used to designate the whole chain which rises steep and wild above the flat deserts from the Caspian to the river Murghab,—a stretch of 600 miles. In structure it is homologous with the Caucasus chain; it appears as an outer wall of the Khorasan plateau, and is separated from it by a broad valley, which, like the Rion and Kura valley of Transcaucasia, is watered by two rivers flowing in opposite directions,—the Atrek, which flows north-west into the Caspian, and the Keshefrud, which flows to the south-east, and is a tributary of the Murghab. On the other side of this valley the Allah-dagh and the Binalund border-ridges (9000 to 11,000 feet) fringe the edge of the Khorasan plateau. At its south-eastern extremity this outer wall loses its regularity where it meets with the spurs of the Hindu-kush. Descending towards the steppe with steep stony slopes, it rises to heights of 6000 and 9000 feet to the east of Kizil-arvat, while the passes which lead from the Turcoman deserts to the valleys of Khorasan are seldom as low as 3500, usually rising to 5000, 6000, and even 8500 feet, and in most cases being very difficult. This wall is pierced by but one wide opening, that between the Great and Little Balkans, through which the sea which once covered the steppe maintained connexion with the Caspian.

While the Allah-dagh and Binalund border-ridges are chiefly composed of crystalline rocks and metamorphic slates covered with Devonian deposits, a series of more recent formations—Upper and Lower Cretaceous, and Miocene—are shown in the outer wall of the Kopet-dagh. Here again we find that the mountains of Asia which stretch towards the north-west continued to be uplifted at a geologically recent epoch. Quaternary deposits have an extensive development on its slopes, and its hillfoots are bordered by a girdle of loess.

The loess terrace, called "Atok" ("mountain base"), is but narrow, ranging in width from 10 to 20 miles; still its chain of settlements have rendered it possible to lay down a railway which now connects the Caspian with Sarakhs. It is very fertile, but could produce nothing without irrigation, and the streams flowing from the Kopet-dagh are few and meagre. The winds which reach the northern slope of the mountains have been deprived of all their moisture in crossing the Kara-kum—the Black Sands of the Turcoman desert; and even such rain as falls on the Kopet-dagh (10½ inches at Kizil-arvat) too often reaches the soil in the shape of showers which do not saturate it, so that the average relative humidity is but 56 and the average nebulosity only 3·9, as against 62 and 4·1 at even so dry a place as Krasnovodsk. Still, at those places where the mountain streams are closer to one another, as at Geok-tepe, Askabad, Lutfabad, and Kahka, the villages are more populous, and the houses are surrounded by gardens, every square yard and every tree of which is fed by irrigation.

Beyond this narrow strip of irrigated land begins the desert,—the Kara-kum,—which extends from the mountains of Khorasan to Lake Aral and the Ust-Urt, and from the Caspian to the Amu, interrupted only by the oases of Merv and Tejeñ. It appears, however, that the terrible shifting sands blown into *barkhans*, or elongated hills, sometimes 50 and 60 feet in height, are grouped chiefly in the west, where the country has more recently emerged from the sea. Farther to the east the *barkhans* are more stable, their slopes being covered with bushes (for the most part leafless); the caravans sometimes follow their crests, and the shifting sands occupy restricted spaces. Large areas amidst the sands are occupied by *takyrs*, or flat surfaces covered with clay which is hard as a rule, but becomes almost impassable after heavy rains. In these *takyrs* the Turcomans dig ditches, draining into a kind of cistern—the *kak*—where the water of the spring rains keeps for a few months. Wells are sunk also along the routes of the caravans, and water is found in them at depths of 10 to 50 or occasionally 100 feet and more. All is not desert in the strict sense; in spring there is for the most part a covering of grass, which allows of journeys across the desert. There are footpaths in several directions, especially from the irrigated and cultivated Atok towards Khiva.

The vegetation of the Kara-kum cannot be described as poor; the typical representative of the sand deserts of Asia, the saksaul (*Anabasis Ammodendron*), has been almost destroyed within the last hundred years, and never appears in forests, but the borders of the spaces covered with salted clay are brightened by forests of tamarisk, which are inhabited by great numbers of the desert warbler (*Atraphornis aralensis*)—a typical inhabitant of the sands,—sparrows, and ground-choughs (*Podoces*); the *Houbara macquennii*, Gray, though not frequent, is characteristic of the region. Hares and foxes, jackals and wolves, marmots, moles, hedgehogs, and one species of marten live in the steppe, especially in spring. As a whole, the fauna is richer than might be supposed, while in the Atok it contains representatives of all the species known in Turkestan, mixed with Persian and Himalayan species.[1]

The Uzboi.—A feature distinctive of the Turcoman desert is seen in the very numerous *shors*, or elongated depressions, the lower portions of which are occupied mostly with sand impregnated with brackish water. They are obviously the remains of brackish lakes, and, like the lakes of the Kirghiz steppes, they often follow one another in close succession, thus closely resembling river-beds. As the direction of these *shors* is generally from the higher terraces watered by the Amu-Daria towards the lowlands of the Caspian, they were usually regarded as old beds of the Amu-Daria, and were held to support the idea of its once having flowed across the Turcoman desert towards what is now the Caspian Sea. A few years ago it seemed almost settled, not only that that river (see OXUS) flowed into the Caspian during historical times, but that, after having ceased to do so in the 7th century, its waters were again diverted to the Caspian about 1221. A succession of elongated depressions, having a faint resemblance to old river-beds, was traced from Urgenj to the gap between the Great and the Little Balkans, marked on the maps as the Uzboi, or old bed of the Oxus.[2] The idea of again diverting the Amu into the Caspian was thus set afloat, and expeditions were sent out for explorations with this view. The result of these investigations by Russian engineers, especially Hedroitz, Konshin, Mushketoff, Lessar, and Svintsoff,[3] was, however, to show that the Uzboi is no river-bed at all, and that no river has ever discharged its waters in that direction. The existence of an extensive lacustrine depression, where the small Sary-kamysh lakes are now the only remains of a wide basin, was proved, and it became evident that this depression, having a length of more than 130 miles, a width of 70 miles, and a depth of 280 feet below the present level of Lake Aral, would have to be filled by the Amu, before its waters could advance farther to the south-west. The sill of this basin being only 28 feet below the present level of Lake Aral, this latter could not be made to disappear, nor even be notably reduced in size by the Amu flowing from Urgenj to the south-west. A more careful exploration of the Uzboi has shown moreover that, while the deposits in the Sary-kamysh depression, and the Aral shells they contain, bear unmistakable testimony as to the fact of the basin having once been fed by the Amu-Daria, no such traces are found along the Uzboi below the Sary-kamysh depression;[4] on the contrary, shells of molluscs still inhabiting the Caspian are found in numbers all along it, and the supposed old bed has all the characters of a series of lakes which continued to subsist at the hillfoots of the Ust-Urt plateau, while the Caspian was slowly receding westwards during the Post-Pliocene period. On rare occasions only did the waters of the Sary-kamysh, when raised by inundations above the sill just mentioned, send their surplus into the Uzboi. It appears most probable that in the 16th century the Sary-kamysh was confounded with a gulf of the Caspian;[5] and this gives much plausibility to Konshin's supposition that the changes in the lower course of the Amu (which no geologist would venture to ascribe to man, if they were to mean the alternative discharge of the Amu into the Caspian and Lake Aral) merely meant that by means of appropriate dams the Amu was made to flow, in the 13th, 14th, 15th, and 16th centuries, alternately into Lake Aral and into the Sary-kamysh.

As for the ancient texts with regard to the Jaxartes and Oxus, it becomes more and more probable that their interpretation, if possible at all, is only so when it is admitted that, since the epoch to which these relate, the outlines of the Caspian Sea and Lake Aral have undergone notable changes, commensurate with those which are supposed to have occurred in the courses of the Central Asian rivers. The desiccation of the Aral-Caspian basin proceeded with such rapidity that the shores of the Caspian could not possibly maintain for some twenty centuries the outlines which they have at present. When studied in detail, the general configuration of the Transcaspian region leaves no doubt that both the Jaxartes and the Oxus, with its former tributaries, the Murghab and the Tejeñ, once flowed towards the west; but the Caspian of that time was not the sea of our days; its gulfs penetrated the Turcoman steppe, and washed the base of the Ust-Urt plateau, as is shown by the deposits of its shells described by the Russian engineers.

Kelif-Uzboi.—There is also no doubt that, instead of flowing north-westward of Kelif, the Amu once flowed to join the Murghab and Tejeñ; the succession of depressions described by the Russian engineers as the Kelif-Uzboi[6] supports this hypothesis, which a geographer cannot avoid making when studying a map of the Transcaspian region; but the date at which the Oxus followed such a course, and the extension which the Caspian basin then had towards the east, remain unsettled. Much, however, has still to be done before we can fully reconstruct the geological history of that region since the Pliocene epoch, or show how far the data of Pliny, Strabo, and Ptolemy were descriptions of actual facts.[7]

Population.—With the exception of some 35,000 Kirghiz encamped with their herds on the Ust-Urt plateau (a swelling some 600 to 1000 feet in height and nearly 92,000 square miles in extent, which, owing to its dryness and cold winter, can be inhabited only by nomad cattle-breeders) and a few Persians in the Lutfabad and Shilghyan villages of the Atok, the whole of the population of the Transcaspian region consists of Turcomans. Until a very recent date their chief occupation was cattle-rearing and robbery. Even those Turcomans who had settled abodes on the oases of the Atok, Tejeñ, and Merv were in the habit of encamping during spring in the steppes, and there practising robbery. Robber bands were easily formed, and on their powerful horses they extended their excursions to distances of 200 and 300 miles from their abodes. They infested the Astrabad province; and the villages of the khanates of Afghan Turkestan, from Balkh to Meshhed, were periodically devastated by them. The aspect of the steppe has, however, greatly changed since the Russian advance, the fall of the Turcoman stronghold of Geok-tepe, and the massacres which ensued; the Persians are already beginning to avenge themselves on the inhabitants of the Atok by disputing with them the supplies of water coming from the Kopet-dagh.

The chief oasis of the Turcoman desert is the Atok, which extends along the base of the Kopet-dagh, and is now traversed by the Transcaspian railway. The Akhal and the Arakadj oases, collectively called Atok, now have a population of about 42,000 Tekke-Turcomans, who have recently settled there, and live for the most part in miserable clay huts or in felt tents (*kibitkas*). They raise wheat, barley, and lucerne; and the Persians have excellent gardens. Some cotton is also grown, and the culture of the silkworm is beginning to spread. The chief settlements are Askabad, Kizil-arvat, and Geok-tepe.

The oasis of MERV (*q.v.*) is inhabited by Akhal-tekkes (about 160,000), mostly poor. In January 1887 they submitted to Russia.

The oasis of Tejeñ has recently sprung up where the river Tejeñ (Heri-rud) terminates in the desert. Formerly it was only temporarily visited by the Tekkes who came to cultivate the fields in summer. In 1883 it was estimated to have 7500 inhabitants.

South-West Turcomania.—The region between the Heri-rud and the Murghab, as they issue from the highlands, described in English maps under the name of Badhyz, and by the Russians as South-West Turcomania, has of late attracted a good deal of attention since the Russian occupation of Sarakhs on the Tejeñ (see AFGHANISTAN and PERSIA) and Penjdeh on the Murghab. It has the characters of a plateau reaching about 2000 feet above the sea, with hills 500 and 600 feet high covered with sand, the spaces between being filled with loess. The Borkhut Mountains which connect the Kopet-dagh with the Sefid-kuh, reach 3000 to 4000 feet, and are crossed in a gorge by the Heri-rud. Thickets of poplar and willow follow the courses of both the Murghab and Heri-rud, and the trees reach a considerable size. Pistachio and mulberry trees grow in isolated groups on the hills; but there are few places available for culture, and the Saryks (some 60,000 in number) congregate in only two oases at Yol-otan and Penjdeh. Cattle-breeding is their chief occupation, and enables them to live in a certain degree of affluence. Brigandage, formerly a notable source of income, is now being suppressed. The Sarakhs oasis is now occupied by the Salors, hereditary enemies of the Tekkes, who number about 3000 tents at Old Sarakhs, and 1700 more on the Murghab, at Tchardjui, at Maimene, and close to Herat.

Great modifications in the life of the steppe have of course been brought about by the Russian conquest, which was followed with great rapidity by the construction of a railway from Mikhailovsk on the Caspian to Kizil-arvat and Sarakhs, and thence to Merv and north-eastward to Tchardjui on the Amu, from which point it is now being continued across Bokhara towards Samarkand. Attempts at growing cotton and tea are being made, and land has been rented at Merv for cotton plantations. Cotton is to be pressed by steam at Bokhara and Tchardjui, to be sent to Russia by the Transcaspian railway.[1]

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[1] See N. Zarudnyi, "Les Oiseaux de la Contrée Transcaspienne," in *Bull. Soc. Nat. Mosc.*, 1885.

[2] It is to be observed that on the original Russian map of the Transcaspian, drawn immediately after the survey of the Uzboi had been completed, the Uzboi has not the continuity which is given to it on subsequent maps.

[3] Their original papers are printed in the *Izvestia* of the Russian Geogr. Soc., 1883 to 1887, as also in the *Journal* of the Russian Ministry of Roads and Communications.

[4] According to A. E. Hedroitz and A. M. Konshin the old Tona-Daria bed of the Amu contains shells of molluscs now living in the Amu (*Cyrena fluminalis*, *Dreissena polymorpha*, and *Anodonta*). The Sary-kamysh basin is characterized by deposits containing *Neritina liturata*, *Dreissena polymorpha*, and *Lymnæus*, characteristic of this basin. Below the Sary-kamysh there are no more deposits containing shells characteristic for the Amu; *Anodontæ* are found quite occasionally on the surface, not in beds, in company with the Caspian *Cardium* (*Didacna*) *trigonoides*, var. *crassum*, *Cardium piramidatum*, *Dreissena polymorpha*, *D. rostriformis*, *Hydrobia caspia*, *Neritina liturata*, and *Dreissena brardii*; the red clays with these fossils extend for 130 miles to the east of the Caspian (*Izvestia* of Russ. Geog. Soc., 1883 and 1886).

[5] As by Jenkinson, who mentions a sweet-water gulf of the Caspian within six days' march from Khwarezm, by which gulf he could mean nothing but the Sary-kamysh depression.

[6] In connexion with this southern "old bed," it is worthy of notice that the Ersari-Turcomans call it Unghyuz or Onguz ("dry old bed"), and there can be no doubt that when the Bolshoi Tchertezh of the 16th century (speaking from anterior information) mentions a river, Ughyus or Ugus, flowing to the west from the Amu towards the Caspian, it is merely describing as a river what its very name shows to have been a dry bed, only supposed to have been once occupied by a river. The similarity of the names Ongus and Ugus with the Ogus and Ochus is so striking that one is inclined to see in the Ogus or Ochus nothing but the mention of a dry old bed. Compare Petrusevitch, "The South-East Shores of the Caspian," in *Zapiski* of the Caucasian Geogr. Soc., vol. xi., 1880.

[7] Such an intermingling of modern data with older traditions is not unknown to geographers. A striking instance of it is given in the supposed connexion of Lake Aral with the Arctic Ocean during historical times; physical changes are proceeding so rapidly in Asia that we find traces of like survivals of traditions even in this age of accurate surveys.

Caspian Littoral.—The Caspian littoral is divided into two districts, Krasnovodsk and Manghishtak. The former has about 15,500 settled inhabitants and 8056 Turcoman kibitkas (partly shifted in summer to Persian territory). The chief settlements of the district are Krasnovodsk on the Krasnovodsk Gulf; Mikhailovsk, the terminus of the Transcaspian railway, in regular communication by steamer with Baku; and Tchikishlyar, close to the mouth of the Atrek. The Manghishtak district, which includes the Ust-Urt plateau, has a population of about 34,500 Kirghiz. Its chief settlement is Alexandrovsk.

The total population of the Transcaspian region was estimated in 1883—that is, before the annexations in South-West Turcomania—at from 214,000 to 260,000 inhabitants (P. A. K.)

See vol. xxi. Plates II., III. **TRANSCAUCASIA**, the name given to that portion of the Russian empire (in Caucasus, Armenia, and Asia Minor) which lies to the south of the main Caucasus ridge. It comprises the governments of Kutais (inclusive of the province of Batum), Tiflis, Elisabethpol, Erivañ, and Kars, with parts of Daghestan and most of Baku, and the separate military districts of Tchernomorsk and Zakataly. Sometimes Transcaucasia is identified with Southern Caucasus, and then it is intended to include the whole of Daghestan. So defined, it would have an area of 95,930 square miles, and a population of 4,173,380.

Three regions must be distinguished:—(1) the narrow strip of land between the main Caucasus ridge and the Black Sea (TCHERNOMORSK district, *q.v.*); (2) the broad valley, watered by the Rion in the west and the Kura in the east, which separates the main Caucasus ridge from the region next to be mentioned; (3) the highlands, mountains, and plateaus of Lazistan, Kars, and Armenia.

The valley referred to, which crosses the isthmus from the Black Sea to the Caspian, consists of two widely different sections,—the drainage-area of the Rion, which is Mediterranean in its physical characteristics, and the valley of the Kura and Araxes, which slopes to the Caspian, and in its lower parts becomes purely cis-Caspian. The Mesques or Meshik Mountains (3000–5000 feet), a ridge running south-west to north-east, and probably a continuation of the Black Sea coast ridge (Tchorokh Mountains), separate the two. The drainage area of the Rion, which corresponds approximately to the government of Kutais, includes the former provinces of Imeritia, Mingrelia, Guria, and Swanetia on the upper Ingur and Tsheniststhali. With the exception of the valley of the Rion (some 25 miles broad), and the sandy and marshy littoral, it is wholly occupied by spurs of the main Caucasus ridge, the Meshik, and the Wakhan Mountains; the last-named rise to 10,000 and 11,000 feet above the sea in their highest summits, and are intersected by deep and fertile valleys. The region is characterized by a heavy rainfall and a moist maritime climate. The vegetation, which is luxuriant, is of a circum-Mediterranean character: fine forests of deciduous trees clothe the mountain slopes, and the highland villages nestle amid thickets of azalea, almond, and rhododendron. Maize, the mulberry, the vine, and a great variety of fruit trees are cultivated. Mingrelia and Imeritia are the real gardens of Caucasus; but the high valleys tributary to the Ingur, inhabited by Swanians, are wild and difficult of access; in some of them, which are narrow and marshy, fevers and scurvy prevail. The Rion is not navigable, and of its tributaries only the Tsheniststhali and the Kvirila are worthy of mention. Several lakes (such as the Paleostom, surrounded by marshes at the mouth of the Rion) occur in the coast region. The population consists of Imeritians, Mingrelians, Gurians, and Swanians, all belonging to the Kartvelian branch of Caucasians (see vol. x. p. 433), with a few Ossetians, Jews, Armenians, and Tartars. Russians are not numerous.

The pass of Suram, by which the Transcaucasian railway now crosses the Mesques Mountains, leads from the valley of the Rion to that of the Kura. Spurs from the Caucasus and the Anticaucasus fill up the broad longitudinal depression between these, so that above Tiflis the bottom of the valley is but a narrow strip. But below that city it suddenly widens, and stretches for nearly 350 miles eastward towards the Caspian with a steadily increasing breadth, until it becomes nearly 100 miles wide in the steppe of Mugañ on the Caspian littoral. The snow-clad peaks of the main Caucasus, descending by short steep slopes, fringe the valley on the north-east; while a huge wall, much lower, and having the characters of a border-ridge of the Armenian plateau, bounds the valley on the south-west.[2] The floor of the valley gently slopes from 1200 feet at Tiflis to 500 feet in its middle, and to 85 feet below the level of the ocean on the Caspian shore; but a plateau ranging from 2000 to 3000 feet in height, very fertile along the Alazañ, a left-hand tributary of the Kura, stretches along the southern hillfoots of the main ridge. In its lower course the Kura is joined by the Araxes, a river nearly as large as itself, which brings to it the waters of the Armenian plateau.

The highest mountains of the Caucasus enclose the upper parts of the valley (now the government of Tiflis). An unbroken series of peaks, from 10,000 to 12,600 feet in height, mostly snow-clad and separated by but slight depressions, is seen in profile as one looks from some height of the Anticaucasus towards the main chain and the broad valley of the Kura. Deep short gorges and valleys indent the steep slopes which are inhabited by Ossetians, Tushes, Pshavs, and Khevsurs in the west, and by the various tribes of the Lesghians in the east. Every available patch is used in these high and stony valleys for the culture of barley, even at heights of 7000 and 8000 feet above the sea; but cattle-breeding is the chief resource of the mountaineers, whose little communities are separated from one another by passes in few cases lower than 10,000 feet. The steppes which cover the bottom of the valley are for the most part too dry to be cultivated without irrigation. It is only nearer the hillfoots in Kahetia, where multitudinous streams supply the fields and the gardens of the plateau of the Alazañ, that wheat, millet, and maize are grown, and orchards, vineyards, and mulberry-tree plantations are possible. Lower down the valley cattle-rearing becomes the chief source of wealth, while in the small towns and villages of the former Georgian kingdom (see GEORGIA) various petty trades, testifying to a high development of artistic taste and technical skill, are widely diffused. Further down the Kura, in the government of Elizabethpol, and especially on the right bank of the river, a population of Russian agriculturists—chiefly Nonconformists—is rapidly springing up, so that corn is exported from the villages on the Ganja. The slopes of the Anticaucasus are covered with beautiful forests, and the vine is grown at their base, while in the broad and wide steppes the Tartars rear cattle, horses, and sheep. The lower part of the Kura valley, which belongs mainly to the province of Baku, assumes the character of a dry steppe where the rainfall hardly reaches 13·7 inches at Baku, and is still less in the Mugañ steppe (in most striking contrast with the moistness of the Lenkorañ region close by). The steep slopes of the Great Caucasus are still covered with thriving forests; but forests and meadows disappear in the steppe, whose scanty vegetation has a Central-Asian character. Only *tugais*, or thickets of poplar, dwarf oak, tamarisk, and so on, follow the actual course of the Kura, whose delta is covered with impenetrable growths of rushes. The Mugañ steppe, however, does not deserve its ancient evil reputation; the serpents with which it was said to abound are entirely fabulous, and in the winter it is full of life; herds of antelopes roam over it, and its southern irrigated parts promise to become the granary of Caucasus,[3] although its unirrigated parts will probably never recover their former richness, the Kura having excavated its bed to a much greater depth. The Apsheron peninsula, in which the Great Caucasus terminates at Baku, to be continued farther south-east by a submarine plateau of the Caspian, is the seat of those remarkable naphtha springs which have recently given rise to an important industry and now supply most of the Volga steamers with fuel; while the western shores of the wide Kizil-agatch Bay—the Talysh, or Lenkorañ district on the slopes of the Armenian plateau—on account of their rich vegetation, fertile soil, and moist climate, are one of the most beautiful possessions of Russia in Asia.

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[1] No Russian sea shows so rapid a growth of navigation as the Caspian Sea during the last fifteen years. In 1884 no less than 1945 steamers (611,000 tons), engaged in foreign trade, entered the Russian ports of the Caspian, as against 409 (113,000 tons) in 1876.

[2] For this valley and the contrasts between the Caucasus and Anticaucasus, see Radde's *Ornis Caucasica*, Cassel, 1884.

[3] Seidlitz, *Spiski naselennykh myest Bakinskoi gubernii.*

The population includes only a few Russians (about 16,000); the majority are Tartar shepherds, next to whom come the Iranian Tates and Talyshes (the latter probably aborigines of Baku), who constitute 23·1 per cent. of the population; some 27,000 Armenians, chiefly about Shemakha, and 35,000 Kurins, or Lezghians, on the slope of the Great Caucasus, must be added, as also some Jews and Arabs.

A mining industry of some importance has been growing up of late in this part of Transcaucasia. The copper works of Kedabek in Elizabethpol yield from 10,000 to 15,000 cwts. of copper annually; nearly 300,000 cwts. of manganese are extracted in Kutais, and 30,000 cwts. of sulphur in Daghestan and Baku; the coal-mines of Kutais, the alum ores of Elizabethpol, and the fire-clay and cement of Tchernomorsk, are but recently opened up.

The highlands of Transcaucasia, which extend from north-west to south-east for nearly 375 miles, with an average width of 160 miles, must in their turn be subdivided into two sections—the Armenian plateau, including the provinces of Erivañ and Kars and parts of Baku, and the Black Sea coast-region, including the former province of Batum (now the Batum and Artvin districts of Kutais).

The former of those is an immense plateau separated by the valley of the Araxes from the highlands of Adherbaijan and of Turkish Armenia, which belong to the drainage-areas of the Euphrates or those of Lakes Van and Urmia. All over Kars and Erivañ is a series of plateaus ranging in altitude from 5000 to 6500 feet, sometimes quite flat, sometimes broadly undulating, covered with rich meadows, and for the most part available for agriculture. Dome-shaped mountains, isolated, or grouped into relatively low ridges, rise from these plateaus to heights which range from 8000 to 9500 feet, and occasionally reach 10,000 or 11,000 above sea-level. Several summits in the east exceed that height, and the Alaghöz reaches 13,436 feet.

This plateau region is bounded on the south by the valley of the Araxes, the river which forms the frontier with Turkey, except where it is crossed by Russia in the south of Kars and west of Erivañ. There the river flows in a broad valley 4500 feet above sea-level, and the Kars plateau falls towards it by a steep slope, while on the other side a steep, rocky ridge of exceedingly wild aspect rises as the northern border-ridge of the South Armenian (Alashkert) plateau and the water-parting between the Caspian Sea and the Indian Ocean. This ridge, which includes the Allah-dagh and Kösa-dagh (10,720 and 11,260 feet respectively), as also the Great and Little Ararats (17,100 and 12,990 feet), has no general name, but is described under the names of Shah-ioly, or Agri-dagh.[1]

A number of lakes occur on the plateau, especially along its northern border-ridge, the chief being that of Goktcha, an extensive alpine basin (500 square miles 6310 feet above sea-level) surrounded by wild mountains. Most of the depressions of the plateau bear traces of having been under water during the Lacustrine (Post-Glacial) period. Granites and other unstratified rocks constitute the nucleus of the Armenian and Kars plateaus. These are covered with Azoic slates, and partly with Devonian and Carboniferous deposits; Jurassic and Cretaceous are wanting, but the Tertiary (Eocene and Miocene) are widely spread both in the valley of the Rion and Kura and in the depressions of the plateau. Rocks of volcanic origin are widely diffused all over Erivañ: the Alexandropol plateau, surrounded by extinct volcanoes, is all covered with volcanic products, which overlie the Tertiary deposits and in turn are covered with Glacial boulder-clay.

The Alaghöz, the Ararats, and the peaks around Lake Goktcha are huge trachitic masses surrounded by volcanic rocks. Iron and copper ores are widely spread; alum and rock-salt are obtained; the latter at Kulpi and Nakhichevañ. Mineral springs are numerous. The region is watered by the upper Araxes—too rapid and rocky to be navigated—and its tributaries, most of which flow at the bottoms of deep gorges. The upper Kura waters western Kars. The climate presents all the varieties which might be expected in a region of so varied altitudes. While cotton grows in the dry and hot climate of the valley of the lower Araxes, the winter is severe on the plateau, and Alexandropol (5010 feet) has an average temperature of only 41°·5 (Jan. 12°·8; July, 73°·6). The difference between summer and winter is still more striking at Erivañ (3210 feet), which has in January an average of only 5° while that of August reaches 77°·7. On the Kars plateau the winter is still more severe. Kaghyzman (4620 feet) and Sary-kamysh (7800 feet) have the winter temperature of Finland, and the latter place, with an annual mean the same as that of Hammerfest (36° F.), has frosts of 27° and heats of 99°. The vegetation of the Kars plateau reflects these extremes of climate, and, besides the alpine vegetation of the high *yailas* (alpine meadows), we find there the Anatolian, Armenian, and Pontic floras meeting. The population of Erivañ consists of Armenians (54 per cent.), Tartars (40 per cent.), some 28,000 Kurds, and some 4400 Russians, together with a few Greeks and Jews. In localities under 4000 feet cotton and rice are the chief crops, oil-yielding plants, the vine, the mulberry, and fruit trees being also cultivated. Higher up wheat and barley are grown, while at altitudes above 6000 and 7000 feet the Tartars and Kurds support themselves by rearing cattle. Many petty trades are developed in the towns among the Armenians, and the trade of Erivañ with Persia and Turkey amounts to about 10,000,000 roubles.

The population of the province of Kars (167,610 in 1883) is very mixed. In a remote antiquity it was inhabited by Armenians, whose capital Ani, Mren with its beautiful ruins of a grand cathedral, and several other towns now in ruins testify to the former wealth and populousness of the country. After the fall of the Armenian empire the Turks occupied the region; Kurds from Kurdistan and Diarbekr invaded the alpine pasturages of the valley of the Araxes; later on, Kabards, Circassians, Osses, and Karapapakhs found refuge there; and finally, after the last war the Mohammedans emigrated to Asia Minor (82,760 in 1878–81), while Christian Armenians, Greeks, Russian Raskolniks, and some Yezids took their place. The population consists now of Turks, Armenians, Turcomans, Greeks, Kurds, Adherbaijan Tartars, Gipsies, and Russians. The Kars *sanjak*, which was one of the granaries of Turkey, has lost this reputation; but the crops (chiefly wheat and barley) are now again increasing where the early frosts do not interfere with agriculture. Cotton is raised in the Olty region; and in the valley of the Araxes gardening and the culture of the silkworm are widely diffused; while cattle-rearing is the chief source of income in the highlands, especially with the Kurds, who move their felt tents on the *yailas* to higher levels as the summer sun burns up the vegetation.

The western part of the Transcaucasian highlands comprises the Batum and Artvin districts, which now belong to Kutais. The whole of the region is occupied by alpine ridges—the Pontic ridge in the west, and those of Arjar and Arsian in the east, whose highest peaks rise to 10,000 and 11,000 feet, without, however, reaching the limits of perpetual snow. The Tchorokh and its tributaries, mountain streams enclosed in deep valleys, water the region; the Tchorokh is navigable by small boats for 60 miles.

The coast region enjoys an excellent climate; the average yearly temperature at Batum is 65° F., that of the coldest month (February) being 41°·5, and that of July 76°·5. During the last four years the thermometer never fell lower than 39°·5 at Batum. The rainfall is excessive (93·4 inches), and days are recorded on which the amount of rain exceeded 10 inches. The region has accordingly a very luxuriant and subtropical vegetation, and even higher up the hills the villages are literally buried amidst gardens. The higher hills have luxuriant meadows. Rice is cultivated in the coast region, and millet, barley, tobacco, and a variety of fruit-trees on higher altitudes. The inhabitants (about 90,000 in 1884) are chiefly Georgians, approaching the Gurians most nearly. The Lazes number about 2000 and the Kurds about 1000. A few Khemshilli, or Mohammedan Armenians, have found refuge in the gorge of Makrial.

Towns.—The chief towns of Transcaucasia are more important than those of northern Caucasus. TIFLIS (*q.v.*), with 104,024 inhabitants in 1883, is the capital of Caucasia. KUTAIS (*q.v.*) (13,000), to which tradition assigns an age of 4000 or 5000 years, has grown rapidly of late, owing to its situation at the head of the alluvial plain of the Rion and the proximity of the Tkvibula coal deposits and the Kvirila manganese mines. Khoni (4000) and Orpiri are mere administrative centres of Kutais. Redut-kale (620) has lost its importance as a seaport, and Poti (3110), at the mouth of the Rion, has not yet become an important port, notwithstanding efforts to improve its roadstead and its railway connexion with Tiflis and Baku. The chief Black Sea port of Transcaucasia is BATUM (*q.v.*), which has been diligently fortified of late, and has now a population of 12,000. Artvin (5860) and Ardjari are the two other chief towns of the Batum region. The chief towns of the government of Tiflis besides its capital are Gori, capital of Georgia (population 4800), Mtzhet (770) at the junction of the Vladikavkaz highway with the Transcaucasian railway, Telav (7020), Dushety (3600), Zakataly (1080), chief town of a separate military district, and Signakh (10,340), which are built in the spurs of the main chain; while Akhaltsikh (18,270), on the upper Kura and on the Kars plateau, is a busy centre for petty trades. The old city of Ahalkalaki (3200) on the same plateau is now a Russian fort. ELIZABETHPOL, NUKHA, and SHUSHA (*qq.v.*) are the principal towns in the province of Elizabethpol. BAKU (*q.v.*), the terminus of the Transcaucasian railway, and in regular steamer communication with Mikhailovsk in the Transcaspian region, derives its importance from the naphtha wells which surround it. Shemakha (*q.v.*) (28,810), and Saliany (10,170), at the head of the delta of the Kura, and notable for its fisheries, are the only places of importance in the province of Baku. Erivañ (*q.v.*) (12,450), capital of the province of Erivañ, and the chief city of the Armenian plateau, is one of the oldest cities of the country, and, owing to its position, would be much more important than it is, but for its climate. Etchmiadzin, or Vagarshapad (2910), is the real capital (the Rome) of Armenia, for its antiquities, monastery, library, and printing offices. Nakhitchevañ (5390)—the Naxuana of Ptolemy—is another centre of Armenia. The most populous town of the region, however, is Alexandropol (23,010) or Gumri (*q.v.*), the chief Russian fortress of Transcaucasia,—the other towns of Erivañ being Ani, or Oni, Novobayazet at Lake Goktcha, and Ordubad (3600) The long-disputed Kars (*q.v.*), which has now 7340 inhabitants, is the chief town of the new Russian province of the same name, annexed in 1878. Kaghyzman (3700), on the upper Araxes, is but a collection of clay houses surrounded by rich gardens; Ardahan (1270), on the upper Kura, and Olty (530) are the only other towns of Kars worthy of notice as administrative centres. (P. A. K.)

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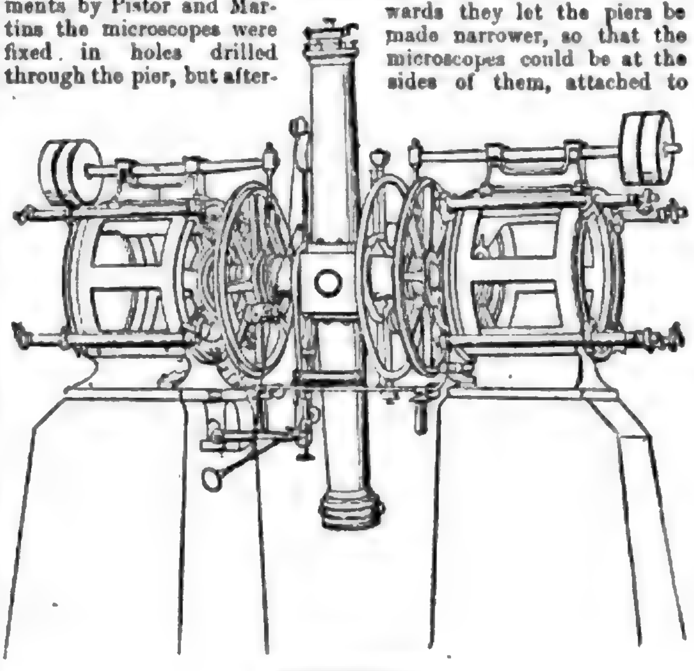
[1] W. Massalsky, "Government of Kars," in *Isvestia* of Russ. Geogr. Soc., vol. xxiii., 1887.

TRANSIT CIRCLE, or **Meridian Circle**, an instrument for observing the time of a star's passing the meridian, at the same time measuring its angular distance from the zenith. The idea of having an instrument (quadrant) fixed in the plane of the meridian occurred even to the ancient astronomers, and is mentioned by Ptolemy, but it was not carried into practice until Tycho Brahe constructed a large meridian quadrant. This instrument enabled the observer to determine simultaneously right ascension and declination, but it does not appear to have been much used for right ascension during the 17th century, the method of equal altitudes by portable quadrants or distance measures with a sextant being preferred (see Observatory and Time). These methods were, however, very inconvenient, which induced Roemer (*q.v.*) to invent the transit instrument about 1690. It consists of a horizontal axis in the direction east and west resting on firmly fixed supports, and having a telescope fixed at right angles to it, revolving freely in the plane of the meridian. At the same time Roemer invented the altitude and azimuth instrument for measuring vertical and horizontal angles, and in 1704 he combined a vertical circle with his transit instrument, so as to determine both coordinates at the same time. This latter idea was, however, not adopted elsewhere, although the transit instrument soon came into universal use (the first one at Greenwich was mounted in 1721), and the mural quadrant continued till the end of the century to be employed for determining declinations. The advantage of using a whole circle, as less liable to change its figure, and not requiring reversal in order to observe stars north of the zenith, was then again recognized by Ramsden (*q.v.*), who also improved the method of reading off angles by means of a micrometer microscope as described below. The making of circles was shortly afterwards taken up by Troughton (*q.v.*), who in 1806 constructed the first modern transit circle for Mr Groombridge's observatory at Blackheath, but he afterwards abandoned the idea, and designed the mural circle to take the place of the mural quadrant. In the United Kingdom the transit instrument and mural circle continued till the middle of the present century to be the principal instruments in observatories, the first transit circle constructed there being that at Greenwich (mounted in 1850), but on the Continent the transit circle superseded them from the years 1818-19, when two circles by Repsold (*q.v.*) and by Reichenbach (*q.v.*) were mounted at Göttingen, and one by Reichenbach at Königsberg.[1] The firm of Repsold was for a number of years eclipsed by that of Pistor and Martins in Berlin, who furnished the observatories of Copenhagen, Albany, Leyden, Leipsic, Berlin, Washington, and Dublin with first class instruments, but since the death of Martins the Repsolds have again taken the lead, and have of late years made transit circles for Strasburg, Bonn, Wilhelmshafen, Williamstown (Massachusetts), Madison (Wisconsin), &c. The observatories of Harvard College (United States), Cambridge, and Dun Echt have large circles by Troughton and Simms, who also made the Greenwich circle from the design of Airy.[2]

We shall describe the principal features of a transit circle, referring for smaller transit instruments and altazimuths to the article Surveying (vol. xxii. p. 719).

In the earliest transit instrument the telescope was not placed in the middle of the axis, but much nearer to one end, in order to prevent the axis from bending under the weight of the telescope. It is now always placed in the centre of the axis. The latter consists of one piece of brass or gun-metal with carefully turned cylindrical pivots at each end. The centre of the axis is shaped like a cube, the sides of which form the basis of two cones which end in cylindrical parts. The pivots rest on Y-shaped bearings, either let into the massive stone or brick piers which support the instrument or attached to metal frameworks bolted on the tops of the piers. In order to relieve the pivots from the weight of the instrument, which would soon destroy their figure, the cylindrical part of each end of the axis is supported by a hook supplied with friction rollers, and suspended from a lever supported by the pier and counterbalanced so as to leave only about 10 pounds pressure on each bearing. Near each end of the axis is attached a circle or wheel (generally of 3 or 3½ feet diameter) finely divided to 2′ or 5′ on a slip of silver let into the face of the circle near the circumference. The graduation is read off by means of microscopes, generally four for each circle at 90° from each other, as by taking the mean of the four readings the eccentricity and to a great extent the accidental errors of graduation are eliminated.[3] In the earlier instruments by Pistor and Martins the microscopes were fixed in holes drilled through the pier, but afterwards they let the piers be made narrower, so that the microscopes could be at the sides of them, attached to radial arms starting from near the bearings of the axis. This is preferable, as it allows of the temporary attachment of auxiliary microscopes for the purpose of investigating the errors of graduation of the circle, but the plan of the Repsolds and of Simms, to make the piers short and to let the microscopes and supports of the axis be carried by an iron framework, is better still, as no part of the circle is exposed to radiation from the pier, which may cause strain and thereby change the angular distance between various parts of the circle. Each microscope is furnished with a micrometer screw, which moves a frame carrying a cross, or



Transit Circle.

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[1] The most notable exception was the transit instrument and vertical circle of the Pulkova observatory, specially designed by the elder Struve for fundamental determinations.

[2] This instrument differs in many particulars from others: the important principle of symmetry in all the parts (scrupulously followed in all others) is quite discarded; there is only one circle; and the instrument cannot be reversed. There is a similar instrument at the Cape observatory.

[3] On Reichenbach's circles there were verniers instead of microscopes, and they were attached to an alidade circle, the immovability of which was tested by a level.

better two close parallel threads of spider's web, with which the distance of a division line from the centre of the field can be measured, the drum of the screw being divided to single seconds of arc (0".1 being estimated) while the number of revolutions are counted by a kind of comb in the field of view. The periodic errors of the screw must be investigated and taken into account, and care must be taken that the microscopes are placed and kept at such a distance from the circle that one revolution will correspond to 1', the excess or defect (error of run) being determined from time to time by measuring standard intervals of 2' or 5' on the circle.

The telescope consists of two slightly conical tubes screwed to the central cube of the axis. It is of great importance that this connexion should be as firm and the tube as stiff as possible,[1] as the flexure of the tube will affect the declinations deduced from the observations. The flexure in the horizontal position of the tube may be determined by means of two collimators or telescopes placed horizontally in the meridian, north and south of the transit circle, with their object glasses towards it. If these are pointed on one another (through holes in the central cube of the telescope), so that the wire-crosses in their foci coincide, then the telescope, if pointed first to one and then to the other, will have described exactly 180°, and by reading off the circle each time the amount of flexure will be found. M. Loewy has constructed a very ingenious apparatus[2] for determining the flexure in any zenith distance, but generally the observer of standard stars endeavours to eliminate the effect of flexure in one of the following ways:—either the tube is so arranged that eye-piece and object-glass can be interchanged, whereby the mean of two observations of the same star in the two positions of the object-glass will be free from the effect of flexure, or a star is not only observed directly (in zenith distance Z), but also by reflexion from a mercury trough (in zenith distance $180^\circ - Z$), as the mean result of the Z.D. of the direct and reflexion observations, before and after reversing the instrument east and west, will only contain the terms of the flexure depending on $\sin 2Z$, $\sin 4Z$, &c. In order to raise the instrument a reversing carriage is provided which runs on rails between the piers, and on which the axis with circles and telescope can be raised by a kind of screw-jack, wheeled out from between the piers, turned exactly 180°, wheeled back, and gently lowered on its bearings.

The eye end of the telescope has in a plane through the focus a number of vertical and one or two horizontal wires (spider lines). The former are used for observing the transits of the stars, each wire furnishing a separate result for the time of transit over the middle wire by adding or subtracting the known interval between the latter and the wire in question. The intervals are determined by observing the time taken by a star of known declination to pass from one wire to the other, the pole star being best on account of its slow motion.[3] The instrument is provided with a clamping apparatus, by which the observer, after having beforehand set to the approximate declination of a star, can clamp the axis so that the telescope cannot be moved except very slowly by a handle pushing the end of a fine screw against the clamp arm, which at the other side is pressed by a strong spring. By this slow motion the star is made to run along one of the horizontal wires (or if there are two close ones, in the middle between them), after which the microscopes are read off. The field or the wires can be illuminated at the observer's pleasure; the lamps are placed at some distance from the piers in order not to heat the instrument, and the light passes through holes in the piers and through the hollow axis to the cube, whence it is directed to the eye-end by a system of prisms.[4]

The time of the star's transit over the middle wire is never exactly equal to the actual time of its meridian passage, as the plane in which the telescope turns never absolutely coincides with the meridian. Let the production of the west end of the axis meet the celestial sphere in a point of which the altitude above the horizon is b (the error of inclination), and of which the azimuth is $90^\circ - a$ (the azimuth being counted from south through west), while the optical axis of the telescope makes the angle $90^\circ + c$ with the west end of the axis of the instrument, then the correction to the observed time of transit will be $a\,\dfrac{\sin(\phi-\delta)}{\cos\delta} + b\,\dfrac{\cos(\phi-\delta)}{\cos\delta} + c\sec\delta$, where ϕ is the latitude of the station and δ the declination of the star (see **Geodesy**, vol. x. p. 166). This is called Tobias Mayer's formula, and is very convenient if only a few observations have to be reduced. Putting $b\sin\phi - a\cos\phi = n$, we get Hansen's formula, which gives the correction $= b\sec\phi + n(\tan\delta - \tan\phi) + c\sec\delta$, which is more convenient for a greater number of observations. The daily aberration is always deducted from c, as it is also multiplied by $\sec\delta$ (being $0^s.31\cos\phi\sec\delta$). The above corrections are for upper culmination; below the pole $180^\circ - \delta$ has to be substituted for δ. The constant c is determined by pointing the instrument on one of the collimators, measuring the distance of its wire-cross from the centre wire of the transit circle by a vertical wire movable by a micrometer screw, reversing the instrument and repeating the operation, or (without reversing) by pointing the two collimators on one another and measuring the distance of first one and then the other wire-cross from the centre wire. The inclination b is measured directly by a level which can be suspended on the pivots. Having thus found b and c, the observation of two stars of known right ascension will furnish two equations from which the clock error and the azimuth can be found. For finding the azimuth it is most advantageous to use two stars differing as nearly 90° in declination as possible, such as a star near the pole and one near the equator, or better still (if the weather permits it) two successive meridian transits of a close circumpolar star (one above and one below the pole), as in this case errors in the assumed right ascension will not influence the result.

The interval of time between the culminations or meridian transits of two stars is their difference of right ascension, 24 hours corresponding to 360° or 1 hour to 15°. If once the *absolute right ascensions* of a number of *standard stars* are known, it is very simple by means of these to determine the R.A. of any number of stars. The absolute R.A. of a star is found by observing the interval of time between its culmination and that of the sun. If the inclination of the ecliptic (ϵ) is known, and the declination of the sun (δ) is observed at the time of transit, we have $\sin\alpha\tan\epsilon = \tan\delta$, which gives the R.A. of the sun, from which together with the observed interval of time corrected for the rate of the clock, we get the R.A. of the star. Differentiation of the formula shows that observations near the equinoxes are most advantageous, and that errors in the assumed ϵ and the observed δ will have no influence if the $\Delta\alpha$ is observed at two epochs when the sun's R.A. is A and 180 − A or as near thereto as possible. A great number of observations of this kind will furnish materials for a standard catalogue; but the right ascensions of many important catalogues have been found by making use of the R.A.'s of a previous catalogue to determine the clock error and thus to improve the individual adopted R.A.'s of the former catalogue.

In order to determine absolute declinations or polar distances, it is first necessary to determine the co-latitude (or distance of the pole from the zenith) by observing the upper and lower culmination of a number of circumpolar stars. The difference between the circle reading after observing a star and the reading corresponding to the zenith is the zenith distance of the star, and this plus the co-latitude is the north polar distance or $90^\circ - \delta$. In order to determine the zenith point of the circle, the telescope is directed vertically downwards and a basin of mercury is placed under it, forming an absolutely horizontal mirror. Looking through the telescope the observer sees the horizontal wire and a reflected image of the same, and if the telescope is moved so as to make these coincide, its optical axis will be perpendicular to the plane of the horizon, and the circle reading will be 180° + zenith point. In observations of stars refraction has to be taken into account as well as the errors of graduation and flexure, and, if the bisection of the star on the horizontal wire was not made in the centre of the field, allowance must be made for curvature (or the deviation of the star's path from a great circle) and for the inclination of the horizontal wire to the horizon. The amount of this inclination is found by taking repeated observations of the zenith distance of a star during the one transit, the pole star being most suitable owing to its slow motion.

Literature.—The methods of investigating the errors of a transit circle and correcting the results of observations for them are given in Brünnow's and Chauvenet's manuals (see **Time**). For detailed descriptions of modern transit circles, see particularly *Annalen der Sternwarte in Leyden* (vol. i.), the *Washington Observations* for 1865, and the *Publications* of the Washburn observatory (vol. ii.). The Greenwich circle is described in an appendix to the *Greenwich Observations* for 1852. (J. L. E. D.)

TRANSMIGRATION. See **Metempsychosis.**

TRANSPORTATION. See **Prison Discipline.**

TRANSUBSTANTIATION. See **Eucharist.**

TRANSVAAL, or **South African Republic**, a country in South Africa, northernmost of the European states, lying between 22° 15' and 28° S. lat., and 25° and 32° 10' E. long., is bounded N. and N.W. by the Limpopo, separating it from the Makalaka and Bamangwato countries: W. partly by the Marico and the Hart, partly by an irregular line between these streams, separating it from the new British protectorate of Bechuanaland; S. by the Vaal and the Buffalo, separating it from the Orange Free State and

See vol. Plate II

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[1] Reichenbach supplied his tubes with counterpoising levers like those on the Dorpat refractor (see **Telescope**, fig. 20).

[2] *Comptes Rendus*, vol. lxxxvii. p. 24.

[3] The transits are either observed by "eye and ear," counting the second beats of the clock and comparing the distance of the star from the wire at the last beat before the transit over the wire with the distance at the first beat after the transit, in this way estimating the time of transit to $0^s.1$; or the observer employs a "chronograph," and by pressing an electric key causes a mark to be made on a paper stretched over a uniformly revolving drum, on which the clock beats are at the same time also marked electrically.

[4] The idea of illuminating through the axis is due to Ussher, professor of astronomy in Dublin (d. 1790).

Natal; E. by the Libomba Mountains, separating it from Zululand and the Portuguese East African possessions.[1] Transvaal thus forms a compact inland territory nearly as broad as long, not more than 45 or 50 miles from the Indian Ocean at Delagoa Bay, but otherwise lying completely within the outer rim of the vast South African tableland. A line drawn from the south-west extremity, where it touches Griqualand West, north-eastwards to the Limpopo-Shasha confluence, gives an extreme length of 500 miles, the distance from the same confluence southwards to the Natal frontier being 425, and the greatest length east and west between the Zulu and Bechuana frontiers about 400 miles. In the absence of accurate surveys, the total area has been variously estimated at from 110,000 to 120,000 square miles, with a population (including aborigines) roughly calculated at from 750,000 to 800,000.

Physical Features.—Physically Transvaal forms a well-marked section of the great South African plateau, an elevated shallow basin with a mean altitude of over 3000 feet, whose conformation has been compared to that of a saucer. On the south and east this basin is separated from the coast by a lofty inner and less elevated outer rim, the former from 6000 to 10,000, the latter about 2000 feet high, sweeping round in curves concentric with that of the seaboard, from Cape Colony through Natal and the east side of Transvaal northwards to the equatorial regions. The inner rim, whose various sections in the extreme south are known as the Roggeveld, Nieuweveld, and Quathlamba ranges, takes in Natal and Transvaal the general name of the Drakenberg Mountains. From the Natal frontier to the Lipalule (Olifant) tributary of the Limpopo, the Drakenberg maintains the aspect of a more or less continuous range 5000 to 7000 feet high, culminating in the Mauchberg (8725), the highest point in Transvaal. A little to the east is the Spitskop (5637), and further south the Klipstad (6020) and Holnek (5600). This section, whose several ridges are known as the Verzamelberg, Randberg, Slangapiesberg, and Komatiberg, falls everywhere precipitously eastwards towards the Libomba range, or outer rim of the plateau, which maintains a mean elevation of 2000 feet along the eastern border of Transvaal. Beyond the Lipalule, the Drakenberg loses the character of a well-defined mountain system, broadening out into uplands moderately elevated above the surrounding plateau, and breaking into ridges, such as the Murchison and Zoutpansberg ranges, which run east and west between the Lipalule and Limpopo. The whole system slopes gently westwards to the central tableland, which is itself intersected by several broken ranges, such as the Maquassieberg, Gat Rand, Witwater Rand, and Magaliesberg in the south, the Dwarsberg, Marikele, Hanglip, Waterberg, and Blauberg in the north, all mostly trending in the direction from east to west. But few of these ridges rise much above 4000 feet, and, as the plateau has a mean altitude of considerably over 3000 feet, they detract little from the aspect of a vast level or slightly rolling upland plain, almost everywhere presented by Transvaal west of the Drakenberg orographic system.

The numerous fossil remains of aquatic life, together with extensive sandy tracts and the presence in several places of water-worn shingle, give to the central tableland the appearance of an upheaved lacustrine basin, whose waters escaped at one time through the Limpopo to the Indian Ocean, at another through the Vaal to the Orange river, and thence to the Atlantic. The Vaal and Limpopo are still the two great fissures in the plateau, which carry off most of the surface waters to the surrounding marine basins. The water-parting between these two river systems lies, not in the Drakenberg, itself pierced by the Lipalule and several of its affluents, but in the Witwater Rand towards the south-west of the state. From this point the Limpopo, or Crocodile, sweeps round first to the west, then to the north-east, describing a semicircle of about 1000 miles to the Limvuba (Pafuri) confluence, where it leaves Transvaal, flowing thence for nearly 340 miles through Portuguese territory south-east to the Indian Ocean. Captain G. A. Chaddock has shown (1884) that it is navigable for steamers to this confluence, above which it is obstructed by the Tolo Azime and other rapids. Throughout its whole course it receives numerous affluents on both sides, such as the Shasha and Nuanetai from the north, the Marico, Nyl, Limvuba, Lipalule, and others from Transvaal, of which region it drains fully 95,000 square miles. With the exception of a few tracts watered by the headstreams of the Buffalo (Tugela), Mvolozi, Usutu, and Umcomati (King George), flowing in independent channels eastwards to the Indian Ocean, all the rest of Transvaal is drained by the Vaal westwards to the Orange and Atlantic. The Vaal has its easternmost sources in the Wakkerstroom district on the west slope of the Drakenberg, whence it flows for about 450 miles, partly within, but mainly along, the southern frontier of Transvaal, of which, with the Hart and other tributaries on its right bank, it drains about 20,000 square miles altogether. Besides these perennial streams, there are numerous shallow lagoons or saltpans scattered over the western and northern districts, as well as thermal and mineral waters, such as the Warmbad in the Nyl valley. But the only lake properly so called is Lake Chrissie, a sheet of water nearly 40 miles round, and in parts very deep, which lies on the west side of the Drakenberg, 5755 feet above sea-level.

Climate.—Although lying on the border of and partly within the tropics, Transvaal, thanks to its great elevation above the sea, and to the absence of extensive marshy tracts, enjoys on the whole a healthy invigorating climate, well suited to the European constitution. Owing to the dryness of the air, due to the proximity of the Kalahari desert, the western and central districts are specially favourable to persons suffering from consumption and other chest complaints. But some of the low-lying moist tracts along the Limpopo and other river valleys, close to or within the torrid zone, are extremely insalubrious, fever of the general African type being here endemic, and its prevalence usually marked by the presence of the destructive tsetse fly. The route from Delagoa Bay to the interior also traverses a fever-stricken coast district between the sea and the Libomba escarpment, dangerous especially in the rainy summer season. The rains generally begin about October, sometimes a little before or after, and last intermittently till April. But the rainfall is very unequally distributed, most of the moisture-bearing clouds from the Indian Ocean being arrested by the great barrier of the Drakenberg, or counteracted by the dry west winds from the Kalahari desert. Thus, while there is abundance of rain in the east, the country gradually becomes drier as it approaches Bechuanaland. During the dry winter season (April to September) keen frosty winds blow from the south, sweeping freely over the central plains and carrying the moisture to be precipitated as snow along the eastern highlands. Nevertheless, according to the careful meteorological observations made by Mr Lys at Pretoria between 1877 and 1880, the mean annual temperature is considerably over 68° F., falling to about 40° in June and rising to 90° and occasionally even 95° in January. The rainfall in the same central district seldom reaches 30 inches, which is probably a fair average for the whole of Transvaal, falling to 12 towards the western and rising to 60 on the eastern frontier.

Mineral Resources.—Transvaal yields to no other African region in the abundance of its mineral resources, while it is altogether unrivalled in their extraordinary variety. These include, besides the precious metals and diamonds, iron, copper, lead, cobalt, sulphur, saltpetre, and coal, this last with gold, copper, and iron being probably the most abundant and widely distributed. Gold, largely diffused throughout the Drakenberg and in the northern Zoutpansberg and Waterberg districts and in the Rustenburg and Marico districts in the extreme west, as well as in the highlands between Transvaal and the Zambesi, has hitherto been worked chiefly in the rich auriferous region of Lydenburg about Mount Mauchberg and Mount Spitskop in the central parts of the Drakenberg range, and farther south in the Johannesburg and Lower Kaap (Sheba) district, Middelburg. The Lydenburg deposits, discovered in 1873, lie at an elevation of 4500 to 5000 feet 40 miles south of the Lipalule river and 125 north-west of Lorenzo Marques on Delagoa Bay, the chief diggings being at Pilgrim's Rest and Mac Mac close to the Spitskop. In the Middelburg district the chief centres of mining operations are the recently founded towns of Barberton and Johannesburg. In some years the Lydenburg, Marabastad, and other diggings have jointly yielded over £300,000, obtained by washing and without any quartz-crushing. Iron ores are also widely distributed, and the Yzerberg ("Iron Mountain") near Marabastad (24° S., 30° E.) consists of an enormous mass of rich iron ore, which the natives have worked for ages. Diamonds are chiefly confined to the Bloemhoff district on the Vaal above the great diamantiferous region of Kimberley in Griqualand West. Coal abounds in the south-eastern districts (Wakkerstroom, Utrecht), and also farther north in Middelburg (Nazareth) and Lydenburg. In some places seams 7 or 8 feet thick lie so near the surface that they are quarried and the coal carted away by the natives. The prevailing formations where this great mineral wealth is embedded are quartz, porphyry, granites, clay slates, greenstone, Lower Devonian strata, conglomerates, and limestones.

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[1] The boundaries of Transvaal, long a subject of dispute with Great Britain and the other conterminous states, were at last precisely defined by the convention of February 27, 1884.

Flora.—In Transvaal, as in most of the continent, an herbaceous flora prevails largely over forest growths, which are here confined chiefly to the deep kloofs (gorges) of the mountain ranges, and to the courses of the larger streams. Bush, including mimosas, thorn thickets, and creepers, covers extensive tracts on the northern and southern plains, and the Wakkerstroom and Utrecht districts towards Natal are well wooded. But elsewhere the characteristic features are grasslands, downs, hill slopes, flats, and even many parts of the higher uplands being covered with savannahs generally affording good pasturage and fodder for cattle. In the woodlands the prevailing species are three varieties of yellow wood (*Podocarpus*), often growing to an enormous size, the Cape beech (*Myrsine*), several varieties of the wild pear (*Olinia*) and of stinkwood (*Oreodaphne*), ironwood, and ebony. The Boers and other settlers have hitherto occupied themselves chiefly with stock-breeding (sheep, cattle, and horses), but there can be no doubt that much of the country is eminently suited for the cultivation of cereals, yielding two annual crops and producing some of the finest wheat in the world. Tobacco, the vine, and most European fruits and vegetables also thrive well, while semi-tropical products, such as cotton, sugar, and coffee, might be raised in the warmer northern districts.

Fauna.—By the early settlers Transvaal was described as the "paradise of hunters,"[1] abounding in the characteristic large animals, such as the lion, leopard, rhinoceros, elephant, giraffe, zebra, quagga, several varieties of antelope, and the ostrich, which roam over the continent from Soudan to the Cape. All these animals still exist, but in greatly reduced numbers, being now largely replaced by the domestic animals—cattle, sheep, and horses—introduced by the white settlers. All the large rivers are inhabited by the hippopotamus and crocodile, the latter giving an alternative name to the Limpopo; the buffalo, gnu, eland, springbok, wildbeeste, baboon, and several other members of the ape family are also frequently met with. The country is occasionally swept by destructive flights of locusts; but the greatest enemy of the stock-breeder is the tsetse fly, which infests the coastlands and many of the riverine tracts, but shows a tendency to disappear with the large game, retreating with the advance of the plough. A tsetse belt 40 miles wide along the whole course of the Limpopo still bars the spread of European settlements beyond Transvaal in the direction of the Zambesi.

Inhabitants.—Of the population not more than 50,000 are whites, mostly Boers (descendants of the early Dutch, French, and German immigrants to the Cape), with a large and increasing percentage of British settlers, attracted in recent years especially to the Lydenburg and other mining districts. All the rest are natives, belonging mainly to the Basuto and Bechuana branches of the Bantu family, and consequently allied in speech and to a large extent in physique to their Zulu-Kaffre neighbours. A considerable number of these natives have abandoned the tribal state and taken service, either freely or by compulsion, with the whites as farm labourers in the rural districts, and as domestic servants in the towns, and are now also largely employed in mining operations. The great bulk of the rest, who retain their national usages and recognize the authority of more or less independent tribal chiefs, are concentrated in the northern and eastern provinces of Zoutpansberg (364,000), Waterberg (174,000), and Lydenburg (123,000). There are also about 40,000 in Bloemhoff (extreme south-west), and the same number in the western provinces of Rustenburg and Marico, but only a few scattered groups in all the rest of the country. These western and south-western tribes (Barolongs, Batlapins, Bakwenas, Bakhatlas, &c.) are all Bechuanas; the others mainly Makatis, as the Basutos are here collectively called. It may be stated in a general way that the whole country south of the Lipalule is now free of native claims and open to European colonization, while the northern region between that river and the Limpopo is still to a large extent occupied by unreduced or unbroken Basuto communities.

Natural and Political Divisions.—Transvaal has been divided into three more or less distinct natural regions, determined chiefly by the relief of the land, and its climatic and economic conditions. These are—(1) the *Hooge veld*, or uplands, comprising the southern districts drained by the Vaal and the Drakenberg highlands as far north as the Lipalule, about 35,000 square miles altogether, with an altitude ranging from 4000 to 7000 feet; (2) the *Banken veld*, or terrace lands, comprising the low eastern zone between the Drakenberg and Libomba ranges, falling in many places down to a level of 2000 feet, with an area of 15,000 to 20,000 square miles; (3) the *Bosch veld*, or bush country, comprising all the rest of the land, with an altitude of 3000 to 4000 feet and an area of 60,000 square miles. For administrative purposes the country is again divided into thirteen provinces:—Zoutpansberg and Waterberg in the north; Lydenburg, Middelburg (formerly Nazareth), Pretoria, Rustenburg, and Marico in the centre; Utrecht, Loudina, Wakkerstroom, Heidelberg, Potchefstroom, and Bloemhoff in the south. In the southern part of Lydenburg lies the somewhat detached district of New Scotland, comprising some 500,000 acres selected by the late Mr M'Corkindale as a Scotch pastoral and agricultural settlement. It is a healthy prosperous country, lying on the slopes of the Drakenberg, within 310 miles of Durban, Natal. But the most thickly settled province is Potchefstroom, a fertile tract, 3500 to 5000 feet high, abundantly watered by the Mooi, Schoen, and other streams flowing to the Vaal, and well suited for tillage and pasturage. Its capital of like name (derived from elements in those of Potgieter, Scherf, and Stockenstroom, three popular Boer leaders during the early migrations) is the most settled and one of the largest towns in Transvaal. The only other places deserving the name of town are Pretoria, capital of the province of like name and of the state, occupying a somewhat central position 100 miles north-east of Potchefstroom, 980 from Cape Town, 820 from Port Elizabeth, and 400 from Durban; Barberton, in the Lower Kaap mining district, 150 miles by road from Delagoa Bay, only three years old, but already by far the largest place in the state, with a population (1887) of 15,000; and Johannesburg, centre of the goldfields of the same name, 30 miles south-east of Pretoria, and 72 east of Potchefstroom, founded in 1886, but already larger than Pretoria, with a population of over 4000.

Administration and Statistics.—Transvaal enjoys representative institutions, with a volksraad or parliament of forty-four members elected for four years, one-half retiring every two years, the executive being entrusted to a president elected for five years by the whole body of electors, assisted by a council of four, the *ex-officio* vice-president and the state secretary, with two others appointed by the volksraad. The revenue, derived chiefly from land sales, quit rents, stamps, hut-tax, and customs, balanced the expenditure in 1885, and exceeded it by £15,000 in 1886, the respective sums being £260,000 and £245,000. In 1884 the public debt was £396,000, the exports (gold, ivory, corn, wool, hides, cattle, ostrich feathers, &c.) about £600,000, and the imports probably over £1,000,000. The long-projected railway, intended to afford an outlet to the coast at Delagoa Bay, was completed in 1887 from Lorenzo Marques, the seaward terminus, to the Transvaal frontier, a distance of 60 miles. Transvaal is in telegraphic communication with the Cape and the rest of the world through the Orange Free State.

History.—The historic life of Transvaal begins with the "Great Trek," or general exodus of the Cape Colony Boers, who, being dissatisfied, especially with the liberal policy of the British Government towards the natives, removed northwards in large numbers between the years 1833 and 1837. By 1836 some thousands had already crossed the Vaal, that is, had reached the "Trans-Vaal" country, which at that time was mostly under the sway of the powerful refugee Zulu chief Moselekatze, whose principal kraal was at Mosega in the present Marico district on the west frontier. To avenge the massacre of some emigrant bands, the Boers under Maritz and Potgieter attacked and utterly defeated Moselekatze at this place in 1837. Next year the Zulu chief withdrew beyond the Limpopo, where he founded the present Matebele state between that river and the Zambesi, thus leaving the region between the Vaal and Limpopo virtually in the hands of the Trekkers. But their position was rendered insecure on the east side by the military despotism of the fierce Zulu chief Dingaan, who, after the murder of his brother Chaka, had asserted his authority over the whole of Zululand and most of the present Natal. The situation was rendered almost desperate by the complete rout and wholesale massacre (1838) of the right division of the emigrant Boers, who had ventured to cross the Buffalo under Pieter Retief, and who were defeated by Dingaan, first at Umkongloof ("Aceldama"), then at Weenen ("Weeping"), and again soon after under Uys, Maritz, and Potgieter, when as many as 800 fell before the irresistible onslaught of the disciplined Zulu warriors. At this critical juncture the Trekkers were saved from utter extermination by

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[1] On the route between the Orange and Vaal (1835–37) the "voor-trekkers" are said to have killed as many as 200 lions.

Andries Pretorius of Graaff Reinet, by whom Dingaan met with a first check before the close of 1838, followed in January 1840 by a still more crushing defeat. Dingaan having been soon after murdered, the friendly Panda was set up in his place, and Natal proclaimed a Boer republic. But the British occupation of that territory in 1843 induced the Boers to retire in two bands across the Drakenberg, the southern division settling in the present Orange Free State, the northern again passing into Transvaal. But, owing to internal dissensions, and the perpetual bickerings of the two most prominent personalities, Pretorius and Potgieter, all attempts at establishing an organized system of government throughout Transvaal ended in failure, till Pretorius induced the British Government to sign the Sand River convention (January 17, 1852), which virtually established the political independence of that region The death both of Pretorius and Potgieter in 1853 prepared the way for a period of internal peace under Pretorius's eldest son Marthinus Wessels Pretorius, first president of the "Dutch African Republic," whose title was afterwards altered (1858) to that of the "South African Republic." But a fatal element of weakness lay in the persistent refusal of the Boers to treat the natives on a footing of equality, or even with common justice. The murder of Hermann Potgieter and family (1854), avenged by Pretorius at Makapan's Cave, was followed (1856) by the "Apprentice Law," establishing a system of disguised slavery, which was further strengthened by the sanction (1858) of the *Grond wet*, or "Fundamental Law," declaring that the "people will admit of no equality of persons of colour with the white inhabitants either in state or church." Owing to this policy opposition was constantly shown both to the English traders, disposed to deal fairly with all, and to the missionaries, preachers of universal equality, as illustrated by the plunder of Livingstone's house by the commando sent against the native chief Secheli in 1852. A brief chronicle must here suffice of subsequent events down to the present time:—

1857. Invasion of the Orange Free State by Pretorius; dispute settled without bloodshed by the treaty of June 1.

1859. Pretorius elected president of the Free State; fails to effect the union of the two states.

1863. Return of Pretorius, during whose absence affairs had fallen into confusion; continued troubles with the natives; quarrels with the Batlapins, Barolongs, and Griquas in the west; in the east with Ketchywayo, king of Zululand, about the Boers' right to the Wakkerstroom and Utrecht districts.

1867. Discovery of diamonds, and Mauch's announcement of gold-fields in the interior.

1868. Pretorius's proclamation extending the boundaries of the state west to Lake Ngami, east to Delagoa Bay, whence disputes and negotiations with England and Portugal, Delagoa Bay being ultimately awarded (July 1875) to Portugal by the French president, Marshal MacMahon, to whose decision the matter had been referred.

1871. Boundary disputes towards the south-west settled by the award of Lieutenant-Governor Keate of Natal, leading to the resignation of Pretorius and appointment of President Burgers.

1875. The Fundamental Law forces Burgers to measures leading to the war with Sikokuni, chief of the Bapedi, south of the Olifant river, who claimed large part of Lydenburg and even of Pretoria; Burgers's visit to Europe in connexion with the Delagoa Railway scheme; on his return he finds everything in the greatest confusion; Boers dispirited by repeated reverses in the Sikokuni war; an empty treasury; broken credit; the state practically bankrupt and exposed to imminent danger of invasion by Bapedis and Zulus. Hence

1876–77. Intervention of England, and Sir Theophilus Shepstone's proclamation (April 12, 1877) annexing Transvaal, followed by the appointment of Sir W. Owen Lanyon as British administrator.

1880–81. Revolt of the discontented Boers, who, being successful in a few contests with British troops, induced the British Government to restore the republic under the "suzerainty" of the queen, by the treaty of peace of March 21, 1881, a British resident being appointed, with the functions of a consul-general.

1883. S. J. Paul Krüger elected president.

1884. Convention of London (February 27, ratified by the volksrand, August 8) recognizing the state as the South African Republic, and considerably restricting the British suzerainty.

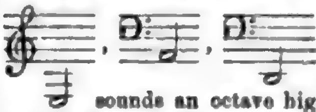
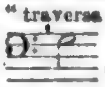
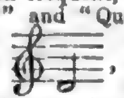
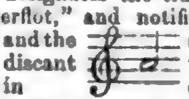
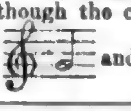
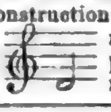
1885. Proclamation (March 23) of the British protectorate over Bechuanaland, thereby arresting the westward advance of the Boers into the Bamangwato, Bakwena, Bangwaketsi, and Barolong territories, and keeping open the great trade route from Cape Colony through Hopetown and Shoshong to the Zambesi.

1886. Fresh discoveries of rich auriferous deposits especially in the Middelburg province, followed by a great influx of English-speaking populations, threatening to swamp the Boer element.

1886. Projected South African confederation, opposed by Krüger, but supported by the Orange State, Cape Colony, and a majority of the Transvaal Boers. Connected with this scheme is the proposal of a uniform tariff and the immediate construction of a through railway from Cape Town to Delagoa Bay. (A. H. K.)

TRANSVERSE FLUTE, THE,—or GERMAN FLUTE, as it was formerly designated in Great Britain,—may be described as a musical instrument in which a column of air is set in vibration by regular pulsations derived from a current of air directed by the lips of the executant against the side of an orifice serving as an embouchure, pierced laterally in the substance of the pipe and towards its upper extremity. This mode of blowing appears to be of very ancient origin: the Hindus, Chinese, and Japanese claim to have used it from time immemorial; in Europe the high antiquity of a lateral embouchure is generally admitted, although it does not really rest, so far as our present knowledge goes, on any conclusive evidence.[1]

The oblique flute of the Greeks was of Egyptian origin, and it is therefore safest to suppose it to have been like the instrument frequently figured on the monuments of ancient Egypt, which, held obliquely, was blown through the orifice itself of the pipe at its upper extremity. The same instrument (called "nay") is still used in Mohammedan countries. The flute is often mentioned in mediæval poetry, but no details of its construction are given. It was the custom, moreover, to designate various instruments by this name. The oldest representation we know of the transverse flute is found in the 11th-century frescos of the cathedral of St Sophia at Kieff. Eustache Deschamps, a French poet of the 14th century, in one of his ballads, makes mention of the "flute traversaine," and we are justified in supposing that he refers to the transverse flute. It had certainly acquired some vogue in the 15th century, being figured in an engraving in Sebastian Virdung's celebrated work,[2] where it is called "Zwerchpfeiff," and, with the drums, it already constituted the principal element of the military music. Agricola[3] alludes to it as the "Querchpfeiff" or "Schweizerpfeiff," the latter designation dating, it is said, from the battle of Marignan (1515), when the Swiss troops used it for the first time in war.

From Agricola onwards transverse flutes formed a complete family, said to comprise the discant, the alto and tenor, and the bass,—  respectively. There is evidently an error in the indications of pitch here given, for the instruments must in fact have produced sounds an octave higher than those noted. Prætorius,[4] who in a special note warns his readers against inaccuracies of this kind which were then frequent, designates the transverse flute as "traversa Querpfeiff" and "Querflot," and notifies the bass in , the tenor and alto in , and the discant in  as varieties then in use. A flute concert at that time included two discants, four altos or tenors, and two basses. The same author distinguishes between the "Traversa" and the "Schweizerpfeiff" (which he also calls "Feldpfeiff," *i.e.*, military flute), although the construction was the same. There were two kinds of "Feldpfeiff," in  and  respectively; they were employed exclusively with the military drum.[5]

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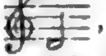
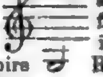
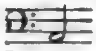
[1] The Louvre has two ancient statues (from the Villa Borghese) representing satyrs playing upon transverse flutes. Unfortunately those marbles have been restored, especially in the details affecting our present subject, and are therefore examples of no value to us. Another statue representing a flute-player occurs in the British Museum. The instrument has been supposed to be a transverse flute, but erroneously, for the insufflation of the lateral tube against which the instrumentalist presses his lips, could not, without the intervention of a reed, excite the vibratory movement of the column of air.

[2] *Musica getutscht und ausgezogen*, Basel, 1511.

[3] *Musica Instrumentalis*, Wittenberg, 1529

[4] *Organographia*, Wolfenbüttel, 1618.

[5] It is from the word *Pfeiff* that the French *Fifre* and the English *Fife*, still applied to the military flutes in present use, are evidently derived.

Mersenne's[1] account of the transverse flute, then designated "flûte d'allemand" or "flûte allemande" in France, is obscure enough; but the tablatures and an "Air de Cour" for four flutes in his work lead us to believe that there were then in use in France the soprano flute in , the tenor or alto flute in  and the bass flute descending to . The Museum of the Conservatoire Royal of Brussels possesses specimens of all varieties hitherto mentioned except the last. All of them are laterally pierced with six finger holes;[2] they have a cylindrical bore, and are fashioned out of a single piece of wood. Their compass consists of two octaves and a fifth. The successive opening of the lateral holes gives rise to a series of fundamental notes forming the first octave. By a stronger pressure of the breath these notes are reproduced in the next octave higher, and the extent of compass of the instrument is completed in the higher region by the production of other harmonics.[3]

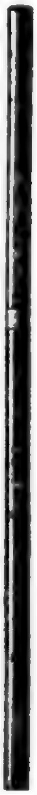


Fig. 1.

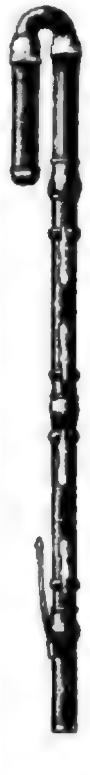
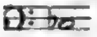
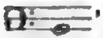
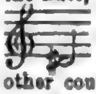
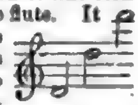


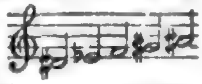
Fig. 2.

The largest bass flute in the Brussels museum is in  at the French normal pitch A 435 double vibrations per second. It measures 0·95 m. from the centre of the blow orifice to the lower extremity of the tube. The disposition of the lateral holes is such that it is impossible to cover them with the fingers if the flute is held in the ordinary way. The instrument must be placed against the mouth in an almost vertical direction, inclining the extremity of the tube either to the right or the left. This inconvenient position makes it necessary that the instrument should be divided into two parts, enabling the player to turn the head joint that the embouchure may be most commodiously approached by the lips, which is not at all easy. The first and fourth of the six lateral holes are double, but those holes are stopped up with wax which have become useless through the player's habit of using the fingers of the right or left hand to cover the higher three holes. The bass flute shown in fig. 1 is the facsimile of an instrument in the Museo Civico of Verona. The original, unfortunately no longer fit for use, is nevertheless sufficiently well preserved to allow of all its proportionate measurements being given. The lowest note, E♭, is obtained with a remarkable amplitude of sound, thus upsetting a very prevalent opinion that it is impossible to produce by lateral insufflation sounds which go a little lower than the ordinary limit downwards of the modern orchestral flute.[4]

The bass flute cited by Mersenne should not differ much from that of the Museo Civico at Verona. We suppose it to have been in , and that it was furnished with an open key like that which was applied to the recorders (*flûtes douces*) of the same epoch, the function of the key being to augment by another note the compass of the instrument in the lower part. Following Quantz,[5] it was in France and about the middle of the 17th century that the first modifications were introduced in the manufacture of the flute. The improvements at this period consisted of the abandonment of the cylindrical bore in favour of a conical one, with the wide part in the head of the instrument. At the same time the flute was made of three separate pieces called head, body, and foot, which were ultimately further subdivided. The body or middle joint was divided into two pieces, so that the instrument could be tuned to the different pitches then in use by a replacement with longer or shorter pieces. It was probably about 1677, when Lully introduced the German flute into the opera, that recourse was had for the first time to keys, and that the key of D♯ was applied to the lower part of the instrument.[6] The engraving of B. Picart, dated 1707, which ornaments the work of the French flautist Hotteterre-le-Romain,[7] represents the flute as having reached the stage of improvement of which we have just spoken, but the body was still formed of one piece only. In 1726 Quantz,[8] finding himself in Paris, had a second key applied to the flute, placed nearly at the same height as the first, that of the , intended to differentiate the D♯ and the E♭. This innovation was generally well received in Germany, but does not appear to have met with corresponding success in other countries. In France and England manufacturers adopted it but rarely; in Italy it was declared useless.[9] About the same time flutes were constructed with the lower extremity lengthened and furnished with two supplementary keys to produce the C♯ and C. This innovation, spoken of by Quantz, did not meet with a very favourable reception, and was shortly afterwards abandoned. Passing mention may be made of the drawing of a flute with a C key in the *Music-Saal* of J. F. B. Mayers, Nuremberg, 1741.

The tuning of the instrument to different pitches was effected, as already explained, by changes in the length, and notably by substituting a longer or shorter upper piece in the middle joint. So wide were the differences in the pitches then in use that seven such pieces for the upper portion of it were deemed necessary. The relative proportions between the different parts of the instrument being altered by these modifications in the length, it was conceived that the just relation could be re-established by dividing the foot into two pieces, below the key. These two pieces were adjusted by means of a tenon, and it was asserted that, in this way, the foot could be lengthened proportionately to the length of the middle joint. Flutes thus improved took the name of "flûtes à registre." The register system was, about 1752, applied by Quantz to the head joint, and, the embouchure section being thus capable of elongation, it was allowable to the performer, according to the opinion of this professor, to lower the pitch of the flute a semitone, without having recourse to other lengthening pieces, and without disturbing the accuracy of intonation.

The upper extremity of the flute, beyond the embouchure orifice, is closed by means of a cork stopper. On the position of this cork depends, in a great measure, the accurate tuning of the flute. It is in its right place when the accompanying octaves are true.  Quantz, in speaking of this accessory, mentions the use of a nut-screw to give the required position to the cork. He does not name the inventor of this appliance, but, according to Tromlitz,[10] the improvement was due to Quantz himself. The invention goes back to 1726.

When the *Method* of Quantz appeared there were still in use, besides the orchestral flute in D, the little fourth flute in G, the low fourth flute in A, and the flûte d'amour a note higher; in France they had, moreover, the little octave flute in D (octave). A bass flute in D had also been attempted (see fig. 2). When Ribocq published his *Bemerkungen über die Flöte*[11] the flute had already the five keys here shown.  This author does not cite the inventor of these new keys, but some claim them for Kusder, a musical-instrument maker in London, others for Johann George Tromlitz of Leipsic, and Ribocq declares he has seen no flutes so constructed other than by these two makers. But Tromlitz lays no claim for himself to the credit of this improvement. He only says that "he had occupied himself for several years in applying these keys so as not to augment the difficulty of playing, but, on the contrary, to render the handling of them as easy as possible."[12] We may therefore regard the London maker as the author of the first flute with five keys, with, however, a reservation as to the G♯ key, which, from 1727, had been applied by Hoffmann of Rastenberg[13] to the transverse flute and the oboe. The higher key of C♮, adopted from 1786 by Tromlitz, we believe to have been first recommended by Ribocq (1782).

In 1785 Richard Potter, of London, improved Quantz's slide applied to the head joint as well as to the register of the foot by a double system of tubes forming double sliding air-tight joints. In the document[14] describing this improvement Potter patented the idea of clothing the holes which were covered by keys formed by metal conical valves. The keys mentioned in the patent were four,—D♯, F, G♯, A♯. The idea of extending the compass of the flute downwards was taken up again about the same time by two players of the flute in London named Tacet and Florio. They devised a new disposition of the keys C and C♯, and confided the execution of their invention to Potter. In Dr Arnold's *New Instructions for the German Flute* occurs a tablature, the engraving of which goes back to the end of the 18th century, and bears the following title, "A Complete Drawing and Concise Scale and Description of Tacet and Florio's new invented German Flute, with all the additional keys explained." It explains the use of six keys,—C, C♯, D♯, F, G♯, A♯—that are not always figured, because the employment of so many keys was at once admitted. Tromlitz himself, who, however, made flutes with nine keys,—adding E♭, another F, and C♮, declared that he was not in favour of so great a complication, and that he preferred the flute with only two keys, D♯ and E♭, with a register foot joint and a cork nut-screw at the head joint. This instrument met all requirements. He was even against the use of the keys for C♮ and C♯, because they altered the recognized quality of tone of the instrument. When Tromlitz published his method, the family of flutes had become modified. It comprehended only the typical flute in D, the flûte d'amour a minor third lower, a "third" flute a minor third higher, and, finally, the little octave flute.

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[1] *Harmonie Universelle*, Paris, 1636.

[2] It is usual to indicate the tonality of flutes by the note produced when the six lateral holes are covered by the fingers. This custom is objectionable, because it is the disposition of the fingers which is made use of to sound D. The practice has for its result that the tonality is always a note lower than the signature used. Thus the flute in D is really in C; that in F in E♭, &c.

[3] Victor Mahillon, *Hints on the Fingering of the Boehm Flute*, London, 1884.

[4] Fétis, *Rapport sur la Fabrication des Instruments de Musique à l'Exposition Universelle de Paris, en 1855.*

[5] *Versuch einer Anweisung die Flöte traversière zu spielen*, Berlin, 1752.

[6] Unless where the contrary is stated, we have always in view, in describing the successive improvements of the flute, the treble flute in D, which is considered to be typical of the family.

[7] *Principes de la Flûte Traversière.*

[8] "Herrn Johann Joachim Quantzens Lebenslauf, von ihm selbst entworfen," in the *Historisch-Kritische Beiträge zur Aufnahme der Musik*, by Marpurg, Berlin, 1754. Quantz was professor of the flute to Frederick the Great.

[9] Antonio Lorenzoni, *Saggio per ben sonare il flauto traverso*, Vicenza, 1779.

[10] *Ausführlicher und gründlicher Unterricht die Flöte zu spielen*, Leipzic, 1791. Compare Schilling, *Univ.-Lexicon*, Leipzic, 1835.

[11] Stendal, 1782.

[12] *Kurze Abhandlung vom Flötenspielen*, Leipzic, 1786.

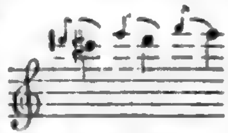
[13] Gerber, *Lexicon der Tonkünstler*, Leipzic, 1790.

[14] English patent, No. 1499.

While Tromlitz was struggling in Germany with the idea of augmenting the compass of the flute downwards by employing open keys for C♮ and C♯, an Italian, Giovanni Batista Orazi,[1] increased the scale of the instrument downwards by the application of five new keys, viz., B, B♭, A, A♭, and G. At the same time that he produced this invention[2] he conceived the plugging of the lateral holes by the valve keys then recently invented by Potter. But it was hardly possible to obtain a perfect plugging of seven lateral holes with the aid of as many keys, for the control of which there were only the two little fingers, and therefore this invention of Orazi proved a failure.

In 1808 Frederick Nolan,[3] of Stratford, near London, conceived an open key, the lever of which, terminating by a ring, permitted the closing of a lateral hole at the same time the key was being acted upon. The combination in this double action is the embryo of the mechanism that a little later was to transform the system of the flute. Two years later Macgregor,[4] a musical-instrument maker in London, constructed a bass flute an octave lower than the ordinary flute. The idea was not new, as is proved by the existence of the bass flute mentioned above. The difference between the two instruments lies in the mechanism of the keys. That employed by Macgregor consisted of a double lever, a contrivance dating from before the middle of the 18th century, of which the application is seen in an oboe of large dimensions preserved in the National Museum at Munich.[5]

About 1830 the celebrated French flautist Tulou added two more keys, those of F♯ and C♯, and a key, called "de cadence," to facilitate the accompanying shakes.



To increase the number of keys, to improve their system of plugging, and to extend the scale of the instrument in the lower region, —these had hitherto been the principal problems dealt with in the improvement of the flute. No maker, no inventor whose labours we have called attention to, had as yet devoted his attention to the rational division of the column of air by means of the lateral holes. In 1831 Theobald Boehm, a Bavarian, happening to be in London, was struck with the power of tone the celebrated English performer Charles Nicholson drew from his instrument. Boehm learned, and not without astonishment, that his English colleague obtained this result by giving the lateral holes a much greater diameter than was then usually admitted. About the same time Boehm made the acquaintance of an amateur player named Gordon, who had effected certain improvements; he had bored the lateral hole for the lower E, and had covered it with a key, while he had replaced the key for F with a ring. These innovations set Boehm about attempting a complete reform of the instrument.[6] He went resolutely to work, and during the year 1832 he produced the new flute which bears his name. This instrument is distinguished by a new mechanism of keys, as well as by larger holes disposed along the tube in geometrical progression.

Boehm's system had preserved the key of G♯ open; Coche,[7] a professor in the Paris Conservatoire, assisted by Auguste Buffet the younger, a musical-instrument maker in that city, modified Boehm's flute by closing the G♯ with a key, wishing thus to render the new fingering more conformable to the old. He thus added a key, facilitating the shake upon C♯ with D♯, and brought about some other changes in the instrument of less importance.

Boehm had not, however, altered the bore of the flute, which had been conical from the end of the 17th century. In 1846, however, he made further experiments, and the results obtained were put in practice by the construction of a new instrument, of which the body was bored cylindrical, but the head was modified at the embouchure. The inventor thus obtained a remarkable equality in the tones of the lower octave, a greater sonorousness, and a perfect accuracy of intonation, by establishing the more exact proportions which a column of air of cylindrical form permitted.

The priority of Boehm's invention was long contested, his detractors maintaining that the honour of having reconstructed the flute was due to Gordon. But an impartial investigation vindicates the claim of the former to the invention of the large lateral holes.[8] His greatest title to fame is the invention of the mechanism which allows the production of the eleven chromatic semitones intermediate between the fundamental note and its first harmonic by means of eleven holes so disposed that in opening them successively they shorten the column of air in exact proportional quantities.[9] Boehm[10] has published a diagram or scheme to be adopted in determining the position of the note-holes of wind instruments for every given pitch. This diagram gives the position of the intermediate holes which he had been enabled to establish by a rule of proportion based on the law of the lengths of strings.

The Boehm flute, notwithstanding the high degree of perfection it has reached, has not secured unanimous favour; even now there are players who prefer the ordinary flute. The change of fingering required for some notes, the great delicacy and liability to derangement of the mechanism, have something to do with this. In England especially, the ordinary flute retains many partisans, thanks to the improvements introduced by a clever player, Abel Siccama, in 1845.[11] He bored the lateral holes of E and A lower, and covered them with open keys. He added some keys, and made a better disposition of the other lateral holes, of which he increased the diameter, producing thus a sonorousness almost equal to that of the Boehm flute, while yet preserving the old fingering for the notes of the first two octaves. But in spite of these improvements the old flute will not bear an impartial comparison with that of Boehm. (V. M.)

TRANSYLVANIA (Germ. *Siebenbürgen*), a mountainous principality (Gross-Fürstenthum) forming the extreme eastern portion of Austria-Hungary, is bounded on the W. and N. by Hungary proper, on the E. by Bukowina and Moldavia, and on the S. by Walachia. The German name is usually derived from the seven principal fortified towns or "burgs" founded by the German colonists, though some authorities prefer to connect it with the Zibin Mountains on the south frontier. The Latin name appears first after the 12th century, and signifies "beyond the woods," *i.e.*, from Hungary; the Magyar and Roumanian names (Erdély and Ardealu) both mean "forest-land." For all political and administrative ends, and in the official statistics and returns, Transylvania is now wholly incorporated with HUNGARY (*q.v.*), and to all intents and purposes is a part of that kingdom. The principality has the form of an irregular circle, with an area of about 21,000 square miles, and is on all sides surrounded by mountain chains, while the interior is barred and striped with lower ranges. On the west or Hungarian side there are various wide and comparatively easy passes into the interior, but on the east and south frontiers the lofty bounding mountains present steep and rugged faces outwards, giving to Transylvania the general aspect of a huge natural fortress. These mountains are a continuation of the Hungarian and Galician Carpathians; in fact, the mountains of Transylvania may be regarded together as forming the south-eastern main group of the Carpathian system. The loftiest and most rugged peaks are on the north and south boundaries. On the north the highest summit is the Pietross (7534 feet), one of the Rodna Alps; on the south are the Butshetsh (8262 feet), the Königstein (7357 feet), and the Negoi (8340 feet). The east is bounded by several parallel chains, the highest peak in which is the Pietrossul (6910 feet); and on the west border the greatest height is attained towards the south, where several peaks reach 7200 feet. On the west are the Transylvanian Ore Mountains (Erzgebirge), with the curious Detunata ("thunder-smit"), and the Bihar group, with its numerous caverns. There are numerous valleys, ravines, and canons in the network of mountains covering the interior of the country, but it is only along the courses of the principal rivers that plains of any size are found. The chief rivers are the Aluta or Alt, which flows south, pierces the southern boundary mountains at the Rother Thurm Pass, and joins the Danube, and the Maros, to the west, and the Szamos, to the north, both tributaries of the Theiss, which also falls into the Danube. All these are navigable, and are fed by various tributaries. The largest lake is the Hodoser or Eseger See, 13 miles long. Transylvania abounds in mineral springs of all kinds, especially saline and chalybeate. The climate is tolerably severe: hot summers alternate with very cold winters; but the rainfall is not great.

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[1] *Saggio per costruire e suonare un flauto traverso enarmonico che ha i suoni bassi del Violino*, Rome, 1797.

[2] The idea of this large flute was taken up again in 1819 by Trexler of Vienna, who called it the "panaulon." [3] Patent, No. 3163. [4] Patent, No. 3349.

[5] Another specimen, almost the same, constructed about 1775, and called "Basse de Musette," may be seen in the Museum of the Paris Conservatoire.

[6] See *Ueber den Flötenbau und die neuesten Verbesserungen desselben*, Mainz, 1847; and W. S. Broadwood, *An Essay on the Construction of Flutes originally written by Theobald Boehm, published with the addition of Correspondence and other Documents*, London, 1882.

[7] *Examen critique de la Flûte Ordinaire comparée à la Flûte Boehm*, Paris, 1838.

[8] They existed long before, however, in the Chinese *Ty* and the Japanese *Fuye*.

[9] The reader may consult with advantage Mr C. Welch's *History of the Boehm Flute* (London, 1883), wherein all the documents relating to this interesting discussion have been collected with great impartiality.

[10] See the *Essay on the Construction of Flutes*, already cited.

[11] Patent, No. 10363.

The mineral wealth of Transylvania is very considerable. Gold is found in certain quantity in mines, and it is also "washed" in some of the streams, chiefly by Gipsies. The gold is often found in conjunction with tellurium (first discovered in Transylvania in 1782, and until the present century not found anywhere else, see TELLURIUM). Silver, copper, lead, and iron are also worked to some profit. Coal occurs in considerable abundance, and it is mined in the Schilthal, but the superabundance of timber has retarded its exploitation. Hills largely formed of pure salt are met with here and there, and there are also very rich subterranean deposits of salt, sometimes cropping up on the surface. Some of the saline springs also yield salt enough to render their evaporation profitable. The vegetation of Transylvania is luxuriant, except of course in the higher mountain zones. Fruits abound, as apples, pears, peaches, apricots, plums, cherries, chestnuts, and almonds; mulberries are also cultivated. The vine flourishes best in the valley of the Maros. Agriculture is one of the most important industries, though the available good land is by no means fully taken up. The chief crop is maize; but wheat, rye, and other grains, potatoes, saffron, hemp, flax, and tobacco are also grown. Extensive forests clothe much of the country, but are in a somewhat neglected condition. On the boundary mountains the trees are mainly coniferous; in the interior oaks, elms, beeches, and ashes are conspicuous.

The forests afford cover for many wild animals. Bears, wolves, foxes, boars, and various varieties of game are found, and on some of the mountains the chamois. There is abundant pasturage on which excellent cattle are reared; and in some districts buffaloes are bred for draught purposes. More important is the breeding of a sturdy race of horses, thousands of which are annually exported. The mountains maintain very large flocks of sheep, of which two kinds are distinguished—with a fine short-stapled and a coarse long-stapled wool respectively. Silkworms are bred, and some silk is spun; and the export of honey and wax, from both wild and domestic bees, is not inconsiderable. Neither the means of communication with the external world nor the manufacturing industry in Transylvania is developed to any important extent; the latter, indeed, has to a certain extent gone back. The most industrious and in general the most advanced of the population are the "Saxons"; and trade, the great bulk of which is with Roumania, is mainly in the hands of Armenians and Greeks. The chief commercial centres and principal towns are Herrmannstadt, Kronstadt, Bistritz, and Szamos-Ujvar.

Perhaps the most interesting point in connexion with Transylvania is the variety of its population, which in 1880 numbered 2,084,048 in all. Until 1848 the chief influence and privileges, as well as the only political rights, were divided among the three "privileged nations" of the Hungarians, Szeklers, and Saxons. The first are the descendants of the Magyar conquerors. The Szeklers, *i.e.*, "guardians," chiefly on the east borders, settled in eastern Transylvania to act as guardians of the frontiers. The Saxons are the posterity of the German immigrants brought by King Geisa II. (1141–1161) from Flanders and the lower Rhine to cultivate and repeople his desolated territories. At first these were known as Teutones, Teutonici Hospites, and Flandrenses, but since the beginning of the 13th century the general name of "Saxons," as tantamount to "Germans," has prevailed (*cf.* SAXONY, vol. xxi. p. 351). The Hungarians and Szeklers together number 609,208, and the Saxons 204,713, but by far the most numerous element, though long excluded from power and political equality, is formed by the Walachians or Roumanians, 1,146,611 in number, a mixed race, not entitled to the descent which they claim from the early Roman colonists of Dacia. The Gipsies of Transylvania, who are heard of under a voivode or prince of their own in 1417, are estimated at 46,460; many of them have abandoned a nomadic life and have taken to agriculture or gold-washing. Jews, Armenians, Bulgarians, Ruthenians, and Greeks are also represented in the medley of peoples. About 70,000 (chiefly children) are returned, unclassed, as "not able to speak." The Magyars are mostly Roman Catholics or Unitarians, the Germans Protestants, and the Roumanians adherents of the Greek Church.

Transylvania formed part of the Roman province of Dacia. After the withdrawal of the Romans the country became for centuries the prey of the various peoples who swept across it in their restless migrations. At the beginning of the 11th century (1004) Stephen I. of Hungary made himself master of the land, which was thenceforward governed as an Hungarian province by a voivode. In 1538 the voivode, John Zapolya, succeeded in rendering himself independent, and he and his successors, who were generally elected by the people, were supported by the Turks against the house of Austria, while the difficult nature of their country preserved them on the other hand from becoming too dependent on their powerful allies. After the defeat of the Turks at Vienna in 1683, their influence in Transylvania waned, and in 1699, by the peace of Carlowitz, the Porte acknowledged the suzerainty of Leopold I. of Austria over Transylvania. By the Leopoldine diploma of 1691 Leopold had guaranteed the ancient rights and laws of the land, and united it formally with the Hungarian crown. In 1765 Maria Theresa made it a grand principality (Gross-Fürstenthum). The efforts of the Roumanian inhabitants to secure recognition as a fourth "nation," and the opposition of the non-Magyar population to a closer union with Hungary, led to troubles and disagreement early in the 19th century, culminating in bloody internecine struggles in 1848. In 1849 Transylvania was divided from Hungary by an imperial decree, and became an Austrian crown-land; but in 1860 the old order was renewed, and the complete incorporation with Hungary was perfected in 1868. Since that time the policy of the Hungarian party has on the whole prevailed, and the Magyarization of the principality is steadily being carried through, in spite of the bitter protests and discontent of both the Saxons and Roumanians. An Hungarian university was founded at Klausenburg in 1872; and Hungarian is recognized as the official language. (F. MU.)

TRAPANI, a seaport of Italy, capital of the province of Trapani, and an episcopal see, lies on the extreme north-west coast of Sicily, 19 miles to the north-north-east of Marsala and 4 miles to the west-south-west of Monte St Giuliano. It lies on a sandy peninsula resembling a sickle (whence the name, from δρέπανον), projecting westward and concave towards the north. It is a place of considerable enterprise; the streets are, comparatively speaking, regularly built and well kept; and the population are above the average in industry and intelligence. The town is still surrounded by a wall with bastions. Some of the mediæval houses are interesting architecturally, but none of the public buildings require special notice. Among the institutions of Trapani may be mentioned the lyceum (with natural history collection and picture gallery), the gymnasium, the technical and navigation schools, and the library. Some of the churches contain choice works of art. The industries of the place include linen manufacture and works in coral, wood, iron, marble, alabaster, mother-of-pearl; there are also extensive salt lagoons in the immediate neighbourhood, and there is considerable traffic in salt, soda, sulphur, and grain. The harbour, on the south-west side of the sickle, is sheltered by a mole and protected by a fort in the islet of Columbara; it has a lighthouse at the entrance, and is accessible to vessels of about 400 tons. The population in 1881 was 32,020.

Trapani, the ancient *Drepanum* or *Drepana*, was the seaport of Eryx (see ERYX and MONTE SAN GIULIANO), and is represented by Virgil as the scene of the death of Anchises, and of the funeral games celebrated in his honour. Towards the beginning of the First Punic War (*c.* 260 B.C.) it was made a fortress by Hamilcar Barca, who removed hither the greater number of the inhabitants of Eryx, the remainder being transferred in 249. It fell into the hands of the Romans at the end of the war, and does not figure again in ancient history. It appears, however, to have continued to flourish as a commercial town, being mentioned both by Cicero and by Pliny. In the Middle Ages it became a royal residence.

TRAPPISTS. The abbey of Notre Dame de la Maison-Dieu de la Trappe was founded in 1140 by Rotrou, count of Perche, at Soligny-la-Trappe, a village of Haut-Perche, now in the arrondissement of Mortagne, department of the Orne, so named from the narrow gorge which forms its entrance, comparable to a trap-door. It was at first attached to the congregation of Savigny, a minor offshoot of the order of Fontevrault, but that congregation was united in 1148 to the Cistercian order, and, by the special intervention of St Bernard, was affiliated, with all its dependencies, to his own abbey of Clairvaux. No mediæval monastic order fell more rapidly and signally from the spirit of its original institute than the

Cistercian, and La Trappe formed no exception to the general decay. Indeed, its geographical position in a district fiercely contested during the long war between France and England hastened its declension, for it was several times taken and pillaged, while the members of the community, at last compelled to break up and disperse, returned at the close of the war with their traditions interrupted, their discipline relaxed, and their moral tone deteriorated. Nor was this the worst. The introduction of the "commendam" system into the French Church, whereby secular ecclesiastics were empowered to hold monastic benefices without residence or conformity to the rule of the society in which they ranked as heads, wrought yet further mischief; and, though the Trappists at first endeavoured to resist Jean du Bellay, the celebrated bishop of Paris (afterwards cardinal-bishop of Ostia), whom Francis I. nominated in 1526 as abbot commendatory, and were upheld by the pope in continuing to elect their own abbots, yet their efforts were fruitless, and Du Bellay was succeeded by a series of titular abbots, under whose nominal rule the estates of the abbey were impoverished, the buildings suffered to fall into nearly total ruin, and the conduct of the monks became a public scandal. In fact, the community was broken up, the dismantled monastic buildings were abandoned to a few domestics and their families, and the scattered Trappists seldom reassembled save for hunting parties and similar amusements. Such was the condition of things when a reformer arose in the person of one of those very abbots commendatory who had been the ruin of the institute.

Armand Jean Bouthillier de Rancé, second son of Denis Bouthillier de Rancé and Charlotte Joly his wife, was born in Paris on January 9, 1626. By his father's side he was sprung from a patrician family of Breton origin long settled in Normandy; by his mother's he was connected with powerful members of the official hierarchy. His near kindred were wealthy, titled, and highly placed in the magistracy, the army, and the dignities of the church; while the fact that Cardinal Richelieu was one of his sponsors and gave him his own fore-names sufficiently attests the political influence just then at their disposal. The child showed early tokens of considerable abilities, and was intrusted by his father to accomplished tutors, under whom he made rapid progress. He was originally intended to enter the order of the Knights of Malta, but the death of his elder brother in 1637, after a long illness, changed his father's plans, and the child (who had been tonsured in 1635 by way of precaution against such a contingency) was at once put in possession of the various benefices which had been secured for his elder; so that, while still under eleven years of age, he was canon of Notre Dame de Paris, abbot of La Trappe, of Notre Dame du Val, and of St Symphorian of Beauvais, and prior of Boulogne, near Chambord, and of St Clementin, in Poitou. In 1642 he was sent to the Collége d'Harcourt, where he began the usual course of philosophy, but addicted himself almost at once to the then popular study of judicial astrology, which he soon forsook for the cognate delusion of alchemy. Nevertheless, he distinguished himself in the more accredited studies of the college, and graduated as M.A. in 1644. It was then usual for Parisian students in theology to attend the course of lectures delivered at the Sorbonne, but De Rancé preferred to return home and pursue his theological studies under private instruction. He was ordained deacon in 1648, and, being in the heyday of youth, with high spirits and popular manners, fell readily into the dissipations of the time, leading a very irregular life, yet not so as to forfeit the goodwill of even his stricter acquaintance. He was ordained priest in 1651, but made no alteration in his habits, and yet so far kept up his studies that, when examined in 1652 for his licence as bachelor in theology, he came out at the head of the candidates, while the famous Bossuet ranked only as third. In 1653 he lost his father, who bequeathed property to him which doubled his already large income, and in 1654 he graduated as doctor of divinity, when his uncle, the archbishop of Tours, made him one of his archdeacons, hinting that this preferment would be merely the preliminary of a mitre. He never so much as pretended to discharge the duties of his new office, but spent his time amusing himself at his chateau of Véretz; in despite of which his uncle nominated him as deputy from the diocese of Tours to the general assembly of the French clergy convoked by the king in 1655 to discuss the Jansenist controversy. The chief matter of interest in this connexion is that he was one of the minority of 65 doctors of the Sorbonne who refused to vote, with the majority of 127, a censure upon the Jansenist leader Arnauld, though he took part later against that school. The sudden death of the duchess of Rohan-Montbazon, with whom he was intimate, and whose relations with him were the subject of much hostile comment, is said to have been the first great shock which began the process of change in his views of life and duty. A story, which was first given currency in an anonymous account of his conversion published at Cologne in 1668, much heightens this by alleging that De Rancé arrived at the duchess's house unaware of her death, and went direct to her apartment without being warned by the servants, only to find her head lying apart from her decapitated body, having been cut off because the coffin was too short and there was no time to procure another. The truth of this story (itself containing several improbable incidents) was promptly denied by Maupeou, the earliest of De Rancé's biographers, and has been rejected by Bayle and St Simon, though accepted by La Harpe and Voltaire. What is certain is that the alteration in his habits nearly synchronizes with the death of Madame de Montbazon, and that the years 1657, 1658, and 1659 were mainly spent in solitary studies or in visits to the monasteries of which he was titular head, varied by conferences with eminent ecclesiastics whose advice he sought, while in 1660 the death of the duke of Orleans, whose chief almoner he was, appears to have given the final direction to his thoughts, though it was not for some years that he carried out his new plans to the full. His first resolution was to sell his patrimony and resign his benefices, and in 1662 he actually sold his chateau of Véretz, made over two mansions in Paris to the hôtel-dieu, and obtained permission to transfer all his abbeys except Boulogne and La Trappe to resident heads chosen by himself. His canonry of Notre Dame had been resigned so far back as 1653 because of some difficulty about residence. After making provision for family claims, and retaining a comparatively small sum for the repair of Boulogne and La Trappe, he distributed the remainder of his property to the poor. In 1662 he visited La Trappe, which he found in a deplorable condition, and the few resident monks so indisposed to listen to his projects of reform that they threatened to murder him and throw his body into the abbey ponds. In his turn he threatened them with the king's direct interference, and such was the terror of Louis XIV.'s name that they at once submitted, and consented to retire upon the payment of a moderate pension; whereupon De Rancé filled their places in 1663 with monks of the strict Cistercian observance, and carefully repaired the monastic buildings there and at Boulogne. In that same year he finally decided to enter the monastic life, and began his noviciate at the Cistercian abbey of Perseigne in Maine, assuming, on his profession in 1664, the actual headship of the abbey of La Trappe, whose nominal abbot he had been for nearly thirty years. Associating himself with other personages who desired to revive the Cistercian discipline, he made two journeys to Rome to obtain papal sanction for their plans, and after considerable delay a brief was procured from Alexander VII. authorizing the abbot of Citeaux, as general of the Cistercians, to hold a grand chapter of the order to discuss the proposed reforms, which actually did meet in 1667. But De Rancé's ideas went much beyond the mere re-establishment of the strict observance; and, though he judged some details of the original rule unsuited to his own day, and blended with it some particulars borrowed from the Benedictine rule, yet he was so far from diminishing its general austerity that he added to the protracted fasts, the total abstinence from flesh-meat, fish, eggs, and wine, the laborious manual occupations, the hard beds, and the severe asceticism, even in the church services, which made part of the original rule, also the obligation of perpetual silence, save at prayers (to which eleven hours daily are devoted), and save also the "Memento mori" with which the Trappists greet each other on first meeting, which is the distinguishing feature of La Trappe, a rule from which none are dispensed save the abbot and the guest-master, as obliged to hold some degree of intercourse with outsiders; and he further ordained that each monk should spend some time each evening digging his own grave, and should sleep on straw in his coffin for a bed. These austerities, though cheerfully embraced by the monks of La Trappe, and attracting enthusiasts from without, were far from being approved generally, even in the Cistercian order itself, and, when a decree was issued by the council of state in 1675 giving the abbot of Citeaux absolute authority over all Cistercians of the strict observance, De Rancé took alarm, and, thinking it possible that an attempt might be made to mitigate the severities he had introduced (particularly as the mortality amongst the members of his society had been very large, and was currently attributed to insufficient nutriment), induced them to renew their vows and to pledge themselves against the admission of any relaxations. Nor was he content with opposing this kind of resistance to the bishops, abbots, and others who remonstrated with him upon the subject, but he also took up his pen in defence of his views, and published in 1683 his treatise *De la Sainteté et des Devoirs de la Vie Monastique*, which involved him in much controversy, notably with the learned Benedictine Mabillon, who replied to him in his well-known work *Traité des Études Monastiques*, published in 1691. Advancing years and unremitting asceticism told even on the strong constitution of De Rancé, and he found himself unable to take his share of the manual labours of the house, or even to be present in chapter, so that in 1695 he felt obliged to resign the abbacy, and procured the nomination of the prior Zosimus to succeed him, but he died before the arrival of the bulls for his installation, and Dom Francis-Armand was substituted in his room, and inducted into office in 1696. He proved a failure as a ruler, and La Trappe broke up into two factions during his headship, some holding to him and others to De Rancé, till the new abbot resigned in a fit of disgust of which he soon repented, but could not succeed in recalling his abdication. Dom Jacques de la Tour, a man in sympathy with De Rancé, was then nominated by the crown, and while he was still abbot De Rancé died, on October 20, 1700, in the seventy-fifth year of his age.

De Rancé was a tolerably copious author, though most of his writings were little more than occasional pamphlets suggested by the controversies in which he was engaged, short devotional treatises, and notices of deceased members of his community, but his reputation for ability and scholarship was never contested. He was a successful administrator, and, though the extreme severity of his institute resulted in the failure of fully six-sevenths of the postulants who presented themselves, he gathered round him during his government of the abbey no fewer than three hundred ascetics, French, Belgians, Germans, Italians, and Irishmen, one-third of whom were drawn from less austere communities or from the ranks of the parochial clergy and candidates for the priesthood. Of lay outsiders who joined him, the largest proportion consisted of rural artisans and labourers, and of soldiers, from officer to private (a class for which La Trappe has always continued to have attractions), with a small sprinkling of the legal profession; while two physicians and a single tradesman complete the tale of those who persevered out of the two thousand or so who presented themselves. No daughter houses were founded from La Trappe during De Rancé's life, for, though he was ready enough to send some of his monks for a time or even permanently to revive the Cistercian discipline in other monasteries, he was opposed on principle to every scheme which tended to drain the resources of La Trappe itself, and it was not till 1705 that the first offshoot of the Trappists was planted at Buon-Solazzo, near Florence, at the solicitation of Cosmo III., grand-duke of Tuscany.

No remarkable events occurred in connexion with La Trappe till the French Revolution, when the order was included in the general suppression of monastic societies by the Constituent Assembly in 1790. Even then the high character borne by La Trappe, and honourably distinguishing it from too many monasteries at that time, seemed likely to exempt it from the common fate, and great efforts were made to obtain its exclusion from the operation of the decree. A petition addressed by the Trappists to the National Assembly was referred to the council-general of the department of the Orne at Alencon, which reported against it to the ecclesiastical committee of the assembly, though admitting that all the local municipalities which they had consulted were in favour of sparing the abbey. Dom Augustin (Louis Henri L'Estrange), at that time master of the novices, foreseeing the result of the inquiry, went to Switzerland to provide a refuge for the brethren, and obtained permission from the authorities of canton Freiburg to take possession of Val-Sainte, an unoccupied Cistercian monastery, and to bring no more than twenty-five persons thither. This necessitated leaving more than a hundred at La Trappe to await the coming storm, which burst upon Trinity Sunday, June 3, 1792, when commissioners seized all the movable goods scheduled in their inventory, and compelled the inmates to disperse. Some betook themselves to Soleure; a few retired singly into private dwellings; but various groups set out together to found colonies in Spain, Germany, England, and Canada; while the earlier Swiss and Tyrolese houses were compelled to break up and seek refuge elsewhere from the French invaders. But amidst all difficulties and discouragements the order not merely maintained itself, but grew and strengthened, and in 1808 ventured to plant anew two houses in France itself. This same year, however, saw the division of the order into two congregations, because the Trappists of Darfeld, under their prior Eugene de Prade, resisted what they considered to be the excessive demands made upon them by the abbot of the order, that very L'Estrange who had led out the colony of Val-Sainte (and who had been constituted its head, and that of the whole society, by a brief of Pius VI. in 1794), and the dispute was appealed to Rome, with the result that in June 1808 judgment was given against L'Estrange, and Darfeld was erected into an independent abbey under De Prade as abbot, and subjected to the jurisdiction of the bishop of Münster. Nearly every Trappist house at this date was within Napoleon's dominions, and, as the order sided with the pope against the emperor, the latter expelled its monks from all monasteries in the empire, and imprisoned not a few of them. With his fall they revived again, and obtained permission to return to France, whither between 1814 and 1825 they drifted back from most of their places of exile, though 1450 were expelled anew in 1880 under the operation of the Ferry laws. La Trappe itself was repurchased by L'Estrange, and became once more the mother house, while there are fifteen other French monasteries of the order, four Belgian, two English (Mount St Bernard, Leicestershire, and Stape Hill, Dorset), two in Ireland, one each in Germany, Savoy, and Algiers, two in Italy, two (Gethsemane in Kentucky and New Melleray in Iowa) in the United States, and one originally settled in Pennsylvania, but now at Tracadie in Nova Scotia. An order of Trappistine nuns was founded by Dom Augustin in 1827, and has nine French houses and one English. The total numbers are computed at 3000 members of both sexes.

The bibliography relating to De Rancé and the Trappists is copious, and the following list is not exhaustive. Savary (Bishop of Séez), *Imago R. P. Dom. Arm. Joan. le Bouthillier de Rancé, Abbatis de Trappa*, 1701; Maupeou, *Vie de M. l'Abbé de la Trappe*, Paris, 1702; Marsollier, *Vie de l'Abbé Bouthillier de Rancé*, Paris, 1702; Le Nain (brother of Tillemont), *Vie de Le Bouthillier de Rancé, Abbé et Réformateur de la Trappe*, Rouen, 1715; Inguimbert, *Genuinus Character D. Arm. Joannis Butilieri Rancæi*, Rome, 1718; Charles Butler, "Life of De Rancé," *Miscellanies*, vol. iii., London, 1817; Dubois, *Histoire de l'Abbé De Rancé et de sa Réforme*, 2 vols., Paris, 1866; Félibien, *Description de la Trappe*, Paris, 1672; Helyot and Badiche, *Histoire des Ordres Religieux*, art.. "La Trappe," Paris, 1859; Wetzer and Welte, *Kirchenlexicon*, art. "Trappisten," Freiburg, 1849. (R. F. L.)

TRAS-OS-MONTES (*i.e.*, "Behind the Mountains") is the north-east frontier province of Portugal, situated on the other side of the Serra de Marão from Oporto. On the W. it is bounded by Entre Minho e Douro, and on the S. by Beira. The area is 4260 square miles, and the population increased from 393,279 in 1878 to 396,676 in 1881. Physically the province is a mountainous plateau, the most elevated in Portugal, and characterized by the picturesqueness and wildness of its scenery. Monte Zinho reaches a height of 7445 feet. Vast tracts are covered with heath; but in certain parts the soil is fertile, and the rich wine-growing district on the upper Douro (Alto Douro) is the native country of port. Silk-growing is also carried on; and wheat, rye, hemp, and flax appear among the exports. The province is divided into the two administrative districts of Villa Real and Braganza. Besides the two towns thus named, two only, Chaves and Miranda do Douro, are of any considerable size.

TRAVANCORE, a native state in Madras presidency, India, between 8° 4' and 10° 22' N. lat. and between 76° 12' and 77° 38' E. long., with an area of 6730 square miles. It is bounded on the N. by the native state of Cochin, on the E. by the British districts of Madura and Tinnevelli, and on the S. and W. by the Indian Ocean. This state is described as one of the most picturesque portions of southern India. Its most marked physical feature is furnished by the Western Ghâts, which rise to an elevation of 8000 feet and are clothed with magnificent primeval forest; they throw out spurs towards the coast, along which there is a belt of flat country of about 10 miles in width, covered with an almost unbroken mass of cocoa-nut and areca palms, which to a great extent constitute the wealth of the country. The whole surface is undulating, and presents a series of hills and valleys traversed from east to west by many rivers, the floods of which, arrested by the peculiar action of the Arabian Sea on the coast, spread themselves out into lagoons or backwaters, connected here and there by artificial canals, and forming an inland line of smooth-water communication for nearly the whole length of the coast. The chief river is the Periyár, which is navigable for 60 miles; other important rivers are the Pámbai and its tributary the Achinkoil, the Kallada, and the Western Támbraparni. Iron is abundant. Elephants are numerous, and tigers, leopards, bears, bison, elk, and various kinds of deer abound in the forests. The state possesses some good roads, and, on the whole, internal communication is tolerably complete. Travancore has an abundant rainfall, with every variety of climate and temperature.

In 1881 the population of Travancore was found to number 2,401,158 (males 1,197,134, females 1,204,024), of whom 1,755,610 were Hindus, 146,909 Mohammedans, and 498,542 Christians. The chief towns are TRIVANDRUM (*q.v.*), the capital, Aleppi, the commercial centre and chief seaport of the state, and Quilon, another seaport and military headquarters. Among the principal articles which the state produces are rice, cocoa-nut palm, pepper, areca-nut, cardamoms, tamarind, coffee, timber, &c. The manufactures comprise cocoa-nut, gingelly, lemon-grass, and laurel oils, jaggery and molasses, salt, arrack, cotton cloths and yarns, pottery, and coir yarn, rope, and matting. Its revenue in 1884–85 was estimated at £640,548. Travancore state is in subsidiary alliance with the British Government, to which it pays a tribute of £80,000 a year. It is one of the few states which have never turned against the British. Under the enlightened rule of the late maharajah the country made great progress, and it now stands very high among native states. It is free from debt, and has a surplus of revenue over expenditure. The sovereignty as well as the inheritance of property passes in the female line.

TRAWLING. See FISHERIES.

TREASON. The law which punishes treason is a necessary consequence of the idea of a state, and is essential to the existence of the state. Most, if not all, nations have accordingly, at an early period of their history, made provision by legislation or otherwise for the punishment of those offences against public order which consist in more or less direct attacks upon the safety of the state or its chief. The principle is universal; it is the application of the principle which leads to differences of opinion. What would have been a capital crime at Rome under Tiberius may be no offence at all in England. It is to the advantage of both the state and the citizen that what is treason and what is not should be clearly defined, so that as little as possible discretionary power, apt to be strained in times of popular excitement, should be left to the judicial or executive authorities. The importance of this was seen by Montesquieu. Vagueness in the crime of treason, says he, is sufficient to make the government degenerate into despotism.[1] At the same time, it may be observed that despotic Governments have not always left the crime undefined. The object of Henry VIII., for instance, was rather to define it as closely as possible by making certain acts treason which would not have been so without such definition. In both ancient and modern history treason has generally been a crime prosecuted by exceptional procedure, and visited with *afflictive* as distinguished from *simple* punishments (to use the terminology of Bentham).

In Roman law the offences originally falling under the head of treason were almost exclusively those committed in military service, such as in England would be dealt with under the Army Act. The very name *perduellio*, the name of the crime in the older Roman law, is a proof of this. *Perduelles* were, strictly, public enemies who bore arms against the state; and traitors were regarded as having no more rights than public enemies. The Twelve Tables made it punishable with death to communicate with the enemy or to betray a citizen to the enemy. Other kinds of *perduellio* were punished by interdiction of fire and water. The crime was tried before a special tribunal, the *duumviri perduellionis*, perhaps the earliest permanent criminal court existing at Rome. At a later period the name of *perduellio* gave place to that of *læsa majestas*, *deminuta* or *minuta majestas*, or simply *majestas*. The lex Julia majestatis, to which the date of 48 B.C. has been conjecturally assigned, continued to be the basis of the Roman law of treason until the latest period of the empire. The original text of the law appears to have still dealt with what were chiefly military offences, such as sending letters or messages to the enemy, giving up a standard or fortress, and desertion. With the empire the law of *majestas* received an enormous development, mainly in the reign of Tiberius, and led to the rise of a class of professional informers, called *delatores*.[1] The conception of the emperor as divine[2] had much to do with this. It became a maxim that treason was next to sacrilege[3] in gravity. The law as it existed in the time of Justinian is contained chiefly in the titles of the *Digest*[4] and *Code*[5] "*Ad legem Juliam majestatis.*" The definition given in the *Digest* (taken from Ulpian) is this: "majestatis crimen illud est quod adversus populum Romanun vel adversus securitatem ejus committitur." Of treasons other than military offences, some of the more noticeable were the raising of an army or levying war without the command of the emperor, the questioning of the emperor's choice of a successor, the murder of (or conspiracy to murder) hostages or certain magistrates of high rank, the occupation of public places, the meeting within the city of persons hostile to the state with weapons or stones, incitement to sedition or administration of unlawful oaths, release of prisoners justly confined, falsification of public documents, and failure of a provincial governor to quit his province at the expiration of his office or to deliver his army to his successor. The intention (*voluntas*) was punishable as much as an overt act (*effectus*).[6] The reported opinions as to what was not treason show the lengths to which the theory of treason must have been carried by at least some person in authority. It was not treason to repair a statue of the emperor which had decayed from age, to hit such a statue with a stone thrown by chance, to melt down such a statue if unconsecrated, to use mere verbal insults against the emperor, to fail in keeping an oath sworn by the emperor, or to decide a case contrary to an imperial constitution. Treason was one of the "publica judicia," *i.e.*, one of those crimes in which any citizen was entitled to prosecute. The law went further than this, and deprived the accused in a charge of treason of his ordinary remedy for malicious prosecution. It also took from him the privilege (which those accused of other crimes generally possessed) from accusation by women or infamous persons, from liability to be put to the torture, and from having his slaves tortured against him (see TORTURE). The punishment from the time of Tiberius was death (usually by beheading)[7] and confiscation of property, coupled with complete civil disability. A traitor could not make a will or a gift or emancipate a slave. Even the death of the accused, if guilty of treason of the gravest kind, such as levying war against the state, did not extinguish the charge, but the memory of the deceased became infamous, and his property was forfeited as though he had been convicted in his lifetime.

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[1] *Esprit des Lois*, bk. xii. c. 7.

The law of England corresponds to a considerable extent with Roman law; in fact, treason is made by Blackstone the equivalent of the *crimen læsæ majestatis*. The history of the crime in the two systems agrees in this that in both the law was settled by legislation at a comparatively early period, and subsequently developed by judicial construction. In both, too, there were exceptional features distinguishing this crime from other offences.[8] For instance, at common law treason was not bailable (except by the Queen's Bench) or clergyable, could not be cleared by sanctuary, and did not admit of accessories, for all were principals, nor could a married woman plead coercion by her husband. To stand mute and refuse to plead did not save the lands of the accused, as it did in felony, so that the "peine forte et dure" (see TORTURE) was unnecessary in treason. These severities were due to the conception of treason as a breach of the oath of allegiance. Other differences introduced by statute will be mentioned later. In some cases a statute simply affirmed the common law, as did the Statute of Treasons to a great extent, and as did 26 Hen. VIII. c. 13, depriving those accused of treason of the benefit of sanctuary. How far the Roman law was consciously imitated in England it is impossible to determine. It was certainly not adopted to its full extent, for many acts were *majestas* which were never treason, even in the most despotic periods. Treason was the subject of legislation in many of the pre-Conquest codes. The laws of Alfred[9] and Æthelred[10] punished with death any one plotting against the life of the king. Soon after the Conquest the *Leges Henrici Primi*[11] put any one slaying the king's messenger in the king's mercy. The crime was shortly defined by Glanvill[12] and at greater length by Bracton,[13] who follows Roman law closely. He includes under treason sedition and coining. Treason seems to have rested chiefly, if not wholly, upon common law until the year 1352, when the famous Statute of Treasons (25 Edw. III. st. 5, c. 2) was passed. The statute appears to have arisen from a petition of the Commons in 1348, praying for a definition of the offence of accroaching royal power, a charge on which several persons—notably Gaveston and the Despencers—had suffered. The offences made treason by the statute are these:—(1) to compass or imagine[14] the death of the king,[15] the queen, or their eldest son and heir; (2) to violate the king's companion, or his eldest daughter unmarried, or the wife of his eldest son and heir; (3) to levy war against the king in his realm, or be adherent to the king's enemies in his realm, giving them aid and comfort in the realm or elsewhere; (4) to counterfeit the king's great or privy seal or his money; (5) to bring false money into the realm, counterfeit to the money of England, as the money called Lushburgh,[16] knowing the money to be false; (6) to slay the chancellor, treasurer, or the king's justices of the one bench or the other, justices in eyre, or justices of assize, and all other justices assigned to hear and determine, being in their places doing their offices. The statute further defined petty treason to be the slaying of a master by his servant, a husband by his wife, or a prelate by a man secular or religious owing him allegiance. In all cases of treason not specified in the statute the justices before whom the case came were to tarry without going to judgment until the cause had been showed and declared before the king and his parliament whether it ought to be judged treason or felony. The statute, so far as it defines the offence, is still law, except the clauses as to counterfeiting the seal, coining, and petit treason, repealed respectively, after a considerable amount of intermediate modification by statute, by 11 Geo. IV. and 1 Will. IV. c. 66, 2 and 3 Will. IV. c. 34, 30 Geo. III. c. 48, and 9 Geo. IV. c. 31. Petit treason is now treated as murder, 24 and 25 Vict. c. 100.[1] From the time of the passing of the Statute of Treasons the limits of treason were continually being extended for a time, and again reduced to the bounds fixed by the statute. It protected only the king's life, and its insufficiency was supplemented in periods of danger by legislation, often of a temporary nature. Under Richard II. and Henry VIII. many new offences were made treason,[2] but the Acts creating these new treasons were repealed at the earliest opportunity by the parliaments of their successors, and the Statute of Treasons was made the final standard by 1 Mary, sess. 1, c. 1. The reign most prolific in statutory additions to the law of treason was undoubtedly that of Henry VIII. Legislation in this reign was little more than a register of the fluctuating opinions of the monarch. Thus, by 25 Hen. VIII. c. 22 it was treason not to believe Mary illegitimate and Elizabeth legitimate; by 28 Hen. VIII. c. 7 it was treason to believe either legitimate; by 35 Hen. VIII. c. 1 it was treason not to believe both legitimate. An interesting act of this reign, 37 Hen. VIII. c. 10, shows that a class of men like the Roman *delatores* must have been called into existence by all the new legislation. The Act constituted it felony to make anonymous charges of treason without daring to appear in support of them before the king or council. Out of the mass of Henry VIII.'s Acts, only two are still law,—28 Hen. VIII. c. 15 and 35 Hen. VIII. c. 2, giving power to try treasons committed within the jurisdiction of the admiralty and out of the realm. Many other instances of offences of a temporary kind made treason at different times occur among the statutes, especially in those levelled at the papal jurisdiction by the parliaments of Elizabeth. A few of the more interesting of other kinds may be briefly noticed. It was treason by 21 Ric. II. c. 4 to attempt to appeal or annul judgments made by parliament against certain traitors; by 2 Hen. V. st. 1, c. 6, and 29 Hen. VI. c. 2 to break a truce or safe-conduct; by 5 and 6 Edward VI. c. 11 to hold castles, fortresses, or munitions of war against the king; by 17 Car. II. c. 5 to adhere to the United Provinces; by 9 Will. III. c. 1 to return without licence if an adherent of the Pretender; by 12 and 13 Will. III. c. 3 to correspond with the Pretender; and by 57 Geo. III. c. 6 to compass or imagine the death of the prince regent. In addition to these, many Acts of attainder were passed at different times. One of the most severe was that against Catherine Howard, 33 Hen. VIII. c. 21, which went as far as to make it treasonable for any queen to conceal her antenuptial incontinence. Other Acts were those against Archbishop Scrope, Owen Glendower, Jack Cade, Lord Seymour, Sir John Fenwick, James Stuart, and Bishop Atterbury. In one case, that of Cromwell, Ireton, and Bradshaw, an Act of attainder was passed after the death of those guilty of the treason, 12 Car. II. c. 30. At times Acts of indemnity were passed to relieve those who had taken part in the suppression of rebellion from any possible liability for illegal proceedings. Three such Acts were passed in the reign of William III.

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[1] See Merivale, *Hist. of the Romans under the Empire*, vol iii. p. 467, vol. v. p. 141.

[2] "Principes instar deorum esse" are the words of Tacitus.

[3] This crime was called *læsa majestas divina* in later law.

[4] xlviii. 4.

[5] ix. 8.

[6] A similar provision was contained in the Golden Bull of Charles IV. c. 24. In English law, with the one exception of a statute of Richard II. (21 Ric. II. c. 3) repealed in the first year of Henry IV., an overt act has always been necessary. The difficulty of proving a mere intention is obvious. In French and German law the overt act (*attentat* or *Unternehmen*) is as indispensable as in English.

[7] To harbour a fugitive enemy was punishable only by deportation, *Dig.*, xlviii. 19, 40.

[8] The position of treason as a special crime prosecuted by special procedure is one common to most legal systems at some period of their existence. For instance, in Germany, by a constitution of Henry VII. the procedure was to be summary, *sine strepitu et figura judicii.*

[9] c. 4.

[10] v. 30.

[11] lxxix. 2.

[12] xiv. 1.

[13] 118b.

[14] These words, according to Luders (*Law Tracts*, note *ad fin.*), mean to attempt or contrive.

[15] This by 1 Mary, sess. 3, c. 1 includes a queen regnant.

[16] *i.e.*, Luxemburg.

The Statute of Treasons, as interpreted by the judges, is still the standard by which an act is determined to be treason or not. The judicial interpretation has been sometimes strained to meet cases scarcely within the contemplation of the framers of the statute: *e.g.*, it became established doctrine that a conspiracy to levy war against the king's person or to imprison or depose him might be given in evidence as an overt act of compassing his death, and that spoken words, though they could not in themselves amount to treason, might constitute an overt act, and so be evidence. Besides decisions on particular cases, the judges at different times came to general resolutions which had an appreciable effect on the law. The principal resolutions were those of 1397 (confirmed by 21 Ric. II. c. 12), of 1557, and those agreed to in the case of the regicides at the Restoration and reported by Sir John Kelyng. A remarkable resolution *in favorem rei* among the latter was that a prisoner ought not to be ironed during trial. The result of judicial decisions on the Statute of Treasons was summed up in Acts passed in 1786, made permanent in 1817 and in 1848 (57 Geo. III. c. 6 and 11 Vict. c. 12, the latter often called the Treason Felony Act). The effect of this legislation, according to Mr Justice Stephen, is that such of the judicial constructions as extend the imagining of the king's death to imagining his death, destruction, or any bodily harm tending to death or destruction, maim or wounding, imprisonment or restraint, have been adopted, while such of the constructions as make the imagining of his deposition conspiring to levy war against him, and instigating foreigners to invade the realm, have not been abolished, but are left to rest on the authority of decided cases. The present state of the law has been incorporated by skilled lawyers in the draft criminal code, which will no doubt become an Act when parliament has leisure to devote to matters of this kind. The code draws a distinction between treason and treasonable crimes, the former including such acts (omitting those that are obviously obsolete) as by the Statute of Treasons and subsequent legislation are regarded as treason proper, the latter including the crimes contained in the Act of 1848. In the words of the code (§ 76) "treason is (*a*) the act of killing Her Majesty, or doing her any bodily harm tending to death or destruction, maim or wounding, and the act of imprisoning or restraining her; or (*b*) the forming and manifesting by an overt act an intention to kill Her Majesty, or to do her any bodily harm tending to death or destruction, maim or wounding, or to imprison or to restrain her; or (*c*) the act of killing the eldest son and heir-apparent of Her Majesty, or the queen consort of any king of the United Kingdom of Great Britain and Ireland; or (*d*) the forming and manifesting by an overt act an intention to kill the eldest son and heir-apparent of Her Majesty, or the queen consort of any king of the United Kingdom of Great Britain and Ireland; or (*e*) conspiring with any person to kill Her Majesty, or to do her any bodily harm tending to death or destruction, maim or wounding, or conspiring with any person to imprison or restrain her; or (*f*) levying war against Her Majesty either with intent to depose Her Majesty from the style, honour, and royal name of the imperial crown of the United Kingdom of Great Britain and Ireland or of any other of Her Majesty's dominions or countries; or in order by force or constraint to compel Her Majesty to change her measures or counsels, or in order to intimidate or overawe both Houses or either House of Parliament; or (*g*) conspiring to levy war against Her Majesty with any such intent or for any such purpose as aforesaid; or (*h*) instigating any foreigner with force to invade this realm or any other of the dominions of Her Majesty; or (*i*) assisting any public enemy at war with Her Majesty in such war by any means whatsoever; or (*j*) violating, whether with her consent or not, a queen consort, or the wife of the eldest son and heir-apparent for the time being of the king or queen regnant." There are a few other Acts still in force besides those of 1817 and 1848 which have dealt with substantive law. By 11 Henry VII. c. 1 obedience to the *de facto* sovereign for the time being is not treason. By 1 Anne st. 2, c. 21, it is treason to endeavour to hinder the next successor to the crown from succeeding, and by 6 Anne c. 41 it is treason to maliciously, advisedly, and directly by writing or printing maintain and affirm that any person has a right to the crown otherwise than according to the Acts of Settlement and Union, or that the crown and parliament cannot pass statutes for the limitation of the succession to the crown.

The Acts dealing with procedure and punishment are more numerous, and are characterized by a slowly increasing favour shown to the accused,—in fact, considerably greater than in felony, for counsel were not allowed to prisoners in charges of felony until 1836, and such prisoners are still not entitled to a copy of the indictment or the names of the witnesses or jury. With respect to the mode of trial, the effect of common law and legislation is that there are now four varieties,—IMPEACHMENT (*q.v.*), trial of a peer by the peers, court martial, and trial by a judge of the High Court of Justice and a jury. The offence cannot be tried at quarter sessions. Trial by battle in cases of treason ceased in the 14th century, as far as regards appeals in the common law courts or in parliament, by the effect of several statutes passed between 1332 and 1399. Appeals of treason were finally abolished in 1819 (see Appeal). In the court of the lord high constable an award of battle occurred as lately as 1631 in the case of Lord Rea.[1] Traitors in the reign of Edward IV., and perhaps later, were at times tried by martial law. The issue of commissions of martial law in time of peace was declared illegal by the Petition of Right in 1628. The prerogative of the crown to try traitors by martial law in time of open rebellion still exists, and is recognized by statute. In two Acts, for instance, dealing with Ireland, 43 Geo. III. c. 117 and 3 and 4 Will. IV. c. 4, it was provided that nothing in the Acts was to take away the undoubted prerogative of the crown for the public safety to resort to the exercise of martial law against open enemies and traitors. A peer is tried before the House of Lords, or the court of the lord high steward if the trial be during the recess of parliament. Procedure in such trials is regulated by 7 and 8 Will. III. c. 3, and other Acts. The last trial of a peer for treason was that of Lord Lovat in 1746–47. Persons subject to naval or military law are triable by court martial in certain cases under the powers given by the Naval Discipline Act, 1866, and the Army Act, 1881. The trial of treason committed out of the realm is regulated by 35 Hen. VIII. c. 2, 5 and 6 Edw. VI. c. 11, and 7 Anne c. 21. Lord Macguire was tried by jury in England under 35 Hen. VIII. c. 2 for treason committed in Ireland.[2] Procedure before and at the trial depends upon a large number of Acts, of which the most important is one passed in 1695 (7 and 8 Will. III. c. 3). It enacted that persons indicted for treason are to have a copy of the indictment delivered to them five days before trial. The court is empowered to assign counsel for the prisoner (a power extended to impeachments by 20 Geo. II. c. 30). The oath of two witnesses, or confession in open court, or refusal to plead, or peremptory challenge of more than thirty-five jurors is necessary for conviction. The witnesses must be both to the same overt act or one to one and the other to another overt act of the same treason. If two or more treasons of divers kinds are alleged in one indictment, one witness to prove one treason and another to prove another are not sufficient. No person is to be indicted unless within three years after the offence, except on a charge of attempted assassination of the king. The accused is to have copies of the panel of the jury[3] two days before trial. He is entitled to the same process to compel his witnesses to appear as is usually granted to compel the witnesses for the prosecution. No evidence is to be given of any overt act not expressly laid in the indictment. The Act expressly denied the prisoner the names of the witnesses against him. The law on this point was altered by 7 Anne c. 21, which enacted that a list of such witnesses was to be delivered to him ten days before trial. Such witnesses had previously been made examinable upon oath by 1 Anne st. 2, c. 9. By 5 and 6 Vict. c. 51 (extending the provisions of an Act of 1800) the advantages given by the Act of William III. are not to extend to a prisoner charged with treason in compassing or imagining any bodily harm tending to the death or destruction, maiming or wounding of the queen, where the overt act is an attempt to injure the person of the queen. In such a case the trial is to proceed in every respect and on the like evidence as if it were for murder. By 11 Vict. c. 12 no prosecution for a felony under the Act, in so far as it is expressed by open and advised speaking only, is to be instituted unless information be given to a justice or sheriff within six days and a warrant issued within ten days of the information, and no person is to be convicted of such an offence except on confession in open court or proof by two witnesses. The prisoner is not to be acquitted if the facts amount to treason. There may be accessories to felonies under this Act, which, as has been already stated, there cannot be to treason. The prosecutor and witnesses are not entitled to costs. By a later Act of the same year (11 and 12 Vict. c. 42, § 23) a person charged with treason is not to be admitted to bail except by order of a secretary of state or by the Queen's Bench Division or a judge thereof in vacation.

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[1] Since the disappearance of petit treason as a distinct crime, it seems useless to retain the old name of high treason by which what may be called treason proper was formerly known.

[2] One reason for making these offences treason rather than felony was no doubt to give the crown rather than the lord of the fee the right to the real estate of the criminal on forfeiture. Had the offences been felony the king would have had only his year, day, and waste on the estate escheating to the lord, as was the case in treason before the Statute of Treasons (see FELONY).

The punishment of treason at common law was barbarous in the extreme.[4] The sentence was that the offender, if a man, be drawn on a hurdle to the place of execution, that there he be hanged by the neck till he be dead, that his head be severed from his body, and that his body be divided into four quarters, the head and quarters to be at the disposal of the crown. A woman was drawn to the place of execution, and there burned alive. The Acts of 30 Geo. III. c. 48 and 54 Geo. III. c. 146 changed the sentence to hanging in the case of women, and in the case of men enabled the crown, by warrant under the sign manual countersigned by a secretary of state, to change the sentence to beheading or remit it altogether. By the Felony Act, 1870, the punishment is hanging only, but 54 Geo. III. c. 146 appears to be still so far in force that beheading may be substituted by warrant of the crown where the criminal is a man. Attainder and forfeiture are abolished by the Felony Act, 1870, except where the offender has been outlawed.[5] The maximum penalty for a felony under the Act of 1848 is penal servitude for life. In every pardon of treason the offence is to be particularly specified therein (see Pardon).

Trials for treason in Great Britain and Ireland have been very numerous, and occupy a large part of the numerous volumes of the *State Trials*. Some of the more interesting may be mentioned. Before the Statute of Treasons were those of Gaveston and the Despensers in the reign of Edward II. on charges of accroaching the royal power. After the Statute were those (some before the peers by trial or impeachment, most before the ordinary criminal courts) of Empson and Dudley, Fisher, More, the earl of Surrey, the duke of Somerset, Anne Boleyn, Lady Jane Grey, Sir Thomas Wyatt, Cranmer, the queen of Scots, Sir Walter Raleigh, Strafford, Laud, Sir Henry Vane and other regicides, William, Lord Russell, Algernon Sidney, the duke of Monmouth, and those implicated in the Pilgrimage of Grace, the Gunpowder, Popish, Rye House, and other plots. Cases where the proceeding was by bill of attainder have been already mentioned. Occasionally the result of a trial was confirmed by statute. In some of these trials, as is well known, the law was considerably strained in order to insure a conviction. Since the Revolution there have been the cases of those who took part in the risings of 1715 and 1745, Lord George Gordon in 1780, Hardy and Horne Tooke in 1794, the Cato Street conspirators in 1820, Frost in 1840, and the Fenians in 1867. It should be noticed that many cases of proceedings for treason against foreigners occur. Treason committed by them within the realm is a breach of what has been called local allegiance, due to the sovereign of the country in which they reside. Such are the cases of Leslie, bishop of Ross, ambassador to Elizabeth from the queen of Scots, the Marquis de Guiscard in Queen Anne's reign, and Gyllenborg, the ambassador from Sweden to George II. Proceedings against ambassadors for treason have never gone beyond imprisonment, more for safe custody than as a punishment. No amount of residence abroad will suffice to exempt a native-born subject from the penalty of treason if he bear arms against the country of his birth.[6]

Misprision (from the old French *mespris*) of treason, in the words of Blackstone, "consists in the bare knowledge and concealment of treason, without any degree of assent thereto, for any assent makes the party a principal traitor." At common law even the concealment was treason, but 5 and 6 Edw. VI. c. 11 and 1 and 2 Ph. and M. c. 10 made concealment a misprision only. The offence was dealt with by many Acts, under some of which rather remarkable crimes were made misprision; *e.g.*, 14 Eliz. c. 3 constituted the counterfeiting of foreign coinage a misprision. The procedure in trials for misprision is in general the same as that followed in trials for treason, most of the Acts regulating procedure including both crimes. The punishment is loss of the profit of the lands of the offender during life, and imprisonment for life.

Cognate Offences.—Under this head may be conveniently grouped certain offences against public order which, though not technically treason or treasonable offences (to use the language of the draft criminal code), are so nearly allied to them as to make it convenient to treat them under the head of treason. The most interesting of these for historical reasons is *præmunire*. The word is derived from *præmunire* or *præmoneri facias*, the introductory words of the writ of summons to the defendant to answer the charge. From this the word came to be used to denote the offences prosecuted by means of such a writ, usually of an ecclesiastical kind. The Statute of Præmunire, specially so called, is 16 Ric. II. c. 5, enacting that the procuring at Rome or elsewhere of any translations, bulls, &c., against the king puts the persons offending out of the king's protection, subjects their goods to forfeiture and themselves to attachment or process of *præmunire facias*. The Act introduced no new principle, but simply continued the anti-papal policy visible in the Statutes of Provisors, the earliest of which dated from 1307. At different times many other Acts were passed, extending the penalties of præmunire to other crimes, usually those connected with the supremacy of the pope (2 Hen. IV. c. 4, mentioned under Tithes, is an example), but sometimes of a more distinctly political as distinguished from religious nature. Thus it is præmunire by 13 Car. I. c. 1 to affirm the power of parliament to legislate without the crown, by the Habeas Corpus Act to send a prisoner beyond seas, and to verbally assert the right of a person to the crown contrary to the Acts of Settlement and Union is præmunire by 6 Anne c. 41. To do so by writing or printing is, as has been said, treason. The latest Act constituting a præmunire is the Royal Marriage Act, 12 Geo. III. c. 11, which subjects to the penalties of præmunire any one guilty of a breach of the provisions of the Act. A peer charged with præmunire is not entitled to trial by his peers, but is to be tried by a jury. The most famous historical instance of a prosecution on the Statute of Præmunire was that of Wolsey in 1529. Other offences cognate to treason are publishing scandalous stories about the king (the leasing-making of Scotch law), maladministration and sale of public offices, coining, offences against the Foreign Enlistment Act, and the crimes specially provided against by 33 Hen. VIII. c. 12 and 5 and 6 Vict. c. 51. The former Act punished malicious striking in the king's palace by perpetual imprisonment, fine, and loss of the right hand. The minute provisions for the mutilation of the offender are very curious, but not of immediate interest, as that part of the Act which inflicted mutilation was repealed by 9 Geo. IV. c. 31. By 5 and 6 Vict. c. 51 it is a high misdemeanour, punishable by penal servitude for seven years, to wilfully discharge, point, aim, or present at the person of the queen any gun or other arms, loaded or not, or to strike at or attempt to throw anything upon the queen's person, or to produce any firearms or other arms, or any explosive or dangerous matter, near her person, with intent to injure or alarm her or to commit a breach of the peace. For other offences which are more or less nearly connected with treason reference may be made to the articles LIBEL, OATHS, PETITION, RIOT, and SEDITION.[1]

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[1] Shakespeare twice makes effective use of the trial by battle in treason, in *King Lear* and *Richard II.*

[2] 4 *State Trials*, 653.

[3] By the Bill of Rights the jurors in trials for treason must have been freeholders. This provision of the Act was repealed by 9 Geo. IV. c. 50.

[4] The exceptional character of the punishment, like that of the procedure, may be paralleled from Germany. The punishment of traitors by Frederick II. by wrapping them in lead and throwing them into a furnace is alluded to by Dante, *Inferno*, xxiii. 66.

[5] Proceedings after the death of an alleged traitor might at one time have been taken, but only to a very limited extent as compared with what was allowed in Roman and Scots law. Sir E. Coke (4 *Rep.*, 57) states that there might have been forfeiture of the land or goods of one slain in rebellion on view of the body by the lord chief justice of England as supreme coroner.

[6] See Æneas Macdonald's case, 18 *State Trials*, 857.

Scotland.—Treason included treason proper, or crimes against the crown or the state, such as rebellion, and crimes which, though not technically treasonable, were by legislation punished as treason. Examples of the latter were the remaining in England against the king's will, 1430, c. 19; wilful fire-raising, 1526, c. 10; kidnapping, 1567, c. 37; theft, reset, and stouthrief by banded men, 1587, c. 34. There were also many acts dealing with offences in the nature of resistance to authority, such as unlawful convocations, and with treasons of a merely transitory nature, such as attempting to restore the Ruthvens (1600), taking or owning the Covenants (1685), or corresponding with James VII. (1698). Acts of forfeiture were sometimes directed against individuals, as 1645, c. 23, against the marquis of Huntly. Scottish procedure was as a rule less favourable to the accused than English. In one matter, however, the opposite was the case. Advocates compellable to act on behalf of the accused were allowed him by 1587, c. 57, more than a century before the concession of a similar indulgence in England. At one time trial in absence and even after death was allowed, as in Roman law. In the case of Robert Leslie, in 1540, a summons after death was held by the estates to be competent, and the bones of the deceased were exhumed and presented at the bar of the court.[2] The Act 1542, c. 13, confined this revolting procedure to certain treasons of the more heinous kind. By 7 Anne c. 21 trial in absence—the last instance of which had occurred in 1698—was abolished. The same Act assimilated the law and practice of treason to that of England in other respects by enacting that no crime should be treason or misprision in Scotland but such as was treason or misprision in England. The Act further provided that the trial was to be by a jury of twelve, not fifteen as in other crimes, before the court of justiciary, or a commission of oyer and terminer containing at least three lords of justiciary. To slay a lord of justiciary or lord of session, or to counterfeit the great seal, was made treason. The Act also contained provisions as to forfeiture,[3] qualification of jurors, and procedure. Outlawry for treason was regulated by 22 Geo. II. c. 48. The punishment still remains the same as it was in England before the Felony Act, 1870, and attainder and forfeiture are still the effects of condemnation for treason, the Act of 1870 not extending to Scotland. One or two other statutory provisions may be briefly noticed. The trial of a peer of Great Britain for treason committed in Scotland is to be by a commission from the crown, on indictment found by a jury of twelve (6 Anne c. 23, 6 Geo. IV. c. 66). Bail in treason-felony is only to be allowed by consent of the public prosecutor or warrant of the high or circuit court (11 Vict. c. 12). The term *lese-majesty* was sometimes used for what was treason proper, *e.g.* in 1524, c. 4, making it lese-majesty to transport the king out of the realm, sometimes as a synonym of *leasing-making*. This crime (also called verbal sedition) consisted in the engendering discord between king and people by slander of the king.[4] The earliest Act against leasing-making *so nomine* was in 1524. The reign of James VI. was pre-eminently prolific in legislation against this crime. It is now of no practical interest, as prosecutions for leasing-making have long fallen into desuetude. At one time, however, the powers of the various Acts were put into force with great severity, especially in the trial of the earl of Argyll in 1681. The punishment for leasing-making, once capital, is now, by 6 Geo. IV. c. 47, fine or imprisonment, or both. The offence of præmunire was introduced into Scotland at a comparatively late period. By 6 Anne c. 23 it is præmunire for the peers of Scotland assembled to elect representatives to treat of any other matter.[5]

Ireland.—Numerous Acts, beginning with 18 Hen. VI. c. 2, were passed by the Irish parliament—in many cases mere echoes of previous English legislation. As in England and Scotland, there was a tendency to include under treason crimes of quite another character. Murder was made treason by 10 Hen. VII. c. 21, and arson by 18 Hen. VIII. c. 1. Apparently the law must sometimes have been strained against accused persons, for 3 and 4 Ph. and M. c. 11 enacted that trials for treason were to be according to the common law. Treasons of a temporary nature were often the subject of legislation. An example is 11 Eliz. c. 6, making it treason to assume the name and authority of O'Neill. The provisions of the English Act of William III. as to witnesses, &c., were not extended to Ireland until 1821 by 1 and 2 Geo. IV. c. 24 Many Acts of indemnity were passed both by the parliaments of Ireland and of the United Kingdom. Among the more important were an Irish Act of 1799 (39 Geo. III. c. 3), indemnifying those who had been active in suppressing the treasonable rising of the previous year, and one of the parliament of the United Kingdom (41 Geo. III. c. 104), indemnifying those who had taken part in the suppression of rebellion subsequent to 1799. The law is now practically the same as that of England, unless where exceptional political circumstances have led to exceptional legislation. Thus a series of enactments called the "Whiteboy Acts" (passed by the Irish and the United Kingdom parliaments between 1775 and 1830) was intended to give additional facilities to the executive for the suppression of tumultuous risings. Many Irish Acts dealt with unlicensed possession and manufacture of arms. A similar policy was continued after the Union, and appears in the Peace Preservation Act, 1881, continued in 1887 for five years. Some Acts, such as 3 and 4 Will. IV. c. 4, went as far as to make offenders in a proclaimed district triable by court-martial. By the Prevention of Crime Act, 1882, now expired, the lord-lieutenant was empowered to issue special commissions for the trial without jury of treason and treason-felony. The power was never exercised. The Criminal Law and Procedure (Ireland) Act, 1887, deals with resistance to authority and offences of a treasonable nature, especially "dangerous associations," though treason is not mentioned by name.

British Colonies and Dependencies.—The law in the main agrees with that of the mother country, but it is quite competent for a colony to deal with treason by its own legislation which need not necessarily be in accordance with English law, and is sometimes expressed in more definite terms. Thus the Indian penal code makes it punishable with transportation for life to wage war against the Government of any Asiatic power in alliance or at peace with the queen, or to attempt to excite feelings of disaffection to the Government. Numerous temporary Acts were passed about the time of the mutiny, one of the most characteristic being an Act of 1858 making rebellious villages liable to confiscation. By the Cape of Good Hope statutes it is treason to deliver arms or gunpowder to the queen's enemies. Many colonies adopt the English legislation as to procedure, and some, as New South Wales, &c., enact the Treason Felony Act. A striking feature of colonial legislation on this subject is the great number of Acts of indemnity passed after different rebellions. Instances of such Acts occur in the legislation of Canada, Ceylon, the Cape of Good Hope, New Zealand, St Vincent, and Jamaica. The most important in the history of law is the Jamaica Act of 1866, indemnifying Mr Eyre for any acts committed during the suppression of the rising in the previous year. It was finally held by the Exchequer Chamber in 1870 that this Act protected Mr Eyre from being sued successfully in England on a cause of action arising out of his acts during the outbreak ("Phillips *v.* Eyre," *Law Reports*, 6 *Queen's Bench*, 1).

United States.—The law is based upon that of England. By Art. 3 s. 3 of the constitution "treason against the United States shall consist only in levying war against them, or in adhering to their enemies, giving them aid and comfort. No person shall be convicted of treason unless on the testimony of two witnesses to the same overt act, or on confession in open court. The Congress shall have power to declare the punishment of treason; but no attainder of treason shall work corruption of blood or forfeiture, except during the life of the person attainted." By Art. 2 s. 4

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[1] *Authorities.*—The text-writers on criminal law, such as Hale and Hawkins; Bacon, *Law Tracts*, Cases of Treason; Coke, 3 *Inst.*, 1-39; Sir R. Holbourne, *Reading on the Statute of Treasons*; Luders, *Law Tracts*; Foster, *Discourse of Treason*; Stephen, *Comm.*, vol. iv. bk. vi. ch. vi. The Statute of Treasons is noticed by Hallam, *Const. Hist.*, vol. iii. p. 203; Stubbs, *Const. Hist.*, vol. iii. p. 513. The most valuable modern authorities are Stephen, *Hist. of the Criminal Law*, vol. ii. ch. xxiii., and Willis Bund, *Selection of Cases from the State Trials*.

[2] In the one instance in England—that of Cromwell, Ireton, and Bradshaw—where the bodies of alleged traitors were exhumed after death they were not brought to the bar of a court as in Scotland

[3] The provisions in the Act as to forfeiture (now repealed) were, according to Blackstone, *Comm.*, vol. iv. p. 384, the result of a compromise between the House of Lords, in favour of its continuance, and the House of Commons, supported by the Scottish nation, struggling to secure a total immunity from this disability.

[4] It is called by Hallam "the old mystery of iniquity in Scots law."

[5] For the existing Scots law of treason see Macdonald, *Criminal Law*, p. 220. For leasing-making see Hume, *Comm.*, vol. i. p. 348.

impeachment for and conviction of treason is a ground for moving the president, vice-president, and other civil officers. The punishment by an Act of 1790 was declared to be death by hanging. But during the Civil War a new Act (17 July 1862) was passed, providing that the punishment should be death, or, at the discretion of the court, imprisonment at hard labour for not less than five years, and a fine of not less than 10.000 dollars to be levied on the real and personal property of the offender, in addition to disability to hold any office under the United States. The Act of 1862 and other Acts also deal with the crimes of inciting or engaging in rebellion or insurrection, criminal correspondence with foreign Governments in relation to any disputes or controversies with the United States, or to defeat the measures of the Government of the United States, seditions, conspiracy, recruiting soldiers or sailors and enlistment to serve against the United States. The Act of 1790 further provides for the delivery to the prisoner of a copy of the indictment and a list of the jurors, for defence by counsel, and for the finding of the indictment within three years after the commission of the treason. Misprision of treason is defined to be the crime committed by a person owing allegiance to the United States, and having knowledge of the commission of any crime against them, who conceals and does not as soon as may be disclose and make known the same to the president or to some judge of the United States, or to the governor or to some judge or justice of a particular State. The punishment is imprisonment for not more than seven years and a fine of not more than 1000 dollars (see *Revised Statutes*, §§ 1033, 1034, 1043, 5331-5338; Story, *Constitution of the United States*, §§ 1296-1301, 1796-1802). Treason against the United States cannot be inquired into by any State court, but the States may, and some of them have, their own constitutions and legislation as to treasons committed against themselves, generally following the lines of the constitution and legislation of the United States. In some cases there are differences which are worth notice. Thus the constitution of Massachusetts, § 25, declares that no subject ought in any case or in any time to be declared guilty of treason by the legislature. The same provision is contained in the constitutions of Vermont, Connecticut, Pennsylvania, Alabama, and others. In some States the crime of treason cannot be pardoned; in others, as in New York, it may be pardoned by the legislature, and the governor may suspend the sentence until the end of the session of the legislature next following conviction. In some States a person convicted of treason is disqualified for exercising the franchise. In New York conviction carries with it forfeiture of real estate for the life of the convict and of his goods and chattels. (J. Wt.)

TREASURE-TROVE is defined by Blackstone to be money or coin, gold, silver, plate, or bullion found hidden in the earth or other private place, the owner thereof being unknown. This definition is simply an extension of the Roman law definition of *thesaurus inventus* as an ancient deposit of money (*vetus depositio pecuniæ*) found by accident and without actual search. The right to treasure-trove was not, however, the same in Roman and English law. The former at its latest stage divided it between the finder and the owner of the land on which it was found, except where it was found on public or imperial property, when one-half went to the fisc. If a man found treasure on his own land, he had a right to the whole. The rights of the crown, modified by those of the feudal lord, gradually became more extensive in the feudal law of Europe, so much so as to become, in the words of Grotius, "jus commune et quasi gentium." In more recent times there has been a return, at any rate in the case of France, to the division made by the Roman law. In England the common law, which at one time apparently conferred treasure-trove, wherever found, upon the finder, now gives it all to the king, in accordance with the maxim "quod nullius est fit domini regis." This is always provided that the owner cannot be known or discovered. If he can be he and not the king is entitled to it.

A right to treasure-trove may be granted by the British crown as a FRANCHISE (*q.v.*). It is the duty of one finding treasure to make it known to the coroner. By the statute *De Officio Coronatoris* (4 Edw. I. st. 2), the coroner is to inquire of treasure that is found, who were the finders and likewise who is suspected thereof, and that may be well perceived where one liveth riotously, haunting taverns, and hath done so of long time. Concealment of treasure-trove is a misdemeanour at common law. There can be no larceny of it until it has been found by the coroner to be the property of the crown. The Home Office has recently issued a notification modifying the existing regulations so far as to permit the finders of coins and antiquities coming under the description of treasure-trove to retain articles not actually required for national institutions, and the sum received from such institutions as the antiquarian value of any articles retained, subject to a deduction of 20 per cent. from the antiquarian value of the objects retained and 10 per cent. from the value of other objects. In the United States treasure-trove is usually vested in the State as *bona vacantia*. Louisiana follows the French *Code Civil*, and gives half to the finder and half to the landowner. The importance of treasure-trove in India led to the passing of the Indian Treasure-Trove Act (Act vi. of 1878). It provides that treasure is to be delivered to the finder if no owner appears. If the owner can be found, three-fourths go to the finder and one-fourth to the owner, power being reserved to the Government to acquire it by payment of a sum equal to one-fifth more than the value of the material.

Terminology.

TREATIES. 1. A treaty is a contract between two or more states. The term "tractatus," and its derivatives, though of occasional occurrence in this sense from the 13th century onwards, only began to be commonly so employed, in lieu of the older technical terms "conventio publica," or "fœdus," from the end of the 17th century. In the language of modern diplomacy the term "treaty" is restricted to the more important international agreements, especially to those which are the work of a congress, while agreements dealing with subordinate questions are described by the more general term "convention." The present article will disregard this distinction.

Antiquity.

2. The making and the observance of treaties is necessarily a very early phenomenon in the history of civilization, and the theory of treaties was one of the first departments of international law to attract attention. Treaties are recorded on the monuments of Egypt and Assyria; they occur in the Old Testament Scriptures; and questions arising under συνθῆκαι and "fœdera" occupy much space in the Greek and Roman historians.[1]

Classification.

3. Treaties have been classified on many principles, of which it will suffice to mention the more important. A "personal treaty," having reference to dynastic interests, is contrasted with a "real treaty," which binds the nation irrespectively of constitutional changes; treaties creating outstanding obligations are opposed to "transitory conventions," *e.g.*, for cession of territory, recognition of independence, and the like, which operate irrevocably once for all, leaving nothing more to be done by the contracting parties; and treaties in the nature of a definite transaction (*Rechtsgeschäft*) are opposed to those which aim at establishing a general rule of conduct (*Rechtssatz*). With reference to their objects, treaties may perhaps be conveniently classified as (1) political, including treaties of peace, of alliance, of cession, of boundary, for creation of international servitudes, of neutralization, of guarantee, of submission to arbitration; (2) commercial, including consular and fishery conventions, and slave trade and navigation treaties; (3) confederations for special social objects, such as the Zollverein, the Latin monetary union, and the still wider unions with reference to posts, telegraphs, submarine cables, and weights and measures; (4) relating to criminal justice, *e.g.*, to extradition and arrest of fugitive seamen; (5) relating to civil justice, *e.g.*, to the protection of trade-mark and copyright, to the execution of foreign judgments, to the reception of evidence, and to actions by and against foreigners; (6) providing general rules for the conduct of warfare, *e.g.*, the declaration of Paris and the convention of Geneva. It must be remarked that it is not always possible to assign a treaty wholly to one or other of the above classes, since many treaties contain in combination clauses referable to several of them.

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[1] For the celebrated treaty of 509 B.C. between Rome and Carthage, see Polybius iii. 22; and, on the subject generally, Barbeyrac's full but very uncritical *Histoire des Anciens Traités*, 1739; Muller-Jochmus, *Geschichte des Volkerrechts im Alterthum*, 1848; E. Egger, *Études Historiques sur les Traités Publics chez les Grecs et chez les Romains*, new ed., 1866.

4. The analogy between treaty-making and legislation is striking when a congress agrees upon general principles which are afterwards accepted by a large number of states, as, for instance, in the case of the Geneva convention for improving the treatment of the wounded. Many political treaties containing "transitory" conventions, with reference to recognition, boundary, or cession, become, as it were, the title-deeds of the nations to which they relate.[1] But the closest analogy of a treaty is to a contract in private law, as will appear from the immediately following paragraphs.

5. The making of a valid treaty implies several requisites. (1) It must be made between competent parties, *i.e.*, sovereign states. A "concordat," to which the pope, as a spiritual authority, is one of the parties, is therefore not a treaty, nor is a convention between a state and an individual, nor a convention between the rulers of two states with reference to their private affairs. Semi-sovereign states, such as San Marino or Egypt, may make conventions upon topics within their limited competence. It was formerly alleged that an infidel state could not be a party to a treaty. The question where the treaty-making power resides in a given state is answered by the municipal law of that state. It usually resides in the executive, though sometimes, as in the United States, it is shared by the legislature, or by a branch of it. (2) There must be an expression of agreement. This is not (as in private law) rendered voidable by duress; *e.g.*, the cession of a province, though extorted by overwhelming force, is nevertheless unimpeachable. Duress to the individual negotiator would, however, vitiate the effect of his signature. (3) From the nature of the case, the agreement of states, other than those the government of which is autocratic, must be signified by means of agents, whose authority is either express, as in the case of plenipotentiaries, or implied, as in the case of, *e.g.*, military and naval commanders for matters, such as truces, capitulations, and cartels, which are necessarily confided to their discretion. When an agent acts in excess of his implied authority he is said to make no treaty, but a mere "sponsion," which, unless adopted by his Government, does not bind it, *e.g.*, the affair of the Caudine Forks (Livy, ix. 5) and the convention of Closter Seven in 1757. (4) Unlike a contract in private law, a treaty, even though made in pursuance of a full power, is, according to modern views, of no effect till it is ratified. (5) No special form is necessary for a treaty, which in theory may be made without writing. It need not even appear on the face of it to be a contract between the parties, but may take the form of a joint declaration, or of an exchange of notes. Latin was at one time the language usually employed in treaties, and continued to be so employed to a late date by the emperor and the pope. Treaties to which several European powers of different nationalities are parties are now usually drawn up in French (the use of which became general in the time of Louis XIV.), but the final act of the congress of Vienna contains a protest against the use of this language being considered obligatory. A great European treaty usually commences "In the name of the Most Holy and Indivisible Trinity," or, if the Porte is a party, "In the name of Almighty God." (6) It is sometimes said that a treaty must have a lawful object, but the danger of accepting such a statement is apparent from the use which has been made of it by writers who deny the validity of any cession of national territory, or even go so far as to lay down, with Fiore, that "all should be regarded as void which are in any way opposed to the development of the free activity of a nation, or which hinder the exercise of its natural rights." (7) The making of a treaty is sometimes accompanied by acts intended to secure its better performance. The taking of oaths, the assigning of "conservatores pacis," and the giving of hostages are now obsolete, but revenue is mortgaged, territory is pledged, and treaties of guarantee are entered into for this purpose.

Duratio

6. A "transitory convention" operates at once, leaving no duties to be subsequently performed, but with reference to conventions of other kinds questions arise as to the duration of the obligation created by them, in other words, as to the moment at which those obligations come to an end. This may occur by the dissolution of one of the contracting states, by the object-matter of the agreement ceasing to exist, by full performance, by performance becoming impossible, by lapse of the time for which the agreement was made, by *contrarius consensus* or mutual release, by "denunciation" by one party under a power reserved in the treaty. By a breach on either side the treaty usually becomes, not void, but voidable. A further cause of the termination of treaty obligations is a total change of circumstances, since a clause "rebus sic stantibus" is said to be a tacit condition in every treaty.[2] Such a contention can only be very cautiously admitted. It has been put forward by Russia in justification of her repudiation of the clauses of the treaty of Paris neutralizing the Black Sea, and of her engagements as to Batoum contained in the treaty of Berlin. The London protocol of 1871, with a view to prevent such abuses, lays down, perhaps a little too broadly, "that it is an essential principle of the law of nations that no power can liberate itself from the engagements of a treaty, nor modify the stipulations thereof, unless with the consent of the contracting powers, by means of an amicable arrangement." Treaties are in most cases suspended, if not terminated, by the outbreak of a war between the contracting parties, and are therefore usually revived in express terms in the treaty of peace.

Interpretation.

7. The rules for the interpretation of treaties are not so different from those applicable to contracts in private law as to need here a separate discussion.

Colle- tions:

8. Collections of treaties are either (i.) general or (ii.) national.

general

(i.) The first to publish a general collection of treaties was Leibnitz, whose *Codex Juris Gentium*, containing documents from 1097 to 1497, "ea quæ sola inter liberos populos legum sunt loco," appeared in 1693, and was followed in 1700 by the *Mantissa*. The *Corps Universel Diplomatique du Droit des Gens* of Dumont, continued by Barbeyrac and Rousset in thirteen folio volumes, containing treaties from 315 A.D. to 1730, was published in 1726–39. Wenck's *Corpus Juris Gentium Recentissimi*, 3 vols. 8vo, 1781–95, contains treaties from 1735 to 1772. The 8vo *Recueil* of G. F. de Martens, continued by C. de Martens, Saalfeld, Murhard, Samwer, Hopf, and Stoerk, commenced in 1791 with treaties of 1761, and is still in progress. The series in 1887 extended to sixty-four volumes. See also the following periodical publications:—*Das Staatsarchiv, Sammlung der officiellen Actenstücke zur Geschichte der Gegenwart*, Leipsic, commencing in 1861; *Archives Diplomatiques*, Stuttgart, since 1821; *Archives Diplomatiques, Recueil Mensuel de Diplomatie et d'Histoire*, Paris, since 1861; and Hertslet's *British and Foreign State Papers, from the termination of the War of 1814 to the latest period, compiled at the Foreign Office by the Librarian and Keeper of the Papers*. London, since 1819, and still in progress.

national

(ii.) The more important collections of national treaties are those of M. Neumann and M. de Plassan for Austria, 1855–84; Beutner for the German empire, 1883; Calvo for "l'Amérique Latine," 1862–69; De Clercq for France, 1864–86; De Garcia de la Vega for Belgium, 1850–83; Lagemans for the Netherlands, 1858–82; Soutzo for Greece, 1858; Count Solar de la Marguerite for Sardinia, 1836–61; De Castro for Portugal, 1856–79; Rydberg for Sweden, 1877; Kaiser (1861) and Eichmann (1885) for Switzerland; Baron de Testa (1864–82) and Aristarchi Bey (1873–74) for Turkey; F. de Martens for Russia, 1874–85; Mayers for China, 1877. The official publication for Italy begins in 1864, for Spain in 1843, for Denmark in 1874. The treaties of Japan were published by authority in 1884. Those of the United States are contained in the *Statutes at Large* of the United States, and in the collections of J. Elliott (1834) and H. Minot (1844–50); see also Mr Bancroft Davis's *Notes upon the Treaties of the United States with other Powers, preceded by a List of the Treaties and Conventions with Foreign Powers, chronologically arranged, and followed by an Analytical Index and a Synoptical Index of the Treaties*, 1873. In England no treaties were published before the 17th century, such matters being thought "not fit to be made vulgar." The treaty of 1604 with Spain was, however, published by authority, as were many of the treaties of the Stuart kings. Rymer's *Fœdera* was published, under the orders of the Government, in twenty volumes, from 1704 to 1732. Treaties are officially published at the present day in the *London Gazette*, and are also presented to parliament, but for methodical collections of treaties made by Great Britain we are indebted to private enterprise, which produced three volumes in 1710–13, republished with a fourth volume in 1732. Other three volumes appeared in 1772–81, the collection commonly known as that of C. Jenkinson (3 vols.) in 1785, and that of Chalmers (2 vols.) in 1795. J. Macgregor published (1841–44) eight volumes of commercial treaties, but the great collection of the commercial treaties of Great Britain is that of L. Hertslet, librarian of the Foreign Office, continued by his son and successor in office, Sir Edward Hertslet, entitled *A Complete Collection of the Treaties and Conventions and Reciprocal Regulations at present subsisting between Great Britain and Foreign Powers, and of the Laws and Orders in Council concerning the same, so far as they relate to Commerce and Navigation, the Slave Trade, Post Office, &c., and to the Privileges and Interests of the Subjects of the Contracting Parties*, 1820–86, 16 vols. Sir Edward Hertslet also commenced in 1875 a series of volumes containing *Treaties and Tariffs regulating the Trade between Britain and Foreign Nations, and Extracts of Treaties between Foreign Powers, containing the Most Favoured Nation Clauses applicable to Great Britain.* The treaties affecting British India are officially set out, with historical notes, in *A Collection of Treaties, Engagements, and Sannuds relating to India and Neighbouring Countries*, by C. W. Aicheson. This work, with the index, extends to eight volumes, which appeared at Calcutta in 1862–66.

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[1] *Cf.* Sir Edward Hertslet's very useful collection entitled *The Map of Europe by Treaty*, 1875.

[2] *Cf* Bynkershoek, *Quæst. Jur. Pub.*, ii. c. 10.

List of important treaties: 9. It may be worth while to add a list of some of the more important treaties, now wholly or partially in force, especially those to which Great Britain is a party, classified according to their objects, in the order suggested in paragraph 3.

political; (i.) The principal treaties affecting the distribution of territory between the various states of Central Europe are those of Westphalia (Osnabrück and Münster), 1648; Utrecht, 1713; Paris and Hubertsburg, 1763; for the partition of Poland, 1772, 1793; Vienna, 1815; London, for the separation of Belgium from the Netherlands, 1831, 1839; Zurich, for the cession of a portion of Lombardy to Sardinia, 1859; Vienna, as to Schleswig-Holstein, 1864; Prague, whereby the German Confederation was dissolved, Austria recognizing the new North German Confederation, transferring to Prussia her rights over Schleswig-Holstein, and ceding the remainder of Lombardy to Italy, 1866; Frankfort, between France and the new German empire, 1871. The disintegration of the Ottoman empire has been regulated by the great powers, or some of them, in the treaties of London, 1832, 1863, 1864, and of Constantinople, 1881, with reference to Greece; and by the treaties of Paris, 1856; London, 1871; Berlin, 1878; London, 1883, with reference to Montenegro, Roumania, Servia, Bulgaria, and the navigation of the Danube. The encroachments of Russia upon Turkey, previous to the Crimean War, are registered in a series of treaties beginning with that of Kutchuk-Kainardji, 1774, and ending with that of Adrianople in 1829. The independence of the United States of America was acknowledged by Great Britain in the treaty of peace signed at Paris in 1783. The boundary between the United States and the British possessions is regulated in details by the treaties of Washington of 1842, 1846, 1871. Switzerland, Belgium, Corfu and Paxo, and Luxemburg are respectively neutralized by the treaties of Vienna, 1815, and of London, 1839, 1864, 1867. A list of treaties of guarantee to which Great Britain is a party, and which are supposed to be still in force, beginning with a treaty made with Portugal in 1373, was presented to parliament in 1859.

commercial; (ii.) For the innumerable conventions to which Great Britain is a party as to commerce, consular jurisdiction, fisheries, and the slave trade, it must suffice to refer to the exhaustive and skilfully devised index to Hertslet's *Commercial Treaties*, forming volume xvi., 1885.

social; (iii.) The social intercourse of the world is facilitated by conventions, such as those establishing the Latin monetary union, 1865; the international telegraphic union, 1865; the universal postal union, 1874; the international bureau of weights and measures, 1875; and providing for the protection of submarine cables in time of peace, 1884. Such treaties are somewhat misleadingly spoken of by recent writers (L. von Stein and F. de Martens) as constituting a "droit administratif international."

as to extradition (iv.) The following are the now operative treaties of extradition to which Great Britain is a party:—with the United States, 1842; Brazil and Germany, 1872; Austria, Denmark, Italy, Norway and Sweden, 1873; Hayti and Netherlands, 1874; Belgium and France, 1876; Spain, Portugal (as to India only), 1878; Tonga, 1879; Luxemburg, Equador, and Switzerland, 1880; Salvador, 1881; Uruguay, 1884; Guatemala, 1885; Russia, 1886. It will be observed that all these, except the treaty with the United States, are subsequent to and governed by the provisions of 33 and 34 Vict. c. 52, "The Extradition Act, 1870." Before the passing of this general Act, it had been necessary to pass a special Act for giving effect to each treaty of extradition. The most complete collection of treaties of extradition is that of F. J. Kirchner, *L'Extradition, Recueil, &c.*, London, 1883.

as to copyright &c.; (v.) General conventions, to which most of the European states are parties, were signed in 1883 at Paris for the protection of industrial, and in 1886 at Bern for the protection of literary and artistic, property.

as to the conduct of warfare. (vi.) Certain bodies of rules intended to mitigate the horrors of war have received the adhesion of most civilized states. Thus the declaration of Paris, 1856 (to which, however, the United States, Spain, Mexico, Venezuela, Columbia, Bolivia, and Uruguay have declined to accede), prohibits the use of privateers and protects the commerce of neutrals; the Geneva convention, 1864, gives a neutral character to surgeons and hospitals; and the St Petersburg declaration, 1868, prohibits the employment of explosive bullets weighing less than 400 grammes.

It were greatly to be wished that the official publication of treaties could be rendered more speedy and more methodical than it now is. The labours of the publicist would also be much lightened were it possible to consolidate the various general collections of diplomatic acts into a new *Corps Diplomatique Universel*, well furnished with cross references, and with brief annotations showing how far each treaty is supposed to be still in force.

Literature. 10. In addition to the works already cited in the course of this article the following are for various reasons important:—Joh. Lupus, *De Confederatione Principum*, Strasburg, 1511 (the first published monograph upon the subject); Bodinus, *Dissertatio de Contractibus Summarum Potestatum*, Halle, 1696; Neyron, *De Vi Fœderum inter Gentes*, Gött., 1778; Neyron, *Essai Historique et Politique sur les Garanties, &c.*, Gött., 1797; Wächter, *De Modis Tollendi Pacta inter Gentes*, Stuttg., 1780; Dresch, *Ueber die Dauer der Völkerverträge*, Landshut, 1808; C. Bergbohm, *Staatsverträge und Gesetze als Quellen des Völkerrechts*, Dorpat, 1877; Jellinek, *Die rechtliche Natur der Statenvertragen*, Vienna, 1880; Holzendorff, *Handbuch des Völkerrechts*, vol. iii., 1887. On the history of the great European treaties generally, see the *Histoire Abrégée des Traités de Paix entre les Puissances de l'Europe*, by Koch, as recast and continued by Schöll, in 1817 and 1818, and again by Count de Garden in 1848–59; as also the *Recueil Manuel* of De Martens and Cussy, now continued by Geffcken. For the peace of Westphalia Putter's *Geist des westphälischen Friedens*, 1795, is useful; for the congress of Vienna, Kluber's *Acten des Wiener Congresses*, 1815–19, and *Le Congrès de Vienne et les Traités de 1815, précédé des Conférences de Dresde, de Prague, et de Chatillon, suivi des Congrès d'Aix-la-Chapelle, Troppau, Laybach, et Vérone*, by Count

Angeberg. The last-mentioned writer has also published collections of treaties relating to Poland, 1762–1862; to the Italian question, 1859; to the congress of Paris, 1856, and the revision of its work by the conference of London, 1871; and to the Franco-German War of 1870–71. For the treaties regulating the Eastern question, see *The European Concert in the Eastern Question*, by T. E. Holland, 1885, and *La Turquie et le Tanzimat*, by E. Engelhardt, 1882–84. (T. E. H.)

TREBIZOND, in Greek Trapezus, a city of Asia Minor, situated on the Black Sea, near its south-eastern angle, from the time of its foundation as a Greek colony to the present day has always been a considerable emporium of commerce, and at one time was for two centuries and a half the capital of an empire. Its importance is due to its geographical position, because it commands the point where the chief and most direct trade route from Persia and Central Asia to Europe, over the tableland of Armenia by Bayazid and Erzeroum, descends to the sea. Its safety also was secured by the barrier of rugged mountains which separates its district from the rest of Asia Minor, rising to the height of 7000 or 8000 feet above the sea-level. So complete is the watershed that no streams pass through these ranges, and there is hardly any communication in this direction between the interior of Asia Minor and the coast. For the same reason, together with its northern aspect, the climate is humid and temperate, and favourable to the growth of vegetation, unlike that of the inland regions, which are exposed to great extremes of heat in summer and cold in winter. The position which was occupied by the Hellenic and mediæval city is a sloping table of ground (whence the original name of the place, Trapezus, or the "Tableland"), which falls in steep rocky precipices on the two sides, where two deep valleys, descending from the interior, run parallel at no great distance from one another down to the sea. The whole is still inclosed by the Byzantine walls, which follow the line of the cliffs, and are carried along the sea-face; and the upper part of the level, which is separated from the lower by an inner cross wall, forms the castle; while at the highest point, where a sort of neck is formed between the two valleys, is the keep which crowns the whole. The fortifications and their surroundings are singularly picturesque, for the towers, some round, some angular, which project from them are in many cases covered with creepers, and the gardens that occupy the valleys below teem with luxuriant vegetation. On each side, about half-way between the keep and the sea, these ravines are crossed by massive bridges, and on the further side of the westernmost of these, away from the city, a large tower and other fortifications remain, which must have served to defend the approach from that quarter. The area of the ancient city is now called the Kaleh, and is inhabited by the Turks; eastward of this is the extensive Christian quarter, and beyond this again a low promontory juts northward into the sea, partly covered with the houses of a well-built suburb, which is the principal centre of commerce. The harbour lies on the eastern side of this promontory, but it is an unsafe roadstead, being unprotected towards the north-east, and having been much silted up, so that vessels cannot approach within a considerable distance of the shore. The neighbourhood of this is the liveliest portion of the city, as it is from here that the caravans start for Persia, and at certain periods of the year long trains of camels may be seen, and Persian merchants conspicuous by their high black caps and long robes. The total population of the place is estimated at 32,000, of whom 2000 are Armenians, 7000 or 8000 Greeks, and the rest Turks.

The city of Trapezus was a colony of Sinope, but it first comes into notice at the time of the Retreat of the Ten Thousand, who found repose there. Notwithstanding its commercial importance, the remoteness of its position prevented it from being much known to fame either in the Hellenic or the early mediæval period; its greatness dates from the time of the fourth crusade (1204), when the Byzantine empire was dismembered and its capital occupied by the Latins. During the confusion that followed that event a scion of the imperial family of the Comneni, called Alexius, escaped into Asia, and, having collected an army of Iberian mercenaries, entered Trebizond, where he was acknowledged as the legitimate sovereign, and assumed the title of Grand Comnenus. Though only twenty-two years of age, Alexius was a man of ability and resolute will, capable of establishing order in a time of anarchy; and thus he succeeded without difficulty in making himself master of the greater part of the southern coast of the Black Sea. The empire that was thus founded continued to exist until 1461, when the city was taken by Mohammed II., eight years after he had captured Constantinople. The cause of this long duration, and at the same time the secret of its history, is to be found in the isolated position of Trebizond and its district, between the mountains and the sea, which has already been described. By this means it was able to defy both the Seljúks and the Ottomans, and to maintain its independence against the emperors of Nicæa and Constantinople. But for the same reason its policy was always narrow, so that it never exercised any beneficial influence on the world at large. It was chiefly in the way of matrimonial alliances that it was brought into contact with other states. The imperial family were renowned for their beauty, and the princesses of this race were sought as brides by Byzantine emperors of the dynasty of the Palæologi, by Western nobles, and by Mohammedan princes; and the connexions thus formed originated a variety of diplomatic relations and friendly or offensive alliances. The palace of Trebizond was famed for its magnificence, the court for its luxury and elaborate ceremonial, while at the same time it was frequently a hotbed of intrigue and immorality. The Grand Comneni were also patrons of art and learning, and in consequence of this Trebizond was resorted to by many eminent men, by whose agency the library of the palace was provided with valuable manuscripts and the city was adorned with splendid buildings. The writers of the time speak with enthusiasm of its lofty towers, of the churches and monasteries in the suburbs, and especially of the gardens, orchards, and olive groves. It excited the admiration of Gonzales Clavijo, the Spanish envoy, when he passed through it on his way to visit the court of Timur at Samarkand (Clavijo, *Historia del Gran Tamorlan*, p. 84); and Cardinal Bessarion, who was a native of the place, in the latter part of his life, when the city had passed into the hands of the Mohammedans, and he was himself a dignitary of the Roman Church, so little forgot the impression it had made upon him that he wrote a work entitled "The Praise of Trebizond" (Ἐγκώμιον Τραπεζοῦντος), which exists in manuscript at Venice. Little was known of the history of the empire of Trebizond until the subject was taken in hand by Prof. Fallmerayer of Munich, who discovered the chronicle of Michael Panaretus among the books of Cardinal Bessarion, and from that work, and other sources of information which were chiefly unknown up to that time, compiled his *Geschichte des Kaiserthums von Trapezunt* (Munich, 1827). Finlay's account of the period, in the fourth volume of his *History of Greece*, is based on this. From time to time the emperors of Trebizond paid tribute to the Seljúk sultans of Iconium, to the grand khans of the Mongols, to Timur the Tartar, to the Turcoman chieftains, and to the Ottomans; but by means of skilful negotiations they were enabled practically to secure their independence. We find them also at war with many of these powers, and with the Genoese, who endeavoured to monopolize the commerce of the Black Sea. The city was several times besieged, the most formidable attack being that which occurred in the reign of Andronicus I., the second emperor, when the Seljúks, under the command of Melik, the son of the great sultan Ala-ed-din, first assaulted the northern wall in the direction of the sea, and afterwards endeavoured to storm the upper citadel by night. They failed, however, in both attempts; and in the latter, owing to the darkness, and to the occurrence of a violent storm which suddenly swelled the torrents in the ravines, their force was thrown into inextricable confusion, and they were compelled to abandon their camp and make the best of their escape from the country. So great was the strength of the fortifications that, when Mohammed II. turned his thoughts towards the subjugation of this state, he might have experienced much difficulty in reducing it, and might have been disposed to offer favourable terms, had it not been for the pusillanimous conduct of David, the last emperor, who surrendered the place almost unconditionally.

Several interesting monuments of this period remain at Trebizond in the form of churches in the Byzantine style of architecture. One of these is within the area of the old city, viz., the church of the Panaghia Chrysokephalos, or Virgin of the Golden Head, a large and massive but excessively plain building, which is now the Orta-hissar mosque. On the further side of the eastern ravine stands a smaller but very well proportioned structure, the church of St Eugenius, the patron saint of Trebizond, now the Yeni Djuma djami, or New Friday mosque. Still more important is the church of Haghia Sophia, which occupies a conspicuous position overlooking the sea, about two miles to the west of the city. The porches of this are handsomely ornamented, and about a hundred feet from it rises a tall campanile, the inner walls of which have been covered in parts with frescos of religious subjects, though these are now much defaced. But the most remarkable memorial of the Middle Ages that exists in all this district is the monastery of Sumelas, which is situated among the mountains, about 25 miles from Trebizond, at the side of a rocky glen, at a height of 4000 feet above the sea. Its position is most extraordinary, for it occupies a cavern in the middle of the face of a perpendicular cliff a thousand feet high, where the white buildings offer a marked contrast to the brown rock which forms their setting. It is approached by a zigzag path at the side of the cliff, from which a flight of stone steps and a wooden staircase give access to the monastery. The valley below is filled with the richest vegetation, the undergrowth being largely composed of azaleas and rhododendrons. An antiquity of 1500 years is claimed for the foundation of the monastery, but it is certain that the first person who raised it to importance was the emperor Alexius Comnenus III. of Trebizond; he rebuilt it in 1360, and richly endowed it. The golden bull of that emperor, which became thenceforth the charter of its foundation, is still preserved; it is one of the finest specimens of such documents, and contains portraits of Alexius himself and his queen. The monastery also possesses the firman of Mohammed II. by which he accorded his protection to the monks when he became master of the country. (H. F. T.)

TREDEGAR, a town of Monmouthshire, England, is situated on the Sirhowy river, and on the London and North Western Railway system, 7 miles east-north-east of Merthyr Tydvil and 249 west of London. The town owes its existence to the establishment in the beginning of the century of the works of the Tredegar Iron and Coal Company, who lease the soil and minerals from Lord Tredegar. The iron-works, chiefly for the smelting of iron and the manufacture of iron and steel rails, are of enormous extent, and employ upwards of 4000 men. The town is also surrounded by iron and coal mines, the property of the company. It consists chiefly of workmen's houses, but is built with regularity and neatness, the principal streets diverging from an open space called the Circle, in the centre of the town, where there are a number of good shops. The church of St George is a tasteful modern building in the Norman style. The temperance hall, union workhouse, and literary institute and library deserve notice. The population of the urban sanitary district (area 7029 acres), a small portion of which is in Brecknockshire, in 1871 was 16,989 and in 1881 it was 18,771

TREE-CREEPER, one of the smallest of British birds, and, regard being had to its requirements, one very generally distributed. It is the *Certhia familiaris* of ornithology, and remarkable for the stiffened shafts of its long and pointed tail-feathers, aided by which, and by its comparatively large feet, it climbs nimbly, in a succession of jerks, the trunks or branches of trees, invariably proceeding upwards or outwards and generally in a spiral direction, as it seeks the small insects that are hidden in the bark and form its chief food. When in the course of its search it nears the end of a branch or the top of a trunk, it flits to another, always alighting lower down than the place it has left, and so continues its work.

Inconspicuous in colour, for its upper plumage is mostly of various shades of brown mottled with white, buff, and tawny, and beneath it is of a silvery white, the Tree-Creeper is far more common than the incurious suppose; but, attention once drawn to it, it can be frequently seen and at times heard, for though a shy singer its song is loud and sweet. The nest is neat, generally placed in a chink formed by a half-detached piece of bark, which secures it from observation, and a considerable mass of material is commonly used to partly stuff up the opening and give a sure foundation for the tiny cup, in which are laid from six to nine eggs of a translucent white, spotted or blotched with rust-colour. The Tree-Creeper inhabits almost the whole of Europe as well as Algeria, and has been traced across Asia to Japan. It is now recognized as an inhabitant of the greater part of North America, though for a time examples from that part of the world, which differed slightly in the tinge of the plumage, were accounted a distinct species (*C. americana*), and even those from Mexico and Guatemala (*C. mexicana*) have lately been referred to the same. It therefore occupies an area not exceeded in extent by that of many Passerine birds, and is one of the strongest witnesses to the close alliance of the so-called Nearctic and Palæarctic Regions.

Allied to the Tree-Creeper, but wanting its lengthened and stiff tail-feathers, is the genus *Tichodroma*, the single member of which is the Wall-Creeper (*T. muraria*) of the Alps and some other mountainous parts of Europe and Asia, and occasionally seen by the fortunate visitor to Switzerland fluttering like a big butterfly against the face of a rock, conspicuous from the scarlet-crimson of its wing-coverts and its white spotted primaries. Its bright hue is hardly visible when the bird is at rest, and it then presents a dingy appearance of grey and black. It is a species of wide range, extending from Spain to China; and, though but seldom leaving its cliffs, it has wandered even so far as England. Merrett (*Pinax*, p. 177) in 1667 included it as a British bird, and the correspondence between Marsham and Gilbert White (*Proc. Norf. and Norw. Nat. Society*, ii. p. 180) proves that an example was shot in Norfolk, 30th October 1792; while another is reported (*Zoologist*, ser. 2, p. 4839) to have been killed in Lancashire, 8th May 1872

The genus *Certhia* as founded by Linnæus contained 25 species, all of which, except the two above mentioned, have now been shewn to belong elsewhere; and for a long while so many others were referred to it that it became a most heterogeneous company. At present, so few are the forms left in the Family *Certhiidæ* that systematists are not wanting to unite it with the *Sittidæ* (*cf.* NUTHATCH), for the two groups, however much their extreme members may differ, are linked by so many forms which still exist that little violence is done to the imagination by drawing upon the past for others to complete the series of descendants from a common and not very remote ancestor, one that was possibly the ancestor of the WRENS (*q.v.*) as well. One thing, however, has especially to be noticed here. The *Certhiidæ* have not the least affinity to the *Picidæ* (*cf.* WOODPECKER, *infra*), but are strictly Passerine, though the Australian genus *Climacteris* may possibly not belong to them. (A. N.)

TREE-FERN. In old and well-grown specimens of some of the familiar ferns of our temperate climates the wide-spreading crown of fronds may be observed to rise at a distance often of a good many inches above the surface of the ground, and from a stem of considerable thickness. The common male fern *Nephrodium* (*Lastræa*) furnishes the commonest instance of this; higher and thicker trunks are, however, occasionally presented by the royal fern (*Osmunda regalis*), in which a height of 2 feet may be attained, and this with very considerable apparent thickness, due, however, to the origin and descent of a new series of adventitious roots from the bases of each annual set of fronds. Some tropical members and allies of these genera become more distinctly tree-like, *e.g.*, *Todea*; *Pteris* also has some sub-arboreal forms. *Oleandra* is branched and shrub-like, while *Angiopteris* and *Marattia* (*Marattiaceæ*) may also rise to 2 feet or more. But the tree-ferns proper are practically included within the family *Cyatheaceæ*. This includes five genera (*Cyathea*, *Alsophila*, *Hemitelia*, *Dicksonia*, *Balantium*) and nearly 200 species, of which a few are herbaceous, but the majority arboreal and palm-like, reaching frequently a height of 50 feet or more, *Alsophila excelsa* of Norfolk Island having sometimes measured 60 to 80 feet. The fronds are rarely simple or simply pinnate, but usually tripinnate or decompound, and may attain a length of 20 feet, thus forming a splendid crown of foliage. The stem may occasionally branch into many crowns. The genera are of wide geographical range, mostly of course within the tropics of the Old and New World; but South Australia, New Zealand, and the Southern Pacific islands all possess their tree-ferns. In Tasmania *Alsophila australis* has been found up to the snow-level, and in the humid and mountainous regions of the tropics tree-ferns are also found to range up to a considerable altitude. The fronds may either contribute to the apparent thickness of the stem by leaving more or less of their bases, which become hardened and persistent, or they may be articulated to the stem and fall off, leaving characteristic scars in spiral series upon the stem. The stem is frequently much increased in apparent thickness by the downgrowth of aerial roots, forming a black coating several inches or even a foot in thickness, but its essential structure differs little in principle from that familiar in the rhizome of the common bracken (*Pteris*). To the ring or rather netted cylinder of fibro-vascular bundles characteristic of all fern stems scattered internal as well as external bundles arising from these are superadded; and in a tree-fern these are of course in greater numbers. The outer bundles give off branches to the descending roots from the region where they pass into the leaves.

Tree-ferns are of course cultivated for their beauty alone; a few, however, are of some economic applications, chiefly as sources of starch. Thus the beautiful *Alsophila excelsa* of Norfolk Island is said to be threatened with extinction for the sake of its sago-like pith, which is greedily eaten by hogs; *Cyathea medullaris* also furnishes a kind of sago to the natives of New Zealand, Queensland, and the Pacific islands. A Javanese species of *Dicksonia* (*D. chrysotricha*) furnishes silky hairs, which have been imported as a styptic, and the long silky or rather woolly hairs, so abundant on the stem and frond-leaves in the various species of *Cibotium*, have not only been put to a similar use, but in the Sandwich Islands furnish wool for stuffing mattresses and cushions, which was formerly an article of export. The "Tartarian lamb," or *Agnus scythicus* of old travellers' tales in China and Tartary, is simply the woolly stock of *C. Barometz*, which, when dried and inverted and all save four of its frond-stalks cut away, has a droll resemblance to a toy sheep.

See Ferns; J. Smith, *Historia Filicum*; Luerssen, *Med. Pharm. Botanik*; and for the structure of the stem, De Bary's *Vergleich. Anatomie d. Phanerog. u. Farne.*

TREGELLES, Samuel Prideaux (1813-1875), New Testament scholar, was born at Wodehouse Place, near Falmouth, on January 30, 1813. His parents were Quakers, and he himself for many years was in communion with the (Darbyite) Plymouth Brethren, but latterly he became a member of the Church of England. He was educated at Falmouth grammar school, and afterwards, without having attended any university, held various modest educational appointments, but finally devoted himself entirely to a laborious student life, until he was incapacitated for literary work by paralysis in 1870. He died at Plymouth on April 24, 1875.

Most of his numerous publications had reference to his great critical edition of the New Testament (see Bible, vol. iii. p. 648). They include an *Account of the Printed Text of the Greek New Testament* (1854), a new edition of Horne's *Introduction* (1860), and *Canon Muratorianus: Earliest Catalogue of Books of the New Testament* (1868). As early as 1844 he published an edition of the Apocalypse, with the Greek text so revised as to rest almost entirely upon ancient evidence. Tregelles wrote *Heads of Hebrew Grammar* (1852), translated Gesenius's *Hebrew Lexicon*, and was the author of a little work on the *Jansenists* (1851) and of various works in exposition of his special eschatological views (*Remarks on the Prophetic Visions of Daniel*, 1852, new ed. 1864).

TREMATODA, popularly known as "flukes," form one of the three main divisions of the flatworms or *Platyhelminthes*. They have been defined thus (Jackson, 1):[1]—

"Unisegmental *Vermes*, with a flattish, leaf-like, more or less cylindrical body provided with organs of adhesion in the shape of suckers and sometimes of chitinoid hooks. The cuticle, so called, appears to be a metamorphosed layer of cells. There is a well-developed nervous system, the ganglia of which are entirely supra-pharyngeal, *i.e.*, dorsal. There is a mouth, and an alimentary canal which is usually forked, but no anus. The excretory system has the form of more or less branching tubes commencing with flame-cells, and either ending in a contractile vesicle or opening by two independent orifices. Hermaphrodite self-impregnation occurs, as well as reciprocal impregnation. The embryo either develops direct into the sexual form (monogenetic *Trematoda*) or gives origin to a series of intermediate non-sexual dimorphic forms (digenetic *Trematoda*). Parasitic."

Historical Sketch.—Some of the more salient points in the history of our knowledge of these animals have already been alluded to in the article Parasitism (*q.v.*); a few additional facts must, however, be mentioned here. The *Trematoda* were first formed into a group by Rudolphi (2), who included in it the following genera:—*Monostoma*, *Amphistoma*, *Distoma*, *Tristoma*, *Pentastoma*, and *Polystoma*; the name had reference to the suckers, which Rudolphi regarded as being for the most part openings into the body (Gr. τρῆμα, an aperture). Some of these forms were soon perceived to have but small connexion with the others; and Cuvier (3) reduced the whole to one genus, for which he adopted the name *Fasciola*, Linn. The Pentastomes have since been transferred to the Arachnida (*q.v.*).

Our scientific acquaintance with the group may be said to date from 1831, when Mehlis noticed that the eggs of certain Distomes hatched into a minute ciliated body with an eye-speck resembling an Infusorian, an observation which gave the key to the life-history of these forms. Von Siebold in 1835 (4) supplemented this discovery by the observation that the ciliated embryo of *Monostomum mutabile* contained, as a "necessary parasite," as it was termed, an organism identical with the "kingsyellow worm" (*Redia*), found by Bojanus in pond-snails, and Von Baer had previously shown (5) that these gave rise to free-swimming organisms not unlike tailed Trematodes. The materials were thus ready to hand for a co-ordination of the whole life-history, and Steenstrup recognized it as an instance of the so-called "alternation of generations" (6). These researches received important additions at the hands of Pagenstecher (7) and others, who showed experimentally that encysted Distomes grow mature directly after their transference from one host to another, and thus that a migration is necessary to the attainment of their maturity. Diesing's great work (8) appeared in 1850, and has formed the groundwork of all subsequent treatises on the systematic arrangement of parasitic worms, although it included forms which really belong to quite different groups. In 1861 Van Beneden gained a prize offered by the French Academy by his elaborate memoir on the intestinal worms (9), in which he not only described many new and interesting forms, but gave anatomical details regarding others previously known, and entered into detailed comparisons between the Cestodes and Trematodes, both in their adult and immature states. Of recent years the chief additions to our knowledge have been more in the direction of further details regarding the structure and life-history of special forms than the elaboration of new general principles.

Anatomy.—In endeavouring to give a very brief account of the more salient points in the anatomy of the *Trematoda* it has been thought expedient to select some well-known form as a type, and afterwards to indicate the characters in which other species differ from it; for this purpose the common liver-fluke, *Fasciola* (*Distomum*) *hepatica* has been chosen, as it is not unfrequently found in the bile-ducts of sheep and other domestic animals, and constitutes a scourge much dreaded by farmers. The account here given is in the main abstracted from Sommer (10).

External Appearance.—The animal has a flattened oval shape, with a sub-triangular process on the broader end, which represents the head. The total length varies from 20 to 35 mm., the breadth from 6 to 12 mm. On superficial examination two narrower lateral areas may generally be distinguished from a broader median one; the former are occasionally of a coarsely granular appearance and reddish-brown or orange in colour, and increase in breadth towards the posterior end of the body, where they commonly unite. The median area is commonly greyish-yellow in colour, sometimes spotted with black; its anterior portion corresponds to the uterus, the posterior to the testes. Two suckers (fig. 1, A, *o*, *s*) are in the middle line of the body; one is at the anterior extremity, and is directed forwards and somewhat downwards; it is known as the anterior or oral sucker, being perforated by the œsophagus. The posterior or ventral sucker is situated, as its name implies, on the inferior surface of the body, just behind the head-papilla. The suckers measure on an average about 1 mm. in diameter, the ventral being slightly the larger. The internal organs communicate with the outer world by four apertures:—(1) the mouth (*o*), situated at the anterior pole of the body and perforating the oral sucker; (2) the excretory pore (*x*), placed at the opposite extremity, and giving exit to the effete products; (3) the porus genitalis (fig. 1, B, *p*), leading into a sinus into which the ducts of both sets of genital organs open,—it is to be found on the under surface of the head-papilla at or near its centre; (4) the opening of the Laurer-Stieda canal, situated on the dorsal surface of the animal, near the junction of the two portions of the median area,—it is excessively minute and difficult of detection, and leads by a narrow canal into the duct of the yolk-gland.

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[1] These figures refer to the bibliography at the end of the article.

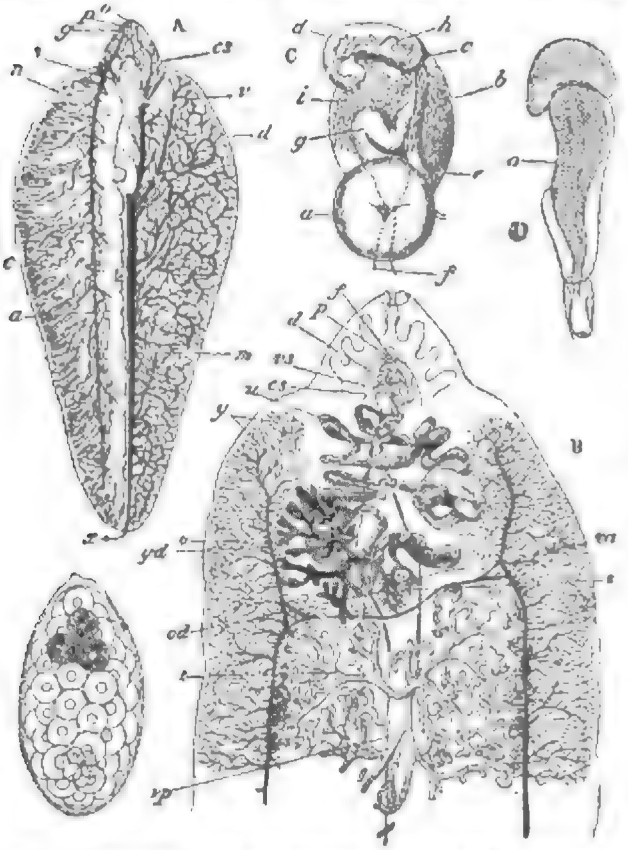

Fig. 1.—A, *Fasciola hepatica*, from the ventral surface (×3); the alimentary and nervous systems only shown on the left side of the figure, the excretory only on the right. *a*, right main branch of the intestine; *c*, a diverticulum; *g*, lateral ganglion; *n*, lateral nerve; *o*, mouth; *p*, pharynx; *v*, ventral sucker; *cs*, cirrus sac; *d*, left anterior dorsal excretory vessel; *m*, main vessel; *v*, left anterior ventral trunk; *x*, excretory pore. B, Anterior portion more highly magnified (from Marshall and Hurst, after Sommer). *cs*, cirrus sac; *d*, ductus ejaculatorius; *f*, female aperture; *o*, ovary; *od*, oviduct; *p*, penis; *s*, shell-gland; *t*, anterior testis; *u*, uterus; *va*, *vp*, vasa deferentia; *vs*, vesicula seminalis; *y*, yolk-gland; *yd*, its duct. C, Genital sinus and neighbouring parts (from Sommer). *a*, ventral sucker; *b*, cirrus sac; *c*, genital pore; *d*, evaginated cirrus sac (? penis); *e*, end of vagina; *f*, vasa deferentia; *g*, vesicula seminalis; *h*, ductus ejaculatorius; *i*, accessory gland. D, A ciliated funnel from the excretory apparatus, highly magnified (from Fraipont.) *o*, orifice of the funnel. E, Egg of *Fasciola hepatica*: ×380 (from Thomas).

Internal Structure.—All *Trematoda* have been commonly regarded, like other flat-worms, as devoid of a body-cavity (cœlom), and as consisting of parenchymatous tissue, in which the various organs were embedded. Recent researches of Fraipont (15) appear to show, however, that the intercellular spaces in this tissue are to be regarded as the homologue of a cœlom. The body is enclosed by a complex sheath (cortex), which may be resolved into several layers, which will be discussed in order, proceeding from without inwards. (1) The cuticle, which encloses the whole body, is a thin, pellucid, structureless membrane; at the margin of the mouth it is reflected so as to form a lining for the œsophagus, and similarly at the opening of the genital sinus it passes inwards to form a lining to the vagina. The same phenomenon is observed at the excretory aperture. By the application of ammonia the cuticle may be separated from the subjacent tissues and its peculiarities demonstrated; although apparently smooth to the naked eye, it presents under the microscope numerous sharp backwardly directed processes, each of which encloses a hard stylet-shaped body. These prominences are closely set over the whole body except immediately around the suckers, extending even into the interior of the sinus genitalis. The cuticle is furthermore perforated by innumerable fine pores, directed outwards and somewhat backwards. With regard to the homology of the cuticle of Trematodes the same uncertainty prevails as in the case of Cestodes (see TAPE-WORMS); the general opinion is that it is not comparable with the chitinous cuticle of *Arthropoda*, but is either a specially developed basement-membrane (Kerbert, 11) or a layer of modified cells (Ziegler, 12, and Schwarze, 13). (2) The outer cellular layer is the matrix of the cuticle. (3) The muscular coat consists of three different layers:—(i.) a thin layer of circular fibres; (ii.) the longitudinal muscles, which form a series of separate bundles; (iii.) the oblique muscles, confined to the anterior half or third of the body, and crossing so as to form a rhomboidal lattice-work,—they are especially strong on the anterior ventral aspect of the animal. (4) The inner cellular layer consists of elements which closely resemble those of the outer, but are somewhat larger; they have been mistaken by various observers for cuticular glands. The suckers may be considered as parts of the cortical layer; speaking generally, each has the form of the segment of a sphere, although the anterior one is shallower at the lower than at the upper margin, and is penetrated by the œsophagus. Each consists of three sets of muscles,—a thin outer equatorial layer, a second meridional, and a mass of radially disposed fibres forming the greater part of the substance. It would appear that the function of the first two of these groups is to flatten out the sucker, whilst the radial ones restore its cavity and thus produce a suctorial action. To the ventral sucker are attached a number of muscular fibres belonging to the dorso-ventral system, and in particular a strong bundle, which passes from behind downwards and forwards.

Digestive system.

The digestive system (fig. 1, A), the presence of which furnishes one of the most characteristic differences between Trematodes and Cestodes, extends throughout the body on a plane between the peripheral nervous and reproductive systems. It has only one aperture, as above mentioned, in the centre of the anterior sucker. The anterior portion or pharynx, although very short, measuring not much more than 1 mm. in length, is again divisible into two sections. The hinder of these is the larger, and is sometimes spheroidal but more commonly fusiform in shape; it has strong muscular walls, which, in conjunction with protractor and retractor muscles, bring about a kind of pumping action whereby nutritive fluids are taken into the stomach, which name may be applied to the larger posterior section of the alimentary tract, since in it the digestive processes are carried on. The canal, which leads from the posterior end of the pharynx, divides almost immediately into two branches, which diverge at first rapidly and then run almost parallel, as far as the hinder end of the body. Each of these gives off from its outer aspect some 16 or 17 lateral branches (*c*), which divide and subdivide till their ramifications fill nearly the whole area of the body. The digestive tract is lined by a layer of simple cells, resembling a cylinder epithelium. These behave towards the blood corpuscles and other contents of the intestine exactly as would a number of *Amœbæ*, putting out processes or pseudopodia, which ingest them,—so that, in common with many of the lower Invertebrates, the liver-fluke lives by "intracellular digestion" (see Metschnikoff, 14).

Excretory system.

The canals of the excretory system (*m*) may be divided into three groups. (1) The collecting network consists of very fine tubules which anastomose freely with each other; they are situated on the boundary between the cortical and middle layers, and are therefore visible from either side of the body. (2) Conducting vessels (*v*, *d*) receive the contents of this network. Each of these is formed by the union of a larger or smaller number of the delicate canals just described, and after a longer or shorter course opens into the median excretory canal (*m*). On the way, however, it communicates with the neighbouring vessels, so that a second network is formed, which is distinguished from that of the collecting tubules by the greater size of its meshes and by the fact that it is specially visible from the dorsal surface of the animal. In the head four of these conducting vessels arise, which are disposed in two pairs, one situated dorsally and one ventrally. As they pass backwards they receive many branches, the dorsal unites with the ventral of its own side, and the two tubes thus formed unite to constitute the last division of the excretory system. (3) The median vessel (*m*) passes along the body for the posterior two-thirds of its length, immediately beneath the dorsal cortical layer. It is widest near the commencement, where it measures about 0·5 mm. in diameter, and finally opens at the posterior extremity of the body. The wall of the excretory apparatus is constituted everywhere by an exceedingly delicate elastic membrane, which exhibits neither a cellular lining nor cilia; furthermore, neither valves nor muscles have been demonstrated in connexion with it. It contains a thin colourless fluid, in which very small highly refractive drops are suspended.

The details of the termination of the excretory system seem to have been first clearly made out by Fraipont (15), who worked upon species in which they are more distinct than in the form now under consideration. The spaces between the round connective-tissue cells of the body are star-shaped in form, and into these the finest excretory tubules, above mentioned, open by funnels (fig. 1, D), into each of which projects a vibratile cilium, thus constituting the so-called "flame-cells." These researches have given rise to numerous differences of opinion, as regards questions both of fact (16) and of priority (17).

The liver-fluke contains a complete set of male and female organs, which form the most conspicuous part of its anatomy, and both of which open into the genital sinus which has been described above. *A. The Male Organs.* (i.) The testes (fig. 1, B, *t*) are two in number, situated one behind the other in the hinder division of the median area. They rest upon the ventral cortical layer in the parenchyma of the body, and immediately above them are the ramifications of the digestive tract. Each consists of a large number of ramifying tubes, often with slightly dilated extremities. These unite into three or four, and eventually into two, main excretory ducts (*va*, *vp*), which terminate at the base of the cirrus-pouch. Within the testicular tubules may be found spermatozoa in all stages of development; the first stage appears to consist of small roundish membraneless cells with a single nucleus; the nucleus then divides and the cells become polygonal from mutual pressure. These large cells lie in the middle rather than at the sides of the tube, and among them are a number which, while they possess on one side a smooth evenly rounded contour, are on the other very irregularly and deeply serrated. These serrations elongate until they become the delicate filaments of spermatozoa, the small shining heads of which are still embedded in the protoplasm of the cell. (ii.) The vasa deferentia (*va*, *vp*) are a pair of slender elongated canals, which lie on the two sides of the middle line, and unite at the inner extremity of the cirrus-pouch, which they penetrate in common. Their walls consist of a very delicate homogeneous but resistant membrane, upon which contractile fibres are disposed, close together and parallel to the axis. (iii.) The cirrus-pouch (*cs*) is a muscular egg-shaped organ; the upper pole, which receives the united vasa deferentia, is situated above the ventral sucker and separated by only a very slight interval from the dorsal cortical layer, whilst the position of the lower pole is indicated by the porus genitalis (*p*). The muscles are disposed in two layers, of which the inner is thin and composed of circular fibres; the outer longitudinal layer is much thicker, and its fibres are disposed in bundles; furthermore its apex receives a large number of dorso-ventral fibres. Within the cirrus-pouch the two terminal sections of the male conducting apparatus are situated. (iv.) The first of these is the vesicula seminalis (fig. 1, B, *vs*; C, *g*), a large, spindle-shaped dilatation of the canal usually more or less curved upon itself. Its wall is somewhat more complex than that of the vasa deferentia, consisting of a layer of tissue with many nuclei but no distinct cell-boundaries, succeeded by a delicate layer of circular muscular fibres, which is again followed by a layer of longitudinal ones. (v.) The ductus ejaculatorius (fig. 1, C, *h*), which immediately succeeds the vesicula seminalis, is a long slender tube, disposed in coils, and usually projecting like a papilla into the base of the sinus genitalis. Its walls are furnished with a number of unicellular glands. *B. The Female Organs.* The female reproductive apparatus may be roughly divided into two portions, that which produces the eggs and that which conveys them to the outside of the body; in the former of these processes three organs take part—one producing the germ, another the secondary or food-yolk, and a third the egg-shell. (i.) The germarium or ovary (fig. 1, B, *o*) is situated between the anterior testis and the ventral sucker, in about three cases out of four on the right hand side of the body. It has the form of a branching tubular gland, the ramification being dichotomous throughout; in most cases the branches are about as large as the stems which give rise to them. The oviduct passes towards the shell-gland, narrowing as it approaches this, and finally unites with the excretory duct of the yolk-glands. (ii.) The yolk-glands (*y*) of the liver-fluke are paired organs of considerable size; they extend over both lateral areas, to which they impart the opaque appearance and reddish colour above alluded to. They are composed of innumerable small acini, spheroidal in shape and situated in groups on minute ductules, which unite to form a longitudinal canal on either side of the body. These canals are on the whole parallel to the margins of the animal and distant from it about one-fifth of its greatest breadth. At the anterior margin of the testicular area each longitudinal canal gives off a transverse branch, which unites with its fellow of the opposite side in the middle line to form a pear-shaped reservoir, situated just behind the posterior margin of the shell-gland. From this reservoir the common yolk-duct passes forwards in the substance of the shell-gland and there unites with the oviduct. Previously to this, however, it gives off a minute canal, which after an upward course opens on the dorsal surface of the animal; it is known as the Laurer-Stieda canal, and its function has been the subject of much discussion. It has been supposed (1) "to serve for copulatory purposes," as has been seen by Zeller (18) in *Polystomum*, and as is supported by its structure in *Axine* and *Microcotyle*, and (2) "to act as a safety tube for the escape of over-abundant or altered vitelline products and spermatozoa," the main argument in support of which is that its calibre is too narrow to admit of copulation taking place by its means; compare Sommer (10), Kerbert (11), Poirier (19), Looss (20), and Lorenz (21). (iii.) The uterus or female conducting apparatus (*u*) originates at the union of the ducts of the germarium and yolk-gland. Its first portion, which lies within the shell-gland, is a delicate narrow canal, except when it is distended either by eggs or by semen. The median section of the organ is by far the largest both in length and breadth; it occupies almost the whole of the anterior part of the median area of the animal, between the ventral sucker and the shell-gland, and forms four or five large coils lying alternately right and left, which as a rule are filled with completely formed eggs. The third section of this organ includes the coils which lie above and anterior to the ventral sucker; it is sometimes called the vagina. When it contains eggs these are generally in a single file, and thus give it a moniliform appearance; it lies entirely on the left side of the body, gradually approaching the middle line as it passes forward, until it ends below the cirrus-pouch at the left and posterior aspect of the genital pore (fig. 1, C, *e*). (iv.) The shell-gland (fig. 1, B, *s*), which (as its name implies) furnishes the external coating of the eggs, has been already several times mentioned. In the Trematodes, as in the tape-worms, it forms a kind of central point of the female generative system; it is a spheroidal mass of unicellular glands, each of which opens by its own special duct into the commencement of the uterus. The secretion of the shell-gland is liberated in the form of small pellucid droplets, which unite to form drops; afterwards it becomes thick and viscid and of a mahogany brown colour. In this condition the drops are dispersed through the uterus mixed with the secretions of the other genital glands, and they apply themselves to the recently formed eggs, producing a delicate membrane around them. This process is carried on in those coils of the uterus which lie immediately outside the shell-gland, corresponding to the "ootype" described by Van Beneden in other Trematodes.

The eggs undergo a gradual development as they pass along the uterus. The ripe primitive ovum, on entering the female conducting apparatus, becomes coated with a larger or smaller number of spherules of secondary yolk, and then undergoes the process of segmentation which leads to the formation of a morula. At this point it receives the secretion of the shell-gland. The completely formed egg (fig. 1, E) has a length of 0·13 mm. and is ovoid in shape, with a small lid or operculum at the broader end; its contents consist of a number of roundly polygonal cells, with only a small quantity of secondary yolk remaining among them. All of these but one have a thick granular protoplasm, the exceptional cell having homogeneous and strongly refracting contents. It usually lies immediately under the operculum, and is partly embedded in the other cells. They are often present in the bile-ducts in such quantities as to form a stiff brownish mass resembling wet sand, and the number produced by a single fluke has been estimated at half a million.

The mode of fertilization of the liver-fluke has given rise to much discussion. According to Sommer, the organ which has usually been described as a cirrus or penis is merely the genital sinus evaginated by abnormal pressure (fig. 1, C, *d*); it is furthermore but ill-adapted to enter either of the canals which could possibly serve as a vagina. He is therefore of opinion that self-impregnation occurs, the external aperture being closed by the oblique muscles, and the semen passing directly from the vas deferens through the genital sinus into the uterus. The whole question of the fertilization of the Trematodes is a matter on which very varied opinions have been expressed, even by authors who have examined the same forms. The assertion of Von Siebold that a direct internal communication exists between the male and female organs has been denied by Stieda (22) and by many subsequent writers, but has been restated by Lorenz (21) and by Zeller in the case of *Polystomum integerrimum* (18); however this may be, there can be no doubt that self-impregnation does occur in certain cases. The structure of the organs renders it more than probable in some species (see Poirier, 19, p. 582); Zaddach has observed it actually taking place in *Distomum cirrigerum* encysted in *Astacus* (23), and a single *Polystomum integerrimum* has been found in a frog's bladder with sperm in the female passages. Reciprocal fertilization, in which two individuals act both as male and female simultaneously, has been recorded by Zeller in *Polystomum integerrimum*, by Looss (20) in *Distomum clavigerum*, and by Cobbold in *Distomum campula*.

Nervous system.

The nervous system consists of a commissure passing round the œsophagus very obliquely, and swelling out into ganglia at three points. *Tristomum molæ* possesses eyes of an extremely simple type, the retina being merely a ganglion cell (Lang, 24).

Life-History and Development.—The life-history of *Fasciola hepatica* was worked out independently by Thomas (25) and Leuckart (26); regarding the question of priority see Jackson (27).

The development of the embryo can only take place outside the body of the host and at a lower temperature, the most favourable being from 23° to 26° C., at which the process occupies two or three weeks. The free embryo (fig. 2, A) is conical in shape, with a rounded apex, its average length being 0·13 mm. At the broader anterior end is a retractile head-papilla, with the exception of which the body is ciliated all over. The interior of the body is composed of granular nucleated cells, and it contains a double eye-spot, composed of two crescentic masses of pigment. There are also two ciliated funnels forming the rudiments of the excretory system and a granular mass behind the head-papilla, probably representing the digestive tract. The embryo swims actively about, but if it does not succeed in meeting the appropriate host for its next stage of development (*Limnæus truncatulus*, a small pond snail) its period of vitality seems to be limited to about eight hours. If it should meet with one of these snails it applies the head-papilla to some part of its surface and begins to bore, twisting round and round on its axis by means of its cilia, the head-papilla becoming pointed and elongated to four or five times its original length. Eventually the tissues of the snail are separated as if by a wedge, and a gap is formed through which the embryo forces an entrance into its body. Here it undergoes a metamorphosis, losing its organs of locomotion and becoming what is termed a "sporocyst" (fig. 2, B). This is an elliptical sac, which commonly attains a length of 0·7 mm. Its wall consists of a structureless cuticle, beneath which are external, circular, and internal longitudinal muscle-fibres. These are succeeded by an epithelium, the elements of which vary greatly in size. These sporocysts may be produced by a process of transverse fission. Within the sporocyst rounded masses of cells are formed (morulæ), which undergo a process of invagination, producing a gastrula, which again develops by the formation of a digestive tract into what is known as a "redia" (fig 2, C, D). This forces its way through the wall of the sporocyst, which heals up immediately, and then wanders through the tissue of the snail, most commonly finding its way to the liver. If many rediæ are present the snail usually perishes. The adult redia may attain a length of 1·6 mm. It has an elongated cylindrical form, and near its posterior extremity are two processes directed backwards, which probably serve as aids to locomotion. At the anterior extremity is the mouth, leading into a muscular pharynx, followed by a saccular digestive tract. A ring-shaped thickening is seen a little way behind the mouth, and immediately posterior to this a special aperture for the exit of the germs formed within the redia. About a score of these are usually to be found in all stages of development, the earliest being a rounded mass of cells (morula), which elongates, one end at the same time becoming more attenuated than the other, and gradually forming an elongated tail, while the body becomes oval and depressed (fig. 2, E). Two suckers and the rudiment of the future digestive tract make their appearance. As soon as the "cercaria," this being the name given to the present organism, has attained this stage of development it emerges from the redia, and by the aid of its suckers and tail wriggles its way out of the host, swimming freely about in the water. Like other cercariæ developed in rediæ this one has no head-spine, but in mature examples the anterior of the body often exhibits a number of very minute spines. An interesting feature in the animal is the presence of the "cystogenous cells," two lobate masses arranged one on each side of the body. These cells contain small rod-like bodies, whence they have been termed "cellules à batonnets," and similar bodies have been found in the protective cyst which they excrete; Sonsino (28) has suggested that they may assist in imparting stiffness to this structure, and has noticed that they are more abundant in those forms which encyst in the open air. When the cercaria has swum about for a short time it finds its way to the water-plants, and encysts itself on their stems and leaves. During this process the tail is swung vigorously about, until finally a more violent motion detaches it; at the same time the cells just mentioned throw out a gummy secretion, which rapidly hardens and encloses the cercaria in a kind of case. It is in this condition that the larvæ are swallowed by the grazing sheep to form sexually mature flukes in their livers.

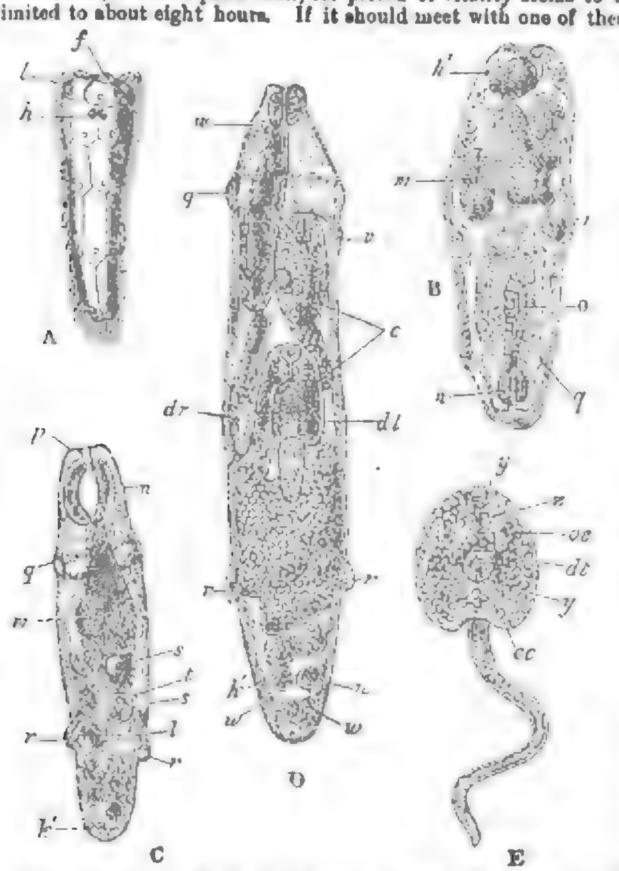

FIG. 2.—Five stages in the life-history of *Fasciola hepatica*; all highly magnified. A, The free-swimming embryo. B, A sporocyst containing young rediæ. C, A young redia, the digestive tract shaded. D, An adult redia, containing a daughter-redia, two almost mature cercariæ, and germs. E, A free cercaria. The letters have the same significance throughout. *c*, nearly ripe cercariæ; *cc*, cystogenous cells; *dr*, daughter-redia; *dl*, limbs of the digestive tract; *f*, head-papilla; *h*, eye-spots; *h'*, same degenerating; *k'*, germinal cell; *l*, cells of the anterior row; *m*, embryo in optical section, gastrula stage; *n*, pharynx of redia; *o*, digestive sac; *oe*, œsophagus; *p*, lips of redia; *q*, collar; *r*, processes serving as rudimentary feet; *s*, embryos; *t*, trabeculæ crossing body-cavity of redia; *u*, glandular cells (?); *v*, birth-opening; *w*, *w'*, morulæ; *y*, oral sucker; *y'*, ventral sucker; *z*, pharynx. (All from Marshall and Hurst after Thomas.)

The life-history of a typical digenetic Trematode may be summed up as follows:—(1) the *egg*, produced sexually; (2) the *ciliated embryo*; (3) the *sporocyst*; (4) the *redia*, produced asexually; (5) the *cercaria*, produced asexually; (6) the *adult Trematode*. Hence it would appear that the digenetic forms have at least one, usually many, asexual generations before the sexual one appears. The embryo may form either a sporocyst or a redia, these two forms being distinguished by the presence of a digestive tract and of a special birth-opening in the latter. Within these parent forms the germs may arise from two sources,—the cells which occupy the central region of the young sporocyst or redia, or the epithelium lining the body-walls. "The germs to which a sporocyst gives origin may develop in some instances into sporocysts, in others into rediæ or into cercariæ. And it does not seem certain that there is any limit to the possible number of successive generations of rediæ. Both cercariæ and rediæ may occur side by side in the same nurse. The last term in the series is, however, invariably a cercaria."

Pagenstecher, Ercolani (29), and others have stated that the tail of a cercaria may become a sporocyst and produce germs, but this has not met with general acceptance, and the supposition is not supported by the structure of the tail, which consists of a "contractile substance, occupying the axis and periphery, with large vesicular cells between" (Schwarze, 18). Ercolani (29) has also published striking statements to the effect that the structure of these entozoa is so profoundly modified by their habitat that what have been hitherto described as distinct species may be only "local varieties"; thus he finds that *Cercaria armata* develops in *Tropidonotus* into *Distomum signatum*, whilst in *Mus musculus* and *M. decumanus* it becomes a distinct dwarfed form, *D. muris*.

Pathological and Economic Relations.—Although the number of Trematodes which have been recorded from the human body is about equal to that of the Cestodes, the medical significance of the former is much less than that of the latter, because as a rule they occur in smaller numbers and are less apt to invade organs of vital importance. The Trematodes which have been found in man are—

Fasciola hepatica, Linn. . . .	in the	liver.
Distomum lanceolatum, Mehlis, .	,,	liver.
D. ophthalmobium, Diesing, .	,,	lens of the eye.
D. heterophyes, Bilharz, . .	,,	small intestine.
D. crassum, Busk = *D. buskii*, Wedl,	,,	intestine.
D. capense, Harley,	,,	eggs in the blood.
D. spathulatum, Leuckart, .	,,	liver.
D. endemicum, Baelz, . . .	,,	liver
D. hepatis innocuum Baelz,	,,	liver.
D. rathouisi, Poirier (42),	,,	liver.
Bilharzia hæmatobia, Cobbold, .	,,	veins of bladder, &c
Monostomum lentis, Nordmann,	,,	lens of the eye.
Hexathyridium pinguicola, Treutler,	,,	ovary
H. venarum, Treutler, . .	,,	veins.

For the general principles which govern the pathological effects of Trematodes in common with other entozoa, reference may be made to the article TAPE-WORMS; only a few special cases need be alluded to here The occurrence of most of the forms in the above list has only been recorded very few times, and in many cases the effects produced were very inadequately studied, so that we can hardly be said to possess a knowledge of their individual pathology. In a case of *Distomum lanceolatum* which occurred in Bohemia, the liver was enormously enlarged and the contracted gall-bladder contained eight calculi and forty-seven flukes; the symptoms during life were emaciation, pain over the liver, and distention of the abdomen.

The effects produced by *Bilharzia hæmatobia* are very well defined and exceedingly disastrous. The mature worms in couples inhabit the veins, especially those of the urinary bladder and mesentery; extravasations of blood and villous growths or ulcerations of the mucous membrane of the bladder present themselves, and thus the eggs of the parasite find their way into the urine, in which they are evacuated, and can be detected by microscopic examination. With the characteristic presence of the eggs are associated colic, anæmia, and great prostration of the vital powers, more particularly in the later stages; the disease when once fairly established is almost always fatal; see Cobbold (1).

From a practical point of view by far the most important Trematode is *Fasciola* (*Distomum*) *hepatica*, which gives rise to the disease known as "liver rot" in sheep. It is always more or less abundant in certain districts, and it is estimated that in the United Kingdom the annual loss of sheep due to it is not less than 1,000,000. The symptoms are said to be emaciation, tenderness in the loins, harshness and dryness of the wool, and a scaly condition of the skin. On post-mortem examination fluid is found in the peritoneal cavity and the viscera have a blanched appearance; the liver is dark chocolate or sometimes pale in colour, nodular, and uneven, the ducts are thickened and Distomes are found within them. Dead flukes have been known to furnish the nuclei of gall-stones in the gall-bladder. Briefly stated, the principal preventive measures seem to be as follows:—(1) destruction of the eggs, and especially abstention from putting manure of rotten sheep on damp ground; (2) slaughter of sheep which are badly fluked; (3) adequate drainage of pastures; (4) an allowance of salt and a little dry food to the sheep; and (5) dressings of lime or salt on the ground to destroy the embryos (Thomas, 25). A series of wet seasons increases the prevalence of the malady, and animals which have been allowed to graze in low-lying ill-drained lands are specially liable to infection—facts which are readily explicable on a consideration of the life-history given above.

Systematic Arrangement.—The *Trematoda* may be classified as follows:—

I. MONOGENEA, Van Beneden; development direct, that is, without the mediation of nurse forms.

(i.) Tristomeæ, Leuckart; body roundish or elongate; posterior extremity never specially developed. Two adoral suckers often present: a large ventral sucker often armed with chitinoid structures. Sexual apertures on the left side or submedian. Laurer-Stieda canal single or double. Ova with a filament at one pole only.

1. Tristomidæ, Van Beneden.—1. *Tristomum*, Cuvier; about a dozen genera of previous writers are here included: over 14 species are known, all parasitic on fishes; Taschenberg (30).
2. Monocotylidæ, Taschenberg.—1. *Calicotyle*, Diesing; only species *C. kröyeri* (31). 2. *Pseudocotyle*, Taschenberg. 3. *Monocotyle*, Taschenberg; only one species, *M. myliobatis*, on the gills of the eagle-ray (*Myliobatis aquila*).
3. Udonellidæ, Johnston.—1. *Udonella*, Johnst.; five species, the type being *U. caligorum*, parasitic on a crustacean (*Caligus*), which in its turn infests the halibut (*Hippoglossus vulgaris*).

(ii.) Polystomeæ, Leuckart; body elongate, pointed and narrow anteriorly; broad behind and generally provided with special organs of adhesion in the shape of suckers or chitinoid hooks, of suckers or claspers with chitinoid structures. Two adoral suckers in some instances. Sexual apertures median. Laurer-Stieda canal single or double. Male sexual aperture often armed with chitinoid hooks. Ova frequently provided with two long appendages.

1. Octobothriidæ, Taschenberg.—1. *Octobothrium*, Nordmann; about a dozen genera of various authors are here included by Taschenberg (30), containing fourteen species, parasitic on fishes, and almost invariably on the gills. 2. *Anthocotyle*, Hesse and Van Beneden; one species (*A. merlucii*), found in the hake. 3. *Phyllocotyle*, Hesse and Van Beneden; one species, from the gurnard. 4. *Platycotyle*, Hesse and Van Beneden; one species, from the gurnard. 5. *Pleurocotyle*, Gervais and Van Beneden (= *Grubea cochlear*, Dies.); one species, from the gills of the mackerel. 6. *Diplozoon*, Nordmann (see below). 7. *Hexacotyle*, Blainville; one species, from *Thynnus brachypterus*. 8. *Plectanocotyle*, Dies.; from the gills of *Labrax mucronatus*.
2. Polystomidæ, Van Beneden.—1. *Polystomum*, Zeder; two species, best known *P. integerrimum* (see below); *Hexathyridium* is probably a synonym. 2. *Onchocotyle*, Dies.; five species, from the gills of sharks and rays. 3. *Erpocotyle*, Hesse and Van Beneden; one species, from the gills of *Mustelus lævis*. 4. *Diplobothrium*, F. S. Leuckart; one species, from the gills of a sturgeon.
3. Microcotylidæ, Taschenberg.—1. *Axine*, Abildgaard; two species. 2. *Microcotyle*, Van Beneden; about half a dozen species, all parasitic on the gills of fishes (see below). 3. *Gastrocotyle*, Hesse and Van Beneden; one species, from the gills of *Caranx trachurus*. 4. *Aspidogaster*, Von Baer (see below). 5. *Cotylaspis*, Leidy; one species, occurring in *Anodonta*. 6. *Aspidocotyle*, Dies.
4. Gyrodactylidæ, Van Beneden.—1. *Gyrodactylus*, Nordmann (see below). 2. *Dactylogyrus*, Dies.; about twenty species, all parasitic on fishes, mostly on the gills. 3. *Tetraonchus*, Dies.; three species, on the gills of freshwater fishes. 4. *Diplectanum*, Dies. 5. *Calceostomum*, Van Beneden; one species, on the gills of *Sciæna aquila*. 6. *Sphyranura*, Wright (34, 45); one species, from the mouth of *Menobranchus lateralis*.

II. DIGENEA, Van Beneden; one or more non-sexual forms intervene between two successive sexual forms.

(i.) Monostomidæ, Van Beneden; elongate, oval, or rounded in shape; one oral sucker.—1. *Monostomum*, Zeder; fifty to sixty species in mammals, birds, and fishes; type, *M. mutabile*, Zeder, found in the body-cavity and eye of water-birds. 2. *Notocotyle*, Dies.; *N. triseriale*, Dies. (= *Monostomum verrucosum*).

(ii.) Distomidæ, Van Beneden; body flattish more or less leaf-like or elongate; an oral and a ventral sub-median or posterior sucker.—1. *Distomum*, Retzius (see below). 2. *Fasciola*, Linn.; three species are known; *F. hepatica* is described above; *F. gigantea* inhabits the liver of the giraffe. 3. *Bilharzia*, Cobbold (= *Gynæcophorus*, Dies.); one species (see below). 4. *Echinostomum*, Dujardin; *E. gadorum*, Van Beneden, in the intestine of *Gadus carbonarius* (the coal-fish), and twenty-five other species in the alimentary canal of mammals, birds, and fishes. 5. *Amphistomum*, Rudolphi; about twenty species in different Vertebrates; *A. subclavatum* (Göze) in the rectum of the frog. 6. *Gastrodiscus* (?), Leuckart (see also 37). 7. *Homalogaster*, Poirier (38). 8. *Gastrothylax*, Poirier. 9. *Eurycœlum*, Brock (44), has the excretory vessels dilated into wide chambers (? cœlom).

(iii.) Gasterostomidæ, Von Siebold; oral sucker sub-median and ventral; also an anterior sucker.—1. *Gasterostomum*, Von Siebold; eight species, all in fishes; larval form *Bucephalus* (see below).

(iv.) Holostomidæ, Claus (43); body flattened, and divided into an anterior and posterior part, the former bearing an anterior and ventral sucker; two adoral lobes with glands in connexion, or a circumoral fold with lobes.—1. *Holostomum*, Nitzsche; twenty-three species, most in water-birds; *H. variabile*, in various raptorial birds; larval forms *Tetracotyle* and *Diplostomum*. 2. *Hemistomum*, Dies.; three species, one in the wild-cat, two in birds. 3. *Eustemma*, Dies.

The true position of the following is doubtful:—*Nematobothrium*, Van Beneden (9); *Didymozoon*, Von Linstow (30); *Stichocotyle*, Cunningham (39).

Diplozoon paradoxum (18) infests the gill of the minnow in large numbers. The eggs hatch in the water, continuing to be attached to the gill by a filament at one extremity. The embryo is elongated oval in shape, and ciliated all over; on its back are two eyes, consisting of a cup-shaped mass of pigment, with a spheroidal lenticular body. It presents also the mouth with two peculiar suckers, the œsophagus and intestine, and the two claspers of the *Diporpa*. The embryo swims vigorously about until it finds its way to the gill of a minnow, failing which it dies in about six hours. Attached to its host it may live isolated for a considerable time, increasing in size; usually, however, it unites with another individual in a kind of reciprocal copulation (fig. 3, A). One individual by means of its ventral sucker seizes the dorsal papilla of another, and then the two twist across each other so that the sucker of the second seizes the papilla of the first. After this a complete fusion of the individuals takes place, the papillæ and suckers growing together so firmly as to be anatomically inseparable. Both individuals continue to grow and develop a second, third, and sometimes a fourth pair of claspers.

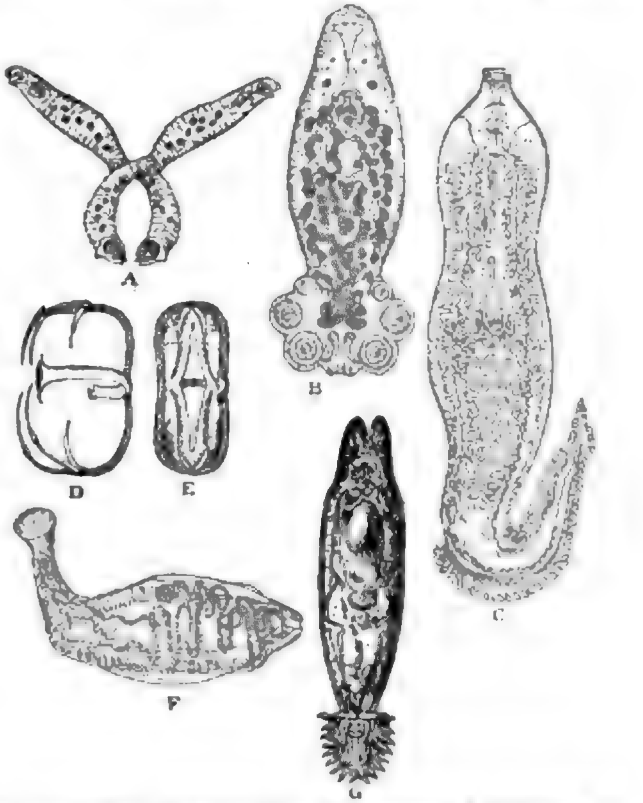

FIG. 3.—A, *Diplozoon paradoxum*; two united specimens. B, *Polystomum integerrimum*; × about 100 (after Zeller). C, *Microcotyle mormyri*; × 7. D, E, two views of the chitinous framework of a sucker of *Axine belones*; highly magnified (after Lorenz). F, *Aspidogaster conchicola*; × about 25 (after Aubert). G, *Gyrodactylus elegans*; × about 80 (after Wagener).

In *Polystomum integerrimum* (18), which inhabits the bladder of the frog, the eggs are developed during the winter and are laid in the spring, when the frogs resort to the water. It appears probable that the worm protrudes its body from the frog and thus deposits the egg directly in the water. The young worm, as it escapes from the egg, which takes place after a lapse of six or eight weeks, measures about 0·3 mm. in length, and swims vigorously about by the aid of a coating of cilia. At its posterior extremity is a rounded disk (fig. 3, B), round the margin of which sixteen delicate hooks are placed at equal intervals. Above the four hindmost of these are two others still smaller and more delicate. Upon the back are situated four eyes disposed in pairs. The mouth is wide and leads into a pharynx, and this into the intestine; two excretory vessels are present, but there is no trace of generative organs. The hindermost pair of suckers is the first to be developed, and they enclose those two hooks which lie at the outer side of the very delicate ones mentioned above, which eventually become the strong terminal hooks of the adult. The other two pairs of suckers are formed in a similar manner, the development of all three being usually completed during the month of July. The young *Polystomum* attacks not the full-grown frog but the tadpole, entering the gill-cavity and subsequently proceeding to the bladder. Like the frog it requires four or five years to attain sexual maturity. In certain cases the *Polystomum* does not migrate; it then becomes prematurely sexual and dies when the tadpole undergoes metamorphosis; under these circumstances the sexual organs are simpler than usual: the testis is simple; the germarium is long and coiled; there is neither prostate nor Laurer-Stieda canal; and the oviduct has no dilated anterior portion.

Microcotyle mormyri, Lorenz (21) (fig. 3, C), has no penis, the semen issuing by an opening posterior to the spiked birth-opening; the vagina opens medially, not marginally. The posterior extremity is pointed. *Axine belones*, Abildg., resembles it, but is broad and obliquely truncated behind, this margin bearing a row of fifty to seventy peculiar attaching organs, which are of the form of a hand-satchel (fig. 3, D, E), the metal clasp being represented by a complicated chitinous framework. There are four groups of hooks and one ring of the same round the genital opening. The mouth has a sucker at either side, and above it an oval body which can be evaginated like the proboscis of a Dendrocele Planarian.

Aspidogaster conchicola (32) is found in the pericardial cavity of the freshwater mussel; it is conical anteriorly with a terminal oral sucker, the ventral sucker is very large and divided into rectangular areas; the excretory pore is at the posterior extremity of the body, and the genital organs open on the left side of the fore-part of the animal (fig. 3, F).

Gyrodactylus elegans (33) is found on the fins and surface of the body of the pike, stickleback, and other freshwater fishes, and measures about 0·5 mm. in length; it is flattened in form and tapers towards either end (fig. 3, G). At the anterior extremity are two lappets, while the posterior is furnished with a subtriangular plate, which bears the organs of attachment in the shape of two large curved hooks in its centre and sixteen smaller ones on its circumference. The most interesting peculiarity, however, of this form is to be found in the fact that each embryo before it is extruded (the animal is viviparous) contains another embryo, and this in its turn another, so that three embryonic generations are present simultaneously.

The genus *Distomum* is by far the most extensive in the group, containing at the present time over 300 species, which occur almost exclusively in Vertebrates; the most important are perhaps *D. lanceolatum*, which inhabits the same situations as *Fasciola hepatica*, *D. clavigerum*, from the frog, and *D. militare*, Van Beneden, from the intestine of the duck. The name *Fasciola* (Linn.) has the priority over *Distomum* (*Distoma*) of Retzius, which, however, has obtained extensive currency. The name *Fasciola* may appropriately be used in a restricted sense for forms which have a branched digestive tract, *F. hepatica* above described being taken as the type. This separation has not met with general recognition, although supported by Blanchard and Cobbold (1). Weinland has proposed to substitute the term *Dicrocœlium*, used by Dujardin, for *Distomum*, retaining *Fasciola* for the type-species, but this proposal has not met with acceptance. The Distomes vary in size from forms almost microscopic to those which, like *D. ingens*, Moniez (35), measure 6 cm. long in alcohol, or even 12·5 cm. in the fresh condition (*D. gigas*, Nardo). *Distomum halosauri*, Bell (36), is parasitic upon a deep-sea fish taken in 1090 fathoms. *Distomum macrostomum* (fig. 4, B) of the woodpecker (*Apternus tridactylus*) has a remarkable larval form known as *Leucochloridium paradoxum*, which is parasitic on *Succinea putris*, and consists of a number of branching threads, from which are developed one or two contractile sacs (fig. 4, C, D). Their growth distends the tentacle until it bursts and the sac hangs outwards. The threads within the *Succinea* contain only granular cells, whilst the contractile sac is occupied by an organism ovoid in form, with a thick clear border, the rudiments of two suckers, a digestive tract, and excretory system.

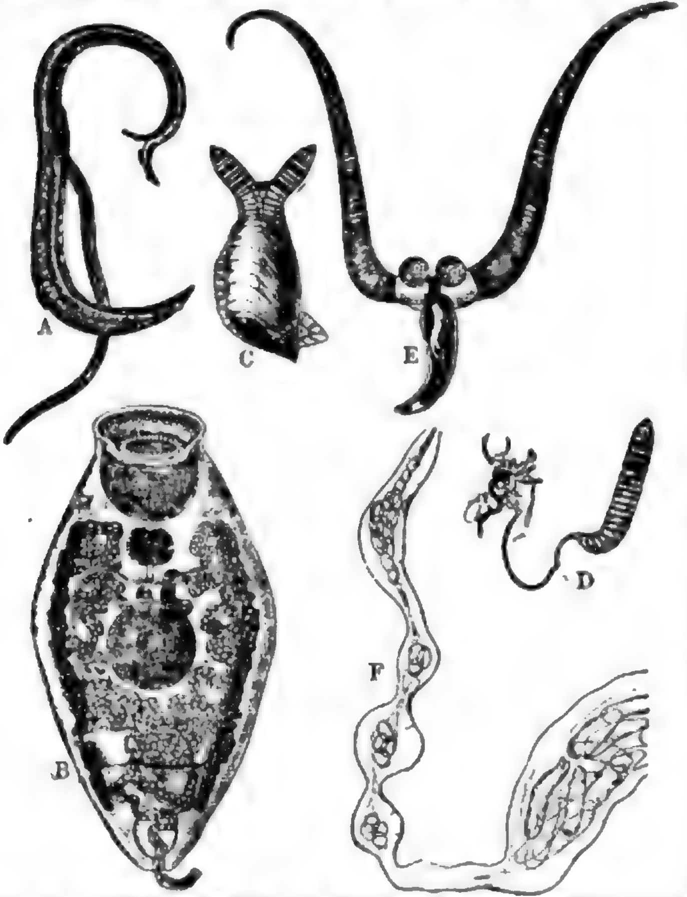

FIG. 4.—A, *Bilharzia hæmatobia*, the thin female in the gynæcophoric canal of the stouter male; ×15 (after Leuckart). B, *Distomum macrostomum*, showing the digestive and the greater part of the genital apparatus with the cirrus protruded; ×30. C, Snail (*Succinea*), the tentacles deformed by *Leucochloridium*; natural size. D, *Leucochloridium* removed from the tentacle; natural size (after Zeller). E, *Bucephalus polymorphus*; highly magnified (after Ziegler). F, Portion of a sporocyst containing *Bucephali* in process of development; ×about 50 (after Lacaze-Duthiers).

Bilharzia hæmatobia, Cobbold (1), is one of the most dangerous human parasites, and occurs in the blood of the portal vein and in the veins of the mesentery and bladder. The sexes are distinct, the female being from 16 to 20 mm. in length, and somewhat resembling a Nematode on superficial examination. The male is only from 10 to 14 mm. in length, but much thicker. The surface of the female is covered with fine spines most distinct towards the tail; at the anterior pointed extremity is the oral sucker, from which a narrow opening leads into a wide pharynx, followed by the intestine, which at first forms two branches, these again uniting posteriorly to the generative organs. The ventral sucker is placed only 0·3 mm. behind the oral one, and it is immediately succeeded by a long narrow groove, which extends down the ventral surface and corresponds to the canalis gynæcophorus of the male (see fig. 4, A).

The stages in the life-history of *Gasterostomum* are so remarkable that a short account of them must be given. From the egg there escapes (1) a club-shaped embryo, which in a manner hitherto unobserved enters the freshwater mussel, *Anodonta* or *Unio*, where it forms (2) the sporocyst (fig. 4, F); this is several centimetres long and provided with lateral branches; it occurs chiefly in the liver and ovary, and it is best developed near the skin. The wall of the sporocyst consists of cells, muscles, and perhaps a cuticle; the extremities are pointed and filled with cells, and it is here that growth takes place. Within moniliform dilatations of these ramified tubes are formed balls of cells, each of which develops into (3) a "bucephalus." This organism (fig. 4, E) consists of a small oval body about 0·25 mm. in length with a double tail. At one extremity is a mass of glands with an invagination of the integument, which has been mistaken by many observers for the alimentary canal. This, however, opens about the middle of the body, and consists of a muscular pharynx, a forwardly-directed œsophagus, and a simple saccular intestine. The excretory system terminates in an S-shaped vesicle, which opens posteriorly in such a way that its contraction drives the fluid into the tail, whence it probably finds its exit by osmosis. Traces of genital organs are found in the form of an elongated plug of cells in the hinder fourth of the body, and two rounded masses of undifferentiated cells situated dorsally. The tail is double, and from about 0·5 to 2·5 mm. long according to its state of contraction. Each half consists of a spheroidal basal portion, and an elongated tapering filament. These caudal appendages contain many nucleated connective-tissue cells with fine protoplasmic processes. The larvæ swim freely in the water, but sink and perish after about twelve hours, unless they enter the mouth of certain fishes (*e.g.*, *Leuciscus erythrophthalmus*), when (4) they lose their tails and become encapsuled under the skin. The generative organs now become further developed; cuticular spines and the anterior sucker are formed. If the fish thus infected be swallowed by a pike or perch the cyst is dissolved, and the worms (5) become adult, continue to live in the intestine, and produce eggs. For further details, see Ziegler (12).

Phylogenetic Relations.—The detailed comparisons of Van Beneden (9) and the subsequent researches of others leave no doubt that the *Trematoda* are closely related to the *Cestoda*. A consideration of their peculiarities leads moreover to the opinion that the former are more primitive than the latter; that is to say, the common ancestors of the two groups resembled Trematodes rather than Cestodes. The ancestry of the *Trematoda* is probably to be sought in types such as the Planarians rather than the Leeches; characters uniting them with the former are the possession of a commonly branched alimentary canal without an anus, but with a powerful pharynx; the generative system is hermaphrodite, and similar arrangements obtain in the excretory vessels, nerves, and muscles, while histological agreements also are not wanting. Furthermore, certain forms are known which help to fill up the gap between the two groups: *Monocelis caudatus* has a discoid posterior organ of attachment, and *M. protractilis* a true sucker. Such forms as these could scarcely be distinguished from ectoparasitic Trematodes except for their ciliated epithelium (Leuckart, 1). In this connexion, however, it is worth while to call attention to the researches of Fewkes (40) on a marine cercaria, which had a tail distinctly annelid in character, with bundles of bristles disposed at intervals along it. Compare also Schauinsland (41).

Bibliography.—(1) Jackson, in Rolleston's *Forms of Animal Life*, 2d ed. Oxford, 1887; other important text-books are Leuckart, *Parasiten des Menschen*, Leipsic, 1863, new edition and English translation in preparation; Küchenmeister und Zürn, *Parasiten des Menschen*, Leipsic, 1881; Cobbold, *Entozoa*, London, 1864; Id., *Parasites*, 1879; (2) Rudolphi, *Entozoorum Hist. Nat.*, Amsterdam, 1808-9, and *Entozoorum Synopsis*, Berlin, 1819; (3) Cuvier, *Règne animal*, Paris, 1829; (4) Von Siebold, *Archiv f. Naturgesch.*, i., 1835; (5) Von Baer, *Nova Acta Acad. Cæs. Leop.*, xiii., 1826; (6) Steenstrup, *Alternation of Generations*, Ray Society, 8vo, London, 1845; (7) Pagenstecher, *Trematodenlarven und Trematoden*, Heidelberg, 1857; (8) Diesing, *Systema Helminthum*, Vienna, 1850; (9) Van Beneden, "Vers intestinaux," *Comptes Rendus*, Paris, 1861; (10) Sommer, *Ztschr. wiss. Zool.*, xxxiv., 1880; (11) Kerbert, *Archiv f. mikr. Anat.*, xix., 1881; (12) Ziegler, *Ztschr. wiss. Zool.*, xxxix., 1883; (13) Schwarze, *Op. cit.*, xliii., 1886; (14) Metschnikoff, *Quart. Jour. Micr. Sci.*, xxiv., 1884; (15) Fraipont, *Arch. de Biol.*, i., 1880, ii., 1881; (16) Pintner, *Arb. Zool. Inst. Wien*, iii., 1880; (17) Van Beneden and Lankester, *Zool. Anz.*, iv., 1881, v. 1882; (18) Zeller, *Ztschr. wiss. Zool.*, xxii., 1872, xxvii., 1876; (19) Poirier, *Arch. Zool. Expér.*, iii., 1885; (20) Looss, *Ztschr. wiss. Zool.*, xli., 1885; (21) Lorenz, *Arb. Zool. Inst. Wien*, i., 1878; (22) Stieda, Reichert, and Du Bois Reymond's *Archiv*, 1881; (23) Zaddach, *Zool. Anz.*, iv., 1881; (24) Lang, *Mitth. Zool. Stat. Neapel*, ii., 1881; (25) Thomas, *Quart. Jour. Micr. Sci.*, xxiii., 1883, also *Jour. Roy. Agric. Soc.*, xix., 1883; (26) Leuckart, *Zool. Anz.*, v., 1882; (27) Jackson, *Op. cit.*, vi., 1883; (28) Sonsino, *Arch. Ital. Biol.*, vi., 1885; (29) Ercolani, *Mem. Acad. Sci. Inst. Bologna*, (4), ii., 1882, iii., 1883, also abstract, *Arch. Ital. Biol.*, i., 1882; (30) Taschenberg, *Ztschr. gesammt. Naturw.*, iii., 1879; (31) Wierzejski, *Ztschr. wiss. Zool.*, xxix., 1877; (32) Huxley, *Anat. Invert. Anim.*, London, 1877; (33) Wagener, *Arch. f. Anat. u. Phys.*, 1860; (34) Wright, *Proc. Canad. Inst.*, i., 1884; (35) Moniez, *Bull. Soc. Zool. France*, xi., 1886; (36) Bell, *Ann. and Mag. Nat. Hist.*, (5), xix., 1887; (37) Lejtenyi, *Abhandl. Senck. Gesellsch.*, xii., 1881; (38) Poirier, *Bull. Soc. Philom. Paris*, (7), vii., 1883; (39) Cunningham, *Trans. Roy. Soc. Edin.*, xxxii., 1884; (40) Fewkes, *Amer. Jour. Sci.*, (3), xxiii., 1882; (41) Schauinsland, *Jena Zeitschr.*, xvi., 1883; (42) Poirier, *Arch. Zool. Expér.*, (2), v., 1887; (43) Von Linstow, *Archiv f. Naturgesch.*, xliii., 1877; (44) Brock, *Göttinger Nachrichten*, 1887; (45) Wright and Macallum, *Amer. Jour. Morph.*, i., 1887. (W. E. HO.)

TRENCH, RICHARD CHENEVIX (1807-1886), archbishop of Dublin, poet, scholar, and divine, was born at Dublin, September 9, 1807, and graduated at Trinity College, Cambridge, in 1829. While incumbent of Curdridge Chapel, near Bishop Waltham in Hampshire, he published (1835) *The Story of Justin Martyr and other Poems*, which, having been very favourably received, was followed in 1838 by *Sabbation, Honor Neale, and other Poems*, and in 1842 by *Poems from Eastern Sources*. These volumes revealed the author as decidedly the most gifted of the immediate disciples of Wordsworth, with a warmer colouring and more pronounced ecclesiastical sympathies than the master, and strong affinities to Tennyson, Keble, and Milnes. In 1841 he resigned his living to become curate to Samuel Wilberforce, then rector of Alverstoke, and upon Wilberforce's promotion to the deanery of Westminster, in 1845, he was presented to the rectory of Itchenstoke. In 1845 and 1846 he preached the Hulsean lecture, and in the former year was made examining chaplain to Wilberforce, now bishop of Oxford. He was shortly afterwards appointed theological professor and examiner at King's College, London. In 1851 he established his fame as a philologist by his charming little work on *The Study of Words*, originally delivered as lectures to the pupils of the Diocesan Training School, Winchester. His purpose, as stated by himself, was to show that in words, even taken singly, "there are boundless stores of moral and historic truth, and no less of passion and imagination laid up"—a truth enforced by a number of most apposite illustrations. The book may be regarded as a comment on the saying that "language is fossil poetry." It was followed by two equally delightful little volumes of similar character—*English Past and Present* (1855), and *A Select Glossary of English Words* (1859). All have gone through numerous editions, and they have probably contributed more than all the labours of severer but less cultured and tasteful philologists to promote the historical study of the English tongue. Yet Trench did little more than indicate the existence of a vast region of research extending over all literary languages. Another great service to English philology was rendered by his paper, read before the Philological Society, "On some Deficiencies in our English Dictionaries" (1857), which gave the first impulse to the great enterprise now proceeding under the auspices of Dr Murray. His advocacy of a revised translation of the New Testament (1858) powerfully aided to promote another great national undertaking. In 1856 he published a valuable essay on Calderon, with a translation of a portion of *Life is a Dream* in the original metre. He had not, meanwhile, been forgetful of professional claims upon his pen. In 1841 he had published his *Notes on the Parables*, and in 1846 his *Notes on the Miracles*, works which, containing much to gratify every school of thought, and little to offend any, obtained the most extensive popularity, and have been resorted to by English theologians of all persuasions, who have turned the author to the same account as he has turned his patristic, Romanist, and Lutheran predecessors. There is, in fact, very little originality in these volumes, but they are treasuries of erudite and acute illustration, selected from various quarters with admirable judgment, and displayed with consummate taste.

In 1856 Trench was raised to the deanery of Westminster, probably the position in the whole church which suited him best. In January 1864 he was advanced to the more dignified but less congenial post of archbishop of Dublin. Stanley had been named, but rejected by the Irish Church, and, according to Bishop Wilberforce's correspondence Trench's appointment was favoured neither by the prime minister nor the lord lieutenant. It was, moreover, unpopular in Ireland, and a blow to English literature; yet the course of events soon proved it to have been most fortunate. Trench, indeed, could do nothing to prevent the disestablishment of the Irish Church, though he resisted with dignity, and repelled the insidious proposal that she should do execution upon herself. But, when the disestablished communion had to be reconstituted under the greatest difficulties, it was found of the highest importance that the occupant of his position should be a man of a liberal and genial spirit, able to ward off the narrowness which would have alienated the sympathies of English churchmen, and sown the seeds of schism in a body beyond all others in need of amity and unity. This was the work of the remainder of Trench's life; and, if less personally agreeable and of less general utility than the literary performances which might have been expected from him if he had remained at Westminster, it was much more weighty and important. It exposed him at times to considerable misconstruction and obloquy, but he came to be appreciated, and, when in November 1884 he resigned his archbishopric from infirmity, clergy and laity unanimously recorded their sense of his "wisdom, learning, diligence, and munificence." He had found time for *Lectures on Mediæval Church History* (1878); his poetical works were rearranged and collected in two volumes (last edition 1885). He died in London, after a lingering illness, on March 28, 1886.

As a man Trench was universally beloved and esteemed. He was remarkable for a high spirit, munificence, and general elevation of sentiment. As a prose author he ranks among the most useful and agreeable of his generation, and may almost be said to gain in both respects by his deficiency in originality. Both as Biblical commentator and philologist, he has done far more by popularizing the researches of more exact scholars and more profound thinkers than he could have done by striving to make discoveries of his own. For durable fame as a poet originality is indispensable, and here Trench fails. The style of his poems is frequently admirable, but even when not obviously derived from some other writer it wants the stamp of strong individuality. He has written little beyond the reach of any man uniting exquisite culture to the accomplishment of verse: the pieces where poetry seems a natural language with him are chiefly to be found among his elegiac poems, which express real personal experience, and appeal movingly to the heart. (R. G.)

TRENCK, the name of two barons of old German extraction, who, endowed with exceptional physical powers, and each blending to a singular if not to an insane degree the hero and the Bobadil, have left startling records of not wholly dissimilar adventures and misfortunes.

1. Franz, Baron von der Trenck (1711–1749), was born at Reggio, Calabria, where his father was lieutenant-colonel in the Austrian service. After his rough early training in the camp, he made himself so unendurable at the college of Vienna that he was speedily removed, and entered in 1727 as ensign in the Palfy regiment, from which, however, after a brief but riotous course of duelling, gambling, and love-making, he received a new dismissal. He returned to his father, and, on the outbreak of war between the Russians and Turks, raised a corps of 300 men at his own expense and joined the Russian army on the Hungarian frontier. His brilliant exploits won him the favour of his commander, but a breach of orders, followed by an assault on his colonel, brought him under sentence of death, from which a daring feat of arms alone saved him. A sentence of exile to Siberia, incurred soon after by a second affray with a superior officer, was commuted to imprisonment at Kieff and expulsion from the country. His term of imprisonment having expired, he retired to his estate, where he armed and drilled his vassals, and in a series of encounters compelled the Slavonian brigands to seek refuge in Turkish territory. From these marauders he recruited in 1740 the formidable body of pandours with which he joined the levies in aid of Maria Theresa. Repulsing the French near Linz, he penetrated into Bavaria, took Deckendorf and Reichenhall, and destroyed Cham,—the conduct of his troops being marked not less by atrocity than by desperate courage. Recalled to Vienna to render account for the cruelties practised, he refused to defend himself, and, being set at liberty, rejoined his men, opened in 1743 a passage across the Rhine for the army, and became as much the terror of Alsace as he had been of Bavaria. On the retreat of the army to Bohemia he covered the rear and took several towns, but had his right

foot crushed by a cannon-ball. Maria Theresa sent him a surgeon, and, having made a species of triumphal entry into Vienna, he resumed his command. But in September 1745, after having boldly penetrated with his pandours to the tent of Frederick II., he suffered the king to escape him while his followers were stopping to plunder, and he was thereupon accused of having been bribed by that monarch to release him. He was condemned on inquiry to pay an indemnity for peremptory dismissal to the officers accusing him, but he refused to acknowledge the sentence, and, raising new troops, added to the list of his exploits. His conduct leading to a renewal of the inquiry, he laid hands on the president of the court-martial and was thrown into prison, but was enabled to escape by the baroness Lestock, with whom he fled to Holland. He was brought back to Vienna, and condemned to perpetual imprisonment in the Spielberg, where, finding escape impossible, he poisoned himself, October 1749, at the age of 38.

See his autobiography—*Merkwürdiges Leben und Thaten des Freiherrn Franz von der Trenck*, Vienna, 1770; also, *Franz von der Trenck*, by E. F. Hübner, with preface by Schubert, 3 vols., 1788.

2. **Friedrich, Freiherr von der Trenck** (1726–1794), cousin of the preceding, born at Königsberg, 16th February 1726. His precocious abilities won him the favour of Frederick the Great, in whose guards he was enrolled at an early age as cadet, and by whom he was made cornet in 1743 and aide-de-camp for his gallantry in 1744. An intrigue with the princess Amelia, sister of the king, led to his temporary confinement until the campaign of 1745 recalled him to the army. He was again thrown into prison, however, on the discovery of a correspondence between him and his cousin, then fighting with his pandours in the service of Maria Theresa, but in December 1746, after many failures, he succeeded in escaping from the fortress of Glatz. He went to Vienna, was involved in several duels by his cousin, who was too closely confined to give expression to his animosities except by proxy, and finally accepted a company in the service of the czar. On the declaration of peace the empress Elizabeth bestowed on him a diamond-hilted sword, and a Russian princess left him a fortune, which was still further increased by the death of his cousin, who, on condition of his entering none but the Austrian service, made him his heir. The latter inheritance being heavily burdened, he spent the next three years in a series of lawsuits, and then, after a journey to Italy, became a captain in an Austrian regiment of cuirassiers. At the death of his mother he revisited Germany, but was promptly seized by the unforgetful king and closely imprisoned in the fortress of Magdeburg, his efforts to escape securing him the honour of a specially constructed cell, a heavy burden of chains, and the additional punishment of being roused every quarter of an hour by the sentries. Still unsubdued, he found means to remove his chains in the brief intervals afforded him, and occupied himself with French and German composition. In the meantime the princess Amelia had not ceased to move in favour of his release, and Trenck, having been set free in 1763, returned to Vienna only to be reconfined there as a lunatic. He was speedily released by the intervention of the king, and raised to the rank of major by way of compensation; but, being by this time satiated with royal patronage and prisons, he retired to Aix-la-Chapelle, commenced business as a wine merchant, and devoted his leisure to literature and politics, publishing, among other works, a gazette entitled the *Friend of Man* and an attack on Frederick II. as the "Macedonian hero." His commercial experiences, however, were not encouraging, and, after spending three years (1774–1777) in England, he returned to Vienna, became the secret agent of Maria Theresa, and at her death withdrew to his castle of Zwerbach, where he gave himself to agriculture and wrote his famous autobiography. Not until 1787 was he permitted to return to his own country, where he is said to have had an affecting interview with the princess Amelia a few days before her death. The publication of his memoirs (*Lebensgeschichte*) in 1786, translated into French by himself in 1789, gave him immediate and wide notoriety, and wax effigies of the illustrious prisoner in his chains were exhibited on the Parisian boulevards *à deux sous en sortant*. Despite the grounds which the memoirs undoubtedly furnish for Carlyle's terse characterization of him as an "extensively fabulous blockhead," they took a strong hold of the popular imagination, and obliterated for a time the fame of his more darkly passionate pandour cousin. The tragic elements in the story were, however, to be emphasized by a still more tragic close. His ready advocacy of the French Revolution involved him in disgrace with the Austrian authorities, and, after deprivation of his pension and further imprisonment, he set out towards the close of 1791 for Paris. In place of an enthusiastic reception, he was arrested by order of the Committee of Public Safety as a secret emissary of the king of Prussia, and, after confinement in the St Lazarus prison, was literally dragged to the guillotine on 25th July 1794. His *Sämmtliche Gedichte und Schriften* were published at Leipsic in 1786.

TRENDELENBURG, Friedrich Adolf (1802–1872), one of the chief revivers of Aristotelian study in the present century, was born on November 30, 1802, at Eutin, near Lübeck. He received his education at the gymnasium of his native town and at the universities of Kiel, Leipsic, and Berlin, displaying from his earliest years an extraordinary industry and thirst for knowledge. He was introduced to philosophy by König, the rector of the gymnasium a Kantian; and at Kiel he came under the influence of Reinhold and Von Berger, to the latter of whom, a follower of Schelling, some of his own most characteristic views may be traced. At Berlin he heard Hegel and Schleiermacher; but his university studies lay chiefly in the direction of classics and classical philology under Wachsmuth, Hermann, and Boeckh. The combination of the philosopher and the philologist, together with a definitely historical turn of mind, is what is most distinctive of all Trendelenburg's work. He became more and more attracted to the study of Plato and Aristotle, and his doctor's dissertation, published in 1826, was an attempt to reach through Aristotle's criticisms a more accurate knowledge of the Platonic philosophy (*Platonis de Ideis et Numeris Doctrina ex Aristotele Illustrata*). Recognizing the sphere in which his best life-work could be done, he declined the offer of a classical chair at Kiel, and accepted instead a post as tutor to the son of Herr von Nagler, postmaster-general, and an intimate friend of Altenstein, the enlightened minister of education in Prussia. He held this position for seven years (1826–33), occupying his leisure time with the preparation of a critical edition of Aristotle's *De Anima*, and conscientiously extending his knowledge in all directions. His acquaintance with Karl Ferdinand Becker, the philologist and scientific grammarian, was of importance for his own views on the origin of the logical categories and the relation of thought to language. In 1833 Trendelenburg was appointed extraordinary professor in Berlin, and four years later he was advanced to an ordinary professorship. During nearly forty years he proved himself markedly successful as an academical teacher, treating in turn all the usual philosophical disciplines, besides holding more select classes for the study of Aristotle with advanced students. During the greater part of that time he had also to examine in philosophy and pedagogics all candidates for the scholastic profession in Prussia. He died on the 24th of January 1872.

It was with a view to the philosophical preparation in the gymnasia that he published (1836) his *Elementa Logices Aristoteleæ.* This useful little book contains a selection of passages from the *Organon*, giving in a connected form the substance of Aristotle's logical doctrine. The Greek text is furnished with a Latin translation and notes, and at a later date Trendelenburg supplemented this book with further explanations for the use of teachers (*Erläuterungen zu den Elementen der aristotelischen Logik*, 1842). The *Elementa* has passed through eight editions, and the *Erläuterungen* through three. In 1840 appeared the first of his important works, which, under the modest title of *Logische Untersuchungen*, develops a coherent philosophical theory, besides acutely criticising other standpoints, and in particular the then dominant Hegelian system. The *Logische Untersuchungen* were, indeed, an important factor in the reaction against Hegel which set in about that time in Germany. Two articles written by Trendelenburg in the controversy which ensued were republished separately, under the title *Die logische Frage in Hegel's System* (1843). A second and enlarged edition of the *Logische Untersuchungen* appeared in 1862, and a third in 1870. In 1846 he published the first volume of his "Historical Contributions to Philosophy" (*Historische Beiträge zur Philosophie*), containing a history of the doctrine of the categories, which forms a pendant to his own elaboration of the same subject in the *Logische Untersuchungen.* A second volume of the "Historical Contributions" appeared in 1855, and a third in 1867, consisting of detached essays on points of interest in the history of philosophy. A number of these are papers originally read before the Prussian Academy of the Sciences, of which Trendelenburg was made a member in 1846. He was secretary of the philosophico-historical section from 1847 till 1871, and devoted much of his valuable time to the duties devolving upon him. A number of his papers dealing with non-philosophical—mainly with national and educational—subjects have been collected in his *Kleine Schriften* (2 vols., 1871). In 1860 the second of his larger works appeared, *Naturrecht auf dem Grunde der Ethik* (second enlarged edition, 1868). In 1865 Trendelenburg became involved in a controversy with Kuno Fischer on the interpretation of Kant's doctrine of space, which was carried on with no little acrimony for a number of years. The war of 1870 drew from him a short treatise on the defects of international law,—*Lücken im Volkerrecht.* He had always had a deeply patriotic interest in the political development of Prussia, and through Prussia of Germany, and in the stormy times after 1848 had even acted for a short period as deputy to the Prussian chamber.

Trendelenburg's philosophizing is conditioned throughout by his loving study of Plato and Aristotle, whom he regards not as opponents but as building jointly on the broad basis of idealism. His own standpoint may almost be called a modern version of Aristotle thus interpreted. While denying the possibility of an absolute method and an absolute philosophy, as contended for by Hegel and others, Trendelenburg was emphatically an idealist in the ancient or Platonic sense; his whole work was devoted to the demonstration of the ideal in the real. But he maintained that the procedure of philosophy must be analytic, rising from the particular facts to the universal in which we find them explained. We divine the system of the whole from the part we know, just as from a torso we may reconstruct a work of art; but the process of reconstruction must, in the case of philosophy, remain approximative. Our position forbids the possibility of a final system. Instead, therefore, of constantly beginning afresh in speculation, it should be our duty to attach ourselves to what may be considered the permanent results of historic development. The classical expression of these results Trendelenburg finds mainly in the Platonico-Aristotelian system. The philosophical question is stated thus—How are thought and being united in knowledge? how does thought get at being? and how does being enter into thought? Proceeding on the principle that like can only be known by like, Trendelenburg next reaches a doctrine peculiar to himself (though based upon Aristotle) which plays a central part in his speculations. Motion is the fundamental fact common to being and thought; the actual motion of the external world has its counterpart in the constructive motion which is involved in every instance of perception or thought. From motion he proceeds to deduce time, space, and the categories of mechanics and natural science. These, being thus derived, are at once subjective and objective in their scope. It is true matter can never be completely resolved into motion, but the irreducible remainder may be treated like the *πρώτη ὕλη* of Aristotle as an abstraction which we asymptotically approach but never reach. The facts of existence, however, are not adequately explained by the mechanical categories. The ultimate interpretation of the universe can only be found in the higher category of End or final cause. Here Trendelenburg finds the dividing line between philosophical systems. On the one side stand those which acknowledge none but efficient causes,—which make force prior to thought, and explain the universe, as it were, *a tergo.* This may be called, typically, Democritism. On the other side stands the "organic" or teleological view of the world, which interprets the parts through the idea of the whole, and sees in the efficient causes only the vehicle of ideal ends. This may be called in a wide sense Platonism. Systems like Spinozism, which seem to form a third class, neither sacrificing force to thought nor thought to force, yet by their denial of final causes inevitably fall back into the Democritic or essentially materialistic standpoint, leaving us with the great antagonism of the mechanical and the organic systems of philosophy. The latter view, which receives its first support in the facts of life, or organic nature as such, finds its culmination and ultimate verification in the ethical world, which essentially consists in the realization of ends. Trendelenburg's *Naturrecht* may, therefore, be taken as in a manner the completion of his system, his working out of the ideal as present in the real. The ethical end is taken to be the idea of humanity, not in the abstract as formulated by Kant, but in the context of the state and of history. Law is treated throughout as the vehicle of ethical requirements. In Trendelenburg's treatment of the state, as the ethical organism in which the individual (the potential man) may be said first to emerge into actuality, we may trace his nurture on the best ideas of Hellenic antiquity. (A. SE.)

TRENT (*Tridentum*; Ital. *Trento*; Germ. *Trient*), a city of the Austrian empire, capital of Italian or "Welsch" Tyrol, stands on the left bank of the Adige, where it is joined by the Fersina, on the Brenner Railway, 35 miles below Botzen and 60 miles above Verona. It has a very picturesque appearance, especially when approached from the north, with its embattled walls and towers filling the whole breadth of the valley, a conspicuous feature being the rocky citadel of Dos Trento (the Roman *Verruca*) on the right bank of the river. Of the old walls some massive remains are attributed by local tradition to Theodoric the Goth. Notwithstanding many symptoms of decay, Trent, with its numerous palaces, substantial houses, broad streets, and spacious squares, still retains the aspect of a flourishing Cisalpine town. In appearance it is quite Italian, and the inhabitants speak Italian only. The cathedral, on the south side of the spacious Piazza del Duomo, was begun in its present form in 1212, and finished about the beginning of the 15th century. It preserves, however, some Lombardic features of ornamentation in the portals and elsewhere which possibly date from the 7th or 8th century. The church of St Maria Maggiore, a simple but good example of the Italian style of the 15th century, was the meeting-place of the famous council (see below), and possesses a picture containing portraits of the members. Trent is the seat of a prince-archbishop, and has all the public offices according with its administrative rank. It has a museum and library, a gymnasium, a "lyceum," a seminary, and a deaf and dumb institute. The chief industries are silk-spinning and weaving, tanning, sugar-refining, and glass-blowing; and there is considerable trade in wine, grain, and fruit, as also in marble from the extensive quarries in the neighbourhood. The population in 1880 was 19,585.

Tridentum is mentioned by the geographers as capital of the Tridentini, and seems ultimately to have been made a Roman colony. It suffered much during the period of barbaric invasion, but was resuscitated by Theodoric, becoming the seat successively of Gothic and Lombard dukes and Frankish counts. In 1027 it passed under the rule of its bishops, with whom it had frequent disputes, in which it sought the favour and alliance of the lords of Tyrol. The Venetians made repeated efforts to set up the lion of St Mark within the walls of Trent, but were decisively and finally repulsed in 1487.

TRENT, THE COUNCIL OF, which may be described as the watershed of Roman Catholicism and Protestantism, is the most important occurrence in post-mediæval church history. It is the culminating event in a long series of similar assemblies, convoked to remedy the evils occasioned during and by the great schism of the papacy, and by the dissolution of lay and clerical morals to which the pagan temper of the Renaissance had largely contributed. But the councils of Pisa, Constance, Basel, Ferrara-Florence, and the Lateran had met and parted without attempting to deal effectually with any of the practical scandals and abuses in the church which were sapping the loyalty and affection it had formerly enjoyed; and these repeated failures, by destroying all hope of redress at the hands of the constituted authorities, precipitated the crash of the Reformation, which was in its inception scarcely concerned with doctrinal issues directly, but aimed mainly at faults of administration and morals.

Consequently a largely new problem presented itself for solution, and necessitated a fundamental change in the attitude of those concerned. Hitherto, whatever may have been the fierceness and bitterness of the disputes which the 15th-century councils had attempted to allay, they were, so to speak, family quarrels between members of the same great household, accustomed to the same mode of looking at religious questions, acknowledging the same hierarchy, and accepting the same standards, and thus with a vast body of agreement to go upon as a basis of reconciliation, leaving only comparatively minor details to be adjusted. But the German and Swiss Reformation had generated new communions, novel alike in their polity and much of their theology, and in active revolt, not merely against this or that detail or abuse, but against the Roman Catholic Church in its entirety, hierarchical, doctrinal, and political. The movement had not been confined long to its earlier limits, but had spread over all western Europe, had virtually conquered Holland and Scandinavia, was making great strides in France and England, and was beginning to threaten even Italy and Spain. Thus, the task was no longer the comparatively simple one of satisfying the demands of friendly remonstrants, but of winning back alienated nations, and, if that were too much to hope for, at least of saving the remnant of the Roman obedience from further disintegration. And for this purpose it was no longer sufficient, as it would have been a few years earlier, to discuss administrative details alone, but a review of the whole theological fabric of Latin Christianity, no part of which had been left wholly unimpeached, became a necessary factor in any possible scheme of reconciliation. True, a precedent had been set in the theological discussions at the council of Ferrara-Florence, with its abortive effort to reunite Oriental and Latin Christendom, but the area and number of differences to be reconciled upon that occasion were incomparably smaller than those which had subsequently arisen, and the situation was thus one of extreme difficulty and delicacy, since there was always the danger of alienating many who had continued loyal so far, if very large concessions were made to the revolted Protestants, not a few of whom, besides, had already passed beyond the possibility of reconciliation. But, on the other hand, Luther had himself appealed to a general council from the bull "Exsurge Domine" launched at him by Leo X. in 1520, and his demand was taken up by the emperor and the princes of Germany, whether Catholics or Protestants, as the only conceivable means of terminating a crisis whose religious and political results might prove far more serious than even the least hopeful ventured to forecast. There was thus steady pressure from one side put upon the Roman curia to obtain the convocation of such a council, while scarcely less resistance to the proposal was offered by two very unlike parties in the Roman Church itself. For not only did those oppose it who were interested in the maintenance of the principal abuses complained of, and who feared that sweeping measures might be taken for their abolition, but some of the ablest champions of internal reforms, such as Cardinals Sadolet, Contarini, and Reginald Pole, were equally hostile to it, for the very different reason that they believed any such council likely to contain a majority determined on making it as abortive as those great synods had been which were fresh in the memory of all. Accordingly, this section gave its voice for the alternative scheme of proceeding by way of less formal conferences, at which mutual explanations and concessions might be made by Catholics and Protestants, whereby a *modus vivendi* could be established, with less chance of the whole effort being wrecked by the intrigues of those who desired nothing less than practical reforms. A fresh difficulty was presented by the opposition of the German princes to the assemblage of the council at Rome or anywhere outside Germany, as they distrusted the probable action of the Italian element, certain to preponderate in that event; and, as the curia was equally bent on holding it within the sphere of direct papal influence, this dispute made it impracticable to agree even on the preliminaries during the pontificates of Hadrian VI. and Clement VII. The diet of Spires in 1529 renewed the demand for a general council, to be held in some large German city; and the diet of Augsburg in 1530 summoned the Lutherans to return into Catholic communion at once and unconditionally, leaving their doctrines (formulated in the Confession of Augsburg that very year) to be judged of in a future council, which the emperor Charles V. pledged himself to obtain within a brief space. Clement VII., then pope, was displeased at this initiative on the emperor's part, but offered to convoke a council in some Italian city, such as Mantua or Milan, belonging to the empire, and outside the States of the Church,—expressing his wish that Charles V. should personally attend it. But he hampered this proposal with conditions which made it valueless for the main object of such an assembly, by declaring that no theological questions upon which the church had spoken could be reopened, and that, if Protestants were to be admitted to the council at all, it must be, not as disputants, but as on their trial, and pledged beforehand to submit to the decisions of the council. No result, consequently, followed upon this step, nor was an embassy which Clement sent in 1533 to the German princes and to the kings of France and England with very similar provisions more successful, for it merely drew out a peremptory rejection of the scheme from the Protestants assembled at Schmalkald, by the emperor's desire, for the purpose of discussing it. So the matter rested till the accession of Alexander Farnese to the papal throne as Paul III. in 1534. A much abler man than his predecessor, he was also more alive to the imperative need of at least appearing to approve some measure of reform, if the church was to be saved from impending dangers (indeed, a report on this subject, drawn up at his desire by a committee of cardinals in 1536, is one of the most important documents of the era), and he was thought to be favourable to the project of a council, whereas there is little doubt that Clement VII. had weighted his acceptance of the plan with impossible conditions, in order to avoid its realization, yet so as to let the responsibility of refusal rest with others than himself. Paul III. sent Vergerio as envoy into Germany, to confer with the emperor and the princes, offering to convoke a council at Mantua, and urging the danger of attempting to hold it in Germany, by reason of the violent lengths to which the Anabaptists were then proceeding. But, while the Catholic princes were content with this offer, it was refused by the Protestants, and the ambassadors of France and England supported them in their attitude. Vergerio, who had also a fruitless interview with Luther, returned to Rome early in 1536, but Paul III. was not discouraged by his failure, and proposed, in a consistory on April 8, to convoke a council at Mantua. This plan was in turn upset, not only by the continued resistance of the Protestants, but by the refusal of the duke of Mantua to permit the use of his city for such a purpose, unless upon conditions which the pope was unwilling to accept. Notice was accordingly given of a council to be opened.

at Vicenza on May 1, 1538, and legates were despatched thither to make the preliminary arrangements, and to preside so soon as the members should assemble. But when the appointed time was only five days off not one bishop had arrived, and the pope was forced to prorogue the council again and again. Meanwhile, the method which Contarini and Sadolet had recommended, that of conferences between the Catholics and Protestants, was being acted on in Germany, and meetings of this nature were convened successively at Haguenau, Worms, and Ratisbon, at the last of which, in 1541, Contarini was present as legate of the pope, and showed so much tact, moderation, and sympathy that he succeeded in securing a large measure of agreement upon the controversies in dispute, notably on the vexed question of Justification. But, as his concessions and explanations were promptly repudiated at Rome, no practical result followed. In 1542 Paul III. sent Morone as his envoy to the diet of Spires to offer Trent as his final concession of the place of assembly, on the ground that its position in Tyrol, and its being part of the dominions of the king of the Romans, ought to meet all the reasonable requirements of the German princes. Ferdinand, king of the Romans, who presided at the diet, was content with this offer, as were the Catholic princes generally, but the Protestants continued to object, and refused any council which should not be completely free from papal influence and authority. However, the pope issued on May 22, 1542, a bull appointing the meeting of the council for November 1 following. He sent three legates to Trent to make preparations,—Morone, Parisio, and Reginald Pole; but they did not reach the city till three weeks later than the appointed date for opening the council, and so few bishops arrived during seven months from that time that it was necessary to prorogue the assembly. In fact, the idea of the council was distasteful to a very large proportion of the Latin clergy, especially such as apprehended danger to their private interests from the reforming plans of the pope, and also such as were alarmed lest serious religious innovations might be made in order to conciliate the Protestants. While this delay continued another diet at Spires in 1544 resulted in great advantages to the Lutherans, who availed themselves of the political straits of Charles V. to extort several important concessions from him. The obnoxious edicts passed against them at Worms and Augsburg were rescinded; they were permitted to retain such ecclesiastical property as they had seized; they were made eligible for such civil and ecclesiastical offices as had been previously barred against them; and general toleration for the time being was established. This policy was extremely distasteful to the pope, who addressed a brief to the emperor, strongly remonstrating against it, and renewing his offer of a council. Charles V., who had not been a free agent in the matter, was much of the pope's mind, and proceeded to relieve himself of one difficulty in the way of reversing his action, by concluding peace with Francis I. of France on September 8, 1544. Hereupon Paul III. directed public thanksgivings to be offered throughout the whole Latin Church, and issued a bull removing the suspension of the council, and summoning it to meet at Trent on March 15, 1545. Unable from age and illness to be present himself, as he had wished, he named Giammaria del Monte, bishop of Palestrina (afterwards Pope Julius III.), Marcello Cervini (afterwards Pope Marcellus II.), and Reginald Pole as his legates. The experience of former abortive openings was repeated, for they found but one bishop awaiting them, and so few continued to arrive that a fresh prorogation was forced upon the legates, and the pope, in the bull authorizing this action, added a proviso that no proxies should be received, but that all bishops summoned should attend in person, under severe penalties for contumacy. On November 7, 1545, the legates received final instructions to open the council upon December 13, and did so with solemn ceremonial, but only as a formal initiative of the proceedings, for the first session was postponed till January 7, 1546. When that time arrived, no more than some five and twenty archbishops and bishops, five generals of religious orders, and the ambassadors of King Ferdinand had assembled, and none of the conciliar officers had yet been nominated, nor any programme of procedure sketched out. The most important question arising under this last head was whether the voting should be taken by nations, as at the council of Constance, or by individuals, and the matter was referred to the pope, who gave his decision for the latter, as at once the more ancient (since Constance and Basel were the only precedents for the national vote) and the more convenient. Moreover, this ruling secured from the outset a working majority of Italian bishops in the assembly, at once by reason of the small size of the average Italian diocese, and of the greater ease with which Trent could be reached from Italy than from any other country which sent representatives thither, besides enabling the pope to swell the majority (as in the Vatican council three centuries later) with bishops *in partibus*, having no dioceses or jurisdiction, thus amply justifying the objection taken all along by the German Protestants to the assemblage of the council anywhere outside Germany.

Some preliminaries had to be settled before the second session, and the plan of holding private "general congregations," where theologians of non-episcopal rank could sit and share in the discussion and preparation of the decrees to be proposed and voted on in public session, was at once adopted and observed thenceforward. And first, the question was raised whether any persons except bishops should be allowed to vote upon matters of doctrine. The decision was that the vote should be allowed to the generals of religious orders also, and that the right of the proxies of absent bishops to vote should be referred to the pope. The title to be given to the council at the head of the decrees in each session was then discussed, and a proposal to add the words "representing the church universal" (as at Basel and Constance) to the usual formula "general and œcumenical" was rejected at the instance of the legates, as indirectly menacing to papal autocracy. The legates also privately informed the pope that the majority of the members desired to take up the question of practical reforms before that of doctrine, and that it might be necessary to yield the point to avoid scandal or the imputation of sympathy with abuses, but that they would insist, in that case, on making the measures of reform apply all round, to princes and laymen as well as to ecclesiastics, which would probably damp the ardour of its advocates.

The actual business of the second session (January 7, 1546) was confined to the promulgation of a decree touching the discipline to be observed by the members of the council during its progress, as well in the matters of their private devotion and their food as in the conduct of the debates. The congregations which preceded the third session were mainly occupied with debating the thorny question of the order in which the discussion of faith and of discipline was to come, and it was at last agreed to take them simultaneously.

So few additional bishops had arrived up to this time that it was judged inexpedient to promulgate any decrees in the third session (February 4, 1546), and little was done except the public recitation of the Niceno-Constantinopolitan creed as the authoritative confession of the Roman Church, and, as the council worded it, "that firm and only foundation against which the gates of hell shall not prevail." A fortnight after this third session Martin Luther died (February 18, 1546), just as the situation in Germany was becoming more strained, and the emperor, alarmed at the rapid advance of Reformed opinions and practices (notably in the Palatinate, where the elector had made large concessions), was taking measures for suppressing the religious revolt by force of arms. The canon of Scripture was proposed in the congregations before the fourth session as the subject for discussion, and the three following questions were raised:—(1) Were all the books of both Testaments to be approved and received? (2) Was there to be a fresh inquiry into their canonical character before giving such approval? (3) Should there be any distinction drawn between the books, as being some of them read merely for moral instruction, and others for proving the doctrines of Christian belief? The first of these questions was decided affirmatively. The second led to much debate; the conclusion arrived at was that a secret examination of the evidence should be made, but not suffered to appear in the public acts of the council. The third question was decided negatively. These congregations were the first wherein theological experts and canonists, not being members of the council, were admitted to a share in the discussions. The nature and function of tradition was also debated at this time, and the legates informed the pope that there was a strong tendency in the council to set it aside altogether, and to make Scripture the sole standard of appeal. Another burning question debated was that of vernacular translation and lay study of Scripture. The result, in the fourth session (April 8, 1546), was the promulgation of two decrees, the first of which enacts, under anathema, that Scripture and tradition are to be received and venerated equally, and that the deutero-canonical books are part of the canon of Scripture. The second decree declared the Vulgate to be the sole authentic and standard Latin version, and gave it such authority as to supersede the original texts; forbade the interpretation of Scripture contrary to the sense received by the church, "or even contrary to the unanimous consent of the fathers"; imposed various restrictions upon printers and vendors of Bibles; made licences to read any Biblical manuscript or publication compulsory; and prohibited the application of Scripture language to profane and superstitious purposes. The subjects next taken up were the doctrine of original sin and the reformation of abuses concerned with preachers and lecturers, which were made the matter of two decrees in the fifth session (June 17, 1546). The most noticeable point in the former is the saving clause, whereby the tenet of the Immaculate Conception of the Blessed Virgin is excepted from decision, and left open; the latter enjoins the erection of a lectureship of Scripture in all cathedrals, collegiate churches, and monasteries, imposes the duty of preaching upon all bishops and persons with cure of souls, lays down stringent rules as to preaching licences, and forbids the "questors" (that is, the collectors of alms commissioned by the mendicant orders) to preach anywhere. There was a treaty concluded between the pope and the emperor a few days after this session, to make war against the German Protestants on the express ground of their refusal to submit to the council, and from this may be dated the end of any serious effort in the council itself to deal with the question of reconciliation, although the original motive for its convocation. Moreover, so little interest was felt even by the Roman episcopate in the proceedings at Trent that, instead of fresh accessions coming to recruit the small numbers present, constant defections took place, and a proposal to stop this by forbidding any bishop to quit Trent without formal permission was carried. The doctrine of Justification, made a burning question by the prominence given to it in Lutheran theology, was next taken up, and, this being, so to speak, a new controversy, with few precedents to guide the council, the discussion was proportionably protracted. It is noteworthy that Luther's views found some supporters, and the resignation of the legateship at this time by Reginald Pole, and his departure from the council, never to return, is attributed to his dissatisfaction with the conclusions arrived at upon this subject in its decree. The disciplinary question discussed at this time was that of the obligation of residence, especially as regards bishops; and decrees upon both these subjects were promulgated in the sixth session (January 13, 1547),—that on Justification being a formal dogmatic treatise in sixteen chapters, thirty-three canons; that on residence reviving former canons, and imposing new penalties, but avoiding the solution of a question hotly debated in the council, whether the residence of bishops was obligatory *jure divino*, or merely by ecclesiastical precept. Meanwhile, Charles V. was victorious in his war with the Protestants, and had all Germany in his power, but, instead of using the opportunity, as the pope expected, to put down the Reformers, he alleged that the recent war had not been one of religion, and assumed an attitude of toleration. Hereupon Paul III., in order to break up this truce, sent instructions to the legates to press on decrees displeasing to the Protestants, judging that the emperor's well-known interest in the council would cause him to be accounted responsible for its measures, and thus lose all credit for his recent forbearance. In the seventh session, held on March 3, 1547, two decrees were promulgated,—one defining the sacraments as seven in number, and as being all channels of grace, also adding special canons concerning baptism and confirmation; the other dealing with pluralities, unions of benefices, repair of churches, and kindred matters, but with no great stringency. A more important part of the business of this session was the open declaration of a measure which the pope and the legates had been privately planning for some time, the transference of the council from Trent to some city more directly under papal control; for, while Trent sufficed for headquarters as against Protestants, yet it was found that a virtual coalition between the Spanish, French, and German bishops to resist the Italians interfered with the intentions of the papal court, and could be most effectively broken up by a change of place. Occasion was accordingly taken from an outbreak of disease, alleged to be infectious, at Trent to issue a bull transferring the council to Bologna, which was read in the seventh session, while the promulgation of a decree in accordance with it formed the whole business of the eighth session (March 11, 1547). When it had been passed, the legates produced a brief which they had obtained more than two years before, empowering them to transfer the council as they pleased. But, while they themselves quitted Trent the next day, and were followed by the majority of the bishops, those of the emperor's party continued in session at Trent, and refused to leave it without the permission of their sovereign, though they abstained from all conciliar action, in order to avoid the charge of schism. Charles V., incensed at the pope's action, sent a mandate approving and confirming their conduct. The ninth session, held at Bologna (April 21, 1547), and the tenth also (June 2, 1547), were merely formal, nothing being done save to prorogue the council. The practical result of this split in the council was to relieve the Protestants from imminent peril; for, while the emperor's successes enabled him to put severe pressure upon them to submit to its decrees, it was itself incapacitated for valid action, as neither the bishops at Bologna nor those at Trent could claim to be the whole council, nor demand acceptance of their acts as binding. Hence Charles V. was urgent for the return of the entire body to Trent, and threatened, in case of refusal, to go to Rome, and hold the council there himself. And he took an even more peremptory step by constituting himself arbiter of the whole controversy, appointing Julius Pflug, bishop of Naumburg, a prelate known to be friendly to the Lutherans, Michael Holding, called Sidonius, afterwards bishop of Merseburg, and John Agricola, a Lutheran writer of some mark, to draft an eirenicon upon the points in dispute, which was published under the title of the "Interim," by the emperor's authority, at the diet of Augsburg, May 15, 1548. It proved, however, inefficacious, and was formally repudiated and answered by the Catholic princes and states of the empire, and yet more peremptorily by the Protestants, its only result being the "Interimistic controversy." It was succeeded by another formulary concerning reformation, accepted by the diet. While the emperor was endeavouring to force the "Interim" upon his dominions, the pope, on his part, strove to remove the dead-lock of the divided council, and convoked a committee to consist of members of both the Bolognese and the Tridentine sections to confer upon ecclesiastical reforms. But the bishops at Trent, having communicated with the emperor, and waited three weeks for his sanction, refused to leave that city, and the pope was compelled to direct the legates at Bologna to dismiss the bishops assembled there, and to announce the suspension of the council, which was accordingly done upon September 17, 1549. Paul III. died on November 10, 1549, and was succeeded on February 7, 1550, by Cardinal del Monte, the chief legate at the council, who took the title of Julius III. The break in the continuity of the council occasioned by these proceedings lasted till May 1, 1551, when the eleventh session was held at Trent under the presidency of Cardinal Crescenzio, sole legate in title, but with two nuncios, Pighini and Lippomani, as co-ordinate assessors. It was merely formal, as was also the twelfth session, on September 1, 1551. Just at this time Henry II., king of France, having quarrelled with the pope about the duchy of Parma, sent an envoy to the council at Trent, with letters styling it a "convention," denying its œcumenical character, declaring that it was not accessible to himself or to the French bishops, and notifying a protest against the validity of its proceedings, which he desired might be registered, and a copy of the register returned to him. No reply was made to this demand; so Henry dismissed the papal nuncio from his court, and published a manifesto to justify himself, at the same time that, in order to repel any charge of sympathy with the Protestants, he promulgated a severe edict against them. But the absence of French bishops, and the comparatively scanty attendance from Germany, threw matters more than ever into the hands of the Italian majority, as appeared from the decrees promulgated in the thirteenth session (October 11, 1551), and indeed from the attitude taken up by the legates just before it. For the obstinate refusal of the Protestants to attend or even recognize the council was on the point of giving way, and the imperial ambassadors demanded a safe-conduct for such as might present themselves, with some warranty that it should be really safe. They also desired the postponement of any decision on the doctrine of the Eucharist, and especially as regards the communion of the laity in the chalice. The pope expressed himself willing to grant both these demands, but no real attention was paid to either of them. As respects the attendance of the Protestants, the letters of Francis Vargas, fiscal (attorney-general) in Spain to Charles V., and his agent at the council, state plainly that the legates merely pretended to desire it, and were secretly doing everything to prevent it, while the very points as to which delay had been promised were made the subject of the decrees in the above-named session. The decree on the Eucharist was specially directed against Lutheran and Zwinglian opinions then recently broached, and was couched in eight chapters with eleven canons appended. It reasserted the doctrine of Transubstantiation, already defined by the fourth Lateran council in 1215, while, by the third of the canons, which declares that the whole sacrament is entire in each kind, it indirectly, though effectively, ruled against the grant of the chalice to the laity; and in fact the Reformed thesis that they were entitled to it by divine right, and could not be deberred from it without sin, was unanimously condemned in the previous congregation. Some unimportant decrees affecting the criminal jurisdiction of bishops, and for referring the trials of bishops themselves to the pope, were enacted at the same time; but more noteworthy was a decree for postponing the decision upon lay and infant communion, and for granting a safe-conduct to the Protestants, which was the last business transacted upon this occasion. But the safe-conduct was worded so as to excite general and reasonable suspicion on the part of those to whom it was offered, and Vargas, who was no friend to their opinions, comments freely upon its deceptive ambiguity. In the fourteenth session (November 25, 1551) decrees upon penance and extreme unction, prepared in the congregations, and embodied in twelve chapters upon the former and three on the latter topic, followed severally by fifteen and four canons, were promulgated. Some disciplinary enactments affecting the clergy, and corrective of minor abuses, were enacted at the same time, the most important provisions being the abolition of the papal dispensations exempting their holders from the jurisdiction of the ordinary, and the restriction of the action of titular bishops. But the reforming party in the council was much discontented with the inadequacy of these measures, which added little to the very small progress made so far in the revival of discipline. Although no Protestant theologians had yet presented themselves at Trent, representatives of the duke of Würtemberg arrived at this time, who were instructed to lay the Würtemberg Confession before the council, and to say that Protestant divines who could give explanations of it were waiting some forty miles from Trent, and were prepared to attend the council so soon as a safe-conduct exactly conformable with that granted to the Bohemians by the council of Basel was issued, and on the further conditions that the discussions actually going on should be suspended and all the matters so far decided be reopened, that the pope should cease to preside by legates or otherwise, but declare his own submission to the decrees of the council, and absolve the bishops from their oath of allegiance to himself in order to secure their liberty of action. The envoys refused to treat with the legates at all, and conducted their negotiations through the imperial ambassadors. Crescenzio was very angry, and refused all concession, even going so far as to abstract the conciliar seal, lest the safe-conduct might be granted; but pressure was put upon him by the imperial ambassadors, and he was forced to consent to the admission of the Protestant envoys at a private congregation to be held in his own house, though he resisted the demand for introducing them to a public session. And, when the safe-conduct was recast, it was found to differ seriously from that proposed as its model, especially by failing to give the Protestants the rights of session and suffrage, of observing their own religion in their houses, and of being guaranteed against insults to their creed. To the remonstrances made in consequence the legate returned a peremptory reply, refusing to make any further change, and only the instances of the emperor, then at Innsbruck, but three days' journey from Trent, induced the Protestant envoys to remain a little longer, to find if any better terms could be obtained. Some more Protestant envoys from Strasburg and other cities, and from Maurice of Saxony, arrived early in 1552, and were admitted to a congregation held on January 24, where they renewed the demands already mentioned, and required also that the decrees of Constance and Basel, declaring the pope inferior and subject to a general council, should be reaffirmed. They were promised an answer in due time, and the fifteenth session was held the next day (January 25, 1552), wherein the council was prorogued, and a safe-conduct more in accordance with the Protestant demands was drawn up and published. It is remarkable, however, for one omission, and for one significant clause. The omission is that of toleration for the private exercise of their religion; the insertion is a proviso pledging the council not to avail itself, "for this one occasion," of any laws or canons whatever, "especially those of Constance and Siena," as against the Protestants. The reference is to the canon of Constance by means of which John Huss was tried and burnt, declaring a safe-conduct no protection against trial for heresy, even if the accused has come in reliance on the safe-conduct, and would not have come without it, which canon was reaffirmed at the council of Siena in 1423. While the negotiations occasioned by these proceedings were in course, war broke out anew in Germany, and Maurice of Saxony obtained considerable successes over the emperor, took Augsburg, and was marching down upon Tyrol, so that Charles V. fled in haste from Innsbruck, and the legate convened the sixteenth session (April 28, 1552) of the council, wherein a decree was promulgated suspending it for two years in consequence of the perils of war. There was a general stampede from Trent at once, and the legate Crescenzio, then very ill, had just strength to reach Verona, where he died three days after his arrival.

So ended what is styled by some historians, and correctly, the first council of Trent, for, although the usual computation recognizes only one such council, yet an interruption of ten years, a widely changed personality, and a marked alteration in tone make the resumed synod virtually another assembly, and one by no means entitled to the degree of respect which the ability and learning of many members of that first convoked won for it. When the council dispersed, Julius III. at once in consistory repeated the policy of Paul III., and nominated a committee to prepare a scheme of reform, but it never took action of any kind; and at the close of the two years' suspension of the council the question was put in consistory as to the resumption of the sessions, and decided, with the pope's approval, in the negative. Julius III. died on March 23, 1555, and was succeeded on April 11, 1555, by Cardinal Marcello Cervini, one of the former legates at the council, a man of high reputation for personal devoutness and freedom from that sympathy with abuses which marked too many of the dignitaries of the time. He took the title of Marcellus II., and his first public utterance was to intimate his purpose of reassembling the council, and of carrying out a plan of thorough reform in discipline, particularly directed to abating the pomp and luxury of the prelacy. But he was in feeble health when elected, and the fatigues of his new position brought on an attack of apoplexy which carried him off three weeks after his accession. In his room was chosen, on May 23, 1555, Cardinal Giovanni Pietro Caraffa, who took the title of Paul IV. He was known to profess great austerity of life, to have actually founded the Theatines, an ascetic community, and to be a stern and implacable advocate for several measures of repression against innovators in matters of religion or impugners of papal prerogative, as he quickly showed by setting up the Inquisition in Rome, and taking care that it should not be idle. His election consequently caused much alarm, and was especially displeasing to the emperor; and the earlier acts of his pontificate seemed to justify the estimate formed of his character and the fears of those who apprehended that he would proceed to reform discipline in a swifter and more drastic fashion than had hitherto been essayed. For in fact he pledged himself to this effect in the first bull published after his accession, following it up with a show of activity by at once setting some minor reforms on foot.

During these three years important events had taken place in Germany. By the peace of Passau in 1552, the Protestants of the Augsburg Confession were secured from all molestation, and in the free exercise of their religion and of their civil rights, and this was followed up by a decree of the diet of Augsburg, on September 25, 1555, that, failing a national council to settle the religious disputes, the emperor, the king of the Romans, and the other Catholic princes should not interfere in any way with the religious liberties of the Lutherans holding to the Confession of Augsburg, provided they in their turn would exhibit equal tolerance towards Catholics; that no penalty, save the loss of benefices, should be imposed on any Catholic ecclesiastics joining the Lutheran body; and that such benefices as the Protestants had already annexed for the support of their schools and ministers should remain in their possession. Paul IV. was much incensed at these proceedings, and used all efforts to procure their repeal, on the failure of which he openly broke with the emperor, formed an alliance with the French king against him, and imprisoned the cardinals and other personages of the imperial party on whom he could lay hands, confiscating the property of such as saved themselves by flight. He continued for a time in the measures of reform with which he began his reign, striking against jobbery, pluralities, dispensations, and laxity of clerical manners; but all this short-lived zeal was speedily neutralized by his nepotism, surpassing that of any of his predecessors, and throwing the government of the States of the Church into the hands of his dissolute nephews, upon whom he rained all the wealth, honours, and authority in his power to bestow. And, as was to be expected, he set himself steadily to oppose every one of the class of reforms which touched doctrinal questions, just those for which the Protestants were urgent, encouraging only such as promoted the unity and discipline of the Roman Church itself, and made it more capable of effective resistance to the Reformation. He was not favourable to the reassembling of the council, not merely because of his experience of its languid action, nor even his dislike of the struggles of the non-Italian minority to assert some measure of independence against the coercive tutelage exerted by the several papal legates from the very first, but because he regarded himself as the sole and proper person to consider such matters at all, and a bull of his own promulgation a better mode of procedure, at once in fulness of authority and swiftness of formulation, than any conciliar decree. Consequently, no step for the resumption of the council was taken during his reign, which ended on August 18, 1559. After a longer interregnum than usual, Giovanni Angelo de' Medici (not a member of the great Florentine house, but of humble Milanese extraction) was elected on December 26, 1559, as Pius IV. Markedly unlike his predecessor in almost every personal quality, he was much his superior in practical shrewdness and tact, and had none of that dislike to a council which Paul IV. had shown. So great, too, had been the strides made by the Reformation during his predecessor's reign that he might well think Paul IV.'s policy undesirable, and he had this special motive for reversing it, that a movement was going on in France for the convocation of a national council there to consider the whole religious situation, which might very conceivably result in a revolt like that of England from the Roman obedience. Accordingly, Pius IV. determined on the resumption of the council of Trent, and issued a bull on November 29, 1560, convoking it anew.

But the whole face of Western Christendom, the whole religious situation, had materially changed since the original assemblage of the synod in 1545. First, the imposing personality of Charles V. was removed from the scene, and Ferdinand I., his successor, enjoyed neither his personal ascendency nor his political power, and could not be accounted as a possible competitor with the pope for the first place in the Catholic world, nor even as an ally with means for crushing the Reformation. Next, the Reformation itself was by this time an accomplished fact, a consummated revolt from mediæval Christianity. It had taken definite shape in various countries; it had its own theological systems and traditions; besides that a whole generation had now grown up under its influence, never having had any personal associations with Latin Christianity. And, on the other hand, the very lengths to which some of the Reformers had gone in their revolt generated a corresponding reaction in the Roman Church, so that many influential persons who had been in favour of moderate reforms and of explaining disputed points of theology were convinced that no limits could be logically or practically set to concessions in this direction, and therefore that it was necessary to make a stand against any concessions at all. And, what is more, one noticeable effect of the wave of controversy which had swept over western Europe was to accentuate points of difference, to close questions previously open, to make the current beliefs more incisive and, so to speak, legal in form, to diminish seriously the neutral area between the competing religious systems, and thus to bring them face to face as irreconcilable foes. One factor more, of greater importance at the time than any other, contributed to the revolution which is marked by the second council of Trent. As Spain took the political lead in the earlier half of the 16th century, so it took also the lead in theology. The Spanish divines were abler and more learned than all save the very foremost in any other country, and their influence was throughout the greatest at the council of Trent on purely theological issues. Now, the political and the theological genius of Spain had both just found their highest exponent in one person and the organization which he devised, Ignatius Loyola and the Company of the Jesuits. Two of his immediate disciples and recruits, Salmeron and Laynez, were chosen to be the pope's theologians at the council of Trent, and exercised a greater influence than any other divines there in the formulation of its dogmatic decrees. But the Jesuits were to do more than this. The militant spirit of their founder had nothing in common with the alarm and vacillation which had for the most part marked the action of the Roman Church in dealing with the Lutheran and Calvinist revolt; and, instead of being content with devising schemes for standing on the defensive, and saving the remnant yet left to the Roman obedience, he conceived the bolder and safer plan of vigorous aggression, to reconquer all that had been lost, and to add fresh acquisitions thereto. The Counter-Reformation which he initiated was in full operation when the second council of Trent assembled, and it was by this spirit that it was guided in its deliberations and decrees. The very thought of compromise was abandoned in fact, if not in open expression, and the only reforms thenceforward taken into consideration were such as would remove causes of weakness and scandal in the Latin Church, enabling it, without sacrificing one of its claims, to overcome by superior mass and discipline, by closer unity and more organized enthusiasm, the heterogeneous, disordered, and already dissociated forces of Protestantism. The most obvious effect of these principles upon the second council of Trent was that the diminution, the all but disappearance, of variety of opinion amongst its members, and the resolution to crush Protestantism rather than to parley with it in any scheme of mutual concession or accommodation, tended to shorten the preliminary discussions in a marked degree, so that little is to be noted of the long and animated debates of the earlier period, and the last few sessions exhibit even tokens of actual hurry to end the matter anyhow.

There was no intention on the pope's part to proclaim the Counter-Reformation as the policy of the council, even if it may be safely assumed that he could predict its action, and he sent nuncios to the Protestant sovereigns as well as to the Catholics to signify the approaching resumption of its sittings. Francis II. of France had died between the promulgation of the bull and its notification in France, but the young king Charles IX., by the advice of the parlement of Paris, directed all the bishops of the kingdom to be in readiness for journeying to Trent. Three nuncios were despatched to Germany, but the princes assembled in diet at Naumburg received them unfavourably, asserting anew their determination to recognize no council which did not avow Scripture as its standard of appeal and give right of free discussion to Protestants, denying the right of any one save the emperor to convene a general council at all, and inveighing strongly against the papacy. The king of Denmark declined to admit the nuncio on any terms, declaring that neither he nor his father had ever had any dealings with the pope; and Martinenghi, the nuncio commissioned to Elizabeth of England, was stopped by a messenger while still on the

Continental side of the Channel, and informed that he would not be permitted to land on the English coast. The free cities of the empire also refused the summons, as did five of the Swiss cantons; and even a large number of Roman Catholic prelates, while professing unqualified obedience to the pope's commands, showed much unwillingness to act upon them, and pleaded age, illness, or diocesan business as excuses for absenting themselves from the council. In this unpromising posture of affairs the preparations for the council were pressed on, and Cardinals Ercole Gonzaga, bishop of Mantua, Seripando, Hosius, Simoneta, and (later on) Altemps, the pope's nephew, were named as legates, being directed to open the session of the council upon Easter Day, April 6, 1561. But they did not even arrive in Trent until April 16, and found no more than nine bishops awaiting them. Several causes conduced to this disappointment: the king of Spain had not yet accepted the bull convoking the council; the French bishops were more than fully occupied with the rapid advances of the Reformation in their midst; and the Germans had no great inclination for the repetition of their experience ten years before. It was thus necessary to postpone the assemblage till January 1 and then to January 18, 1562. That there might be a sufficient number of Italian bishops present to outvote any possible combination of others, the pope collected a large number of prelates, appointed them salaries for maintenance, and sent them off to Trent. Two questions of the highest practical importance came up for discussion in the preliminary congregation, wherein ninety-two bishops were present:—(1) Was the council to be styled a "continuation" of the previous one, or to be reckoned as a new synod? (2) Should the unprecedented clause in the papal decree for opening the council (but not found in the bull of convocation), "proponentibus legatis ac præsidentibus," be accepted and acted on, or rescinded? To declare the council a "continuation" of its precursor was to accept and ratify all which had been done therein; to treat it as a new one was to make every decree of the earlier sessions merely provisional and alterable. To adopt the novel clause embodied in the papal decree was to gag the council from the outset and deprive it of freedom by concentrating the initiative in the hands of the legates; and Guerrero, archbishop of Granada, pressed this objection with much urgency. On the other hand, this same prelate, acting on the orders of Philip II., demanded that the council should be plainly declared a continuation of its precursor, for Philip had already introduced some of the regulations of that synod into his dominions, and would lose credit if they were rescinded, or even treated as lacking full sanction. Contrariwise, the bishops of other nations present held that there was no prospect of inducing the Germans, English, and other partly alienated nationalities to send representatives, unless the proceedings so far should be regarded as capable of reconsideration and alteration at the hands of the actual assembly. The authorities at Rome were not unprepared for some difficulty on this head, and had endeavoured to evade it by using the indeterminate word "celebrated," which might be taken either way, and the Spanish remonstrants were privately told that it was understood that business should be taken up just where it had left off under Julius III., thus making the synod a continuation of the former one, but that any express statement to that effect had been carefully avoided, lest the Protestants should take offence, and thus one aim of the council might be defeated. The Spaniards were partly contented with this reply, but urged that nothing which could be interpreted as the convocation of a new council should be suffered to appear in the wording of the decree about to be publicly read, which was conceded.

The seventeenth session was held (January 18, 1562) in the presence of the legates,—106 bishops, 4 abbots, 4 generals of orders, and the duke of Mantua, nephew of the chief legate, being present. Four Spanish bishops lodged a protest against the proposing clause—two of them unreservedly, two in a more qualified manner—and they particularly objected to the novelty of the clause, and to the manner in which it had been sprung upon the council, the archbishop of Granada and the bishop of Orense pointing out that it was not in the original bull, with which the subsequent decree ought to be in complete agreement, and the former adding that it was not even in the copy of the decree shown to him. But the Italian majority was too strong, and the protest was overruled,—the prorogation of the council to February 26, 1562, being the only further business transacted. But a very important question was laid before the congregations which followed this session, that of providing some remedy for the injury done to the Roman Catholic Church by the circulation of more or less hostile books, a difficulty made incomparably greater from the middle of the 15th century onwards than at any previous time in history, by reason of the invention of printing. The council of Lateran in 1515 had made a licence from the ecclesiastical authorities requisite before any book could be printed, under pain of excommunication, but this penalty did not affect Protestant printers, and the issue of a catalogue of books forbidden to Catholics became a necessary addition. Such a catalogue was issued by Paul IV. in 1559, but some machinery for supplementing it as fresh books poured from the press could alone meet the permanent danger. Another matter debated in these congregations was the invitation of Protestants to attend, and in what character. In the eighteenth session (February 26, 1562) two decrees on these subjects were promulgated,—one appointing a committee to report to the council on the whole question of heretical books; the other publishing a safe-conduct to the German Protestants, extended by a rider to those of other nations. The congregations held after this session were busied chiefly with the questions of residence and the abuse of indulgences, besides several less important details of reform. A warm debate arose as to the nature of the obligation to reside,—the Spaniards holding it to be of divine right, the Italians to be of no more than ecclesiastical precept. So powerful a body in the council took the Spanish view that the legates were alarmed, especially as ominous speeches were made to the effect that the Roman curia must be reformed on the basis of the report of cardinals to Paul III. before anything of moment could be done in the way of real improvement. Accordingly, they sent a messenger to the pope, bringing with him a schedule of the proposed reforms, and asking for advice in the crisis. The pope desired them to counteract the opposition bishops, to postpone the question of residence, if they could not suppress it altogether, and despatched Visconti, bishop of Ventimiglia, as extra nuncio to the council, to report accurately to him everything said or done there, and with him sent also all the bishops who could be collected at Rome to swell the Italian vote, and thus defeat the opposition indirectly. There was much debate also on the scope of the safe-conduct, as the Spaniards were anxious that it should not protect those against whom the Inquisition had taken action, while others desired to see its terms enlarged sufficiently to meet the requirements of the Protestants, who objected to its suspicious silence on several weighty particulars. As the French ambassadors were expected, nothing was done in the nineteenth session (May 14, 1562) save to prorogue the council. On May 26, 1562, De Lansac (who had been lately French envoy at Rome), Du Ferrier, and De Pibrac, envoys from Charles IX., were admitted to audience, and demanded, amongst other matters, that the council should be formally declared a new one, wherein the imperial ambassadors supported them, while Philip II. of Spain, contrariwise, insisted that it should be declared a continuation of the former synod. The legates strove to satisfy both parties, and received contradictory directions from Rome, at first ordering them to announce the continuation of the former council, and afterwards leaving the matter to their discretion. So little agreement could be arrived at that the twentieth session (June 4, 1562) was held merely to prorogue the council. The question of communion in both kinds was the next to come up for consideration. It was such a capital one, if any hope of winning back the Protestants was to be entertained, that the imperial and French ambassadors had special injunctions to forward by all means in their power an affirmative decision. The Frenchmen saw little prospect of carrying this matter in the temper of the Italian majority, and were for opposing the discussion which the legates had announced, but the imperial ambassadors were more hopeful, and persuaded them to give way. While the question was being debated in the congregations, the Venetian and Bavarian ambassadors arrived, the latter armed with a formidable schedule of complaints against prevalent abuses, and of demands for correspondingly drastic reforms, beginning with the pope and the curia, and making havoc amongst cardinals, dispensations, exemptions, pluralities, office-books, exclusively Latin services, and other like matters, thus threatening all manner of vested interests and long-rooted customs. The legates put them off, alleging the pressure of other business, notably the question of communion in both kinds, which was, in fact, being discussed and decided in accordance with the views of the Italians and Spaniards, and against those of the French and Germans. In the twenty-first session (July 16, 1562) a decree couched in four dogmatic chapters and four canons was promulgated upon it, to the following purport:—laymen, and priests other than the actual celebrant, are not bound by divine right to communicate in both kinds; the church has full power to make what changes it pleases in the mode of administering sacraments; the whole sacrament of the Eucharist is received entire under either kind singly; and little children are not bound to communicate. The canons pronounce anathemas against maintainers of the contrary propositions. At the same time a decree upon reformation was enacted, most of the clauses dealing with the duties of bishops in the matters of ordination, patronage, division, and union of benefices, discipline of ineffective parish priests, and visitation of monasteries, but a more permanent interest attaches to the ninth and concluding chapter of the decree, whereby the name and office of the "questors of alms," that is to say, the vendors of indulgences, are abolished on the ground of the impossibility of otherwise putting a stop to the abuses and depravity of their proceedings. All privileges and customs to the contrary, even if of time immemorial, are rescinded; the publication of indulgences is confined thenceforth to the ordinaries of each place, assisted by two members of the chapter; and these same officers are directed to collect the alms and charitable donations of the people, but forbidden to receive any commission or payment for so doing. This decree is a virtual confession of the justice of the agitation against Tetzel and his fellows which served as the signal for beginning the great religious strife of the 16th century; and it is noticeable that it was the pope's own voice against the system which decided the action of the council, wherein a powerful minority was found to defend it. Several weighty matters then came before the congregations, that of residence again being pressed by the Spaniards, while the imperial and Bavarian ambassadors renewed their requisition for permissive communion in both kinds (for the decree on that subject had gone no further than to declare it unnecessary, and had not explicitly forbidden it), and the French ambassador not only supported them in their demand, but added on his own part that in France they desired vernacular services, the abolition of image-worship, and permission for the clergy to marry. The nuncio Visconti wrote to the pope in great alarm, expressing apprehensions at the very free language employed by the fathers of the council on these matters, the probability of their conceding the emperor's demands, and of similar ones being advanced thereupon, all making in the same direction. An intrigue to compel the resignation of Cardinal Gonzaga, who was not thought sufficiently opposed to these measures, and who was far less peremptory in his presidency of the council and use of the closure than Crescenzio had been, was set on foot, and defeated only by the strong representations made at Rome by the archbishop of Lanciano, who said that there was already so much division in the council that it could but just hold together, and would almost certainly be broken up by any step of the kind. The next subject which was brought on for consideration was the sacrifice of the Mass, and the debates thereon were very animated, disclosing considerable variety of opinion amongst the theologians,—no fewer than five clearly distinct views of the tenet, apart from mere verbal or minor differences, being adduced and argued for. As sixty French bishops, to be accompanied by twelve theologians, and headed by Charles de Guise, cardinal of Lorraine, were under orders to repair to Trent, the French ambassador pressed the legates to postpone the next session till their arrival, as De l'Isle, ambassador at Rome, did the pope; but each replied evasively, referring the applicant to the other. The question of communion in both kinds was also very warmly discussed, and the council was warned that a negative decision would lead to the secession of multitudes who had not yet broken with the Roman Church; but the Jesuit Laynez, who was the chief advocate for refusal, replied that to diminish the church would not destroy it, and that anything was better than concession in the matter. The numbers in the division taken on the question were as follows:—29 were in favour of granting communion in both kinds; 31 agreed thereto, but desired the execution of the decree to be left to the pope's discretion; 38 were for total refusal; 24 strove to evade responsibility by referring the matter to the pope entirely; 19 were willing to make the concession to the Bohemians and Hungarians, but would refuse it to all others; 14 asked for a postponement; and 11 remained neutral, declining to vote any way—being a total of 166 suffrages, so split up as to make it impracticable to frame a decree. In this difficulty, the legate seized the opportunity of persuading the council to refer the matter to the pope's decision, thereby at once checkmating the reforming section, and indirectly ruling the vexed point of the relative superiority of pope and council in favour of the former, and so virtually reversing those decrees of Constance and Basel which had long been thorns in the side of the Roman curia. In point of fact, the pope had written some time before to the legates, recommending them to yield to the emperor's demand of the chalice for the laity, but they had replied that it would be impolitic to make it a conciliar act, and that it would be more expedient to frame a mere general declaration that it might be proper to make the concession in certain cases, but that the pope should be the sole judge of them. In the twenty-second session (September 17, 1562) the decree on the sacrifice of the Mass was promulgated in nine chapters and as many canons, directed for the most part against current Protestant objections to the doctrine and ceremonial of the Missal. Rules to secure greater order and reverence in the celebration of Mass, and for the suppression of sundry superstitious observances connected therewith, were also enacted,—besides some minor reforms of little note, and a decree referring to the pope the whole question of the concession of the chalice. The meagreness and insignificance of the reforms enacted thus far caused much displeasure in France, and the king directed his ambassador to press once more for delay till the arrival of the French, German, and Polish bishops who were expected at Trent, as the emperor also instructed his envoy. But the pope was busy in recruiting the Italian majority, and was unfavourable to this request, lest the Italians should be outvoted by the new-comers; yet so contentious were the debates on the sacrament of orders, and on the nature and extent of the rights of bishops—notably whether they were inherently above priests, and whether they were necessarily subject to the pope, deriving their jurisdiction and other powers solely through delegation from him, or if they were not of Divine institution, and his colleagues rather than his deputies (which latter thesis was steadily maintained by the Spaniards)—that it proved impossible to frame the decrees and hold the session before the arrival of the cardinal of Lorraine, who reached Trent on November 13, 1562, accompanied by fourteen bishops, three abbots, and eighteen theologians. The discussions, further complicated with the question of residence, were renewed hereupon, and long before any signs of agreement were visible the French ambassadors laid before the legates a schedule of reform in thirty-four articles, requiring, not only the removal of various abuses in patronage, and the punishment of negligence on the part of the parochial and monastic clergy, but also that vernacular services should be permitted, and communion in both kinds enjoined, while all abuses and superstitions connected with image-worship, indulgences, pilgrimages, and relics should be summarily abolished. Lorraine, on being asked how far he agreed with these demands, said that he disapproved of some of them, but that if he had not consented to take charge of them in their actual form, they would have been made still more drastic. No definite action was taken upon them either at Trent or at Rome, and the proceedings dragged on ineffectively for some months longer. On March 2, 1563, Cardinal Gonzaga, first legate, died, and was speedily followed by Cardinal Seripando. The imperial and French ambassadors endeavoured to get the cardinal of Lorraine named as first legate and president, but he was not acceptable at Rome, and the post was given to Cardinal Morone, with whom Cardinal Navagero was associated, to fill the place of Seripando. All these events delayed the twenty-third session until July 15, 1563, nearly ten months later than the preceding one. A decree on the sacrament of orders, in four chapters and eight canons, laid down that there is a sacrificial priesthood of the New Testament, instituted by Christ; that there have been seven orders in the Christian ministry from the earliest times; that holy order is a sacrament; that orders are indelible; that bishops are superior to priests; that a call from the laity, or from any secular authority, is unnecessary as a title to ordination, and that a merely lay call is invalid, while bishops appointed solely by the pope, without the intervention of any other persons, are validly created. A decree of eighteen chapters on reformation, enacting, amongst much else, penalties for non-residence on the part of beneficiaries, and providing for the erection of those theological seminaries which have ever since been the nurseries of the Latin clergy, was also promulgated in this session. The congregations which followed it were occupied chiefly with the question of matrimony, which had been mooted earlier, but with no definite result, and with framing a scheme to repress the encroachments of the civil power upon the church in most countries, one clause of which proposed to exempt all ecclesiastics from civil jurisdiction in all cases whatever, and from the payment of taxes, with penalty of excommunication upon such civil authorities as contravened this ruling. This was never pushed to the stage of promulgation, but it was successful as a manifestation against the reforming party in the council, and actually drove the French ambassadors away, since they judged their further presence useless in such a temper of the assembly. Yet it was itself by no means agreed or harmonious. The old disputes about the claim of the council to represent the church universal, about the proposing clause, limiting the initiative to the legates, and about the need of reform in the Roman curia itself were renewed, and that with much acrimony, but with no practical result. In the twenty-fourth session (November 11, 1563) a decree on matrimony, couched in ten chapters and eleven canons, was promulgated, the most noticeable points of which are the assertion that the church can constitute other impediments to matrimony besides the forbidden degrees of the Levitical code, and can dispense with such impediments; that clerks in holy orders and regulars vowed to celibacy cannot contract valid marriage; and that celibacy is superior to matrimony. The simultaneous decree on reformation lays down rules for the creation of bishops and cardinals, so as to avoid unfit promotions; directs that diocesan synods shall be held yearly, and provincial synods triennially; lays down rules for episcopal visitations, and for the qualifications to be exacted of persons promoted to cathedral dignities and canonries; appoints the provincial synod the judge of minor causes against bishops, referring graver causes to the pope's decision; and enacts various other technical regulations. By this time all concerned were thoroughly weary of the council, and the remaining matters for discussion were hurriedly discussed, resulting, in the twenty-fifth and last session (December 3 and 4, 1563), in a decree, very cautiously worded, upon purgatory, the cultus of saints, and that of relics and images. In this same session was also enacted a decree in twenty-two chapters, regulating several matters affecting the discipline of convents of monks and nuns; and another decree on reformation, in twenty-one chapters, the most important of which enjoin all cardinals and bishops to keep modest households, and not to enrich their kindred with church property; that all prelates shall receive and publish the decrees of the council; that duelling shall be prohibited under severe penalties; and that the authority of the Holy See both is, and is to be understood to be, untouched by any decrees of the council touching the reform of morals and discipline. On the last day of the session was passed a somewhat indefinite decree upon indulgences, forbidding all evil gains connected therewith, and directing that, wherever abuses or superstitions are prevalent concerning them, the bishops shall collect the facts, lay them before the provincial synod, and after discussion there refer them to the pope for ultimate decision. The distinction of meats, and the due observance of festivals and fasts, were also enjoined; and a formal statement was made that the committees which had been engaged upon the index of prohibited books, on the draft of a catechism, and on the revision of the Missal and Breviary, thinking that the synod could not deal with them conveniently, had determined to lay their reports before the pope to ratify and publish at his pleasure. Formal acclamations, and an anathema against all heretics, closed the session; and the legates, after forbidding any bishop, under pain of excommunication, to leave Trent till he had either signed his assent to the decrees, or left documentary proof of such assent, gave the blessing and dissolved the assembly.

Two hundred and fifty-five signatures were attached to the decrees, and also those of the ambassadors still remaining at Trent. The bull of confirmation was issued at Rome on January 26, 1564, and followed by another fixing May 1, 1564, as the date from which the decrees should be held binding. The bull of confirmation forbade all persons whatsoever, whether ecclesiastics or laymen, to gloss or interpret the decrees upon any pretext whatever, without papal authority for the purpose. The republic of Venice was the first power to signify its reception of the decrees, followed speedily by the other Italian states (except Naples) and by Portugal; but the king of Spain, though receiving the decrees, issued them at first in his own name, and not in that of the pope; the emperor and the king of Bohemia demanded the lay use of the chalice and the marriage of priests as the terms on which they would accept the council, and obtained a partial concession of the former demand, but were refused the latter; and in France, while the dogmatic decrees were accepted, the disciplinary ones were not, and have never, in spite of efforts many times renewed, made part of French ecclesiastical law. The provision referring the explanation of the council to the pope was given shape by Sixtus V., who erected in 1588 a Congregation of the Council of Trent to sit permanently at Rome, where it has ever since continued to be included amongst those standing committees which divide among them the administration of the pontifical government.

Two questions remain to be considered in relation to this great synod:—how far was it free, and representative of the mind of Latin Christianity at that time? and what have been its effects upon dogma and discipline? Ample materials exist for answering the first question, in the form of contemporary letters, either separately published, as those of Vargas, or included in the great collection of documents made by Le Plat, and in the official acts of the council itself, drawn up by the secretaries Paleotto and Massarelli. From these it is perfectly clear that the council was never free for a moment, but was hampered and fettered, not merely by the permanent fact of a large Italian majority, subsidized by the pope,[1] but by the method of procedure in the congregations, since by a skilful distribution of the members into groups or classes, so as to prevent combined action, and by careful packing of the sub-committees to which the preparation of business for debate was entrusted, little could be done save when and how the majority pleased; and, above all, the vigilant supervision exercised by the legates, their constant reference to Rome of every point of any importance before they would permit it to come on for regular discussion (so that Lanssac, one of the French envoys, somewhat profanely said that the Holy Spirit was brought to the council in a carpet-bag from Rome), and their uncompromising use of their presidential authority to interrupt or silence unacceptable speakers (as frequently appears in the Acts) effectually bound the council hand and foot; and thus its decisions, as a whole, represent little more than the Italian and, to some extent, Spanish opinions of the time, and not those of German, French, or Hungarian Catholics. The demeanour of the legates differed much, and there is a wide interval between the open browbeating employed by Crescenzio and the high-bred dignity of Gonzaga or the diplomatic subtlety of Morone; but the policy was alike in all cases, and its results the same. As to the dogmatic effect of the council, it went much further than merely restating the current Catholic theology of the pre-Reformation era; for it marks a new departure, closing many questions previously left open (nothing is more noteworthy in the debates than the manner in which several divines of unquestioned ability and loyalty delivered themselves of opinions closely allied to those advocated by leading Reformers, and then still tenable within the Roman obedience), re-wording old propositions, or framing new ones, in an incisive fashion. It recovered for papal authority all it had lost, or was likely to lose, through the action of Basel and Constance; and, above all, it unified Roman teaching for the first time, and crystallized it into rigid compactness. Thus it made concessions and explanations for the reconciliation of the revolted Protestants, although the primary cause of the council, practically impossible thenceforward, since the Roman Catholic system, thus hastily consolidated out of a former condition of partial flux, became like a "Prince Rupert's drop," from which, if the smallest fragment be broken, the mass is at once resolved into disintegrated powder. In the matter of disciplinary reform the council enacted but little of an effective nature, except in the abolition of the traffic in indulgences, and the establishment of theological seminaries, which has proved the most effectual agency for creating that doctrinal uniformity which now prevails throughout the Roman obedience; and the real honours of the Counter-Reformation rest with the Jesuits, to whose unremitting diligence, powerful organization, and ceaseless precept and example must be attributed by far the larger part of the abatement of ecclesiastical abuses and scandals which marks the succeeding era. Doubtless, the Tridentine decrees, in strong and resolute hands, proved most useful subsidiary weapons to compel local reforms; but decrees of little less stringency had been enacted by previous synods, and had rusted unused, because there was no one able and willing to put them in operation against the passive resistance of powerful vested interests.

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[1] The Italian character of the council of Trent can best be exhibited by a classified table, showing the nationality of the bishops present in the later sessions:—Italians, 189; Spaniards, 31; French, 26; Greeks (titulars), 6; Portuguese, 3; Illyrians, 8; Irish, 3; Germans, 2. Flemish. 2; Polish, 2; Croatian, 1; Moravian, 1; English, 1.

The bibliography of the council of Trent is very extensive, but a comparatively small number of volumes really suffices the student. The first work of importance is F. Paolo Sarpi's *Istoria del Concilio Tridentino*, originally published in London (1619) by Antonio de Dominis, archbishop of Spalato, under the pseudonym of Pietro Soave Polano (an imperfect anagram of Paolo Sarpi Veneto), but better studied in the French version by Père Le Courayer, with valuable notes (see Sarpi). The rival work of Sforza Palavicino, *Istoria del Concilio di Trento* (1656–57), written to order as a refutation of Sarpi's work, is also indispensable. He had free access to many official documents which Sarpi could not consult, and often corrects him upon points of detail, but a careful reader will find that he confirms him far oftener than he refutes him. It is not enough, as Ranke points out, to compare those two, and take the mean statement as a guide, for they are sometimes in blank contradiction, and other witnesses must be called in to decide the matter. The Acts of the council, so far as they were drafted by Paleotto, were first published by Mendham in 1842; the complete Acts, by both Paleotto and Massarelli, were not accessible till published as *Acta Genuina Œcumenici Concilii Tridentini* by Theiner in 1874. The vast compilation of Jodocus Le Plat, *Monumentorum ad Historiam Concilii Tridentini Amplissima Collectio* (7 vols. 4to, 1781–87), is full of valuable and interesting matter. The speeches of the Jesuit Laynez, which had such a powerful effect upon the council, have been recently published under the title of Lainez, *Disputationes Tridentinæ*, 2 vols., 1886. Vargas, *Lettres et Mémoires concernant le Concile de Trent* (1700, partly translated in Geddes, *The Council of Trent no Free Assembly*, 1714), is of much value. The canons and decrees of the council have been many times published, and are readily accessible; the best edition is that by Richter and Schulte (1853). There is a convenient abridgment of Palavicino's history prefixed to the Rev. James Waterworth's English version of the *Decrees and Canons of Trent* (1848), but it is not trustworthy, for the translator has suppressed many statements of the original which tell in various ways against the freedom of the action of the council. To these may be added Sickel, *Aktenstücke zur Geschichte des Konzils zu Trient*, 1872; Calenzio, *Documenti Inediti e Nuovi Lavori Letterarii sul Concilio di Trento*, 1874; Döllinger, *Sammlung von Urkunden zur Geschichte des Concils von Trient*, 1876; and the article on the council in Wetzer and Welte's *Kirchenlexicon*. (R. F. L.)

TRENTON, a city of the United States, county seat of Mercer county, New Jersey, and capital of the State, is situated in 40° 14′ N. lat. and 74° 45′ W. long., 33 miles north-east of Philadelphia and 57 south-west of New York. It lies very near sea-level (under 45 feet), upon the left (eastern) bank of the Delaware river, at the head of navigation. The city is irregularly built, the streets of different sections running in various directions, without any appearance of system; this is doubtless due to the fact that different portions of the city were originally settled as independent villages. Till recently Trenton was rather backward in the matter of municipal improvements, but an extensive system of paving and sewage has now been entered on. The water supply is obtained by pumping into a reservoir. Street cars run upon one or two of the principal streets; and the city is traversed by the main line of the New York division of the Pennsylvania Railroad. Manufactures are the leading industry, the capital invested in 1880 having been $6,966,830 and the production $12,712,762. In iron and steel manufactures over $2,000,000 were invested, the industry next in importance being the manufacture of stone and earthen ware, for which this city has a national reputation. Rubber goods, watches, and woollen cloths are also made. The population, 22,874 in 1870, was 29,910 in 1880.

Trenton was formed by a consolidation under one charter of several independent villages, known as Falls of the Delaware (settled in 1680), Kingsborough, Bloomsburg, and Lamberton. The name Trenton was given to the settlements about 1720. Its early growth was slow. In 1790 it was selected as the State capital, and two years later it received a city charter. Its growth since that time has been steady, and during the past thirty years has been very rapid.

TREPANG. See Bêche-de-Mer.

TRESPASS, in law, is any transgression of the law less than treason, felony, or misprision of either. The term includes a great variety of torts committed to land, goods, or person, distinguished generally by names drawn from the writs once used as appropriate to the particular transgression, such as *vi et armis*, *quare clausum fregit*, *de bonis asportatis*, *de uxore abducta cum bonis viri*, *quare filium et heredem rapuit*, &c. Up to 1694 the trespasser was regarded, nominally at any rate, as a criminal, and was liable to a fine for the breach of the peace, commuted for a small sum of money, for which 5 W. and M. c. 12 substituted a fee of 6s. 8d. recoverable as costs against the defendant. Trespass is not now criminal except by special statutory enactment, *e.g.*, the old statutes against forcible entry, the Game Acts, and the private Acts of many railway companies. When, however, trespass is carried sufficiently far it may become criminal, and be prosecuted as assault if to the person, as nuisance if to the land. At one time an important distinction was drawn between trespass general and trespass special or trespass on the case, for which see Tort. The difference between trespass and case was sometimes a very narrow one; the general rule was that where the injury was directly caused by the act of the defendant the proper remedy was trespass, where indirectly, case. The difference is illustrated by the action for false imprisonment: if the defendant himself imprisoned the plaintiff the action was trespass; if a third person did so on the information of the defendant it was case. A close parallel is found in Roman law in the *actio directa* under the lex Aquilia for injury caused directly, the *actio utilis* for that caused indirectly. One of the reasons for the rapid extension of the action on the case, especially that form of it called *assumpsit*, was no doubt the fact that in the action on the case the defendant was not allowed to wage his law (see Wager).

In its more restricted sense, trespass is generally used for entry on land without lawful authority by either a man, his servants, or his cattle. To maintain an action for such trespass the plaintiff must have possession of the premises. The quantum of possession necessary to enable him to bring the action is often a question difficult to decide. In most instances the tenant can bring trespass, the reversioner only case. By the Judicature Act, 1873, a mortgagor in possession can sue for trespass in his own name. Remedies for trespass are either judicial or extra-judicial. The most minute invasion of private right is trespass, though the damages may be nominal if the injury was trivial. On the other hand, they may be exemplary if circumstances of aggravation were present. Pleading in the old action of trespass was of a very technical nature, but the old-fashioned terms *alia enormia*, replication *de injuria*, new assignment, &c., once of such frequent occurrence in the reports, are of merely historical interest since the introduction of a simpler system of pleading, unless in those American States where the old pleading has not been reformed. The Venue (*q.v.*) in trespass was formerly local, in case transitory. In addition to damages for trespass, an injunction may be granted by the court. The power to grant injunctions against threatened or apprehended trespass has been considerably enlarged by the Judicature Act, 1873. The principal instances of extra-judicial remedies are distress damage feasant of cattle trespassing, and removal of a trespasser without unnecessary violence, expressed in the terms of Latin pleading by *molliter manus imposuit*.

Trespass may be justified by exercise of a legal right, as to serve the process of the law, or by invitation or licence of the owner, or may be excused by accident or inevitable necessity, as deviation from a highway out of repair. Where a man abuses an authority given by the law, his wrongful act relates back to his entry, and he becomes a trespasser *ab initio*, that is, liable to be treated as a trespasser for the whole time of his being on the land. Mere breach of contract, such as refusal to pay for wine in a tavern which a person has lawfully entered, does not constitute him a trespasser *ab initio*. A trespass of a permanent nature is called a continuing trespass; such would be the permitting of one's cattle to feed on another's land without authority.

In Scots law trespass is used only for torts to land. By the Trespass (Scotland) Act, 1865, trespassers are liable on summary conviction to fine and imprisonment for encamping, lighting fires, &c., on land without the consent and permission of the owner.

TREVES (French, *Trèves*; German, *Trier*), formerly the capital of an archbishopric and spiritual electorate of the empire, and now the seat of a Roman Catholic bishop and the chief town of a governmental district in the Prussian province of the Rhine, is situated on the right bank of the Moselle, pleasantly surrounded by low vine-clad hills, 60 miles south-west of Coblentz and 86 miles south of Cologne. It lies in the midst of a carefully cultivated and fertile plain, the rich vegetation of which forms a pleasing setting to its red sandstone walls and venerable towers. Most of the old streets of the town are quaint and irregular; but much of the space enclosed within the circuits of the walls is now occupied by orchards and gardens. The population of Treves in 1885 was 26,125, five-sixths of whom were Roman Catholics. Their chief occupations are fruit-growing and vine-dressing; the industries of the place, including the manufacture of cotton and linen, dyeing, and tanning, are not very extensive. A specialty of Treves is the preparation of stones for Gothic churches, which are sent off ready to be at once placed in position. A river traffic is carried on in wine, cattle, and wood.

Treves claims to be the oldest town in Germany, and it contains more important Roman remains than any other place in northern Europe. The most remarkable of these is the Porta Nigra, a huge fortified gateway, 115 feet long, 70 to 95 feet high, and 30 feet deep. It is formed of uncemented blocks of sandstone, held together by clamps of iron, and now blackened with time; the details are very rude. Opinions vary widely as to the date of its erection, but recent authorities refer it to the 1st century of the Christian era. During the Middle Ages the structure was converted into two churches, one above the other; all additions have, however, now been removed, except the apse at the east end. The basilica, long used as the archiepiscopal palace and now consecrated as a Protestant church, probably dates from the reign of Constantine. The so-called Roman baths are in all probability the relics of an extensive imperial palace. Just outside the town are the remains of an amphitheatre, capable of accommodating 30,000 spectators, where Constantine caused several thousand Franks and Bructeri to be butchered for the public amusement. Perhaps the oldest Roman remains in Treves are some of the piers of the bridge over the Moselle, dating from about 28 B.C. This bridge, which is at one corner of modern Treves, lay near the middle of the much more extensive Roman city. There are also numerous Roman antiquities in the neighbourhood of Treves, the most important of which are the Igel column, a sepulchral monument of the 2d century, and the mosaic pavements at Nennig and Fliessem.

Another group of interesting buildings belongs to the second period of prosperity enjoyed by Treves under the rule of its mediæval prelates. The cathedral, described by Lübke as the most important example of pre-Carlovingian building in Germany, mirrors the entire history of the town. Its kernel consists of part of a Roman basilica of the 4th century, which seems to have been converted into a Christian church at a very early period. It was restored by Bishop Nicetius about 550, and in the 11th and 12th centuries it was again restored and greatly extended by Archbishop Poppo and his successors, who added an apse at each end and left it substantially in its present form. The cathedral is connected by beautiful cloisters of the 13th century with the circular Liebfrauenkirche, one of the most interesting early Gothic churches in Germany (1227–43), catching up the architectural thread at the point dropped by the cathedral. Among the treasures of the latter is the "holy coat of Treves," believed by the devout to be the seamless garment worn by our Saviour at the crucifixion, and said to have been presented to the town by the empress Helena, the central figure in Treveran Christian legend. Its exhibition in 1844 attracted a million and a half of pilgrims to Treves. According to recent authorities, the earliest churches in Treves were those of Sts Eucharius, Maximin, Matthew, and Paul, all without the walls, now rebuilt or converted to secular purposes. Of the modern buildings none call for special remark. The town library contains about 100.000 volumes, including several valuable specimens of early printing. Its greatest treasure is the *Codex Aureus*, a manuscript of the Gospels presented to the abbey of St Maximin by Ada, sister of Charlemagne. The same building also contains an interesting collection of Roman and mediæval antiquities.

A mediæval legend, preserved in an inscription on the old Rothes Haus inn, places the foundation of Treves 1300 years before that of Rome, and ascribes it to Thebetas, son of Ninus, king of Assyria. But, fable apart, we must still allow that Treves has good claim to call itself the oldest town in Germany. It is a little doubtful whether the Treviri were of Teutonic or Celtic stock. St Jerome records that the language of the Treviri of the 4th century resembled that of the Gauls of Asia; but, even if we admit this evidence as conclusive of their Celtic origin, we must recognise the fact that they were Celts who were long under Teutonic influence. Their authentic history begins with the story of their subjection by Julius Cæsar (56 B.C.), who describes them as a warlike race, with the best cavalry in Gaul. The Roman town, *Colonia Augusta Trevirorum* (or *Treverorum*), was probably founded by the emperor Claudius, and rapidly obtained a wealth and importance which justified the poet Ausonius (4th century) in describing it as the second metropolis of the empire, or "Rome beyond the Alps." It became the capital of Belgica Prima, and during the 4th century was a favourite residence of Constantine and other Roman emperors. Most of the palaces and public buildings, of which the remains are still extant, were built at this period, while the surrounding hills were covered with villas. Treves was laid in ruins by Attila in 451, and about 465 was permanently taken possession of by the Franks. It was included in the kingdom of Austrasia, and became a German city in 870. Like its prototype Rome, it attained a second era of prosperity and importance as an ecclesiastical capital (see below), and in the Middle Ages the "Sancta Civitas Trevirorum" swarmed with "religious" of all kinds and grades. Unlike most of the German episcopal cities, however, it did not succeed in shaking off the ecclesiastical yoke, nor did it attain, except transitorily, the position of a free imperial city. Wars and sieges occasionally checked but did not stop its growth. Art and science were sedulously fostered in the monastic schools, and a university, founded in 1473, existed down to 1798. The importance of Treves departed with the overthrow of the ecclesiastical principality. In 1786 the last elector shifted his residence to Coblentz, and from 1794 to 1814 Treves was capital of the French department of the Sarre. Since the latter date it has belonged to Prussia.

The archbishopric and ecclesiastical electorate of Treves, bounded by Nassau, Cologne, Luxemburg, Lorraine, the Rhenish Palatinate, Hesse-Rheinfels, and Katzenelnbogen, had an area of about 3200 square miles and a population of 250,000 to 300,000. Its suffragan bishops were those of Metz, Toul, and Verdun, and after 1777 also those of Nancy and St Dié. As elector of the German empire the archbishop took the second place, and bore the style of arch-chancellor of Gaul or Burgundy. Legend places the foundation of the bishopric of Treves in the 1st century of the Christian era, but the first bishop known to history is Agricius, who flourished about 314. The see appears as an archbishopric in the 9th century, and in the Middle Ages the archbishops attained considerable temporal power. Among the most prominent were Baldwin of Luxemburg (1307–1354), brother of the emperor Henry VII., who may be regarded as the founder of the territorial greatness of the see, and Richard von Greiffenklau (1511–1531), who distinguished himself by his successful opposition to the Reformation. The last archbishop was Clemens Wenceslaus (1768–1802) of Saxony. The part of the archbishopric on the left bank of the Rhine was taken by France in 1801, and the rest was secularized in favour of the prince of Nassau-Weilburg in 1803. After the fall of Napoleon the archbishopric was incorporated with Prussia. A new bishopric of Treves was instituted in 1821, the boundaries of which are almost conterminous with those of the old archbishopric; the bishop is a suffragan to the archbishop of Cologne.

See "Augusta Treverorum," an article by E. A. Freeman in the *British Quarterly Review* for July 1875.

TREVIRANUS, Gottfried Reinhold (1776–1837), German naturalist, was born at Bremen, February 4, 1776, studied medicine at Göttingen, in 1797 became professor of mathematics in the Bremen lyceum, and died at Bremen, February 16, 1837.

He made numerous important contributions to comparative anatomy, especially in regard to birds and spiders. Though noted for his learning and acute observation, his studies in geographical distribution cannot be said to have led to any very definite results. It is rather on account of his contributions to ætiology that he deserves to be remembered, though his work in this department has been to a great extent overlooked. In the first of his larger works, *Biologie oder Philosophie der lebenden Natur*, which appeared from 1802–1805, he gave clear expression to the theory of "descent with modification." He believed that simple forms (Protists), which he termed "zoophytes," were "the primitive types from which all the organisms of the higher classes had arisen by gradual development." "Every living creature has a potentiality of endless modification of adapting its structure to the changes in the external world." He also maintained that each species has its day or period, at the end of which it does not become extinct, but has simply ceased to be, because it has become something else. That he stated the theory of descent with much clearness, and with a sufficient background of actual knowledge of forms, must be acknowledged by all; the only difficulty relates to the question of priority. The first volume of his biology was published in 1802, but he states that this had been written about 1796. Now it was not till 1801 that Lamarck first began to free himself from the traditional dogma of the immutability of species, and to publish his views of evolution. Neither Goethe nor Oken can be said to have done much more than follow up the ironical insinuations of Buffon (1753–76) and the ingenious suggestions of Erasmus Darwin, whose *Zoonomia* was translated into German between 1795 and 1797, while both Treviranus and Lamarck tackled the problem not merely of the theory of descent but of the mechanism of evolution. On this point the merits of Lamarck certainly outweigh those of his contemporary. Treviranus laid down as a fundamental proposition "that all living forms are the results of physical influences which are still in operation, and vary only in degree and direction." Like many after him, he directed attention to the influence of the male elements in fertilization as a source of variation, but laid emphasis only on the intra-organismal power of adaptation to surroundings. Whatever opinion be entertained in regard to the priority and the importance of the contribution made by Treviranus to the theory of evolution, it is at least certain that he was a learned naturalist and an acute thinker. His most important later work of a synthetic nature was entitled *Erscheinungen und Gesetze des organischen Lebens* (1831).

See EVOLUTION; E. Haeckel's *Schöpfungsgeschichte*, pp. 83–5; Carus, *Geschichte der Zoologie*, p. 610.

TREVISO, a town of Italy, in the province of the same name, lies in the midst of a district of great fertility, at the confluence of the Piavesella with the Sile, which is here navigable for large boats and communicates by canals with the lagoons of Venice (17 miles distant). It is an old town, with narrow irregular colonnaded streets and some good squares. The cathedral of San Pietro, dating from 1141 and restored and enlarged in the 15th century by Pietro Lombardo, but still unfinished, contains a fine Annunciation by Titian (1519), an Adoration of the Shepherds, the masterpiece of Paris Bordone (born at Treviso in 1500), and frescos by Pordenone. There are numerous statues and reliefs by Pietro, Tullio, and Martino Lombardo, and by Sansovino. The Gothic church of San Niccolò (1310–52) contains a fine tomb by Tullio Lombardo, frescos by Giovanni Bellini, and a large altar-piece by Fra Marco Pensabene and others; in the adjoining chapter-house are forty portraits of celebrated Dominicans by Tommaso da Modena (1352). The Monte di Pietà contains an Entombment by Pordenone (according to others by Giorgione). The churches of S. Leonardo, S. Andrea, S. Maria Maggiore, and S. Maria Maddalena also contain precious art treasures, and the town is enriched besides by various open-air frescos. The town-hall and theatre are also conspicuous buildings. Silk and cotton goods, cutlery, majolica, and paper are the chief manufactures of the place, and an active trade is also carried on in corn, fruit, and cattle. The population in 1881 was 31,249.

Treviso, the ancient *Tarvisium*, is not mentioned by any of the ancient geographers, though Pliny speaks of the Silis as flowing "ex montibus Tarvisanis." In the 6th century it appears as an important place. From 1318 it was for a short time the seat of a university (see UNIVERSITIES). In 1339 it came under the Venetian sway. In the 15th century its walls and ramparts were renewed under the direction of Fra Giocondo, two of the gates being built by the Lombardi. Treviso was taken in 1797 by the French under Mortier (duke of Treviso). In March 1848 the Austrian garrison was driven from the town by the revolutionary party, but in the following June the town was bombarded and compelled to capitulate.

TREVITHICK, RICHARD (1771–1833), inventor of the locomotive, was descended from a family of great antiquity in the county of Cornwall, and was born 13th April 1771, in the parish of Illogan. Shortly afterwards the family removed to Penponds, near Camborne, where the boy attended his first and only school, his attainments being limited to reading, writing, and arithmetic. Though slow and obstinate as a scholar, he spent much time drawing lines and figures on his slate, and possessed such instinctive skill in mechanics that while still a youth he was able to solve a difficulty in the correction of underground levels which had puzzled some of the mine agents. He inherited more than the average strength for which his family were famous, standing 6 feet 2 inches in height, while his frame was the very model of an athlete. His feats in wrestling and lifting and throwing weights were unexampled in the district. At the age of eighteen he began to assist his father as mine manager, and, manifesting great fertility of mechanical invention, was soon recognized as the great rival of Watt in improvements on the steam-engine (see vol. xxii. p. 476). On the death of his father in 1797, he succeeded him as leading engineer in Cornish mining. He married the same year. His earliest invention of importance was his improved plunger pole pump (1797), which has superseded all others for deep mining. In 1798 he applied the principle of the plunger pole pump to the construction of the water-pressure engine, which he subsequently improved in various ways. About this time he also perfected a high-pressure non-conducting steam-engine, which became a successful rival of the low-pressure steam-vacuum engine of Watt. At an early period he had begun experiments in the construction of locomotives, and a model constructed by him before 1800 is now in the South Kensington Museum. On Christmas eve 1801 his common road locomotive carried the first load of passengers ever conveyed by steam, and on 24th March 1802 he and Andrew Vivian applied for a patent for steam-engines in propelling carriages. In 1803 his locomotive was run in the streets of London, from Leather Lane by Gray's Inn Lane and along Oxford Street to Paddington, the return journey being made by Islington. The cost was, however, found too great, and his thoughts were now directed to the construction of a steam locomotive for tramways, with such success that in February 1804 he worked a tramroad locomotive in Wales, running with facility up and down inclines of 1 in 50. In 1808 he constructed a circular railway in London near Euston Square, on which the public were carried at the rate of twelve or fifteen miles an hour round curves of 50 or 100 feet radius. The ideas of Trevithick were successfully developed by Stephenson so as to revolutionize the system of modern travelling, but Trevithick had made considerable progress towards this before Stephenson had begun his experiments. Trevithick applied his high-pressure engine with great success to rock boring and breaking, as well as to dredging. In 1806 he entered into a twenty-one years' engagement with the board of Trinity House, London, to lift ballast from the bottom of the Thames, at the rate of 500,000 tons a year, for a payment of 6d. a ton. The following year he was appointed along with Vazie to execute the Thames driftway, but the work was abandoned owing to disputes about payment when unexpected difficulties had occurred. He then set up workshops at 72 Fore Street, Limehouse, for the construction of iron tanks and buoys and model iron ships. He was the first to recognize the importance of iron in the construction of large ships, and in various ways his ideas have also influenced the construction of steamboats. In the application of steam to agriculture the name of Trevithick occupies one of the chief places. A high-pressure steam threshing engine was erected by him in 1812 at Trewithen, the property of Sir Charles Hawkins, while, in the same year, in a letter to the Board of Agriculture, he stated his belief that every part of agriculture might be performed by steam, and that such a use of the steam-engine would "double the population of the kingdom and make our markets the cheapest in the world." In 1814 he entered on an agreement for the construction of engines for the Peruvian mines, and to superintend their working removed to Peru in 1816. Thence he went in 1822 to Costa Rica. He returned to England in 1827, and in 1828 petitioned parliament for a reward for his inventions, but without success. He was equally unsuccessful in his endeavours to induce the lords commissioners of the Admiralty to afford him facilities for demonstrating the value of certain improvements he claimed to have made in steam navigation. He died 22d April 1833.

See *Life of Richard Trevithick, with an Account of his Inventions*, by Francis Trevithick, C.E., 2 vols., 1872.

TRIAL, in law, is the examination of a cause before a court of justice. It is the stage in the cause next after Pleading (*q.v.*). Advance in legal development is generally marked by difference in the mode of trial. This was especially the case in the history of Roman law, and it has been the same in England (see Action). Many forms of trial, notably those by Ordeal (*q.v.*), by wager of battle or of law (see Wager), and by grand assize, have become obsolete, and new forms have been created by legislation in order to meet altered circumstances of society. Up to a very recent date the tendency of the Roman and English systems was in opposite directions. In the former and in systems founded on it, such as the Scotch, trial by the judge became the rule, in the latter trial by judge and jury. But the Judicature and Summary Jurisdiction Acts have recently made considerable innovations upon the old common-law right to trial by Jury (*q.v.*) or *per pais*, as it was also called. The modes of trial in England are very numerous, as to a certain extent each Court (*q.v.*) has its own procedure. Certain broad rules of justice are observed by all courts, such as that both sides are to be heard, or to have an opportunity of being heard, before decision, and that (unless in very exceptional cases) the trial is to be in public.

For purposes of convenience rather than as a scientific division trials may be divided into civil and criminal. An ordinary trial in a civil case may be either in a court of appellate jurisdiction (in which case it is perhaps more properly called a hearing), in the High Court of Justice before a judge or referee, or in an inferior court. Where the trial is in a court of first instance, it may be either with or without a jury. In Chancery and Admiralty proceedings a jury is not used, and the right to a jury in the Queen's Bench Division has been considerably restricted by the Rules of the Supreme Court, 1883, Order xxxvi. Before these rules either party had an absolute right to have issues of fact in an action in that division tried by jury. Now, unless in certain actions, mainly of tort, in which a jury is as of right, a jury can only be obtained by application of a party to the action, subject to the power of the court to direct trial without a jury of any issue requiring prolonged examination of documents or accounts or scientific or local investigation. The question of Venue (*q.v.*) in civil actions has ceased to be of importance since the Judicature Acts. Most courts are entitled in proper cases to the assistance of assessors. Trial with assessors is in frequent use in the Admiralty Division. A trial whether by jury or not may be by affidavit or on *viva voce* evidence. The latter is the rule where the trial is by jury. In a county court a jury of five is allowed in certain cases on application. In other inferior courts of local jurisdiction a jury is sometimes the rule, as in the (London) Lord Mayor's Court, sometimes not, as in the Chancellor's Court at Oxford or Cambridge. In criminal cases the trial is by jury, except where a court of Summary Jurisdiction (*q.v.*) is empowered to try offences of a comparatively unimportant nature. The right to trial by due process of law before condemnation is secured to the subject by sec. 29 of Magna Charta. A new trial may be ordered in civil actions and in misdemeanours (in the latter case only after conviction of the defendant) on various grounds, the most usual of which are misdirection by the judge, improper admission or rejection of evidence, and the finding of a verdict against the weight of evidence. In actions in the High Court new trials are less liberally granted than was the case before the Judicature Acts, Order xxxix. considerably restricting the right. An application for a new trial of an action is no longer made by *ex parte* motion in the first instance, as was the course before 1883, but upon notice of motion. Besides the ordinary modes of trial, there are others of an exceptional nature or of rare occurrence. In a trial by arbitration, the tribunal is chosen by the parties themselves, and they are not entitled to object to the trial as conducted by the arbitrator as long as it conforms to rules of ordinary justice. Peers are tried for treason or felony before the House of Lords, or the court of the Lord High Steward if the trial takes place during the recess of parliament. A trial at bar—a survival of the universal mode of trial before the writ of Nisi Prius (*q.v.*) was given by the Statute of Westminster the Second—takes place before three or four judges of the Queen's Bench Division, and is in use as of right where the crown is interested in the litigation, or at the discretion of the court in other cases where questions of unusual importance or difficulty are raised. The trial of a petition of right (see Petition, vol. xviii. p. 705) is now assimilated to that in civil actions. Trials by record, by certificate, and by inspection, though not expressly abolished, appear to have become obsolete. Impeachment (*q.v.*) is still a right of the House of Commons, but has not recently been exercised. Court-Martial (*q.v.*) is the mode of trial for offences committed by persons in the naval or military service of the crown.

In Scotland and the United States trials are either with or without a jury. The most usual trials in Scotland are those before a judge of the Court of Session or the High Court of Justiciary or in a sheriff court. In the United States trials are either in a United States or a State court; in the latter case they are regulated by State legislation.

TRIBONIAN, the famous jurist and minister of Justinian, was born in Pamphylia in the latter part of the 5th century. Adopting the profession of an advocate, he came to Constantinople and practised in the prefectural courts there, reaching such eminence as to attract the notice of the emperor Justinian, who appointed him in 528 one of the ten commissioners directed to prepare the first *Codex* of imperial constitutions. In the edict creating this commission (known as *Hæc Quæ*) Tribonian is named sixth, and is called "virum magnificum, magisteria dignitate inter agentes decoratum" (see *Hæc Quæ* and *Summa Reipublicæ*, prefixed to the *Codex*). When the commission of sixteen eminent lawyers was created in 530 for the far more laborious and difficult duty of compiling a collection of extracts from the writings of the great jurists of the earlier empire, Tribonian was made president and no doubt general director of this board. He had already been raised to the office of quæstor, which at that time was a sort of ministry of law and justice, its holder being the assessor of the emperor and his organ for judicial purposes, something like the English lord chancellor of the later Middle Ages. The instructions given to these sixteen commissioners may be found in the constitution *Deo Auctore* (*Cod.*, i. 17, 1), and the method in which the work was dealt with in the constitution *Tanta* (*Cod.*, i. 17, 2), great praise being awarded to Tribonian, who is therein called ex-quæstor and ex-consul, and also as magister officiorum. This last constitution was issued in December 533, when the *Digest* was promulgated as a law-book. During the progress of the work, in January 532, there broke out in Constantinople a disturbance in the hippodrome, which speedily turned to a terrible insurrection, that which goes in history by the name of Nika, the watchword of the insurgents. Tribonian was accused of having prostituted his office for the purposes of gain, and the mob searched for him to put him to death (Procop., *Pers.*, i. 24-26). Justinian, yielding for the moment, removed him from office, and appointed a certain Basilides in his place. After the suppression of the insurrection the work of codification was resumed. A little earlier than the publication of the *Digest*, or *Pandects*, there had been published another but much smaller law-book, the *Institutes*, prepared under Justinian's orders by Tribonian, with Theophilus and Dorotheus, professors of law (see Preface to *Institutes*). About the same time the emperor placed Tribonian at the head of a fourth commission, consisting of himself as chief and four others,—Dorotheus, professor at Beyrut, and three practising advocates, who were directed to revise and re-edit the first *Codex* of imperial constitutions. The new *Codex* was published in November 534 (see constitution *Cordi Nobis* prefixed to the *Codex*). With it Tribonian's work of codification was completed. But he remained Justinian's chief legal minister. He was reinstated as quæstor some time after 534 (Procop., *Pers.*, i. 25; *Anecd.*, 20), and seems to have held the office as long as he lived. He was evidently the prime mover in the various changes effected in the law by the novels of Justinian (*Novellæ Constitutiones*), which became much less frequent and less important after death had removed the great jurist. The date of his death has been variously assigned to 545, 546, and 547. Procopius says (*Anecd.*, 20) that, although he left a son and many grandchildren, Justinian confiscated part of the inheritance.

The above facts, which are all that we know about Tribonian, rest on the authority of his contemporary Procopius and of the various imperial constitutions already cited. There are, however, two articles in the *Lexicon* of Suidas under the name "Tribonianos." They appear to be different articles, purporting to refer to different persons, and have been generally so received by the editors of Suidas and by modern legal historians Some authorities, however, as for instance Gibbon, have supposed them to refer to the same person. The first article is unquestionably meant for the jurist. It is based on Procopius, whose very words are to some extent copied, and indeed it adds nothing to what the latter tells us, except the statement that Tribonian was the son of Macedonianus, was *ἀπὸ δικηγόρων τῶν ὑπάρχων*, and was a heathen and atheist, wholly averse to the Christian faith. The second article says that the Tribonian to whom it refers was of Side (in Pamphylia), was also *ἀπὸ δικηγόρων τῶν ὑπάρχων*, was a man of learning, and wrote various books, among which are mentioned certain astronomical treatises, a dialogue *On Happiness*, and two addresses to Justinian. None of these books relate to law; and the better opinion seems to be that there were two Tribonians, apparently contemporaries, though possibly some of the attributes of the jurist have been, by a mistake of the compilers or transcribers of the *Lexicon* of Suidas, extended to the man of letters of the same name.

The character which Procopius gives to the jurist, even if touched by personal spite, is entitled to some credence, because it is contained in the *Histories* and not in the scandalous and secret *Anecdota*. It is as follows:—"Tribonian was a man of great natural powers, and had attained as high a culture as any one of his time; but he was greedy of money, capable of selling justice for gain, and every day he repealed or enacted some law at the instance of people who purchased this from him according to their several needs. . . . He was pleasant in manner and generally agreeable, and able by the abundance of his accomplishments to cast into the shade his faults of avarice" (*Pers.*, i. 24, 25). In the *Anecdota* Procopius adds as an illustration of Justinian's vanity the story that he took in good faith an observation made to him by Tribonian while sitting as assessor, that he (Tribonian) greatly feared that the emperor might some day, on account of his piety, be suddenly carried up into heaven. This agrees with the character for flattery which the minister seems to have enjoyed. The charge of heathenism we find in Suidas is probable enough; that is to say, Tribonian may well have been a crypto-pagan, like many other eminent courtiers and litterateurs of the time (including Procopius himself), a person who, while professing Christianity, was at least indifferent to its dogmas and rites, cherishing a sentimental recollection of the older and more glorious days of the empire.

In modern times Tribonian has been, as the master workman of Justinian's codification and legislation, charged with three offences,—bad Latinity, a defective arrangement of the legal matter in the *Code* and *Digest*, and a too free handling of the extracts from the older jurists included in the latter compilation. The first of these charges cannot be denied; but it is hard to see why a lawyer of the 6th century, himself born in a Greek-speaking part of the empire, should be expected to write Latin as pure as that of the age of Cicero, or even of the age of Gaius and the Antonines. To the second charge also a plea of guilty must be entered. The *Code* and *Digest* are badly arranged according to our notions of scientific arrangement. These, however, are modern notions. The ancients generally cared but little for what we call a philosophic distribution of topics, and Tribonian seems to have merely followed the order of the Perpetual Edict which custom had already established, and from which custom would perhaps have refused to permit him to depart. He may more fairly be blamed for not having arranged the extracts in each title of the *Digest* according to some rational principle; for this would have been easy, and would have spared much trouble to students and practitioners ever since. As to the third complaint, that the compilers of the *Digest* altered the extracts they collected, cutting out and inserting words and sentences at their own pleasure, this was a process absolutely necessary according to the instructions given them, which were to prepare a compilation representing the existing law, and to be used for the actual administration of justice in the tribunals. The so-called *Emblemata* (insertions) of Tribonian were therefore indispensable, though, of course, we cannot say whether they were always made in the best way. Upon the whole subject of the codification and legislation in which Tribonian bore a part, see JUSTINIAN.

Tribonian, from the little we know of him, would seem to have been a remarkable man, and in the front rank of the great ones of his time. There is nothing to show that he was a profound and philosophical jurist, like Papinian or Ulpian. But he was an energetic clear-headed man, of great practical force and skill, cultivated, accomplished, agreeable, flexible, possibly unscrupulous, just the sort of person whom a restless despot like Justinian finds useful. His interest in legal learning is proved by the fact that he had collected a vast legal library, which the compilers of the *Digest* found valuable (see const. *Tanta*).

The usual criticisms on Tribonian may be found in the *Anti-Tribonianus* (1567) of Francis Hotman, the aim of which is shown by its alternative title, *Sive discursus in quo jurisprudentiæ Tribonianeæ sterilitas et legum patriarum excellentia exhibetur*; and an answer to them in J. P. von Ludewig, *Vita Justiniani et Theodoræ, nec non Triboniani*. (J. BR.)

TRIBUNE (*tribunus*) was a name assigned to officers of several different descriptions in the constitution of ancient Rome. The connexion of the word with *tribus*, "tribe," is obvious. The original tribunes were no doubt the commanders of the several contingents of cavalry and infantry which were supplied to the Roman army by the early gentilician tribes,—the Ramnes, the Tities, and the Luceres. In the historical period the infantry in each legion were commanded by six tribunes, and the number six is probably to be traced to the doubling of the three tribes by the incorporation of the new elements which received the names of *Ramnes secundi*, *Tities secundi*, *Luceres secundi*. The *tribuni celerum* or commanders of the cavalry no longer existed in the later times of the republic, having died out with the decay of the genuine Roman cavalry.[1] So long as the monarchy lasted these tribunes were doubtless nominated by the commander-in-chief, the king; and the nomination passed over on the establishment of the republic to his successors, the consuls. But, as the army increased, the popular assembly insisted on having a voice in the appointments, and from 362 B.C. six tribunes were annually nominated by popular vote, while in 311 the number was raised to sixteen, and in 207 to twenty-four, at which figure it remained. The tribunes thus elected ranked as magistrates of the Roman people, and were designated *tribuni militum a populo*, while those who owed their office to the consuls bore the curious title of *tribuni rufuli*. The rights of the assembly passed on to the emperors, and "the military tribunes of Augustus" were still contrasted with those nominated in the camp by the actual commanders. The obscure designation *tribunus ærarius*, "tribune of the treasury," had also, in all probability, a connexion with the early organization of the army. The officer thus designated was at any rate the paymaster of the troops, and the soldier who was defrauded of his pay was allowed to exact it from this tribune by a very summary process. There was still another and important class of tribunes who owed their existence to the army. In the long struggle between the patrician and plebeian sections of the population, the first distinctions in the public service to which the plebeians forced their way were military, and the contest for admission to the consulate was in large part a contest for admission to the supreme command of the national forces. In 445 B.C., the year in which mixed marriages of patricians and plebeians were for the first time permitted, power was given to the senate (then wholly patrician) of determining from year to year whether consuls or military tribunes with consular authority (*tribuni militares consulari potestate* or *imperio*) should be appointed. But, even when the senate decided in favour of electing tribunes, no election was valid without the express sanction of the senate superadded to the vote of the centuriate assembly. If it happened to be too invidious for the senate openly to cancel the election, it was possible for the patricians to obtain a decision from the sacred authorities to the effect that some religious practice had not been duly observed, and that in consequence the appointment was invalid. According to tradition, recourse was had to this device at the first election, a plebeian having been successful. Forty-five years elapsed after the creation of the office before any plebeian was permitted to fill it, and it was held by very few down to the time at which it was abolished (367 B.C.) and the plebeians were fully admitted to the consulate. The number of consular tribunes elected on each occasion varied from three to six; there was no year without a patrician, and to the patrician members were probably confined the most highly esteemed duties, those relating to the administration of the law and to religion.

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[1] In the legends of the foundation of the republic Brutus is represented as having exercised authority, when the king was banished, merely by virtue of holding the office of *tribunus celerum*.

But by far the most important tribunes who ever existed in the Roman community were the tribunes of the commons (*tribuni plebis*). These, as has been explained in ROME (vol. xx. p. 736 *sq.*), were the most characteristic outcome of the long struggle between the two orders, the patrician and the plebeian. When in 494 B.C. the plebeian legionaries met on the Sacred Mount and bound themselves to stand by each other to the end, it was determined that the plebeians should by themselves annually appoint executive officers to stand over against the patrician officers,—two tribunes (the very name commemorated the military nature of the revolt) to confront the two consuls, and two helpers called ædiles to balance the two patrician helpers, the quæstors. The name ædile is obviously connected with *ædes*, "a temple," and is an indication of the fact that there was a religious core to the insurrection, just as there was a religious core to the patrician opposition. The temple of Diana and Ceres on the Aventine Hill became for a time to the plebeians what the temple of Saturn was to the patricians,—their official centre and their record office. The insurgent leaders also pressed religion into their service in another way. The masses assembled on the Sacred Mount bound themselves by a solemn oath to regard the persons of their tribunes and ædiles as inviolable, and to treat as forfeited to Diana and Ceres the lives and property of those who offered them insult. That this purely plebeian oath was the real ultimate basis of the sanctity which attached to the tribunate during the whole time of its existence can hardly be believed, though this view has had powerful support both in ancient and in recent times. The revolution must have ended in something which was deemed by both the contending bodies to be a binding compact, although the lapse of time has blotted out its terms. The historian Dionysius may have been only technically wrong in supposing that peace was concluded between the two parties by the fetial priests, with the forms adopted by Rome in making treaties with a foreign state. If this were fact, the "sacrosanctity" of the tribunes would be adequately explained, because all such formal *fœdera* were "sacrosanct." But, notwithstanding that the plebeians may safely be assumed to have been conscious of having to a large extent sprung from another race than the patricians and their retainers, it is not likely that the feeling was sufficiently strong to permit of the compact taking the form of a treaty between alien powers. Yet there must have been a formal acceptance by the patricians of the plebeian conditions; and most probably the oath which was first sworn by the insurgents was afterwards taken by the whole community, and the "sacrosanctity" of the plebeian officials became a part of the constitution. There must also have been some constitutional definition of the powers of the tribunes. These rested at first on an extension of the power of veto which the republic had introduced. Just as one consul could annul an act or order of his colleague, so a tribune could annul an act or order of a consul, or of any officer inferior to him. There was no doubt a vague understanding that only acts or orders which sinned against the just and established practice of the constitution should be annulled, and then only in cases affecting definite individuals. The tribune was to give his help against illegality in concrete instances. The cases which arose most commonly concerned the administration of justice and the levying of troops.

Although the revolution of 494 gave the tribunes a foothold in the constitution, it left them with no very definite resources against breaches of compact by the patricians. The traditional history of the tribunate from 494 to 451 B.C. is obscure, and, so far as details are concerned, nearly worthless; but there is a thread running through it which may well be truth. We hear of attacks by patricians on the newly won privileges, even of the assassination of a tribune, and of attempts on the part of the plebeians to bring patrician offenders to justice. The assembled plebeians attempt to set up a criminal jurisdiction for their own assembly parallel to that practised by the older centuriate assembly, in which the nobles possess a preponderating influence. Nay, more, the plebs attempts something like legislation; it passes resolutions which it hopes to force the patrician body to accept as valid. As to details, only a few are worth notice. In the first place, the number of tribunes is raised to ten, how we do not know; but apparently some constitutional recognition of the increase is obtained. Then an alteration is made in the mode of election. As to the original mode, the ancient authorities are hopelessly at variance. Some of them gravely assert that the appointment lay with the assembly of the curiæ—the most ancient and certainly the most patrician in Rome, even if we allow the view, which, in spite of great names, is more than doubtful—that the plebeians were members of it at any time when it still possessed political importance. The opinion of Mommsen about the method of election is more plausible than the others. It was in accordance with the Roman spirit of order that the tribunes, in summoning their assemblies, should not ask the plebeians to come *en masse* as individuals, and vote by heads, but should organize their supporters in bands. The *curia* was certainly a territorial district, and the tribunes may have originally used it as the basis of their organization. If tribunes were elected by plebeians massed *curiatim*, such a meeting would easily be mistaken in later times for the *comitia curiata*. At any rate, a change was introduced in 471 by the Publilian Law of Volero, which directed that the tribunes should be chosen in an assembly organized on the basis of the Servian or local tribe, instead of the *curia*. This assembly was the germ of the *comitia tributa*. The question by what authority the Law of Volero was sanctioned is difficult to answer. Possibly the law was a mere resolution of the plebeians with which the patricians did not interfere, because they did not consider that the mode of election was any concern of theirs. In the first period of the tribunate the tribunes almost certainly agitated to obtain for their supporters a share in the benefits of the state domain. And, whatever view may be taken of the movement which led to the decemvirate, an important element in it was of a certainty the agitation carried on by the tribunes for the reduction of the law of Rome to a written code. Until they obtained this, it was impossible for them effectually to protect those who appealed against harsh treatment by the consuls in their capacity of judges.

During the decemvirate the tribunate was in abeyance. It was called into life again by the revolution of 449, which gave the tribunes a considerably stronger position. Their personal privileges and those of the ædiles were renewed, while sacrosanctity was attached to a body of men called *judices decemviri*, who seem to have been the legal assistants of the tribunes. The road was opened up to valid legislation by the tribunes through the assembly of the tribes, but in this respect they were submitted to the control of the senate. The growth of the influence of the tribe assembly over legislation belongs rather to the history of the COMITIA (*q.v.*) than to that of the tribunate. After the Hortensian Law of 287 B.C. down to the end of the republic nearly all the legislation of Rome was in the hands of the tribunes. The details of the history of the tribunate in its second period, from 449 to 367 B.C., are hardly less obscure than those which belong to the earlier time. There was, however, on the whole, undoubtedly an advance in dignity and importance. Gradually a right was acquired of watching and interfering with the proceedings of the senate, and even with legislation.

Whether the absolute right of veto had been achieved before 367 may well be doubted. But the original *auxilium*, or right of protecting individuals, was, during this period, undergoing a very remarkable expansion. From forbidding a single act of a magistrate in relation to a single person, the tribunes advanced to forbidding by anticipation all acts of a certain class, whoever the persons affected by them might prove to be. It therefore became useless for the senate or the comitia to pass ordinances if a tribune was ready to forbid the magistrates to carry them out. Ultimately the mere announcement of such an intention by a tribune was sufficient to cause the obnoxious project to drop: that is to say, the tribunes acquired a right to stop all business both in the deliberative assembly, the senate, and in the legislative assemblies, the *comitia*. The technical name for this right of veto is *intercessio*. To what extent the tribunes during the time from 449 to 367 took part in criminal prosecutions is matter of doubt. The XII. Tables had settled that offenders could only be punished in person by the centuries, but tradition speaks of prosecutions by tribunes before the tribes where the penalty sought was pecuniary. The two main objects of the tribunes, however, at the time of which we are speaking were the opening of the consulate to plebeians and the regulation of the state domain in the interests of the whole community. Both were attained by the Licinio-Sextian Laws of 367.

Then a considerable change came over the tribunate. From being an opposition weapon it became an important wheel in the regular machine of state. The senate became more and more plebeian, and a new body of nobility was evolved which comprised both orders in the state. The tribunes at first belonged to the same notable plebeian families which attained to the consulate. The old friction between senate and tribunes disappeared. It was found that the tribunate served to fill some gaps in the constitution, and its power was placed by common consent on a solid constitutional basis. From 357 to 134 B.C. (when Tiberius Gracchus became tribune) the tribunate was for the most part a mere organ of senatorial government. As the change made by the Gracchi was rather in the practice than in the theory of the tribunate, it will be convenient at this point to give a definite sketch of the conditions and privileges attaching to the office.

Even after the difference between patrician and plebeian birth had ceased to be of much practical consequence in other directions, the plebeian character was a necessity for the tribune. When the patricians P. Sulpicius Rufus and, later, P. Clodius (the antagonist of Cicero) desired to enter on a demagogic course, they were compelled to divest themselves of their patrician quality by a peculiar legal process. Even the patricians who became so by mere fiat of the emperors were excluded from the tribunate. The other necessary qualifications were for the most part such as attached to the other Roman magistracies,—complete citizenship, absence of certain conditions regarded as disgraceful, fulfilment of military duties. The minimum age required for the office was, as in the case of the quæstorship, twenty-seven. The tribunate stood outside the round of magistracies the conditions of which were regulated by the Villian Law of 180 B.C. The election took place in a purely plebeian assembly, ranged by tribes, under the presidency of a tribune selected by lot. The tribune was bound by law to see a complete set of ten tribunes appointed. Technically, the tribunes were reckoned, not as magistrates of the Roman people, but as magistrates of the Roman plebs; they therefore had no special robe of office, no lictors, but only messengers (*viatores*), no official chair, like the curule seat, but only benches (*subsellia*). Their right to summon the plebs together, whether for the purpose of listening to a speech (in which case the meeting was a *contio*) or for passing ordinances (*comitia tributa*), was rendered absolute by the "laws under sacred sanction" (*leges sacratæ*), which had been incorporated with the constitution on the abolition of the decemvirate. The right to summon the senate and to lay business before it was acquired soon after 367, but was seldom exercised, as the tribunes had abundant means of securing what they wanted by pressure applied to the ordinary presidents,—the consuls or the urban prætor. When an *interregnum* came about and there were no "magistrates of the Roman people," the plebeian tribunes became the proper presidents of the senate and conductors of ordinary state business. At the end of the republic there were *interregna* of several months' duration, when the tribunes held a position of more than usual importance. A tenure of the tribunate did not, until a comparatively late period (probably about the time of the Second Punic War), confer a claim to a permanent seat in the senate. The candidates for the office were mainly young men of good family who were at the beginning of their political career, but the office was often filled by older men of ambition who were struggling upwards with few advantages. The plebeian ædiles very soon after 367 became dissociated from the tribunes and associated with the curule ædiles, so that in the political hierarchy they really ranked higher than those who were originally their superior officers.

The real kernel of the tribune's power consisted in his *intercessio* or right of annulling ordinances, whether framed by the senate or proposed by a magistrate to the *comitia*, or issued by a magistrate in pursuance of his office. From 367 B.C. down to the time of the Gracchi the power of veto in public matters was on the whole used in the interests of the aristocratic governing families to check opposition arising in their own ranks. A recalcitrant consul was most readily brought to obedience by an exercise of tribunician power. But, although modern readers of the ancient historians are apt to carry away the idea that the tribunate was an intensely political office, it is safe to say that the occasions on which tribunes found it possible to play a prominent part in politics were extremely few, even in the late republic. On the other hand, the tribunes found a field for constant activity in watching the administration of justice and in rendering assistance to those who had received harsh treatment from the magistrates. The tribunes were in fact primarily legal functionaries, and constituted in a way the only court of appeal in republican Rome. It was to this end that they were forbidden to pass a whole night away from the city, except during the Latin festival on the Alban Mount, and that they were expected to keep their doors open to suppliants by night as well as by day. They held court by day in the Forum close by the Porcian basilica, and frequently made elaborate legal inquiries into cases where their help was sought. Naturally this ordinary humdrum work of the tribunes has left little mark on the pages of the historians, but we hear of it not unfrequently in Cicero's speeches and in other writings which deal with legal matters. According to the general principle of the constitution, magistrates could forbid the acts of magistrates equal to or inferior to themselves. For this purpose the tribunes were deemed superior to all other officers. If a tribune exercised his veto no other tribune could annul it, for the veto could not be itself vetoed, but it was possible for another tribune to protect a definite individual from the consequences of disobedience. The number of the tribunes (ten) made it always possible that one might baulk the action of another, except at times when popular feeling was strongly roused. In any case it was of little use for a tribune to move in any important matter unless he had secured the co-operation or at least the neutrality of all his colleagues. The veto was not, however, absolute in all directions. In some it was limited by statute: thus the law passed by Gaius Gracchus about the consular provinces did not permit a tribune to veto the annual decree of the senate concerning them. When there was a dictator at the head of the state, the veto was of no avail against him. One of the important political functions of the tribunes was to conduct prosecutions of state offenders, particularly ex-magistrates. These prosecutions began with a sentence pronounced by the tribune upon the culprit, whereupon, exercising the right given him by the XII. Tables, the culprit appealed. If the tribune sought to inflict punishment on the culprit's person, the appeal was to the assembly of the centuries; if he wished for a large fine, the appeal was to the assembly of the tribes. As the tribune had no right to summon the centuries, he had to obtain the necessary meetings through the urban prætor. In the other event he himself called together the tribute assembly and proposed a bill for fining the culprit. But the forms of trial gone through were very similar in both cases.

It is commonly stated that a great change passed over the tribunate at the time of the Gracchi, and that from their day to the end of the republic it was used as an instrument for setting on foot political agitation and for inducing revolutionary changes. This view is an inversion of the facts. The tribunate did not create the agitation and the revolutions, but these found vent through the tribunate, which gave to the democratic leaders the hope that acknowledged evils might be cured by constitutional means, and in the desperate struggle to realize it the best democratic tribunes strained the theoretic powers of their office to their ruin. For the bad tribunes did not hesitate to use for bad ends the powers which had been strained in the attempt to secure what was good. But herein the tribunate only fared like all other parts of the republican constitution in its last period. The consuls and the senate were at least as guilty as the tribunes. After a severe restriction of its powers by Sulla and a restoration by Pompey, which gave a twenty years' respite, the tribunate was merged into the imperial constitution, of which indeed it became the chief corner-stone. The emperors did not become tribunes, but took up into their privileges the essence of the office, the "tribunician authority." This distinction between the essential principle of the office and the actual tenure of the office was a creation of the late republic. Pompey, for example, when he went to the East, was not made proconsul of all the Eastern provinces, but he exercised in them a "proconsular authority" which was superior to that of the actual proconsuls,—an authority which was the prototype of the imperial authority on its military side. Similarly the emperor, as civil governor, without being tribune, exercised powers of like quality with the powers of the tribune, though of superior force. By virtue of his tribunician authority he acquired a veto on legislation, he became the supreme court of appeal for the empire, and to his person was attached the ancient sacrosanctity. Augustus showed the highest statesmanship in founding his power upon a metamorphosed tribunate, rather than upon a metamorphosed dictatorship, upon traditions which were democratic rather than upon traditions which were patrician and optimate. The tribunes continued to exist till a late period, with gradually vanishing dignity and rights; but it is not necessary here to trace their decay in detail.

The name "tribune" was once again illuminated by a passing glory when assumed by Cola di Rienzi. The movement which he headed was in many respects extremely like the early movements of the plebeians against the patricians, and his scheme for uniting Italy in one free republic was strangely parallel with the greatest dream of the Gracchi. See Rome, vol. xx. p. 800 *sq.*

The history of the tribunate is interwoven with that of Rome, and must, to a large extent, be sought for in the same sources. The principles attaching to the office are profoundly analysed by Mommsen in his *Staatsrecht*, and are clearly set forth by E. Herzog in his *Geschichte u. System der römischen Staatsverfassung* (Leipsic, 1884). (J. S. R.)

TRICHINA, TRICHINOSIS. See Nematoidea, and Parasitism, vol. xviii. p. 270.

TRICHINOPOLI, a district of British India, in the Madras presidency, lying between 10° 37′ and 11° 30′ N. lat. and 78° 12′ and 79° 30′ E. long. Its area is 3561 square miles. It is bounded on the north and north-west by Salem, on the north and north-east by South Arcot, on the east and south-east by Tanjore, on the south by Pudukottai state and Madura, and on the west by Coimbatore. The surface is generally flat, though diversified by masses of crystalline rock, of which the Trichinopoli rock in the fort is a well-known example. The district is well wooded, though nothing worthy of the name of forest is to be found in it. The only mountains are the Pachaimalais, which rise to 2500 feet and extend into Salem district. The Kaveri (*q.v.*) and its branch the Colerun are the only rivers of any importance. Trichinopoli has numerous roads, and the South Indian Railway traverses it from east to west. The climate is very hot, and not liable to great variations; the annual average rainfall is about 38 inches.

In 1881 the population of the district was 1,215,033 (males 586,434, females 628,599), of whom Hindus numbered 1,119,434, Mohammedans 84,104, and Christians 58,809. The only town with a population exceeding 10,000 is Trichinopoli, the capital, with 84,443 inhabitants. This city is chiefly noticeable for its strong fort, perched on a granite peak 500 feet high, and the group of temples and temple buildings situated on and around it. The town next in importance is Srirangam (*q.v.*). The chief crops of the district are rice, cotton, tobacco, indigo, sugar-cane, cocoa-nut, plantain, areca-nut, and chillies; and the most important local industries are weaving and the manufacture of cigars. The principal exports are grain of all kinds, especially rice; the imports, tobacco and salt. In 1885-86 the gross revenue of the district was £225,806, the land-tax yielding £165,889. Trichinopoli district, along with the rest of the Carnatic, of which it formed part, passed to the British by treaty in 1801.

TRIC TRAC. See Backgammon, vol. iii. p. 199.

TRICYCLE. Though velocipedes were made and used more than one hundred years ago, none were practically successful until the brothers Starley constructed in 1876 the Coventry tricycle. One of the earliest descriptions of a cycle occurs in the *Journal de Paris* of 17th July 1779. Somewhat later M. Richard invented a machine driven by mechanism almost identical with that of the modern omnicycle, but without the expanding segments. Early in the 19th century the cranked axle worked by treadles and levers came into fashion; then the heavy four-wheelers were preferred. All these machines, however, laboured under three fatal defects: it was almost impossible to drive them up-hill, to check them in going down-hill, and to prevent their overturning in rounding a corner.

It was the success of the early bicycle (see Bicycle) which suggested the belief that a serviceable tricycle could be made. One of these bicycles was specially constructed for ladies, the hind wheel being placed well on one side; but, though it could be ridden, it was not a commercial success. The brothers Starley, by putting a second small wheel in front of the large driving wheel and on the same side as the small hind wheel, gave stability to the machine; it was steered by turning the small wheels opposite ways, and driven by the large wheel by means of cranks and connecting rods. The same machine with chain driving —the Coventry rotary—is still very largely used. In 1877 James Starley, it is believed without any knowledge of the gear used by Fowler for traction engines, re-invented the same differential gear for tricycles. By this the same force is, under all circumstances, applied to each of two equal driving wheels, and the evil effects of driving a single wheel are done away with. This gear was used in the original Salvo tricycle, which is the type of the surest machine at the present day. In the early days of the modern tricycle other designs were carried out, which have now become practically obsolete. In one form the hind wheel of a bicycle was replaced by a pair of equal wheels, one on each side, but the instability of such a construction was fatal. In another, the Challenge, the two wheels were placed in front of the large driver and turned together to steer the machine; stability was obtained by putting the rider in front of the large wheel and lower down, the power being communicated by cranks and connecting rods. But the weight of this machine and the small proportion of the load on the driving wheel were serious defects.

Single-driving rear-steerers were at this time very common, and, though highly objectionable, are still to be seen. Rear-steerers were improved by making both front wheels drivers and allowing for the overrunning of one or the other by clutch, as in the Cheylesmore, or by ratchet driving; but steering by the hind wheel is essentially wrong, and these machines are avoided by experienced riders. Rear-steerers have, however, lately been made with a through axle and differential gear (Rover), the rider being placed further back so as to increase the load on the steering wheel; but the evil of rear-steering is only reduced, not removed. The clutch is also employed on some front-steerers; and, though in certain respects it has an advantage over the differential gear, for general use it is not so suitable. The differential gear is an essential feature of the modern tricycle.

In 1878 Messrs Doubleday and Humber patented the Humber machine, which is both driven and steered by the two front wheels, the rider being seated on a trailing backbone and hind wheel as in the bicycle. This machine requires skill to manage: the steering is at first difficult to control and a spill over the handles is quite possible; under a skilful rider, however, the Humber is generally recognized as one of the fastest machines. It is steered by a cross handle, like the bicycle, and this method of steering, in spite of the fact that it boxes the rider into the machine, is becoming very general in front steerers in place of the rack and pinion steering hitherto in use. The Cripper is a very popular example. The brake is an important feature in roadster tricycles. It is always made to act on the box of the differential gear where that is used; but in clutch or single-driven machines one or two independent band-brakes or spoon-brakes are used.

In early days the steering wheel was made small to save weight; the drivers were often 50 inches or more in diameter; and the machine was as short as possible. Owing to the discomfort attending a small wheel and a short base the tendency at present is to increase the size of the steering wheel and the length of the base, and to diminish the diameter of the drivers,—two notable examples being the Quadrant and the Crescent. It is usual, especially when small driving wheels are used, to gear the machine up, just as in the old days they were commonly geared down; that is, the chain wheel on the crank axle has more or fewer teeth than that on the wheel axle, and thus the wheels turn faster or slower than the cranks, or are equivalent to larger or smaller wheels. Two-speed gears are becoming general, among which may be especially mentioned the Cryptodynamic. By means of these it is possible to change the gear of the machine so as to have a high gear under favourable conditions and a low gear when mud, wind, or an ascent make travelling difficult. Although chain gearing is used in nearly every machine made, connecting rods, wheels, or bands are fitted instead to some machines. The necessity for such mechanism has been avoided by making the wheel axle also the treadle axle; but great instability is the result.

Machines in which the arms instead of the legs supply the power are made, and are of immense service to those who have lost the use of their legs.

Owing to the inconvenience caused by doorways being often too narrow to allow a tricycle to pass through, many machines are made to fold up into a narrower space or to shut up like a telescope.

It is important that the rider should be so placed that he can, without leaning forward, put most of his weight on the treadles, and this is more than ever needed as the steepness of an ascent increases, because the slope of the machine has a contrary effect. Sliding seats were arranged for this purpose; but Mr Warner Jones has made use of a swinging frame which the rider can lock in any position he pleases. It is this same swinging frame which gives such comfort to the rider of the Otto bicycle, placing him at all times in the position most suitable for the occasion.

Carrier tricycles, in which due provision is made for the proper distribution of the load, are largely used by the post-office and by tradesmen in their business. The "Coventry chair" is a kind of bath chair driven as a tricycle by a rider behind. When invalids have overcome a certain prejudice as to the danger of this kind of vehicle, it will no doubt be more generally used.

In machines for two riders the riders sit side by side (*sociables*) or one is placed before the other (*tandems*). Sociable machines are both front-steering and rear steering. Rear-steerers with each rider driving the wheel on his side only are nearly as objectionable as the single-driving rear-steerer. Front-steering sociables with differential gear are safe and comfortable; but all sociables are slow machines. For nearly every make of single tricycle there is a corresponding tandem. The Coventry rotary in the tandem form suffers more from the single-side driving than in the single form, the rear-steering machines not so much, owing to the greater weight which the steering wheel has to bear. The Humber is less sensitive in the steering, owing to the greater moment of inertia of the frame and the front rider. The front-steerer cannot be made safer, but an excellent tandem is formed by placing the rear-rider on a trailing tail as in the Humber. Tandems have an advantage over sociables and perhaps over single tricycles in the matter of speed; they are, however, not quite so safe, and their appearance alone prevents many from riding them. Many sociables and tandems are convertible into single machines with but little trouble.

The following tables of quickest times which have been accomplished up to the end of 1886 (certified by the National Cyclists' Union) will show the comparative value of the bicycle and tricycle as racing machines.

On a prepared racing path.

Distance.	Time, tricycle.	Time, bicycle.
1 mile	2 min. 46·8 sec.	2 min. [illegible] sec.
5 miles	14 ,, [illegible] ,,	14 ,, 18 ,,
20 ,,	59 ,, 10·6 ,,	59 ,, 6·8 ,,
100 ,,	6 hrs. 43 min. [illegible] sec.	5 hrs. 50 min. 5·4 sec.

Greatest distance in one hour { [illegible] miles [illegible] yds., tricycle.
{ 20 ,, [illegible] ,, bicycle.

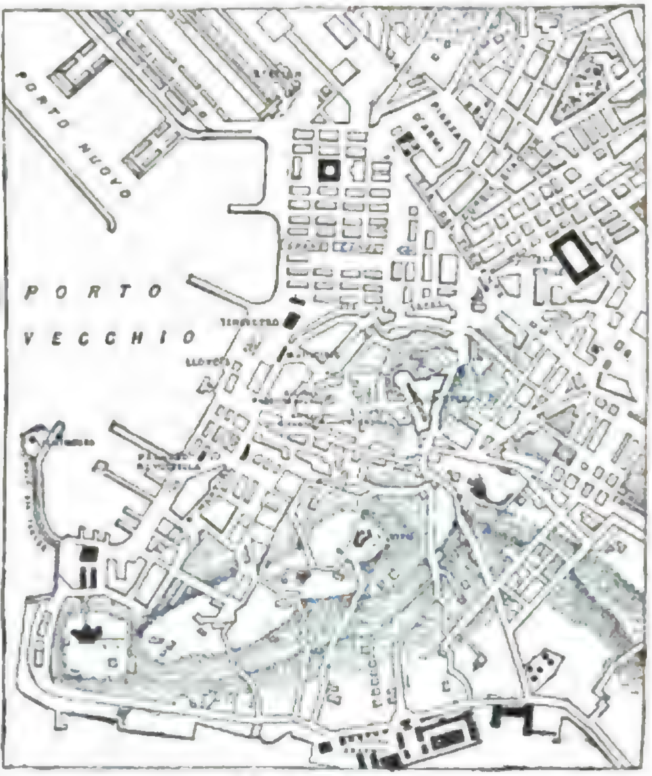
On a public road.

Land's End to John o' Groats¹ { [illegible] days 10 hrs., tricycle.
(about 870 miles) { [illegible] ,, 1 ,, [illegible] min., bicycle.

Greatest distance in 24 hours { [illegible] miles, tricycle.
{ [illegible] ,, bicycle.

(C. V. B.)

TRIESTE (Germ. *Triest*, Slav. *Trst*, Lat. *Tergeste*), the principal seaport of the Austrian-Hungarian empire, is picturesquely situated at the north-east angle of the Adriatic Sea, in the Gulf of Trieste and at the foot of the barren Karst Hills. The old town, nestling round the hill on which the castle stands, consists of narrow, steep, and irregular streets. It is connected by the broad and handsome Corso with the well built new town, which lies on the flat expanse adjoining the crescent-shaped bay, partly on ground that has been reclaimed from the sea. The prevailing air of the town is Italian rather than German. The castle, built in 1680, is believed to occupy the site of the Roman capitol (see below). Near it is the cathedral of S. Giusto, an unimposing but interesting building, mainly of the 14th century, and incorporating fragments of a Roman temple and early Christian churches. Don Carlos of Spain (d. 1855) is interred in the south aisle, and Fouché, Napoleon's minister of police, in front of the church, while the churchyard contains the grave and monument of Winckelmann, the archæologist, who was murdered at Trieste in 1768. The Arco di Riccardo, also in the old town, derives its name from a popular delusion that it was connected with Richard Cœur-de-Lion, but is probably an arch of a Roman aqueduct. A collection of Roman antiquities found in or near the town has been formed near the castle. The most prominent building in the new town is the Tergesteo, a huge edifice containing the exchange and numerous shops and offices. The new municipal buildings, with the handsome hall of the provincial diet, the Palazzo Revoltella, the offices of the Austrian Lloyd's, and the handsome old exchange are also noteworthy. The church of S. Maria Maggiore is a characteristic specimen of Jesuit architecture, and the new Greek church is one of the handsomest Byzantine structures in the empire. The city hospital has accommodation for 2000 patients. The huge Politeama is the largest theatre. In front of the Palazzo Revoltella is a monument to the emperor Maximilian of Mexico, who had been an admiral in the Austrian service. His sumptuous château of Miramar is one of the lions of the neighbourhood. The capacious harbour, consisting of two parts, the old and the new, is protected by extensive moles and breakwaters, and has been greatly improved within the last ten or fifteen years. From the harbour the Canal Grande extends into the town, allowing large vessels to unload at the warehouses. At the end of the Molo Sta Teresa is a lighthouse upwards of 100 feet high. The population of the town (6424 in 1758) and district of Trieste in 1880 was 144,844, of whom 74,544 belonged to the town proper and 133,019 to the town and suburbs. The town population is very heterogeneous, but the Italian element far exceeds all the rest. There are about 5000



Plan of Trieste.

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¹ These two by the same rider.

Germans and also numerous Greeks, English, and French. The population includes 26,000 Slavs, most of whom live in the country districts and are engaged in agriculture

Trieste has been a free imperial port since 1719. It may be said to nearly monopolize the trade of the Adriatic, and has long eclipsed its ancient rival Venice. The annual value of its exports and imports is about 30 millions sterling. Among the chief imports are coffee, wine, fruit, grain, tobacco, petroleum, cotton, coals, and manufactured goods of various kinds; the exports include spirits, liqueurs, sugar, meal, timber, glass, and machinery. Large quantities of fish are sent to Vienna. In 1885 the port was entered by 6971 vessels with an aggregate burden of 1,267,946 tons. The trading fleet of Trieste numbers about 500 ships of 100,000 tons burden. The chief shipping company is the Austrian Lloyd's, founded in 1836, the steamers of which ply to the Mediterranean ports, Alexandria, Constantinople, the Black Sea, &c. The extensive wharfs and dockyards of the company lie to the south of the town. The chief branches of industry practised at Trieste are shipbuilding, soap-boiling, machine-making (especially marine engines), tanning, brewing, rope-making, and the manufacture of liqueurs (rosoglio). Trieste is the seat of government for the so-called Küstenland or Coast district, and is the seat of naval and military commanders and other officials. The town council, presided over by the podestà, is also the diet of the crownland of Trieste (35 square miles). Trieste is the seat of the bishop of Capo d'Istria.

History.—At the time of the foundation of Aquileia by the Romans, the district which now includes Trieste was occupied by Celtic and Illyrian tribes; and the Roman colony of Tergeste does not seem to have been established till the reign of Vespasian. After the break-up of the Roman dominion Trieste shared the general fortunes of Istria and passed through various hands. From the emperor Lothaire it received an independent existence under its count-bishops, and it maintained this position down to its capture by Venice in 1203. For the next 180 years its history consists chiefly of a series of conflicts with this city, which were finally put an end to by Trieste placing itself in 1382 under the protection of Leopold III. of Austria. The overlordship thus established insensibly developed into actual possession; and except in the Napoleonic period (1797-1805 and 1809-1813) Trieste has since remained an integral part of the Austrian dominions.

TRIGGER-FISH. See FILE-FISH.

TRIGONOMETRY

TRIGONOMETRY is primarily the science which is concerned with the measurement of plane and spherical triangles, that is, with the determination of three of the parts of such triangles when the numerical values of the other three parts are given. Since any plane triangle can be divided into right-angled triangles, the solution of all plane triangles can be reduced to that of right-angled triangles; moreover, according to the theory of similar triangles, the ratios between pairs of sides of a right-angled triangle depend only upon the magnitude of the acute angles of the triangle, and may therefore be regarded as functions of either of these angles. The primary object of trigonometry, therefore, requires a classification and numerical tabulation of these functions of an angular magnitude; the science is, however, now understood to include the complete investigation not only of such of the properties of these functions as are necessary for the theoretical and practical solution of triangles but also of all their analytical properties. It appears that the solution of spherical triangles is effected by means of the same functions as are required in the case of plane triangles. The trigonometrical functions are employed in many branches of mathematical and physical science not directly concerned with the measurement of angles, and hence arises the importance of analytical trigonometry. The solution of triangles of which the sides are geodesic lines on a spheroidal surface requires the introduction of other functions than those required for the solution of triangles on a plane or spherical surface, and therefore gives rise to a new branch of science, which is from analogy frequently called spheroidal trigonometry. Every new class of surfaces which may be considered would have in this extended sense a trigonometry of its own, which would consist in an investigation of the nature and properties of the functions necessary for the measurement of the sides and angles of triangles bounded by geodesics drawn on such surfaces.

HISTORY.

Greek. An account of Greek trigonometry is given under PTOLEMY (*q.v.*).

Indian. The Indians, who were much more apt calculators than the Greeks, availed themselves of the Greek geometry which came from Alexandria, and made it the basis of trigonometrical calculations. The principal improvement which they introduced consists in the formation of tables of half-chords or sines instead of chords. Like the Greeks, they divided the circumference of the circle into 360 degrees or 21,600 minutes, and they found the length in minutes of the arc which can be straightened out into the radius to be 3438 The value of the ratio of the circumference of the circle to the diameter used to make this determination is 62832 : 20000, or $\pi = 3{\cdot}1416$, which value was given by the astronomer Âryabhaṭa (476-550; see SANSKRIT, vol. xxi. p. 294) in a work called *Âryabhattya*, written in verse, which was republished[1] in Sanskrit by Dr Kern at Leyden in 1874. The relations between the sines and cosines of the same and of complementary arcs were known, and the formula $\sin\frac{1}{2}a = \sqrt{1719(\overline{3438 - \cos a})}$ was applied to the determination of the sine of a half angle when the sine and cosine of the whole angle were known. In the *Sûrya-Siddhânta*, an astronomical treatise which has been translated by Ebenezer Bourgess in vol. vi. of the *Journal* of the American Oriental Society (New Haven, 1860), the sines of angles at an interval of 3° 45′ up to 90° are given; these were probably obtained from the sines of 60° and 45° by continual application of the dimidiary formula given above and by the use of the complementary angle. The values sin 15° = 890′, sin 7° 30′ = 449′, sin 3° 45′ = 225′, were thus obtained. Now the angle 3° 45′ is itself 225′; thus the arc and the sine of $\frac{1}{96}$th of the circumference were found to be the same, and consequently special importance was attached to this arc, which was called the right sine. From the tables of sines of angles at intervals of 3° 45′ the law expressed by the equation

$$\sin(\overline{n+1}\,.\,225') - \sin(n\,.\,225') = \sin(n\,.\,225') - \sin(\overline{n-1}\,.\,225') - \sin\frac{(n\,.\,225')}{225}$$

was discovered empirically, and used for the purpose of recalculation. Bháskara (*fl.* 1150) used the method, to which we have now returned, of expressing sines and cosines as fractions of the radius; he obtained the more correct values sin 3° 45′ = 100/1529, cos 3° 45′ = 466/467, and showed how to form a table, according to degrees, from the values sin 1° = 10/573, cos 1° = 6568/6569, which are much more accurate than Ptolemy's values. The Indians did not apply their trigonometrical knowledge to the solution of triangles; for astronomical purposes they solved right-angled plane and spherical triangles by geometry.

Arabian. The Arabs were acquainted with Ptolemy's *Almagest*, and they probably learned from the Indians the use of the sine. The celebrated astronomer of Batnæ, Abû 'Abdallah Mohammed b. Jâbir al-Battânî (Bategnius), who died in 929 930 A.D., and whose *Tables* were translated in the 12th century by Plato of Tivoli into Latin, under the title *De scientia stellarum*, employed the sine regularly, and was fully conscious of the advantage of the sine over the chord; indeed, he remarks that the continual doubling is saved by the use of the former. He was the first to calculate $\sin\phi$ from the equation $\sin\phi/\cos\phi = k$, and he also made a table of the lengths of shadows of a vertical object of height 12 for altitudes 1°, 2°, ... of the sun; this is a sort of cotangent table. He was acquainted, not only with the triangle formulæ in the *Almagest*, but also with the formula $\cos a = \cos b \cos c + \sin b \sin c \cos A$ for a spherical triangle ABC. Abú 'l-Wafá of Baghdad (b. 940) was the first to introduce the tangent as an independent function: his "umbra" is the half of the tangent of the double arc, and the secant he defines as the "diameter umbræ." He employed the umbra to find the angle from a table and not merely as an abbreviation for sin/cos; this improvement was, however, afterwards forgotten, and the tangent was re-invented in the 15th century. Ibn Yúnos of Cairo, who died in 1008, showed even more skill than Al-Battání in the solution of problems in spherical trigonometry and gave improved approximate formulæ for the calculation of sines. Among the West Arabs, Abú Mohammed Jábir b. Aflah, known as Geber b. Aflah, who lived at Seville in the 11th century, wrote an astronomy in nine books, which was translated into Latin in the 12th century by Gerard of Cremona and was published in 1534. The first book contains a trigonometry which is a considerable improvement on that in the *Almagest*. He gave proofs of the formulæ for right-angled spherical triangles, depending on a rule of four quantities, instead of Ptolemy's rule of six quantities. The formulæ $\cos B = \cos b \sin A$, $\cos c = \cot A \cot B$, in a triangle of which C is a right angle had escaped the notice of Ptolemy and were given for the first time by Geber. Strangely enough, he made no progress in plane trigonometry. Arrachel, a Spanish Arab who lived in the 12th century, wrote a work of which we have an analysis by Purbach, in which, like the Indians, he made the sine and the arc for the value 3° 45′ coincide.

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[1] See also vol. ii. of the *Asiatic Researches* (Calcutta).

Modern.

Purbach (1423-1461), professor of mathematics at Vienna, wrote a work entitled *Tractatus super propositiones Ptolemæi de sinubus et chordis* (Nuremberg, 1541). This treatise consists of a development of Arrachel's method of interpolation for the calculation of tables of sines, and was published by Regiomontanus at the end of one of his works. Johannes Müller (1436-1476), known as REGIOMONTANUS (*q.v.*), was a pupil of Purbach and taught astronomy at Padua; he wrote an exposition of the *Almagest* and a more important work, *De triangulis planis et sphericis cum tabulis sinuum*, which was published in 1533, a later edition appearing in 1561. He re-invented the tangent and calculated a table of tangents for each degree, but did not make any practical applications of this table, and did not use formulæ involving the tangent. His work was the first complete European treatise on trigonometry, and contains a number of interesting problems; but his methods were in some respects behind those of the Arabs. Copernicus (1473-1543) gave the first simple demonstration of the fundamental formula of spherical trigonometry; the *Trigonometria Copernici* was published by Rheticus in 1542. George Joachim (1514-1576), known as RHETICUS (*q.v.*), wrote *Opus Palatinum de triangulis* (see TABLES, p. 9 above), which contains tables of sines, tangents, and secants of arcs at intervals of 10″ from 0° to 90°. His method of calculation depends upon the formulæ which give $\sin na$ and $\cos na$ in terms of the sines and cosines of $(n-1)a$ and $(n-2)a$; thus these formulæ may be regarded as due to him. Rheticus found the formulæ for the sines of the half and third of an angle in terms of the sine of the whole angle. In 1599 there appeared an important work by Pitiscus (1561-1613), entitled *Trigonometriæ seu de dimensione triangulorum*; this contained several important theorems on the trigonometrical functions of two angles, some of which had been given before by Finck, Landsberg, and Adriaan van Roomen. François Viète or VIETA (*q.v.*) (1540-1603) employed the equation $(2\cos\frac{1}{3}\phi)^3 - 3(2\cos\frac{1}{3}\phi) = 2\cos\phi$ to solve the cubic $x^3 - 3a^2x = a^2b\,(a > \frac{1}{2}b)$; he obtained, however, only one root of the cubic. In 1593 Van Roomen proposed, as a problem for all mathematicians, to solve the equation

$$45y - 3795y^3 + 95634y^5 - \ldots + 945y^{41} - 45y^{43} + y^{45} = C.$$

Viète gave $y = 2\sin\frac{1}{45}\phi$, where $C = 2\sin\phi$, as a solution, and also twenty-two of the other solutions, but he failed to obtain the negative roots. In his work *Ad angulares sectiones* Viète gave formulæ for the chords of multiples of a given arc in terms of the chord of the simple arc.

A new stage in the development of the science was commenced after Napier's invention of logarithms in 1614. Napier also simplified the solution of spherical triangles by his well-known analogies and by his rules for the solution of right-angled triangles. The first tables of logarithmic sines and tangents were constructed by Edmund Gunter (1581-1626), professor of astronomy at Gresham College, London; he was also the first to employ the expressions cosine, cotangent, and cosecant for the sine, tangent, and secant of the complement of an arc. A treatise by Albert Girard (1590-1634), published at The Hague in 1626, contains the theorems which give areas of spherical triangles and polygons, and applications of the properties of the supplementary triangles to the reduction of the number of different cases in the solution of spherical triangles. He used the notation sin, tan, sec for the sine, tangent, and secant of an arc. In the second half of the 17th century the theory of infinite series was developed by Wallis, Gregory, Mercator, and afterwards by Newton and Leibnitz. In the *Analysis per æquationes numero terminorum infinitas*, which was written before 1669, Newton gave the series for the arc in powers of its sine; from this he obtained the series for the sine and cosine in powers of the arc; but these series were given in such a form that the law of the formation of the coefficients was hidden. James Gregory discovered in 1670 the series for the arc in powers of the tangent and for the tangent and secant in powers of the arc. The first of these series was also discovered independently by Leibnitz in 1673, and published without proof in the *Acta eruditorum* for 1682. The series for the sine in powers of the arc he published in 1693; this he obtained by differentiation of a series with undetermined coefficients.

In the 18th century the science began to take a more analytical form; evidence of this is given in the works of Kresa in 1720 and Mayer in 1727. Oppel's *Analysis triangulorum* (1746) was the first complete work on analytical trigonometry. None of these mathematicians used the notation sin, cos, tan, which is the more surprising in the case of Oppel, since Euler had in 1744 employed it in a memoir in the *Acta eruditorum*. John Bernoulli was the first to obtain real results by the use of the symbol $\sqrt{-1}$; he published in 1712 the general formula for $\tan n\phi$ in terms of $\tan\phi$, which he obtained by means of transformation of the arc into imaginary logarithms. The greatest advance was, however, made by Euler, who brought the science in all essential respects into the state in which it is at present. He introduced the present notation into general use, whereas until his time the trigonometrical functions had been, except by Girard, indicated by special letters, and had been regarded as certain straight lines the absolute lengths of which depended on the radius of the circle in which they were drawn. Euler's great improvement consisted in his regarding the sine, cosine, &c., as functions of the angle only, thereby giving to equations connecting these functions a purely analytical interpretation, instead of a geometrical one as heretofore. The exponential values of the sine and cosine, De Moivre's theorem, and a great number of other analytical properties of the trigonometrical functions are due to Euler, most of whose writings are to be found in the *Memoirs* of the St Petersburg Academy.

The preceding sketch has been mainly drawn from the following sources:—Cantor, *Gesch. d. Math.*; Hankel, *Gesch. d. Math.*; Marie, *Hist. des sc. math.*; Suter, *Gesch. d. Math.*; Klügel, *Math. Wörterbuch.*

Plane Trigonometry.

Imagine a straight line terminated at a fixed point O, and initially coincident with a fixed straight line OA, to revolve round O, and finally to take up any position OB. We shall suppose that, when this revolving straight line is turning in one direction, say that opposite to that in which the hands of a clock turn, it is describing a positive angle, and when it is turning in the other direction it is describing a negative angle. Before finally taking up the position OB the straight line may have passed any number of times through the position OB, making any number of complete revolutions round O in either direction. Each time that the straight line makes a complete revolution round O we consider it to have described four right angles, taken with the positive or negative sign according to the direction in which it has revolved; thus, when it stops in the position OB, it may have revolved through any one of an infinite number of positive or negative angles any two of which differ from one another by a positive or negative multiple of four right angles, and all of which have the same bounding lines OA and OB. If OB' is the final position of the revolving line, the smallest positive angle which can have been described is that described by the revolving line making more than one-half and less than the whole of a complete revolution, so that in this case we have a positive angle greater than two and less than four right angles. We have thus shown how we may conceive an angle not restricted to less than two right angles, but of any positive or negative magnitude, to be generated.

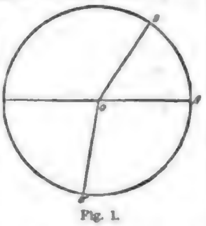


Fig. 1.

Two systems of numerical measurement of angular magnitudes are in ordinary use. For practical measurements the sexagesimal system is the one employed: the ninetieth part of a right angle is taken as the unit and is called a degree; the degree is divided into sixty equal parts called minutes; and the minute into sixty equal parts called seconds; angles smaller than a second are usually measured as decimals of a second, the "thirds," "fourths," &c., not being in ordinary use. In the common notation an angle, for example, of 120 degrees, 17 minutes, and 14·36 seconds is written $120° 17' 14''·36$. The decimal system measurement of angles has never come into ordinary use. In analytical trigonometry the circular measure of an angle is employed. In this system the unit angle is the angle subtended at the centre of a circle by an arc equal in length to the radius. The constancy of this angle follows from the geometrical propositions—(1) the circumferences of different circles vary as their radii; (2) in the same circle angles at the centre are proportional to the arcs which subtend them. It thus follows that the unit mentioned above is an angle independent of the particular circle used in defining it. The constant ratio of the circumference of a circle to its diameter is a quantity incommensurable with unity, usually denoted by π. We shall indicate later on (p. 571 *sq.*) some of the methods which have been employed to approximate to the value of this quantity. Its value to 20 places is 3·14159265358979323846; its reciprocal to the same number of places is ·31830988618379067153. In circular measure every angle is measured by the ratio which it bears to the unit angle. Two right angles are measured by the quantity π, and, since the same angle is 180°, we see that the number of degrees in an angle of circular measure θ is obtained from the formula $180 \times \theta/\pi$. The value of the unit of circular measure has been found to 41 places of decimals by Glaisher (*Proc. London Math. Soc.*, vol. iv.); the value of $\frac{1}{\pi}$, from which the unit can be easily calculated, is given to 140 places of decimals in *Grunert's Archiv*, vol. i., 1841. To 10 decimal places the value of the unit angle is $57° 17' 44''·8062470964$. The unit of circular measure is too large to be convenient for practical purposes, but its use introduces a simplification into the series in analytical trigonometry, owing to the fact that the sine of an angle and the angle itself in this measure, when the magnitude of the angle is indefinitely diminished, are ultimately in a ratio of equality.

If a point moves from a position A to another position B on a straight line, it has described a length AB of the straight line. It is convenient to have a simple mode of indicating in which direction on the straight line the length AB has been described; this may be done by supposing that a point moving in one specified direction is describing a positive length, and when moving in the opposite direction a negative length. Thus, if a point moving from A to B is moving in the positive direction, we consider the length AB as positive; and, since a point moving from B to A is moving in the negative direction, we consider the length BA as negative. Hence any portion of an infinite straight line is considered to be positive or negative according to the direction in which we suppose this portion to be described by a moving point; which direction is the positive one is, of course, a matter of convention.

Sign of portions of an infinite straight line.

If perpendiculars AL, BM be drawn from two points A, B on any straight line, not necessarily in the same plane with AB, the length LM, taken with the positive or negative sign according to the convention as stated above, is called the projection of AB on the given straight line; the projection of BA being ML has the opposite sign to the projection of AB. If two points A, B be joined by a number of lines in any manner, the algebraical sum of the projections of all these lines is LM,—that is, the same as the projection of AB. Hence the sum of the projections of all the sides of any closed polygon, not necessarily plane, on any straight line, is zero. This principle of projections we shall apply below to obtain some of the most important propositions in trigonometry.

Projections of straight lines on each other.

Let us now return to the conception of the generation of an angle as in fig. 1. Draw BOB' at right angles to and equal to AA'. We shall suppose that the direction from A' to A is the positive one for the straight line AOA', and that from B' to B for BOB'. Suppose OP of fixed length, equal to OA, and let PM, PN be drawn perpendicular to $A'A$, $B'B$ respectively; then OM and ON, taken with their proper signs, are the projections of OP on $A'A$ and $B'B$. The ratio of the projection of OP on $B'B$ to the absolute length of OP is dependent only on the magnitude of the angle POA, and is called the sine of that angle; the ratio of the projection of OP on $A'A$ to the length OP is called the cosine of the angle POA. The ratio of the sine of an angle to its cosine is called the tangent of the angle, and that of the cosine to the sine the cotangent of the angle; the reciprocal of the cosine is called the secant, and that of the sine the cosecant of the angle. These functions of an angle of magnitude α are denoted by $\sin\alpha$, $\cos\alpha$, $\tan\alpha$, $\cot\alpha$, $\sec\alpha$, $\operatorname{cosec}\alpha$ respectively. If any straight line RS be drawn parallel to OP, the projection of RS on either of the straight lines $A'A$, $B'B$ can be easily seen to bear to RS the same ratios which the corresponding projections of OP bear to OP: thus, if α be the angle which RS makes with $A'A$, the projections of RS on $A'A$, $B'B$ are $RS\cos\alpha$ and $RS\sin\alpha$ respectively, where RS denotes the absolute length RS. It must be observed that the line SR is to be considered as parallel not to OP but to OP'', and therefore makes an angle $\pi+\alpha$ with $A'A$; this is consistent with the fact that the projections of SR are of opposite sign to those of RS. By observing the signs of the projections of OP for the positions P, P', P'', P''' of P we see that the sine and cosine of the angle POA are both positive; the sine of the angle $P'OA$ is positive and its cosine is negative; both the sine and the cosine of the angle $P''OA$ are negative; and the sine of the angle $P'''OA$ is negative and its cosine positive. If α be the numerical value of the smallest angle of which OP and OA are boundaries, we see that, since these straight lines also bound all the angles $2n\pi+\alpha$, where n is any positive or negative integer, the sines and cosines of all these angles are the same as the sine and cosine of α. Hence the sine of any angle $2n\pi+\alpha$ is positive if α is between 0 and π and negative if α is between π and 2π, and the cosine of the same angle is positive if α is between 0 and $\frac{1}{2}\pi$ or $\frac{3}{2}\pi$ and 2π and negative if α is between $\frac{1}{2}\pi$ and $\frac{3}{2}\pi$.

Definition of trigonometrical functions.

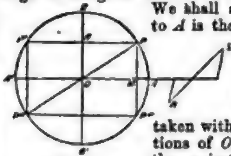


Fig. 2.

In fig. 2 if the angle POA is α, the angle $P'''OA$ is $-\alpha$, $P'OA$ is $\pi-\alpha$, $P''OA$ is $\pi+\alpha$, POB is $\frac{\pi}{2}-\alpha$. By observing the signs of the projections we see that

$$\sin(-\alpha)=-\sin\alpha,\quad \sin(\pi-\alpha)=\sin\alpha,\quad \sin(\pi+\alpha)=-\sin\alpha,$$
$$\cos(-\alpha)=\cos\alpha,\quad \cos(\pi-\alpha)=-\cos\alpha,\quad \cos(\pi+\alpha)=-\cos\alpha,$$
$$\sin(\tfrac{1}{2}\pi-\alpha)=\cos\alpha,\quad \cos(\tfrac{1}{2}\pi-\alpha)=\sin\alpha.$$

Also
$$\sin(\tfrac{1}{2}\pi+\alpha)=\sin(\pi-\tfrac{1}{2}\pi-\alpha)=\sin(\tfrac{1}{2}\pi-\alpha)=\cos\alpha,$$
$$\cos(\tfrac{1}{2}\pi+\alpha)=\cos(\pi-\tfrac{1}{2}\pi-\alpha)=-\cos(\tfrac{1}{2}\pi-\alpha)=-\sin\alpha.$$

From these equations we have $\tan(-\alpha)=-\tan\alpha$, $\tan(\pi-\alpha)=-\tan\alpha$, $\tan(\pi+\alpha)=-\tan\alpha$, $\tan(\frac{1}{2}\pi-\alpha)=\cot\alpha$, $\tan(\frac{1}{2}\pi+\alpha)=-\cot\alpha$, with corresponding equations for the cotangent.

The only angles for which the projection of OP on $B'B$ is the same as for the given angle POA $(=\alpha)$ are the two sets of angles bounded by OP, OA and OP', OA; these angles are $2n\pi+\alpha$ and $2n\pi+\pi-\alpha$, and are all included in the formula $r\pi+(-1)^r\alpha$, where r is any integer; this therefore is the formula for all angles having the same sine as α. The only angles which have the same cosine as α are those bounded by OA, OP and OA, OP''', and these are all included in the formula $2n\pi\pm\alpha$. Similarly it can be shown that $n\pi+\alpha$ includes all the angles which have the same tangent as α.

Relations between trigonometrical functions. From the Pythagorean theorem, the sum of the squares of the projections of any straight line upon two straight lines at right angles to one another is equal to the square on the projected line, we get $\sin^2\alpha+\cos^2\alpha=1$, and from this by the help of the definitions of the other functions we deduce the relations $1+\tan^2\alpha=\sec^2\alpha$, $1+\cot^2\alpha=\operatorname{cosec}^2\alpha$. We have now six relations between the six functions; these enable us to express any five of these functions in terms of the sixth. The following table shows the values of the trigonometrical functions of the angles 0, $\frac{1}{2}\pi$, π, $\frac{3}{2}\pi$, 2π, and the signs of the functions of angles between these values; I denotes numerical increase and D numerical decrease.

Angle	0	$0\ldots\frac{1}{2}\pi$	$\frac{1}{2}\pi$	$\frac{1}{2}\pi\ldots\pi$	π	$\pi\ldots\frac{3}{2}\pi$	$\frac{3}{2}\pi$	$\frac{3}{2}\pi\ldots 2\pi$	2π
Sine	0	$+I$	1	$+D$	0	$-I$	-1	$-D$	0
Cosine	1	$+D$	0	$-I$	-1	$-D$	0	$+I$	1
Tangent ..	0	$+I$	$\pm\infty$	$-D$	0	$+I$	$\pm\infty$	$-D$	0
Cotangent	$\pm\infty$	$+D$	0	$-I$	$\pm\infty$	$+D$	0	$-I$	$\pm\infty$
Secant	1	$+I$	$\pm\infty$	$-D$	-1	$-I$	$\pm\infty$	$+D$	1
Cosecant ..	$\pm\infty$	$+D$	1	$+I$	$\pm\infty$	$-D$	-1	$-I$	$\pm\infty$

The correctness of the table may be verified from the figure by considering the magnitudes of the projections of OP for different positions.

Values of trigonometrical functions for some angles. The following table shows the sine and cosine of some angles for which the values of the functions may be obtained geometrically:—

		sine	cosine		
$\frac{\pi}{12}$	15°	$\frac{\sqrt{6}-\sqrt{2}}{4}$	$\frac{\sqrt{6}+\sqrt{2}}{4}$	75°	$\frac{5}{12}\pi$
$\frac{\pi}{10}$	18°	$\frac{\sqrt{5}-1}{4}$	$\frac{\sqrt{10+2\sqrt{5}}}{4}$	72°	$\frac{2}{5}\pi$
$\frac{\pi}{6}$	30°	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	60°	$\frac{1}{3}\pi$
$\frac{\pi}{5}$	36°	$\frac{\sqrt{10-2\sqrt{5}}}{4}$	$\frac{\sqrt{5}+1}{4}$	54	$\frac{3}{10}\pi$
$\frac{\pi}{4}$	45°	$\frac{1}{\sqrt{2}}$	$\frac{1}{\sqrt{2}}$	45°	$\frac{1}{4}\pi$
		cosine	sine		

These are obtained as follows. (1) $\frac{\pi}{4}$. The sine and cosine of this angle are equal to one another, since $\sin\frac{\pi}{4}=\cos\left(\frac{\pi}{2}-\frac{\pi}{4}\right)$; and since the sum of the squares of the sine and cosine is unity each is $\frac{1}{\sqrt{2}}$. (2) $\frac{\pi}{6}$ and $\frac{\pi}{3}$. Consider an equilateral triangle; the projection of one side on another is obviously half a side; hence the cosine of an angle of the triangle is $\frac{1}{2}$ or $\cos\frac{\pi}{3}=\frac{1}{2}$, and from this the sine is found. (3) $\frac{\pi}{10}, \frac{\pi}{5}, \frac{2\pi}{5}, \frac{3\pi}{10}$. In the triangle constructed in Euc. iv. 10 each angle at the base is $\frac{2\pi}{5}$, and the vertical angle is $\frac{\pi}{5}$. If a be a side and b the base, we have by the construction $a(a-b)=b^2$; hence $2b=a(\sqrt{5}-1)$; the sine of $\frac{\pi}{10}$ is $\frac{b}{2a}$ or $\frac{\sqrt{5}-1}{4}$, and $\cos\frac{\pi}{5}$ is $\frac{a}{2b}=\frac{\sqrt{5}+1}{4}$. (4) $\frac{\pi}{12}, \frac{5\pi}{12}$. Consider a right-angled triangle, having an angle $\frac{1}{6}\pi$. Bisect this angle, then the opposite side is cut by the bisector in the ratio of $\sqrt{3}$ to 2; hence the length of the smaller segment is to that of the whole in the ratio of $\sqrt{3}$ to $\sqrt{3}+2$, therefore $\tan\frac{1}{12}\pi=\frac{\sqrt{3}}{\sqrt{3}+2}\tan\frac{1}{3}\pi$ or $\tan\frac{1}{12}\pi=2-\sqrt{3}$, and from this we can obtain $\sin\frac{1}{12}\pi$ and $\cos\frac{1}{12}\pi$.

Formulæ for sine and cosine of sum and difference of two angles. Draw a straight line OD making any angle A with a fixed straight line OA, and draw OF making an angle B with OD, this angle being measured positively in the same direction as A; draw FE a perpendicular on DO (produced if necessary). The projection of OF on OA is the sum of the projections of OE and EF on OA. Now OE is the projection of OF on DO, and is therefore equal to $OF\cos B$, and EF is the projection of OF on a straight line making an angle $+\frac{1}{2}\pi$ with OD, and is therefore equal to $OF\sin B$; hence

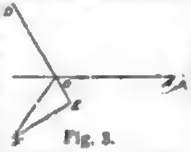


Fig. 3.

$$OF\cos(A+B)=OE\cos A+EF\cos(\tfrac{1}{2}\pi+A)$$
$$=OF(\cos A\cos B-\sin A\sin B),$$

or $$\cos(A+B)=\cos A\cos B-\sin A\sin B.$$

The angles A, B are absolutely unrestricted in magnitude, and thus this formula is perfectly general. We may change the sign of B, thus

$$\cos(A-B)=\cos A\cos(-B)-\sin A\sin(-B),$$

or $$\cos(A-B)=\cos A\cos B+\sin A\sin B.$$

If we projected the sides of the triangle OEF on a straight line making an angle $+\frac{1}{2}\pi$ with OA we should obtain the formulæ

$$\sin(A\pm B)=\sin A\cos B\pm\cos A\sin B,$$

which are really contained in the cosine formula, since we may put $\frac{1}{2}\pi-B$ for B. The formulæ

$$\tan(A\pm B)=\frac{\tan A\pm\tan B}{1\mp\tan A\tan B},\quad \cot(A\pm B)=\frac{\cot A\cot B\mp 1}{\cot B\pm\cot A}$$

are immediately deducible from the above formulæ. The equations

$$\sin C+\sin D=2\sin\tfrac{1}{2}(C+D)\cos\tfrac{1}{2}(C-D),$$
$$\sin C-\sin D=2\sin\tfrac{1}{2}(C-D)\cos\tfrac{1}{2}(C+D),$$
$$\cos D+\cos C=2\cos\tfrac{1}{2}(C+D)\cos\tfrac{1}{2}(C-D),$$
$$\cos D-\cos C=2\sin\tfrac{1}{2}(C+D)\sin\tfrac{1}{2}(C-D),$$

may be obtained directly by the method of projections. Take two equal straight lines OC, OD, making angles C, D with OA, and draw OE perpendicular to CD. The angle which OE makes with OA is $\frac{1}{2}(C+D)$ and that which DC makes is $\frac{1}{2}(\pi+C+D)$; the angle COE is $\frac{1}{2}(C-D)$. The sum of the projections of OD and DE on OA is equal to that of OE, and the sum of the projections of OD and DE is equal to that of OC; hence the sum of the projections of OC and OD is twice that of OE, or $\cos C+\cos D=2\cos\frac{1}{2}(C+D)\cos\frac{1}{2}(C-D)$. The difference of the projections of OD and OC on OA is equal to that of ED, hence we have the formula $\cos D-\cos C=2\sin\frac{1}{2}(C+D)\sin\frac{1}{2}(C-D)$. The other two formulæ will be obtained by projecting on a straight line inclined at an angle $+\frac{1}{2}\pi$ to OA.

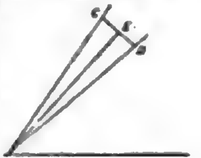


Fig. 4.

Sum of series of cosines in arithmetical progression. As another example of the use of projections, we will find the sum of the series $\cos\alpha+\cos(\alpha+\beta)+\cos(\alpha+2\beta)+\ldots+\cos(\alpha+\overline{n-1}\,\beta)$. Suppose an unclosed polygon each angle of which is $\pi-\beta$ to be inscribed in a circle, and let $A_1, A_2, A_3, \ldots, A_n$ be $n+1$ consecutive angular points; let D be the diameter of the circle; and suppose a straight line drawn making an angle α with AA_1, then $\alpha+\beta$, $\alpha+2\beta, \ldots$ are the angles it makes with A_1A_2, $A_2A_3, \ldots$; we have by projections

$$AA_n\cos\left(\alpha+\frac{\overline{n-1}\,\beta}{2}\right)=AA_1(\cos\alpha+\cos\overline{\alpha+\beta}+\ldots+\cos\overline{\alpha+\overline{n-1}\,\beta}).$$

also $$AA_1=D\sin\frac{\beta}{2},\quad AA_n=D\sin\frac{n\beta}{2};$$

hence the sum of the series of cosines is $\cos\left(\alpha+\frac{\overline{n-1}\,\beta}{2}\right)\sin\frac{n\beta}{2}\operatorname{cosec}\frac{\beta}{2}$.

Formulæ for sine and cosine of sum of angles. By a double application of the addition formulæ we may obtain the formulæ

$$\sin(A_1+A_2+A_3)=\sin A_1\cos A_2\cos A_3+\cos A_1\sin A_2\cos A_3$$
$$+\cos A_1\cos A_2\sin A_3-\sin A_1\sin A_2\sin A_3;$$
$$\cos(A_1+A_2+A_3)=\cos A_1\cos A_2\cos A_3-\cos A_1\sin A_2\sin A_3$$
$$-\sin A_1\cos A_2\sin A_3-\sin A_1\sin A_2\cos A_3.$$

We can by induction extend these formulæ to the case of n angles

Assume $$\sin(A_1+A_2+\ldots+A_n)=S_1-S_3+S_5-\ldots$$
$$\cos(A_1+A_2+\ldots+A_n)=S_0-S_2+S_4-\ldots$$

where S_r denotes the sum of the products of the sines of r of the angles and the cosines of the remaining $n-r$ angles; then we have

$$\sin(A_1+A_2+\ldots+A_n+A_{n+1})=\cos A_{n+1}(S_1-S_3+S_5-\ldots)$$
$$+\sin A_{n+1}(S_0-S_2+S_4-\ldots).$$

The right-hand side of this equation may be written

$$(S_1\cos A_{n+1}+S_0\sin A_{n+1})-(S_3\cos A_{n+1}+S_2\sin A_{n+1})+\ldots,$$

or $$S'_1-S'_3+\ldots$$

where S'_r denotes the quantity which corresponds for $n+1$ angles to S_r for n angles; similarly we may proceed with the cosine formula. The theorems are true for $n=2$ and $n=3$; thus they are true generally.

Formulæ for multiple and sub-multiple angles. The formulæ

$$\cos 2A=\cos^2A-\sin^2A=2\cos^2A-1=1-2\sin^2A,$$
$$\sin 2A=2\sin A\cos A,\qquad \tan 2A=\frac{2\tan A}{1-\tan^2A},$$
$$\sin 3A=3\sin A-4\sin^3A,\quad \cos 3A=4\cos^3A-3\cos A,$$
$$\sin nA=n\cos^{n-1}A\sin A-\frac{n(n-1)(n-2)}{|\underline{3}}\cos^{n-3}A\sin^3A+\ldots$$
$$+(-1)^r\frac{n(n-1)\ldots(n-2r)}{|\underline{2r+1}}\cos^{n-2r-1}A\sin^{2r+1}A,$$
$$\cos nA=\cos^nA-\frac{n(n-1)}{|\underline{2}}\cos^{n-2}A\sin^2A+\ldots$$
$$+(-1)^r\frac{n(n-1)\ldots(n-2r+1)}{|\underline{2r}}\cos^{n-2r}A\sin^{2r}A+\ldots$$

may all be deduced from the addition formulæ by making the angles all equal. From the last two formulæ we obtain by division

$$\tan nA=\frac{n\tan A-\frac{n(n-1)(n-2)}{|\underline{3}}\tan^3A+\ldots+(-1)^r\frac{n(n-1)\ldots(n-2r)}{|\underline{2r+1}}\tan^{2r+1}A+\ldots}{1-\frac{n(n-1)}{|\underline{2}}\tan^2A+\ldots+(-1)^r\frac{n(n-1)\ldots(n-2r+1)}{|\underline{2r}}\tan^{2r}A+\ldots}$$

In the particular case of $n=3$ we have $\tan 3A=\frac{3\tan A-\tan^3A}{1-3\tan^2A}$.

The values of $\sin\frac{1}{2}A$, $\cos\frac{1}{2}A$, $\tan\frac{1}{2}A$ are given in terms of $\cos A$ by the formulæ

$$\sin\tfrac{1}{2}A=(-1)^p\left(\frac{1-\cos A}{2}\right)^{\frac{1}{2}},\ \cos\tfrac{1}{2}A=(-1)^q\left(\frac{1+\cos A}{2}\right)^{\frac{1}{2}},$$

$$\tan\tfrac{1}{2}A=(-1)^r\left(\frac{1-\cos A}{1+\cos A}\right)^{\frac{1}{2}},$$

where p is the integral part of $\frac{A}{2\pi}$, q the integral part of $\frac{A}{2\pi}+\frac{1}{2}$, and r the integral part of $\frac{A}{\pi}$.

Sin $\frac{1}{2}A$, $\cos\frac{1}{2}A$ are given in terms of $\sin A$ by the formulæ

$$2\sin\tfrac{1}{2}A=(-1)^{p'}(1+\sin A)^{\frac{1}{2}}+(-1)^{q'}(1-\sin A)^{\frac{1}{2}},$$

$$2\cos\tfrac{1}{2}A=(-1)^{p'}(1+\sin A)^{\frac{1}{2}}-(-1)^{q'}(1-\sin A)^{\frac{1}{2}},$$

where p' is the integral part of $\frac{A}{2\pi}+\frac{1}{4}$ and q' the integral part of $\frac{A}{2\pi}-\frac{1}{4}$.

Properties of triangles.

In any plane triangle ABC we will denote the lengths of the sides BC, CA, AB by a, b, c respectively, and the angles BAC, ABC, ACB by A, B, C respectively. The fact that the projections of b and c on a straight line perpendicular to the side a are equal to one another is expressed by the equation $b\sin C=c\sin B$; this equation and the one obtained by projecting c and a on a straight line perpendicular to a may be written $\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}$. The equation $a=b\cos C+c\cos B$ expresses the fact that the side a is equal to the sum of the projections of the sides b and c on itself; thus we obtain the equations

$$\left.\begin{array}{l}a=b\cos C+c\cos B\\ b=c\cos A+a\cos C\\ c=a\cos B+b\cos A\end{array}\right\}.$$

If we multiply the first of these equations by $-a$, the second by b, and the third by c, and add the resulting equations, we obtain the formula $b^2+c^2-a^2=2bc\cos A$ or $\cos A=\frac{b^2+c^2-a^2}{2bc}$, which gives the cosine of an angle in terms of the sides. From this expression for $\cos A$ the formulæ $\sin\frac{1}{2}A=\left\{\frac{(s-b)(s-c)}{bc}\right\}^{\frac{1}{2}}$, $\cos\frac{1}{2}A=\left\{\frac{s(s-a)}{bc}\right\}^{\frac{1}{2}}$, $\tan\frac{1}{2}A=\left\{\frac{(s-b)(s-c)}{s(s-a)}\right\}^{\frac{1}{2}}$, $\sin A=\frac{2}{bc}\{s(s-a)(s-b)(s-c)\}^{\frac{1}{2}}$, where s denotes $\frac{1}{2}(a+b+c)$, can be deduced by means of the dimidiary formula.

From any general relation between the sides and angles of a triangle other relations may be deduced by various methods of transformation, of which we give two examples.

(α) In any general relation between the sines and cosines of the angles A, B, C of a triangle we may substitute $pA+qB+rC$, $rA+pB+qC$, $qA+rB+pC$ for A, B, C respectively, where p, q, r are any quantities such that $p+q+r+1$ is a positive or negative multiple of 6, provided that we change the signs of all the sines. Suppose $p+q+r+1=6n$, then the sum of the three angles $2n\pi-(pA+qB+rC)$, $2n\pi-(rA+pB+qC)$, $2n\pi-(qA+rB+pC)$ is π; and, since the given relation follows from the condition $A+B+C=\pi$, we may substitute for A, B, C respectively any angles of which the sum is π; thus the transformation is admissible.

(β) It may easily be shown that the sides and angles of the triangle formed by joining the feet of the perpendiculars from the angular points A, B, C on the opposite sides of the triangle ABC are respectively $a\cos A$, $b\cos B$, $c\cos C$, $\pi-2A$, $\pi-2B$, $\pi-2C$; we may therefore substitute these expressions for a, b, c, A, B, C respectively in any general formula. By drawing the perpendiculars of this second triangle and joining their feet as before, we obtain a triangle of which the sides are $-a\cos A\cos 2A$, $-b\cos B\cos 2B$, $-c\cos C\cos 2C$ and the angles are $4A-\pi$, $4B-\pi$, $4C-\pi$; we may therefore substitute these expressions for the sides and angles of the original triangle; for example, we obtain thus the formula

$$\cos 4A=\frac{a^2\cos^2 A\cos^2 2A-b^2\cos^2 B\cos^2 2B-c^2\cos^2 C\cos^2 2C}{2bc\cos B\cos C\cos 2B\cos 2C}.$$

This transformation obviously admits of further extension.

Solution of triangles.

(1) The three sides of a triangle ABC being given, the angles can be determined by the formula

$$L\tan\frac{A}{2}=10+\tfrac{1}{2}\log(s-b)+\tfrac{1}{2}\log(s-c)-\tfrac{1}{2}\log s-\tfrac{1}{2}\log(s-a)$$

and two corresponding formulæ for the other angles.

(2) The two sides a, b and the included angle C being given, the angles A, B can be determined from the formulæ

$$A+B=\pi-C,$$

$$L\tan\tfrac{1}{2}(A-B)=\log(a-b)-\log(a+b)+L\cot\tfrac{1}{2}C,$$

and the side c is then obtained from the formula

$$\log c=\log a+L\sin C-L\sin A.$$

(3) The two sides a, b and the angle A being given, the value of $\sin B$ may be found by means of the formula

$$L\sin B=L\sin A+\log b-\log a;$$

this gives two supplementary values of the angle B, if $b\sin A<a$. If $b\sin A>a$ there is no solution, and if $b\sin A=a$ there is one solution. In the case $b\sin A<a$, both values of B give solutions provided $b>a$, but the acute value only of B is admissible if $b<a$. The other side c can then be determined as in case (2).

(4) If two angles A, B and a side a are given, the angle C is determined from the formula $C=\pi-A-B$ and the side b from the formula $\log b=\log a+L\sin B-L\sin A$.

Areas of triangles and quadrilaterals.

The area of a triangle is half the product of a side into the perpendicular from the opposite angle on that side; thus we obtain the expressions $\frac{1}{2}bc\sin A$, $\{s(s-a)(s-b)(s-c)\}^{\frac{1}{2}}$ for the area of a triangle. A large collection of formulæ for the area of a triangle are given in the *Annals of Mathematics* for 1885 by M. Baker.

Let a, b, c, d denote the lengths of the sides AB, BC, CD, DA respectively of any plane quadrilateral and $A+C=2\alpha$; we may obtain an expression for the area S of the quadrilateral in terms of the sides and the angle α.

We have $$2S=ad\sin A+bc\sin(2\alpha-A)$$
and $$\tfrac{1}{2}(a^2+d^2-b^2-c^2)=ad\cos A-bc\cos(2\alpha-A);$$
hence $$4S^2+\tfrac{1}{4}(a^2+d^2-b^2-c^2)^2=a^2d^2+b^2c^2-2abcd\cos 2\alpha.$$
If $2s=a+b+c+d$, the value of S may be written in the form

$$S=\{s(s-a)(s-b)(s-c)(s-d)-abcd\cos^2\alpha\}^{\frac{1}{2}}.$$

Radii of circumscribed, inscribed, and escribed circles of a triangle.

Let R denote the radius of the circumscribed circle, r of the inscribed, and r_1, r_2, r_3 of the escribed circles of a triangle ABC; the values of these radii are given by the following formulæ.

$$R=\frac{abc}{4S}=\frac{a}{2\sin A},$$

$$r=\frac{S}{s}=(s-a)\tan\tfrac{1}{2}A=4R\sin\tfrac{1}{2}A\sin\tfrac{1}{2}B\sin\tfrac{1}{2}C,$$

$$r_1=\frac{S}{s-a}=s\tan\tfrac{1}{2}A=4R\sin\tfrac{1}{2}A\cos\tfrac{1}{2}B\cos\tfrac{1}{2}C$$

Spherical Trigonometry

We shall throughout assume such elementary propositions in spherical geometry as are required for the purpose of the investigation of formulæ given below.

Definition of spherical triangle.

A spherical triangle is the portion of the surface of a sphere bounded by three arcs of great circles of the sphere. If BC, CA, AB denote these arcs, the circular measure of the angles subtended by these arcs respectively at the centre of the sphere are the sides a, b, c of the spherical triangle ABC; and, if the portions of planes passing through these arcs and the centre of the sphere be drawn, the angles between the portions of planes intersecting at A, B, C respectively are the angles A, B, C of the spherical triangle. It is not necessary to consider triangles in which a side is greater than π, since we may replace such a side by the remaining arc of the great circle to which it belongs. Since two great circles intersect each other in two points, there are eight triangles of which the sides are arcs of the same three great circles. If we consider one of these triangles ABC as the fundamental one, then one of the others is equal in all respects to ABC, and the remaining six have each one side equal to, or common with, a side of the triangle ABC, the opposite angle equal to the corresponding angle of ABC, and the other sides and angles supplementary to the corresponding sides and angles of ABC. These triangles may be called the associated triangles of the fundamental one ABC. It follows that from any general formula containing the sides and angles of a spherical triangle we may obtain other formulæ by replacing two sides and the two angles opposite to them by their supplements, the remaining side and the remaining angle being unaltered, for such formulæ are obtained by applying the given formulæ to the associated triangles.

Associated triangles.

Transformation.

If A', B', C' are those poles of the arcs BC, CA, AB respectively which lie upon the same sides of them as the opposite angles A, B, C, then the triangle $A'B'C'$ is called the polar triangle of the triangle ABC. The sides of the polar triangle are $\pi-A$, $\pi-B$, $\pi-C$, and the angles $\pi-a$, $\pi-b$, $\pi-c$. Hence from any general formula connecting the sides and angles of a spherical triangle we may obtain another formula by changing each side into the supplement of the opposite angle and each angle into the supplement of the opposite side.

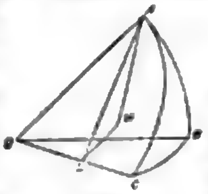


Fig. 5.

Fundamental equations between sides and angles.

Let O be the centre of the sphere on which is the spherical triangle ABC. Draw AL perpendicular to OC and AM perpendicular to the plane OBC. Then the projection of OA on OB is the sum of the projections of OL, LM, MA on the same straight line. Since AM has no projection on any straight line in the plane OBC, this gives

$$OA\cos c=OL\cos a+LM\sin a.$$

Now $$OL=OA\cos b,\ LM=AL\cos C=OA\sin b\cos C;$$
therefore $$\cos c=\cos a\cos b+\sin a\sin b\cos C.$$
We may obtain similar formulæ by interchanging the letters a, b, c, thus

$$\left.\begin{array}{l}\cos a=\cos b\cos c+\sin b\sin c\cos A\\ \cos b=\cos c\cos a+\sin c\sin a\cos B\\ \cos c=\cos a\cos b+\sin a\sin b\cos C\end{array}\right\}\ \ldots\ldots\ldots\ldots(1).$$

These formulæ (1) may be regarded as the fundamental equations connecting the sides and angles of a spherical triangle; all the other relations which we shall give below may be deduced analytically from them; we shall, however, in most cases give independent proofs. By using the polar triangle transformation we have the formulæ

$$\left.\begin{array}{l}\cos A = -\cos B\cos C+\sin B\sin C\cos a\\ \cos B = -\cos C\cos A+\sin C\sin A\cos b\\ \cos C = -\cos A\cos B+\sin A\sin B\cos c\end{array}\right\}\quad\ldots\ldots\ldots(2).$$

In the figure we have $AM=AL\sin C=r\sin b\sin C$, where r denotes the radius of the sphere. By drawing a perpendicular from A on OB, we may in a similar manner show that $AM=r\sin c\sin B$, therefore

$$\sin B\sin c=\sin C\sin b.$$

By interchanging the sides we have the equation

$$\frac{\sin A}{\sin a}=\frac{\sin B}{\sin b}=\frac{\sin C}{\sin c}=k\ \ldots\ldots\ldots\ldots\ldots\ldots(3);$$

we shall find below a symmetrical form for k.

If we eliminate $\cos b$ between the first two formulæ of (1) we have

$$\cos a\sin^2 c=\sin b\sin c\cos A+\sin c\cos c\sin a\cos B;$$

therefore

$$\cot a\sin c=\frac{\sin b}{\sin a}\cos A+\cos c\cos B$$
$$=\sin B\cot A+\cos c\cos B.$$

We thus have the six equations

$$\left.\begin{array}{l}\cot a\sin b=\cot A\sin C+\cos b\cos C\\ \cot b\sin a=\cot B\sin C+\cos a\cos C\\ \cot b\sin c=\cot B\sin A+\cos c\cos A\\ \cot c\sin b=\cot C\sin A+\cos b\cos A\\ \cot c\sin a=\cot C\sin B+\cos a\cos B\\ \cot a\sin c=\cot A\sin B+\cos c\cos B\end{array}\right\}\quad\ldots\ldots\ldots\ldots(4).$$

When $C=\frac{\pi}{2}$ formula (1) gives

$$\cos c=\cos a\cos b\ \ldots\ldots\ldots\ldots\ldots\ldots(\alpha),$$

and (3) gives

$$\left.\begin{array}{l}\sin b=\sin B\sin c\\ \sin a=\sin A\sin c\end{array}\right\}\quad\ldots\ldots\ldots(\beta);$$

from (4) we get

$$\left.\begin{array}{l}\tan a=\tan A\sin b=\tan c\cos B\\ \tan b=\tan B\sin a=\tan c\cos A\end{array}\right\}\quad\ldots\ldots\ldots\ldots(\gamma).$$

The formulæ

$$\cos c=\cot A\cot B\ldots\ldots\ldots\ldots\ldots\ldots(\epsilon)$$

and

$$\left.\begin{array}{l}\cos A=\cos a\sin B\\ \cos B=\cos b\sin A\end{array}\right\}\quad\ldots\ldots\ldots\ldots(\zeta)$$

follow at once from (α), (β), (γ). These are the formulæ which are used for the solution of right-angled triangles. Napier gave mnemonical rules for remembering them.

The following proposition follows easily from the theorem in equation (3):—If AD, BE, CF are three arcs drawn through A, B, C to meet the opposite sides in D, E, F respectively, and if these arcs pass through a point, the segments of the sides satisfy the relation $\sin BD\sin CE\sin AF=\sin CD\sin AE\sin BF$; and conversely if this relation is satisfied the arcs pass through a point. From this theorem it follows that the three perpendiculars from the angles on the opposite sides, the three bisectors of the angles, and the three arcs from the angles to the middle points of the opposite sides, each pass through a point.

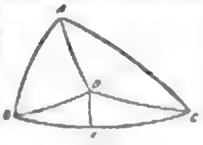


Fig. 6.

Formulæ for sine and co-sine of half angles;

If D be the point of intersection of the three bisectors of the angles A, B, C, and if DE be drawn perpendicular to BC, it may be shown that $BE=\frac{1}{2}(a+c-b)$ and $CE=\frac{1}{2}(a+b-c)$, and that the angles BDE, ADC are supplementary. We have also $\dfrac{\sin c}{\sin BD}=\dfrac{\sin ADB}{\sin\frac{A}{2}}$, $\dfrac{\sin b}{\sin CD}=\dfrac{\sin ADC}{\sin\frac{A}{2}}$; therefore $\sin^2\frac{A}{2}$ $=\dfrac{\sin BD\sin CD\sin CDE\sin BDE}{\sin b\sin c}$. But $\sin BD\sin BDE=\sin BE$ $=\sin\dfrac{(a+c-b)}{2}$, and $\sin CD\sin CDE=\sin CE=\sin\dfrac{a+b-c}{2}$; therefore

$$\sin\frac{A}{2}=\left\{\frac{\sin\frac{a+c-b}{2}\sin\frac{a+b-c}{2}}{\sin b\sin c}\right\}^{\frac{1}{2}}\quad\ldots\ldots\ldots(5).$$

Apply this formula to the associated triangle of which $\pi-A$, $\pi-B$, C are the angles and $\pi-a$, $\pi-b$, c are the sides; we obtain the formula

$$\cos\frac{A}{2}=\left\{\frac{\sin\frac{b+c-a}{2}\sin\frac{a+b+c}{2}}{\sin b\sin c}\right\}^{\frac{1}{2}}\quad\ldots\ldots\ldots(6).$$

By division we have

$$\tan\frac{A}{2}=\left\{\frac{\sin\frac{a+c-b}{2}\sin\frac{a+b-c}{2}}{\sin\frac{b+c-a}{2}\sin\frac{a+b+c}{2}}\right\}^{\frac{1}{2}}\quad\ldots\ldots\ldots(7),$$

and by multiplication

$$\sin A=\frac{2}{\sin b\sin c}\left\{\sin\frac{a+b+c}{2}\sin\frac{b+c-a}{2}\sin\frac{c+a-b}{2}\sin\frac{a+b-c}{2}\right\}^{\frac{1}{2}}$$
$$=\frac{1}{\sin b\sin c}\{1-\cos^2 a-\cos^2 b-\cos^2 c+2\cos a\cos b\cos c\}^{\frac{1}{2}}.$$

Hence the quantity k in (3) is

$$\frac{1}{\sin a\sin b\sin c}\{1-\cos^2 a-\cos^2 b-\cos^2 c+2\cos a\cos b\cos c\}^{\frac{1}{2}}\ (8).$$

Apply the polar triangle transformation to the formulæ (5), (6), (7), (8) and we obtain

Of half-sides.

$$\cos\frac{a}{2}=\left\{\frac{\cos\frac{A+C-B}{2}\cos\frac{A+B-C}{2}}{\sin B\sin C}\right\}^{\frac{1}{2}}\quad\ldots\ldots\ldots\ldots(9);$$

$$\sin\frac{a}{2}=\left\{\frac{-\cos\frac{B+C-A}{2}\cos\frac{A+B+C}{2}}{\sin B\sin C}\right\}^{\frac{1}{2}}\quad\ldots\ldots\ldots(10);$$

$$\tan\frac{a}{2}=\left\{\frac{-\cos\frac{B+C-A}{2}\cos\frac{A+B+C}{2}}{\cos\frac{A+C-B}{2}\cos\frac{A+B-C}{2}}\right\}^{\frac{1}{2}}\quad\ldots\ldots\ldots(11).$$

If $k'=\dfrac{1}{\sin A\sin B\sin C}\{1-\cos^2 A-\cos^2 B-\cos^2 C-2\cos A\cos B\cos C\}^{\frac{1}{2}}$, we have

$$kk'=1\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(12).$$

Delambre's formulæ

Let E be the middle point of AB; draw ED at right angles to AB to meet AC in D; then DE bisects the angle ADB. Let CF bisect the angle DCB and draw FG perpendicular to BC, then

$$CG=\frac{a-b}{2},\ \angle FBE=\frac{A+B}{2},$$
$$\angle FCG=90^\circ-\frac{C}{2}.$$

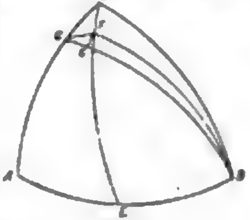


Fig. 7.

From the triangle CFG we have $\cos CFG=\cos CG\sin FCG$, and from the triangle FEB $\cos EFB=\cos EB\sin FBE$. Now the angles CFG, EFB are each supplementary to the angle DFB, therefore

$$\cos\frac{a-b}{2}\cos\frac{C}{2}=\sin\frac{A+B}{2}\cos\frac{c}{2}\quad\ldots\ldots\ldots(13).$$

Also $\sin CG=\sin CF\sin CFG$ and $\sin EB=\sin BF\sin EFB$;

therefore

$$\sin\frac{a-b}{2}\cos\frac{C}{2}=\sin\frac{A-B}{2}\sin\frac{c}{2}\ \ldots\ldots\ldots\ldots(14).$$

Apply the formulæ (13), (14) to the associated triangle of which a, $\pi-b$, $\pi-c$, A, $\pi-B$, $\pi-C$ are the sides and angles, we then have

$$\sin\frac{a+b}{2}\sin\frac{C}{2}=\cos\frac{A-B}{2}\sin\frac{c}{2}\ \ldots\ldots\ldots\ldots(15),$$

$$\cos\frac{a+b}{2}\sin\frac{C}{2}=\cos\frac{A+B}{2}\cos\frac{c}{2}\ \ldots\ldots\ldots\ldots(16).$$

The four formulæ (13), (14), (15), (16) were first given by Delambre in the *Connaissance des Temps* for 1808. Formulæ equivalent to these were given by Mollweide in Zach's *Monatliche Correspondenz* for November 1808. They were also given by Gauss (*Theoria motus*, 1809), and are usually called after him.

Napier's analogies.

From the same figure we have

$$\tan FG=\tan FCG\sin CG=\tan FBG\sin BG;$$

therefore

$$\cot\frac{C}{2}\sin\frac{a-b}{2}=\tan\frac{A-B}{2}\sin\frac{a+b}{2},$$

or

$$\tan\frac{A-B}{2}=\frac{\sin\frac{a-b}{2}}{\sin\frac{a+b}{2}}\cot\frac{C}{2}\quad\ldots\ldots\ldots\ldots\ldots(17).$$

Apply this formula to the associated triangle ($\pi-a$, b, $\pi-c$, $\pi-A$, B, $\pi-C$), and we have

$$\cot\frac{A+B}{2}=\frac{\cos\frac{a+b}{2}}{\cos\frac{a-b}{2}}\tan\frac{C}{2},$$

or

$$\tan\frac{A+B}{2}=\frac{\cos\frac{a-b}{2}}{\cos\frac{a+b}{2}}\cot\frac{C}{2}\ \ldots\ldots\ldots\ldots(18).$$

If we apply these formulæ (17), (18) to the polar triangle, we have

$$\tan\frac{a-b}{2}=\frac{\sin\frac{A-B}{2}}{\sin\frac{A+B}{2}}\tan\frac{c}{2}\quad\ldots\ldots\ldots\ldots\ldots(19);$$

$$\tan\frac{a+b}{2}=\frac{\cos\frac{A-B}{2}}{\cos\frac{A+B}{2}}\tan\frac{c}{2}\quad\ldots\ldots\ldots\ldots\ldots(20).$$

The formulæ (17), (18), (19), (20) are called Napier's "Analogies" they were given in the *Mirif. logar. canonis descriptio.*

Schmeisser's formulæ. If we use the values of $\sin\frac{a}{2}$, $\sin\frac{b}{2}$, $\sin\frac{c}{2}$, $\cos\frac{a}{2}$, $\cos\frac{b}{2}$, $\cos\frac{c}{2}$ given by (9), (10) and the analogous formulæ obtained by interchanging the letters, we obtain by multiplication

$$\left.\begin{aligned}\sin\frac{a}{2}\cos\frac{b}{2}\sin C&=\sin\frac{c}{2}\cos\frac{B+C-A}{2}\\ \cos\frac{a}{2}\cos\frac{b}{2}\sin C&=\cos\frac{c}{2}\cos\frac{A+B-C}{2}\\ \sin\frac{a}{2}\sin\frac{b}{2}\sin C&=\cos\frac{c}{2}\cos\frac{A+B+C}{2}\end{aligned}\right\}.$$

These formulæ were given by Schmeisser in *Crelle's Journ.*, vol. x.

Cagnoli's formula. The relation $\sin b\sin c+\cos b\cos c\cos A=\sin B\sin C-\cos B\cos C\cos a$ was given by Cagnoli in his *Trigonometry* (1786), and was rediscovered by Cayley (*Phil. Mag.*, 1859). It follows from (1), (2), and (3) thus: the right-hand side of the equation equals $\sin B\sin C+\cos a(\cos A-\sin B\sin C\cos a)=\sin B\sin C\sin^2 a+\cos a\cos A$, and this is equal to $\sin b\sin c+\cos A(\cos a-\sin b\sin c\cos A)$ or $\sin b\sin c+\cos b\cos c\cos A$.

Solution of triangles; The formulæ we have given are sufficient to determine three parts of a triangle when the other three parts are given; moreover such formulæ may always be chosen as are adapted to logarithmic calculation. The solutions will be unique except in the two cases (1) where two sides and the angle opposite one of them are the given parts, and (2) where two angles and the side opposite one of them are given.

Ambiguous cases. Suppose a, b, A are the given parts. We determine B from the formula $\sin B=\frac{\sin b}{\sin a}\sin A$; this gives two supplementary values of B, one acute and the other obtuse. Then C and c are determined from the equations $\tan\frac{C}{2}=\frac{\sin\frac{a-b}{2}}{\sin\frac{a+b}{2}}\cot\frac{A-B}{2}$, $\tan\frac{c}{2}=\frac{\sin\frac{A+B}{2}}{\sin\frac{A-B}{2}}\tan\frac{a-b}{2}$.

Now $\tan\frac{C}{2}$, $\tan\frac{c}{2}$ must both be positive; hence $A-B$ and $a-b$ must have the same sign. We shall distinguish three cases. First, suppose $\sin b<\sin a$; then we have $\sin B<\sin A$. Hence A lies between the two values of B, and therefore only one of these values is admissible, the acute or the obtuse value according as a is greater or less than b; there is therefore in this case always one solution. Secondly, if $\sin b>\sin a$, there is no solution when $\sin b\sin A>\sin a$; but if $\sin b\sin A<\sin a$ there are two values of B both greater or both less than A. If a is acute, $a-b$, and therefore $A-B$, is negative; hence there are two solutions if A is acute and none if A is obtuse. These two solutions fall together if $\sin b\sin A=\sin a$. If a is obtuse there is no solution unless A is obtuse, and in that case there are two, which coincide as before if $\sin b\sin A=\sin a$. Hence in this case there are two solutions if $\sin b\sin A\leqq\sin a$ and the two parts A, a are both acute or both obtuse, these being coincident in case $\sin b\sin A=\sin a$; and there is no solution if one of the two A, a is acute and the other obtuse, or if $\sin b\sin A>\sin a$. Thirdly, if $\sin b=\sin a$ then $B=A$ or $\pi-A$. If a is acute, $a-b$ is zero or negative, hence $A-B$ is zero or negative; thus there is no solution unless A is acute, and then there is one. Similarly, if a is obtuse, A must be so too in order that there may be a solution. If $a=b=\frac{\pi}{2}$, there is no solution unless $A=\frac{\pi}{2}$, and then there are an infinite number of solutions, since the values of C and c become indeterminate.

The other case of ambiguity may be discussed in a similar manner, or the different cases may be deduced from the above by the use of the polar triangle transformation. The method of classification according to the three cases $\sin b\overset{>}{\underset{<}{=}}\sin a$ was given by Professor Lloyd Tanner (*Messenger of Math.*, vol. xiv.).

Radii of circles related to triangles. If r is the angular radius of the small circle inscribed in the triangle ABC, we have at once $\tan r=\tan\frac{A}{2}\sin(s-a)$, where $2s=a+b+c$; from this we can derive the formulæ

$$\tan r=n\operatorname{cosec}s=\frac{N}{2}\sec\frac{A}{2}\sec\frac{B}{2}\sec\frac{C}{2}=\sin a\sin\frac{B}{2}\sin\frac{C}{2}\sec\frac{A}{2}\ (21),$$

where n, N denote the expressions

$$\{\sin s\sin(s-a)\sin(s-b)\sin(s-c)\}^{\frac{1}{2}},$$
$$\{-\cos S\cos(S-A)\cos(S-B)\cos(S-C)\}^{\frac{1}{2}}.$$

The escribed circles are the small circles inscribed in three of the associated triangles; thus, applying the above formulæ to the triangle $(a, \pi-b, \pi-c, A, \pi-B, \pi-C)$, we have for r_1, the radius of the escribed circle opposite to the angle A, the following formulæ

$$\tan r_1=\tan\frac{A}{2}\sin s=n\operatorname{cosec}(s-a)=\frac{N}{2}\sec\frac{A}{2}\operatorname{cosec}\frac{B}{2}\operatorname{cosec}\frac{C}{2}$$
$$=\sin a\cos\frac{B}{2}\cos\frac{C}{2}\sec\frac{A}{2}\ \ldots\ldots\ldots\ldots(22).$$

The pole of the circle circumscribing a triangle is that of the circle inscribed in the polar triangle, and the radii of the two circles are complementary; hence, if R be the radius of the circumscribed circle of the triangle, and R_1, R_2, R_3 the radii of the circles circumscribing the associated triangles, we have by writing $\frac{\pi}{2}-R$ for r, $\frac{\pi}{2}-R_1$ for r_1, $\pi-a$ for A, &c., in the above formulæ

$$\cot R=\cot\frac{a}{2}\cos(S-A)=\frac{n}{2}\operatorname{cosec}\frac{a}{2}\operatorname{cosec}\frac{b}{2}\operatorname{cosec}\frac{c}{2}=-N\sec S$$
$$=\sin A\cos\frac{b}{2}\cos\frac{c}{2}\operatorname{cosec}\frac{a}{2}\ \ldots\ldots\ (23);$$
$$\cot R_1=-\cot\frac{a}{2}\cos S=\frac{n}{2}\operatorname{cosec}\frac{a}{2}\sec\frac{b}{2}\sec\frac{c}{2}=N\sec(S-A)$$
$$=\sin A\sin\frac{b}{2}\sin\frac{c}{2}\operatorname{cosec}\frac{a}{2}\ldots\ldots\ldots\ldots\ (24).$$

The following relations follow from the formulæ just given:—

$$2\tan R=\cot r_1+\cot r_2+\cot r_3-\cot r,$$
$$2\tan R_1=\cot r+\cot r_2+\cot r_3-\cot r_1,$$
$$\tan r\tan r_1\tan r_2\tan r_3=n^2,\ \sin^2 s=\cot r\tan r_1\tan r_2\tan r_3,$$
$$\sin^2(s-a)=\tan r\cot r_1\tan r_2\tan r_3.$$

Formulæ for spherical excess. If $E=A+B+C-\pi$, it may be shown that E multiplied by the square of the radius is the area of the triangle. We give some of the more important expressions for the quantity E, which is called the spherical excess.

We have $\frac{\cos\frac{A+B}{2}}{\sin\frac{C}{2}}=\frac{\cos\frac{a+b}{2}}{\cos\frac{c}{2}}$ and $\frac{\sin\frac{A+B}{2}}{\cos\frac{C}{2}}=\frac{\cos\frac{a-b}{2}}{\cos\frac{c}{2}}$,

or $\frac{\sin\left(\frac{C}{2}-\frac{E}{2}\right)}{\sin\frac{C}{2}}=\frac{\cos\frac{a+b}{2}}{\cos\frac{c}{2}}$ and $\frac{\cos\left(\frac{C}{2}-\frac{E}{2}\right)}{\cos\frac{C}{2}}=\frac{\cos\frac{a-b}{2}}{\cos\frac{c}{2}}$;

hence $\frac{\sin\frac{C}{2}-\sin\left(\frac{C-E}{2}\right)}{\sin\frac{C}{2}+\sin\left(\frac{C-E}{2}\right)}=\frac{\cos\frac{c}{2}-\cos\frac{a+b}{2}}{\cos\frac{c}{2}+\cos\frac{a+b}{2}}$;

therefore $\frac{\tan\frac{E}{4}}{\tan^2\frac{C-E}{4}}=\tan\frac{s}{2}\tan\frac{s-c}{2}$.

Similarly $\tan\frac{E}{4}\tan^2\frac{C-E}{4}=\tan\frac{s-a}{2}\tan\frac{s-b}{2}$;

therefore $\tan\frac{E}{4}=\left\{\tan\frac{s}{2}\tan\frac{s-a}{2}\tan\frac{s-b}{2}\tan\frac{s-c}{2}\right\}^{\frac{1}{2}}$ . . (25).

This formula was given by L'Huillier.

Also $\sin\frac{C}{2}\cos\frac{E}{2}-\cos\frac{C}{2}\sin\frac{E}{2}=\frac{\cos\frac{a+b}{2}}{\cos\frac{c}{2}}\sin\frac{C}{2}$;

$$\cos\frac{C}{2}\cos\frac{E}{2}+\sin\frac{C}{2}\sin\frac{E}{2}=\frac{\cos\frac{a-b}{2}}{\cos\frac{c}{2}}\cos\frac{C}{2};$$

whence, solving for $\cos\frac{E}{2}$, we get

$$\cos\frac{E}{2}=\frac{1+\cos a+\cos b+\cos c}{4\cos\frac{a}{2}\cos\frac{b}{2}\cos\frac{c}{2}}\ \ldots\ldots\ldots\ldots(26).$$

This formula was given by Euler (*Nova acta*, vol. x.). If we find $\sin\frac{E}{2}$ from this formula, we obtain after reduction

$$\sin\frac{E}{2}=\frac{n}{2\cos\frac{a}{2}\cos\frac{b}{2}\cos\frac{c}{2}},$$

a formula given by Lexell (*Acta Petrop.*, 1782).

From the equations (21), (22), (23), (24) we obtain the following formulæ for the spherical excess:—

$$\sin^2\frac{E}{2}=\tan R\cot R_1\cot R_2\cot R_3$$
$$=\frac{4(\cot r_1+\cot r_2+\cot r_3)}{(\cot r-\cot r_1+\cot r_2+\cot r_3)(\cot r+\cot r_1-\cot r_2+\cot r_3)(\cot r+\cot r_1+\cot r_2-\cot r_3)}.$$

The formula (26) may be expressed geometrically. Let M, N be the middle points of the sides AB, AC. Then we find $\cos MN=\frac{1+\cos a+\cos b+\cos c}{4\cos\frac{b}{2}\cos\frac{c}{2}}$; hence $\cos\frac{E}{2}=\cos MN\sec\frac{a}{2}$.

A geometrical construction has been given for E by Gudermann (in *Crelle's Journ.*, vi. and viii.). It has been shown by Cornelius Keogh that the volume of the parallelepiped of which the radii of the sphere passing through the middle points of the sides of the triangle are edges is $\sin\frac{B}{2}$

Properties of spherical quadrilateral inscribed in small circle.

Let $ABCD$ be a spherical quadrilateral inscribed in a small circle; let a, b, c, d denote the sides AB, BC, CD, DA respectively, and x, y the diagonals AC, BD. It can easily be shown by joining the angular points of the quadrilateral to the pole of the circle that $A+C=B+D$. If we use the last expression in (23) for the radii of the circles circumscribing the triangles BAD, BCD, we have

$$\sin A\cos\frac{a}{2}\cos\frac{d}{2}\operatorname{cosec}\frac{y}{2}=\sin C\cos\frac{b}{2}\cos\frac{C}{2}\operatorname{cosec}\frac{y}{2};$$

whence

$$\frac{\sin A}{\cos\frac{b}{2}\cos\frac{c}{2}}=\frac{\sin C}{\cos\frac{a}{2}\cos\frac{d}{2}}.$$

This is the proposition corresponding to the relation $A+C=\pi$ for a plane quadrilateral. Also we obtain in a similar manner the theorem

$$\frac{\sin\frac{x}{2}}{\sin B\cos\frac{b}{2}}=\frac{\sin\frac{y}{2}}{\sin A\cos\frac{d}{2}},$$

analogous to the theorem for a plane quadrilateral, that the diagonals are proportional to the sines of the angles opposite to them. Also the chords AB, BC, CD, DA are equal to $2\sin\frac{a}{2}$, $2\sin\frac{b}{2}$, $2\sin\frac{c}{2}$, $2\sin\frac{d}{2}$ respectively, and the plane quadrilateral formed by these chords is inscribed in the same circle as the spherical quadrilateral; hence by Ptolemy's theorem for a plane quadrilateral we obtain the analogous theorem for a spherical one

$$\sin\frac{x}{2}\sin\frac{y}{2}=\sin\frac{a}{2}\sin\frac{c}{2}+\sin\frac{b}{2}\sin\frac{d}{2}.$$

It has been shown by Remy (in *Crelle's Journ.*, vol. iii.) that for any quadrilateral, if z be the spherical distance between the middle points of the diagonals,

$$\cos a+\cos b+\cos c+\cos d=4\cos\tfrac{1}{2}x\cos\tfrac{1}{2}y\cos\tfrac{1}{2}z.$$

This theorem is analogous to the theorem for any plane quadrilateral, that the sum of the squares of the sides is equal to the sum of the squares of the diagonals, together with twice the square on the straight line joining the middle points of the diagonals.

A theorem for a right-angled spherical triangle, analogous to the Pythagorean theorem, has been given by Gudermann (in *Crelle's Journ.*, vol. xlii.)

Analytical Trigonometry.

Periodicity of functions.

Analytical trigonometry is that branch of mathematical analysis in which the analytical properties of the trigonometrical functions are investigated. These functions derive their importance in analysis from the fact that they are the simplest singly periodic functions, and are therefore adapted to the representation of undulating magnitude. The sine, cosine, secant, and cosecant have the single real period 2π; *i.e.*, each is unaltered in value by the addition of 2π to the variable. The tangent and cotangent have the period π. The sine, tangent, cosecant, and cotangent belong to the class of odd functions; that is, they change sign when the sign of the variable is changed. The cosine and secant are even functions, since they remain unaltered when the sign of the variable is reversed.

Connexion with theory of complex quantities.

The theory of the trigonometrical functions is intimately connected with that of complex quantities,—that is, of quantities of the form $x+\iota y$ ($\iota=\sqrt{-1}$). Suppose we multiply together, by the rules of ordinary algebra, two such quantities, we have

$$(x_1+\iota y_1)(x_2+\iota y_2)=(x_1x_2-y_1y_2)+\iota(x_1y_2+x_2y_1).$$

We observe that the real part and the real factor of the imaginary part of the expression on the right-hand side of this equation are similar in form to the expressions which occur in the addition formulæ for the cosine and sine of the sum of two angles; in fact, if we put $x_1=r_1\cos\theta_1$, $y_1=r_1\sin\theta_1$, $x_2=r_2\cos\theta_2$, $y_2=r_2\sin\theta_2$, the above equation becomes

$$r_1(\cos\theta_1+\iota\sin\theta_1)\times r_2(\cos\theta_2+\iota\sin\theta_2)=r_1r_2(\cos\overline{\theta_1+\theta_2}+\iota\sin\overline{\theta_1+\theta_2}).$$

We may now, in accordance with the usual mode of representing complex quantities, give a geometrical interpretation of the meaning of this equation. Let P_1 be the point whose coordinates referred to rectangular axes Ox, Oy are x_1, y_1; then the point P_1 is employed to represent the quantity $x_1+\iota y_1$. In this mode of representation real quantities are measured along the axis of x and imaginary ones along the axis of y, additions being performed according to the parallelogram law. The points A, A_1 represent the magnitudes ± 1, the points a, a_1 the magnitudes $\pm\iota$. Let P_2 represent the expression $x_2+\iota y_2$ and P the expression $(x_1+\iota y_1)(x_2+\iota y_2)$. The quantities $r_1\theta_1, r_2\theta_2$ are the polar coordinates of P_1 and P_2 respectively referred to O as origin and Ox as initial line; the above equation shows that r_1r_2 and $\theta_1+\theta_2$ are the polar coordinates of P; hence $OA:OP_1::OP_2:OP$ and the angle POP_2 is equal to the angle P_1OA. Thus we have the following geometrical construction for the determination of the point P. On OP_2 draw a triangle similar to the triangle OAP_1 so that the sides OP_2, OP are homologous to the sides OA, OP, and so that the angle POP_2 is positive; then the vertex P represents the product of the expressions represented by P_1, P_2. If $x_2+\iota y_2$ were to be divided by $x_1+\iota y_1$, the triangle $OP'P_2$ would be drawn on the negative side of P_2, similar to the triangle OAP_1 and having the sides OP', OP_2 homologous to OA, OP, and P' would represent the quotient.

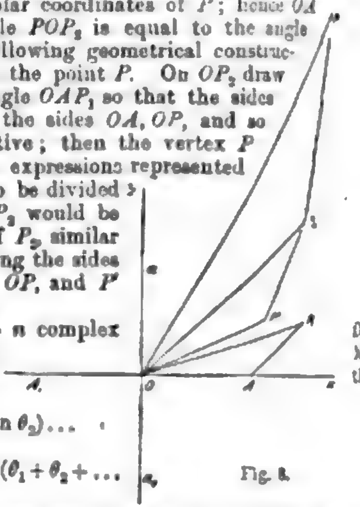


Fig. 8.

De Moivre's theorem.

If we extend the above to n complex quantities by continual repetition of a similar operation, we have—

$$(\cos\theta_1+\iota\sin\theta_1)(\cos\theta_2+\iota\sin\theta_2)\ldots(\cos\theta_n+\iota\sin\theta_n)$$
$$=\cos(\theta_1+\theta_2+\ldots+\theta_n)+\iota\sin(\theta_1+\theta_2+\ldots+\theta_n).$$

If $\theta_1=\theta_2=\ldots=\theta_n=\theta$, this equation becomes $(\cos\theta+\iota\sin\theta)^n=\cos n\theta+\iota\sin n\theta$; this shows that $\cos\theta+\iota\sin\theta$ is a value of $(\cos n\theta+\iota\sin n\theta)^{\frac{1}{n}}$. If now we change θ into $\frac{\theta}{n}$, we see that $\cos\frac{\theta}{n}+\iota\sin\frac{\theta}{n}$ is a value of $(\cos\theta+\iota\sin\theta)^{\frac{1}{n}}$; raising each of these quantities to any positive integral power m, $\cos\frac{m\theta}{n}+\iota\sin\frac{m\theta}{n}$ is one value of $(\cos\theta+\iota\sin\theta)^{\frac{m}{n}}$. Also

$$\cos\left(-\frac{m}{n}\right)\theta+\iota\sin\left(-\frac{m}{n}\theta\right)=\frac{1}{\cos\frac{m}{n}\theta+\iota\sin\frac{m}{n}\theta};$$

hence the expression of the left-hand-side is one value of $\frac{1}{(\cos\theta+\iota\sin\theta)^{m/n}}$ or of $(\cos\theta+\iota\sin\theta)^{-\frac{m}{n}}$. We have thus De Moivre's theorem that $\cos k\theta+\iota\sin k\theta$ is always one value of $(\cos\theta+\iota\sin\theta)^k$, where k is any real quantity.

The roots of complex quanti

The principal object of De Moivre's theorem is to enable us to find all the values of an expression of the form $(a+\iota b)^{\frac{m}{n}}$, where m and n are positive integers prime to each other. If $a=r\cos\theta$, $b=r\sin\theta$, we require the values of $r^{\frac{m}{n}}(\cos\theta+\iota\sin\theta)^{\frac{m}{n}}$. One value is immediately furnished by the theorem; but we observe that, since the expression $\cos\theta+\iota\sin\theta$ is unaltered by adding any multiple of 2π to θ, the $\frac{n}{m}$th power of $r^{\frac{m}{n}}\left(\cos\frac{m.\overline{\theta+2s\pi}}{n}+\iota\sin\frac{m.\overline{\theta+2s\pi}}{n}\right)$ is $a+\iota b$, if s is any integer; hence this expression is one of the values required. Suppose that for two values s_1 and s_2 of s the values of this expression are the same; then we must have $\frac{m.\overline{\theta+2s_1\pi}}{n}-\frac{m.\overline{\theta+2s_2\pi}}{n}$ a multiple of 2π or s_1-s_2 must be a multiple of n. Therefore, if we give s the values $0, 1, 2, \ldots n-1$ successively, we shall get n different values of $(a+\iota b)^{\frac{m}{n}}$, and these will be repeated if we give s other values: hence all the values of $(a+\iota b)^{\frac{m}{n}}$ are obtained by giving s the values $0, 1, 2, \ldots n-1$ in the expression $r^{\frac{m}{n}}\left(\cos\frac{m.\overline{\theta+2s\pi}}{n}+\iota\sin\frac{m.\overline{\theta+2s\pi}}{n}\right)$, where $r=(a^2+b^2)^{\frac{1}{2}}$ and $\theta=\text{arc}\tan\frac{b}{a}$.

We now return to the geometrical representation of the complex quantities. If the points $B_1, B_2, B_3, \ldots B_n$ represent the expression $x+\iota y, (x+\iota y)^2, (x+\iota y)^3, \ldots (x+\iota y)^n$ respectively, the triangles OAB_1, $OB_1B_2 \ldots OB_{n-1}B_n$ are all similar. Let $(x+\iota y)^n=a+\iota b$, then the converse problem of finding the nth root of $a+\iota b$ is equivalent to the geometrical problem of describing such a series of triangles that OA is the first side of the first triangle and OB_n the second side of the nth. Now it is obvious that this geometrical problem has more solutions than one, since any number of complete revolutions round O may be made in travelling from B_1 to B_n. The first solution is that in which the vertical angle of each triangle is $\frac{1}{n}B_nOA$; the second is that in which each is $\frac{1}{n}(B_nOA+2\pi)$, in this case one complete revolution being made round O; the third

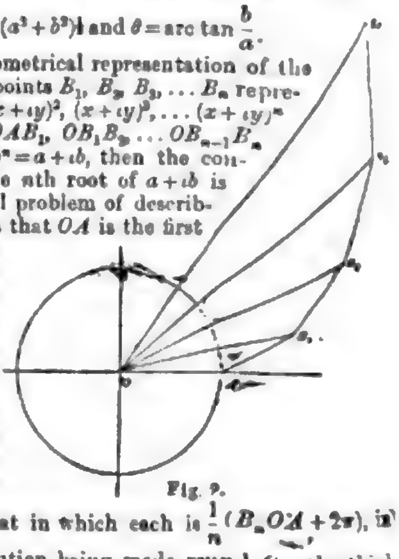


Fig. 9.

has $\frac{1}{n}(B_nOA+4\pi)$ for the vertical angle of each triangle; and so on. There are n sets of triangles which satisfy the required conditions. For simplicity we will take the case of the determination of the values of $(\cos\theta+\iota\sin\theta)^{\frac{1}{3}}$. Suppose B to represent the expression $\cos\theta+\iota\sin\theta$. If the angle AOP_1 is $\frac{1}{3}\theta$, P_1 represents the root $\cos\frac{\theta}{3}+\iota\sin\frac{\theta}{3}$; the angle AOB is filled up by the angles of the three similar triangles AOP_1, P_1Op_1, p_1OB. Also, if P_2, P_3 be such that the angles P_1OP_2, P_1OP_3 are $\frac{2\pi}{3}$, $\frac{4\pi}{3}$ respectively, the two sets of triangles AOP_2, P_2Op_2, p_2OB and AOP_3, P_3Op_3, p_3OB satisfy the conditions of similarity and of having OA, OB for the bounding sides; thus P_2, P_3 represent the roots $\cos\frac{\theta+2\pi}{3}+\iota\sin\frac{\theta+2\pi}{3}$, $\cos\frac{\theta+4\pi}{3}+\iota\sin\frac{\theta+4\pi}{3}$ respectively. If B coincides with A, the problem is reduced to that of finding the three cube roots of unity. One will be represented by A and the others by the two angular points of an equilateral triangle, with A as one angular point, inscribed in the circle.

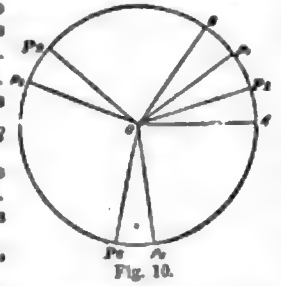


Fig. 10.

The nth roots of unity.

The problem of determining the values of the nth roots of unity is equivalent to the geometrical problem of inscribing a regular polygon of n sides in a circle. Gauss has shown in his *Disquisitiones arithmeticæ* that this can always be done by the compass and ruler only when n is a prime of the form 2^p+1. The determination of the nth root of any complex quantity requires in addition, for its geometrical solution, the division of an angle into n equal parts.

Factorizations.

We are now in a position to factorize an expression of the form $x^n-(a+\iota b)$. Using the values which we have obtained above for $(a+\iota b)^{\frac{1}{n}}$, we have

$$x^n-(a+\iota b)=\overset{s=n-1}{\underset{s=0}{P}}\left[x-r^{\frac{1}{n}}\left(\cos\frac{\theta+2s\pi}{n}+\iota\sin\frac{\theta+2s\pi}{n}\right)\right]\quad\ldots(1).$$

If $b=0$, $a=1$, this becomes

$$x^n-1=\overset{s=n-1}{\underset{s=0}{P}}\left[x-\cos\frac{2s\pi}{n}-\iota\sin\frac{2s\pi}{n}\right]$$

$$=(x-1)(x+1)\overset{s=\frac{n}{2}-1}{\underset{s=1}{P}}\left(x-\cos\frac{2s\pi}{n}\pm\iota\sin\frac{2s\pi}{n}\right)$$

$$=(x-1)(x+1)\overset{s=\frac{n}{2}-1}{\underset{s=1}{P}}\left(x^2-2x\cos\frac{2s\pi}{n}+1\right)(n\text{ even})(2).$$

$$x^n-1=(x-1)\overset{s=\frac{n-1}{2}}{\underset{s=1}{P}}\left(x^2-2x\cos\frac{2s\pi}{n}+1\right)\quad(n\text{ odd})\quad\ldots(3).$$

If in (1) we put $a=-1$, $b=0$, and therefore $\theta=\pi$, we have

$$x^n+1=\overset{s=n-1}{\underset{s=0}{P}}\left[x-\cos\frac{\overline{2s+1}\pi}{n}-\iota\sin\frac{\overline{2s+1}\pi}{n}\right]$$

$$=\overset{s=\frac{n-2}{2}}{\underset{s=0}{P}}\left[x^2-2x\cos\frac{\overline{2s+1}\pi}{n}+1\right]\quad(n\text{ even})\quad\ldots\ldots(4).$$

$$x^n+1=(x+1)\overset{s=\frac{n-3}{2}}{\underset{s=0}{P}}\left[x^2-2x\cos\frac{\overline{2s+1}\pi}{n}+1\right]\quad(n\text{ odd})\ (5).$$

Also $x^{2n}-2x^ny^n\cos n\theta+y^{2n}$

$$=(x^n-y^n\,\overline{\cos n\theta+\iota\sin n\theta})(x^n-y^n\,\overline{\cos n\theta-\iota\sin n\theta})$$

$$=\overset{s=n-1}{\underset{s=0}{P}}\left(x-y\cos\frac{\theta+2s\pi}{n}\pm\iota\sin\frac{\theta+2s\pi}{n}\right)$$

$$=\overset{s=n-1}{\underset{s=0}{P}}\left[x^2-2xy\cos\overline{\theta+\frac{2s\pi}{n}}+y^2\right]\quad\ldots\ldots\ldots\ldots\ldots(6).$$

Airy and Adams have given proofs of this theorem which do not involve the use of the symbol ι (see *Camb. Phil. Trans.*, vol. xi.).

A large number of interesting theorems may be derived from De Moivre's theorem and the factorizations which we have deduced from it; we shall notice one of them.

Example of De Moivre's theorem.

In equation (6) put $y=\frac{1}{x}$, take logarithms, and then differentiate each side with respect to x, and we get

$$\frac{2n(x^{2n-1}-x^{-2n-1})}{x^{2n}-2\cos n\theta+x^{-2n}}=\sum_{s=0}^{s=n-1}\frac{2(x-x^{-3})}{x^2-2\cos\overline{\theta+\frac{2s\pi}{n}}+x^{-2}}$$

Put $x^2=\frac{a}{b}$, then we have the expression

$$\frac{n(a^{2n}-b^{2n})}{(a^2-b^2)(a^{2n}-2a^nb^n\cos n\theta+b^{2n})}$$

for the sum of the series

$$\sum_{s=0}^{s=n-1}\frac{1}{a^2-2ab\cos\overline{\theta+\frac{2s\pi}{n}}+b^2}$$

Complex quantities as exponentials.

We shall now consider what meaning can be assigned to the symbol $e^{x+\iota y}$. The quantity e is defined as the limit of $\left(1+\frac{1}{n}\right)^n$, where n is a positive quantity, and is increased indefinitely; then, for a real value of x, e^x is the limit of $\left(1+\frac{1}{n}\right)^{nx}$ or of $\left(1+\frac{x}{m}\right)^m$, where $m=nx$, when m is increased indefinitely. We may define $e^{x+\iota y}$ as the limit of $\left(1+\frac{x+\iota y}{m}\right)^m$ when m is increased indefinitely. To determine the value of this limit put $1+\frac{x}{m}=r\cos\theta$, $\frac{y}{m}=r\sin\theta$; then $e^{x+\iota y}$ is the limit of $r^m(\cos m\theta+\iota\sin m\theta)$, and r^m is equal to $\left\{1+\frac{2x}{m}+\frac{x^2+y^2}{m^2}\right\}^{\frac{m}{2}}$ or ultimately to $\left(1+\frac{2x}{n}\right)^{\frac{m}{2}}$, which has e^x for its limiting value. Also θ is arc tan $\frac{y}{x+m}$ or $\frac{y}{x+m}$ in the limit; hence $m\theta$ is ultimately equal to y, and thus the equation $e^{x+\iota y}=e^x(\cos y+\iota\sin y)$ follows from our definition. It may be shown at once that $e^{x+\iota y}\times e^{x_1+\iota y_1}=e^{x+x_1+\iota(y+y_1)}$, and, if we suppose that $a^{x+\iota y}$ denotes $e^{(x+\iota y)\log a}$, we may show that complex exponents defined thus obey the same laws as real ones.

Exponential values of sine and cosine.

When the exponent is entirely imaginary we have, in accordance with the above definition,

$$e^{\iota y}=\cos y+\iota\sin y\text{ and }e^{-\iota y}=\cos(-y)+\iota\sin(-y)=\cos y-\iota\sin y;$$

we thus obtain the exponential values of the sine and cosine—

$$\sin y=\frac{1}{2\iota}(e^{\iota y}-e^{-\iota y}),\ \cos y=\frac{1}{2}(e^{\iota y}+e^{-\iota y}).$$

Expansions of sines and cosines and their powers.

If we give imaginary or complex values to the variables in algebraical expansions we obtain analogous trigonometrical theorems; it is, however, necessary to consider the convergency of the series so obtained in order to determine within what limits the values of the variables must lie. If we expand $e^{\iota y}$ and $e^{-\iota y}$ by putting ιy and $-\iota y$ in the series $1+y+\frac{y^2}{1.2}+\frac{y^3}{1.2.3}+\ldots$,

we obtain the series $\sin y=y-\frac{y^3}{\underline{|3}}+\frac{y^5}{\underline{|5}}-\frac{y^7}{\underline{|7}}+\ldots$;

$$\cos y=1-\frac{y^2}{\underline{|2}}+\frac{y^4}{\underline{|4}}-\frac{y^6}{\underline{|6}}+\ldots.$$

These series are convergent for all finite values of y. They may also be got from the expressions which we have obtained for the cosine and sine of a multiple of an angle in terms of the cosine and sine of the angle, and would thus be made to rest upon a basis independent of the symbol ι.

Expansion of powers of sines and cosines in series of sines and cosines of multiple arcs.

Consider the binomial theorem

$$(a+b)^n=a^n+na^{n-1}b+\frac{n(n-1)}{\underline{|2}}a^{n-2}b^2+\ldots$$
$$+\frac{n(n-1)\ldots(n-r+1)}{\underline{|r}}a^{n-r}b^r+\ldots+b^n.$$

Putting $a=e^{\iota\theta}$, $b=e^{-\iota\theta}$, we obtain

$$(2\cos\theta)^n=2\cos n\theta+n2\cos\overline{n-2}\theta+\frac{n(n-1)}{\underline{|2}}2\cos\overline{n-4}\theta+\ldots$$
$$+\frac{n(n-1)\ldots(n-r+1)}{\underline{|r}}\cos(n-2r)\theta+\ldots$$

When n is odd the last term is $2\frac{n(n-1)\ldots\frac{1}{2}(n+3)}{\underline{|\tfrac{1}{2}(n-1)}}\cos\theta$,

and when n is even it is $\frac{n(n-1)\ldots(\frac{1}{2}n+1)}{\underline{|\tfrac{1}{2}n}}$.

If we put $a=e^{\iota\theta}$, $b=-e^{-\iota\theta}$, we obtain the formula

$$(-1)^{\frac{n}{2}}(2\sin\theta)^n=2\cos n\theta-2n\cos(n-2)\theta+\frac{n(n-1)}{1.2}2\cos(n-4)\theta-\ldots$$
$$+(-1)^{n-r}\frac{n(n-1)\ldots(n-r+1)}{\underline{|r}}2\cos(n-2r)\theta\ldots+(-1)^{\frac{n}{2}}\frac{n(n-1)\ldots\frac{1}{2}n+1)}{\underline{|\tfrac{1}{2}n}}$$

when n is even, and

$$(-1)^{\frac{n-1}{2}}(2\sin\theta)^n=2\sin n\theta-n.2\sin(n-2)\theta+\frac{n(n-1)}{1.2}2\sin(n-4)\theta\ldots$$
$$+(-1)^{\frac{n-1}{2}}\frac{n(n-1)\ldots\frac{1}{2}(n+3)}{\underline{|\tfrac{1}{2}(n-1)}}\sin\theta$$

when n is odd. These formulæ enable us to express any positive integral power of the sine or cosine in terms of sines or cosines of multiples of the argument. There are corresponding formulæ when n is not a positive integer.

Expansion of sines and cosines of multiple arcs in powers of sines and cosines of arc.

Consider the identity $\log(1-px)+\log(1-qx)=\log(1-p+qx+pqx^2)$. Expand both sides of this equation in powers of x, and equate the coefficients of x^n, we then get

$$p^n+q^n=(p+q)^n-n(p+q)^{n-2}pq+\frac{n(n-3)}{\underline{|2}}(p+q)^{n-4}p^2q^2+\ldots$$
$$+(-1)^r\frac{n(n-r-1)(n-r-2)\ldots(n-2r+1)}{\underline{|r}}(p+q)^{n-2r}p^rq^r+\ldots$$

If we write this series in the reverse order, we have

$$p^n+q^n=2(-1)^{\frac{n}{2}}\Big[(pq)^{\frac{n}{2}}-\frac{n^2}{\underline{|2}}(pq)^{\frac{n}{2}-1}\Big(\frac{p+q}{2}\Big)^2+\frac{n^2(n^2-2^2)}{\underline{|4}}(pq)^{\frac{n}{2}-2}\Big(\frac{p+q}{2}\Big)^4$$
$$\frac{n^2(n^2-2^2)(n^2-4^2)}{\underline{|6}}(pq)^{\frac{n}{2}-3}\Big(\frac{p+q}{2}\Big)^6+\ldots+(-1)^{\frac{n}{2}}\tfrac{1}{2}(p+q)^n\Big]$$

when n is even, and

$$p^n+q^n=2(-1)^{\frac{n-1}{2}}\Big[n(pq)^{\frac{n-1}{2}}\Big(\frac{p+q}{2}\Big)-\frac{n(n^2-1^2)}{\underline{|3}}(pq)^{\frac{n-3}{2}}\Big(\frac{p+q}{2}\Big)^3$$
$$+\frac{n(n^2-1^2)(n^2-3^2)}{\underline{|5}}(pq)^{\frac{n-5}{2}}\Big(\frac{p+2}{2}\Big)^5+\ldots+(-1)^{\frac{n-1}{2}}\tfrac{1}{2}(p+q)^n\Big]$$

when n is odd. If in these three formulæ we put $p=\epsilon^{\iota\theta}$, $q=\epsilon^{-\iota\theta}$, we obtain the following series for $\cos n\theta$:—

$$2\cos n\theta=(2\cos\theta)^n-n(2\cos\theta)^{n-2}+\frac{n(n-3)}{\underline{|2}}(2\cos\theta)^{n-4}-\ldots$$
$$+(-1)^r\frac{n(n-r-1)(n-r-2)\ldots(n-2r+1)}{\underline{|r}}(2\cos\theta)^{n-2r}+\ldots(7)$$

when n is any positive integer ;

$$(-1)^{\frac{n}{2}}\cos n\theta=1-\frac{n^2}{\underline{|2}}\cos^2\theta+\frac{n^2(n^2-2^2)}{\underline{|4}}\cos^4\theta-\frac{n^2(n^2-2^2)(n^2-4^2)}{\underline{|6}}\cos^6\theta$$
$$+\ldots+(-1)^{\frac{n}{2}}2^{n-1}\cos^n\theta.\ \ldots\ldots\ldots\ldots(8)$$

when n is an even positive integer ;

$$(-1)^{\frac{n-1}{2}}\cos n\theta=n\cos n\theta-\frac{n(n^2-1^2)}{\underline{|3}}\cos^3\theta+\frac{n(n^2-1^2)(n^2-3^2)}{\underline{|5}}\cos^5\theta-$$
$$\ldots+(-1)^{\frac{n-1}{2}}2^{n-1}\cos^n\theta\ \ \ldots\ldots\ldots\ldots(9)$$

when n is odd. If in the same three formulæ we put $p=\epsilon^{\iota\theta}$, $q=-\epsilon^{-\iota\theta}$, we obtain the following four formulæ :—

$$(-1)^{\frac{n}{2}}2\cos n\theta=(2\sin\theta)^n-n(2\sin\theta)^{n-2}+\frac{n(n-3)}{\underline{|2}}(2\sin\theta)^{n-4}-\ldots$$
$$+(-1)^r\frac{n(n-r-1)\ldots(n-2r-1)}{\underline{|r}}(2\sin\theta)^{n-2r}+\ldots(n\text{ even})(10);$$
$$(-1)^{\frac{n-1}{2}}2\sin n\theta=\text{the same series }(n\text{ odd})\ \ldots\ldots\ldots(11);$$
$$\cos n\theta=1-\frac{n^2}{\underline{|2}}\sin^2\theta+\frac{n^2(n^2-2^2)}{\underline{|4}}\sin^4\theta-\frac{n^2(n^2-2^2)(n^2-4^2)}{\underline{|6}}\sin^6\theta$$
$$+\ldots+2^{n-1}\sin^n\theta\ (n\text{ even})\ \ldots\ldots\ldots(12);$$
$$\sin n\theta=n\sin\theta-\frac{n(n^2-1^2)}{\underline{|3}}\sin^3\theta+\frac{n(n^2-1^2)(n^2-3^2)}{\underline{|5}}\sin^5\theta-\ldots$$
$$+(-1)^{\frac{n-1}{2}}2^{n-1}\sin^n\theta\ (n\text{ odd})\ \ldots\ldots\ldots(13).$$

Next consider the identity $\dfrac{p}{1-px}-\dfrac{q}{1-qx}=\dfrac{p-q}{1-(p+q)x+pqx^2}$. Expand both sides of this equation in powers of x, and equate the coefficients of x^{n-1}, then we obtain the equation

$$\frac{p^n-q^n}{p-q}=(p+q)^{n-1}-(n-2)(p+q)^{n-3}pq+\frac{(n-3)(n-4)}{\underline{|2}}(p+q)^{n-5}p^2q^2-\ldots$$
$$+(-1)^r\frac{(n-r-1)(n-r-2)\ldots(n-2r)}{\underline{|r}}(p+q)^{n-2r-1}p^rq^r+\ldots$$

If, as before, we write this in the reverse order, we have the series

$$(-1)^{\frac{n}{2}-1}\Big[n\Big(\frac{p+q}{2}\Big)(pq)^{\frac{n}{2}-1}-\frac{n(n^2-2^2)}{\underline{|3}}\Big(\frac{p+q}{2}\Big)^3(pq)^{\frac{n}{2}-3}$$
$$+\frac{n(n^2-2^2)(n^2-4^2)}{\underline{|5}}\Big(\frac{p+q}{2}\Big)^5(pq)^{\frac{n}{2}-5}+\ldots+(-1)^{\frac{n}{2}-1}(p+q)^{n-1}\Big]$$

when n is even, and

$$(-1)^{\frac{n-1}{2}}\Big[(pq)^{\frac{n-1}{2}}-\frac{n^2-1^2}{\underline{|2}}\Big(\frac{p+q}{2}\Big)^2(pq)^{\frac{n-3}{2}}$$
$$+\frac{(n^2-1^2)(n^2-3^2)}{\underline{|4}}\Big(\frac{p+q}{2}\Big)^4(pq)^{\frac{n-5}{2}}+\ldots+(-1)^{\frac{n-1}{2}}(p+q)^{n-1}\Big]$$

when n is odd.

If we put $p=\epsilon^{\iota\theta}$, $q=\epsilon^{-\iota\theta}$, we obtain the formulæ

$$\sin n\theta=\sin\theta\Big\{(2\cos\theta)^{n-1}-(n-2)(2\cos\theta)^{n-3}+\frac{(n-3)(n-4)}{\underline{|2}}(2\cos\theta)^{n-5}$$
$$+(-1)^r\frac{(n-r-1)(n-r-2)\ldots(n-2r)}{\underline{|r}}(2\cos\theta)^{n-2r-1}+\ldots\Big\}\ (14),$$

where n is any positive integer ;

$$(-1)^{\frac{n}{2}-1}\sin n\theta=\sin\theta\Big\{n\cos\theta-\frac{n(n^2-2^2)}{\underline{|3}}\cos^3\theta+\frac{n(n^2-2^2)(n^2-4^2)}{\underline{|5}}\cos^5\theta-\ldots$$
$$+(-1)^{\frac{n}{2}-1}(2\cos\theta)^{n-1}\Big\}\ (n\text{ even})\ \ldots\ldots\ldots(15);$$
$$(-1)^{\frac{n-1}{2}}\sin n\theta=\sin\theta\Big\{1-\frac{n^2-1^2}{\underline{|2}}\cos^2\theta+\frac{(n^2-1^2)(n^2-3^2)}{\underline{|4}}\cos^4\theta-\ldots$$
$$+(-1)^{\frac{n}{2}-1}(2\cos\theta)^{n-1}\Big\}\ (n\text{ odd})\ldots\ldots\ldots(16).$$

If we put in the same three formulæ $p=\epsilon^{\iota\theta}$, $q=-\epsilon^{-\iota\theta}$, we obtain the series

$$(-1)^{\frac{n-2}{2}}\sin n\theta=\cos\theta\Big[\sin^{n-1}\theta-(n-2)\sin^{n-3}\theta+\frac{(n-3)(n-4)}{\underline{|2}}\sin^{n-5}\theta-\ldots$$
$$+(-1)^r\frac{(n-r-1)(n-r-2)\ldots(n-2r)}{\underline{|r}}\sin^{n-2r-1}\theta+\ldots\Big](n\text{ even})\ (17);$$
$$(-1)^{\frac{n-1}{2}}\cos n\theta=\text{the same series }(n\text{ odd})\ \ldots\ldots(18);$$
$$\sin n\theta=\cos\theta\Big\{n\sin\theta-\frac{n(n^2-2^2)}{\underline{|3}}\sin^3\theta+\frac{n(n^2-2^2)(n^2-4^2)}{\underline{|4}}\sin^5\theta+$$
$$\ldots+(-1)^{\frac{n}{2}-1}(2\sin\theta)^{n-1}\Big\}\ (n\text{ even})\ \ldots\ldots\ldots(19);$$
$$\cos n\theta=\cos\theta\Big\{1-\frac{n^2-1^2}{\underline{|2}}\sin^2\theta+\frac{(n^2-1^2)(n^2-3^2)}{\underline{|4}}\sin^4\theta-\ldots$$
$$+(2\sin\theta)^{n-1}\Big\}\ (n\text{ odd})\ \ldots\ldots\ldots(20).$$

We have thus obtained formulæ for $\cos n\theta$ and $\sin n\theta$ both in ascending and in descending powers of $\cos\theta$ and $\sin\theta$. Viète obtained formulæ for chords of multiple arcs in powers of chords of the simple or complementary arcs equivalent to the formulæ (13) and (19) above. These are contained in his work *Theoremata ad angulares sectiones.* James Bernoulli found formulæ equivalent to (12) and (13) (*Mém. de l'Académie des Sciences*, 1702), and transformed these series into a form equivalent to (10) and (11). John Bernoulli published in the *Acta eruditorum* for 1701, among other formulæ already found by Viète, one equivalent to (17). These formulæ have been extended to cases in which n is fractional, negative, or irrational ; see a paper by D. F. Gregory in *Camb. Math. Journ.*, vol. iv., in which the series for $\cos n\theta$, $\sin n\theta$ in ascending powers of $\cos\theta$ and $\sin\theta$ are extended to the case of a fractional value of n. These series have been considered by Euler in a memoir in the *Nova acta*, vol. ix., by Lagrange in his *Calcul des fonctions* (1806), and by Poinsot in *Recherches sur l'analyse des sections angulaires* (1825).

The of b rith

The general definition of Napierian logarithms is that, if $\epsilon^{x+\iota y}=a+\iota b$, then $x+\iota y=\log(a+\iota b)$. Now we know that $\epsilon^{x+\iota y}=\epsilon^x\cos y+\iota\epsilon^x\sin y$; hence $\epsilon^x\cos y=a$, $\epsilon^x\sin y=b$, or $\epsilon^x=(a^2+b^2)^{\frac{1}{2}}$, $y=\text{arc tan}\,\frac{b}{a}\pm m\pi$, where m is an integer. If $b=0$, then m must be even or odd according as a is positive or negative ; hence

$$\log_e(a+\iota b)=\log_e(a^2+b^2)^{\frac{1}{2}}+\iota\Big(\text{arc tan}\,\frac{b}{a}\pm 2n\pi\Big)$$

or

$$\log_e(a+\iota b)=\log_e(a^2+b^2)^{\frac{1}{2}}+\iota\Big(\text{arc tan}\,\frac{b}{a}\pm\overline{2n+\pi}\Big),$$

according as a is positive or negative. Thus the logarithm of any complex or real quantity is a multiple-valued function, the difference between successive values being $2\pi\iota$; in particular, the most general form of the logarithm of a real positive quantity is obtained by adding positive or negative multiples of $2\pi\iota$ to the arithmetical logarithm. On this subject, see De Morgan's *Trigonometry and Double Algebra*, chap. iv., and a paper by Prof. Cayley in vol. ii. of *Proc. London Math. Soc.*

Hy bol trig met

We may suppose the exponential values of the sine and cosine extended to the case of complex arguments; thus we accept $\dfrac{\epsilon^{\iota(x+\iota y)}+\epsilon^{-\iota(x+\iota y)}}{2}$ and $\dfrac{\epsilon^{\iota(x+\iota y)}-\epsilon^{-\iota(x+\iota y)}}{2\iota}$ as the definitions of the functions $\cos(x+\iota y)$, $\sin(x+\iota y)$ respectively. If $x=0$, we have $\cos\iota y=\dfrac{\epsilon^y+\epsilon^{-y}}{2}$ and $\sin\iota y=\frac{\iota}{2}(\epsilon^y-\epsilon^{-y})$. The quantities $\dfrac{\epsilon^y+\epsilon^{-y}}{2}$, $\dfrac{\epsilon^y-\epsilon^{-y}}{2}$ are called the hyperbolic cosine and sine of y and are written $\cosh y$, $\sinh y$; thus $\cosh y=\cos\iota y$, $\sinh y=-\iota\sin\iota y$. The functions $\cosh y$, $\sinh y$ are connected with the rectangular hyperbola in a manner analogous to that in which the cosine and sine are connected with the circle. We may easily show from the definitions that

$$\cos^2(x+\iota y)+\sin^2(x+\iota y)=1,$$
$$\cosh^2 y-\sinh^2 y=1\,;$$
$$\cos(x+\iota y)=\cos x\cosh y-\iota\sin x\sinh y,$$
$$\sin(x+\iota y)=\sin x\cosh y+\iota\cos x\sinh y,$$
$$\cosh(\alpha+\beta)=\cosh\alpha\cosh\beta+\sinh\alpha\sinh\beta,$$
$$\sinh(\alpha+\beta)=\sinh\alpha\cosh\beta-\cosh\alpha\sinh\beta.$$

These formulæ are the basis of a complete hyperbolic trigonometry. The connexion of these functions with the hyperbola was first pointed out by Lambert.

Expansion of an angle in powers of its sine.

If we equate the coefficients of n on both sides of equation (13), we get

$$\theta=\sin\theta+\frac{1}{2}\frac{\sin^3\theta}{3}+\frac{1.3}{2.4}\frac{\sin^5\theta}{5}+\frac{1.3.5}{2.4.6}\frac{\sin^7\theta}{7}+\ldots\ldots(21)\,;$$

θ must lie between the values $\pm\frac{\pi}{2}$. This equation may also be written in the form

$$\text{arc}\sin x=x+\frac{1}{2}\frac{x^3}{3}+\frac{1.3}{2.4}\frac{x^5}{5}+\frac{1.3.5}{2.4.6}\frac{x^7}{7}+\ldots$$

when x lies between ± 1.

By equating the coefficients of n^2 on both sides of equation (12) we get

$$\theta^2=\sin^2\theta+\frac{2}{3}\frac{\sin^4\theta}{2}+\frac{2.4}{3.5}\frac{\sin^6\theta}{3}+\frac{2.4.6}{3.5.7}\frac{\sin^8\theta}{4}+\ldots\ldots(22),$$

which may also be written in the form

$$(\text{arc}\sin x)^2=x^2+\frac{2}{3}\frac{x^4}{2}+\frac{2.4}{3.5}\frac{x^6}{3}+\frac{2.4.6}{3.5.7}\frac{x^8}{4}+\ldots$$

when x is between ± 1. Differentiating this equation with regard to x, we get

$$\frac{\text{arc}\sin x}{\sqrt{1-x^2}}=x+\frac{2}{3}x^3+\frac{2.4}{3.5}x^5+\frac{2.4.6}{3.5.7}x^7+\ldots\,;$$

if we put arc sin x = arc tan y, this equation becomes

$$\text{arc}\tan y=\frac{y}{1+y^2}\left\{1+\frac{2}{3}\frac{y^2}{1+y^2}+\frac{2.4}{3.5}\left(\frac{y^2}{1+y^2}\right)^2+\ldots\right\}\quad(23).$$

This equation was given with two proofs by Euler in the *Nova acta* for 1793.

Gregory's series.

We have $\frac{1}{2}\log\frac{1+x}{1-x}=x+\frac{x^3}{3}+\frac{x^5}{5}+\frac{x^7}{7}+\ldots\,;$

put ιy for x, the left side then becomes $\frac{1}{2}\{\log(1+\iota y)-\log(1-\iota y)\}$ or ι arc tan $y\pm\iota n\pi$;

hence $$\text{arc}\tan y\pm n\pi=y-\frac{y^3}{3}+\frac{y^5}{5}-\frac{y^7}{7}+\ldots.$$

The series is convergent if y lies between ± 1 ; if we suppose arc tan y restricted to values between $\pm\frac{\pi}{4}$, we have

$$\text{arc}\tan y=y-\frac{y^3}{3}+\frac{y^5}{5}-\ldots\quad\ldots\ldots\ldots\ldots(24),$$

which is Gregory's series.

Series for calculation of π.

Various series derived from (24) have been employed to calculate the value of π. At the end of the 17th century π was calculated to 72 places of decimals by Abraham Sharp, by means of the series obtained by putting arc tan $y=\frac{\pi}{6}$, $y=\frac{1}{\sqrt{3}}$ in (24). The calculation is to be found in Sherwin's *Mathematical Tables* (1742). About the same time Machin employed the series obtained from the equation 4 arc tan $\frac{1}{5}$ − arc tan $\frac{1}{239}=\frac{\pi}{4}$ to calculate π to 100 decimal places. Long afterwards Euler employed the series obtained from $\frac{\pi}{4}$ = arc tan $\frac{1}{2}$ + arc tan $\frac{1}{3}$, which, however, gives less rapidly converging series (Introd., *Anal. infin.*, vol. i.). Lagny employed the formula arc tan $\frac{1}{\sqrt{3}}=\frac{\pi}{6}$ to calculate π to 127 places ; the result was communicated to the Paris Academy in 1719. Vega calculated π to 140 decimal places by means of the series obtained from the equation $\frac{\pi}{4}=5$ arc tan $\frac{1}{7}+2$ arc tan $\frac{3}{10}$. The formula $\frac{\pi}{4}$ = arc tan $\frac{1}{2}$ + arc tan $\frac{1}{5}$ + arc tan $\frac{1}{8}$ was used by Dase to calculate π to 200 decimal places. Rutherford used the equation $\pi=4$ arc tan $\frac{1}{5}$ − arc tan $\frac{1}{70}$ + arc tan $\frac{1}{99}$.

If in (23) we put $y=\frac{1}{3}$ and $\frac{1}{7}$, we have

$$\pi=8\,\text{arc}\tan\frac{1}{3}+4\,\text{arc}\tan\frac{1}{7}=2{\cdot}4\left\{1+\frac{2}{3}\cdot\frac{1}{10}+\frac{2.4}{3.5}\frac{1}{10^2}+\ldots\right\}$$
$$+{\cdot}56\left\{1+\frac{2}{3}\cdot\frac{2}{100}+\frac{2.4}{3.5}\left(\frac{2}{100}\right)^2+\ldots\right\},$$

a rapidly convergent series for π which was first given by Hutton in *Phil. Trans.* for 1776, and afterwards by Euler in *Nova acta* for 1793. Euler gives an equation deduced in the same manner from the identity $\pi=20$ arc tan $\frac{1}{7}+8$ arc tan $\frac{3}{79}$. The calculation of π has been carried out to 707 places of decimals : see *Proc. Roy. Soc.*, xxi. and xxii. ; also SQUARING THE CIRCLE (vol. xxii. p. 435 *sq.*).

Factorization of sine and cosine.

We shall now obtain expressions for $\sin x$ and $\cos x$ as infinite products of rational factors. We have

$$\sin x=2\sin\frac{x}{2}\sin\frac{x+\pi}{2}=2^3\sin\frac{x}{4}\sin\frac{x+\pi}{4}\sin\frac{x+2\pi}{4}\sin\frac{x+3\pi}{4}\,;$$

proceeding continually in this way with each factor, we obtain

$$\sin x=2^{n-1}\sin\frac{x}{n}\sin\frac{x+\pi}{n}\sin\frac{x+2\pi}{n}\ldots\sin\frac{x+\overline{n-1}\pi}{n},$$

where n is any positive integral power of 2. Now

$$\sin\frac{x+r\pi}{n}\sin\frac{x+\overline{n-r}\pi}{n}=\sin\frac{x+r\pi}{n}\sin\frac{r\pi-x}{n}=\sin^2\frac{r\pi}{n}-\sin^2\frac{x}{n},$$

and $$\sin\frac{x+\frac{1}{2}n\pi}{n}=\cos\frac{x}{n}.$$

Hence the above may be written

$$\sin x=2^{n-1}\sin\frac{x}{n}\left(\sin^2\frac{\pi}{n}-\sin^2\frac{x}{n}\right)\left(\sin^2\frac{2\pi}{n}-\sin^2\frac{x}{n}\right)\ldots$$
$$\left(\sin^2\frac{k\pi}{n}-\sin^2\frac{x}{n}\right)\cos\frac{x}{n},$$

where $k=\frac{1}{2}n-1$. Let x be indefinitely small, then we have

$$1=\frac{2^{n-1}}{n}\sin^2\frac{\pi}{n}\sin^2\frac{2\pi}{n}\ldots\sin^2\frac{k\pi}{n}\,;$$

hence

$$\sin x=n\sin\frac{x}{n}\cos\frac{x}{n}\left(1-\frac{\sin^2 x/n}{\sin^2\pi/n}\right)\left(1-\frac{\sin^2 x/n}{\sin^2 2\pi/n}\right)\ldots\left(1-\frac{\sin^2 x/n}{\sin^2 k\pi/n}\right).$$

We may write this

$$\sin x=n\sin\frac{x}{n}\cos\frac{x}{n}\left(1-\frac{\sin^2 x/n}{\sin^2\pi/n}\right)\ldots\left(1-\frac{\sin^2 x/n}{\sin^2 m\pi/n}\right)R,$$

where R denotes the product

$$\left(1-\frac{\sin^2\frac{x}{n}}{\sin^2\frac{\overline{m+1}\pi}{n}}\right)\left(1-\frac{\sin^2\frac{x}{n}}{\sin^2\frac{\overline{m+2}\pi}{n}}\right)\ldots\left(1-\frac{\sin^2\frac{x}{n}}{\sin^2\frac{k\pi}{n}}\right),$$

and m is any fixed integer independent of n. It is necessary, when we make n infinite, to determine the limiting value of the quantity R ; then, since the limit of $\frac{\sin x}{n\sin\frac{x}{n}\cos\frac{x}{n}}$ is $\frac{\sin x}{x}$, and that of $\frac{\sin m\pi/n}{m\pi/n}$ is unity, we have

$$\frac{\sin x}{x}=\left(1-\frac{x^2}{\pi^2}\right)\left(1-\frac{x^2}{2^2\pi^2}\right)\ldots\left(1-\frac{x^2}{m^2\pi^2}\right)R.$$

Now R is less than unity, since $\sin\frac{x}{n}$ is less than $\sin\frac{\overline{m+1}\pi}{n}$, $\sin\frac{\overline{m+2}\pi}{n}$ … ; also by an elementary algebraical proposition R is greater than $1-\sin^2\frac{x}{n}\left(\text{cosec}^2\frac{\overline{m+1}\pi}{n}+\ldots+\text{cosec}^2\frac{k\pi}{n}\right)$ and $\text{cosec}\,\theta<\frac{\pi}{2\theta}$, if $\theta<\frac{\pi}{2}$; R is therefore greater than

$$1-\frac{x^2}{4}\left(\frac{1}{\overline{m+1}|^2}+\frac{1}{\overline{m+2}|^2}+\ldots+\frac{1}{k^2}\right),$$

or than $$1-\frac{x^2}{4}\left\{\frac{1}{m}-\frac{1}{m+1}+\frac{1}{m+1}-\frac{1}{m+2}+\ldots+\frac{1}{k-1}-\frac{1}{k}\right\},$$

or than $1-\frac{x^2}{4m}$. Hence $R=1-\frac{\theta x^2}{4m}$, where θ is some proper fraction ; whence

$$\sin x=x\left(1-\frac{x^2}{\pi^2}\right)\left(1-\frac{x^2}{2^2\pi^2}\right)\ldots\left(1-\frac{x^2}{m^2\pi^2}\right)\left(1-\frac{\theta x^2}{4m}\right).$$

When m is indefinitely increased this becomes

$$\sin x=x\left(1-\frac{x^2}{\pi^2}\right)\left(1-\frac{x^2}{2^2\pi^2}\right)\ldots=x\underset{n=-\infty}{\overset{n=+\infty}{P}}\left(1+\frac{x}{n\pi}\right)\quad(25).$$

The expression for $\cos x$ in factors may be found in a similar manner by means of the equation $\cos x=2\sin\frac{\pi-2x}{4}\cos\frac{3\pi-2x}{4}$, or may be deduced thus

$$\cos x=\frac{\sin 2x}{2\sin x}=\frac{P\left(1-\frac{4x^2}{n^2\pi^2}\right)}{P\left(1-\frac{x^2}{n^2\pi^2}\right)}=\left(1-\frac{4x^2}{\pi^2}\right)\left(1-\frac{4x^2}{3^2\pi^2}\right)\left(1-\frac{4x^2}{5^2\pi^2}\right)\ldots$$
$$=\underset{n=-\infty}{\overset{n=+\infty}{P}}\left(1+\frac{2x}{\overline{2n+1}\pi}\right)\quad\ldots\ldots\ldots\ldots\ldots(26).$$

If we change x into ιx, we have the formulæ for $\sinh x$, $\cosh x$ as infinite products—

$$\sinh x=x\underset{n=0}{\overset{n=\infty}{P}}\left(1+\frac{x^2}{n^2\pi^2}\right),\ \cosh x=\underset{n=0}{\overset{n=\infty}{P}}\left(1+\frac{4x^2}{\overline{2n+1}|^2\pi^2}\right).$$

In the formula for $\sin x$ as an infinite product put $x=\frac{\pi}{2}$, we then get $1=\frac{\pi}{2}\cdot\frac{1.3.3.5.5\ldots}{2.2.4.4.6\ldots}$; if we stop after $2n$ factors in the numerator and denominator, we obtain the approximate equation

$$1=\frac{\pi}{2}\,\frac{1^2.3^2.5^2\ldots(2n-1)^2}{2^2.4^2.6^2\ldots(2n)^2}\cdot(2n+1)$$

or $\frac{2.4.6\dots 2n}{1.3.5\dots 2n-1}=\sqrt{n\pi}$, where n is a large integer. This expression was obtained in a quite different manner by Wallis (*Arithmetica infinitorum*, vol. i. of *Opp.*).

Series for cot, cosec, tan, and sec.

We have

$$\frac{\sin(x+y)}{\sin x}=\frac{(x+y)P\left(1+\frac{x+y}{n\pi}\right)}{xP\left(1+\frac{x}{n\pi}\right)},$$

or $\cos y+\sin y\cot x$

$$=\left(1+\frac{y}{x}\right)\left(1+\frac{y}{x+\pi}\right)\left(1+\frac{y}{x-\pi}\right)\left(1+\frac{y}{x+2\pi}\right)\left(1+\frac{y}{x-2\pi}\right)\dots$$

Equating the coefficients of the first power of y on both sides we obtain the series

$$\cot x=\frac{1}{x}+\frac{1}{x+\pi}+\frac{1}{x-\pi}+\frac{1}{x+2\pi}+\frac{1}{x-2\pi}+\dots\quad\dots\dots(27).$$

From this we may deduce a corresponding series for $\operatorname{cosec} x$, for, since $\operatorname{cosec} x=\cot\frac{x}{2}-\cot x$, we obtain

$$\operatorname{cosec} x=\frac{1}{x}-\frac{1}{x+\pi}-\frac{1}{x-\pi}+\frac{1}{x+2\pi}+\frac{1}{x-2\pi}-\frac{1}{x+3\pi}-\frac{1}{x-3\pi}+\dots(28).$$

By resolving $\frac{\cos(x+y)}{\cos x}$ into factors we should obtain in a similar manner the series

$$\tan x=\frac{2}{\pi-2x}-\frac{2}{\pi+2x}+\frac{2}{3\pi-2x}-\frac{2}{3\pi+2x}+\frac{2}{5\pi-2x}-\frac{2}{5\pi+2x}+\dots(29),$$

and thence

$$\sec x=\tan\left(\frac{\pi}{4}+\frac{x}{2}\right)-\tan x=\frac{2}{\pi-2x}+\frac{2}{\pi+2x}-\frac{2}{3\pi-2x}-\frac{2}{3\pi+2x}+\dots\quad\dots\dots\dots(30).$$

These four formulæ may also be derived from the product formulæ for $\sin x$ and $\cos x$ by taking logarithms and then differentiating. Glaisher has proved them by resolving the expressions for $\frac{\cos x}{\sin x}$ and $\frac{1}{\sin x}\dots$ as products into partial fractions (see *Quart. Journ. Math.*, vol. xvii.). The series for $\cot x$ may also be obtained by a continued use of the equation $\cot x=\frac{1}{2}\left(\cot\frac{x}{2}+\cot\frac{x+\pi}{2}\right)$ (see a paper by Dr Schröter in Schlömilch's *Zeitschrift*, vol. xiii.).

Series for π derived from series for cot and cosec.

Various series for π may be derived from the series (27), (28), (29), (30), and from the series obtained by differentiating them one or more times. For example, in the formulæ (27) and (28), by putting $x=\frac{\pi}{n}$ we get

$$\pi=n\tan\frac{\pi}{n}\left\{1-\frac{1}{n-1}+\frac{1}{n+1}-\frac{1}{2n-1}+\frac{1}{2n+1}\dots\right\},$$

$$\pi=n\sin\frac{\pi}{n}\left\{1+\frac{1}{n-1}-\frac{1}{n+1}-\frac{1}{2n-1}+\frac{1}{2n+1}\dots\right\};$$

if we put $n=3$, these become

$$\pi=3\sqrt{3}\left(1-\frac{1}{2}+\frac{1}{4}-\frac{1}{5}+\frac{1}{7}-\frac{1}{8}+\dots\right),$$

$$\pi=\frac{3\sqrt{3}}{2}\left(1+\frac{1}{2}-\frac{1}{4}-\frac{1}{5}+\frac{1}{7}+\frac{1}{8}\dots\right).$$

By differentiating (27) we get

$$\operatorname{cosec}^2 x=\frac{1}{x^2}+\frac{1}{(x+\pi)^2}+\frac{1}{(x-\pi)^2}+\frac{1}{(x-2\pi)^2}+\frac{1}{(x-2\pi)^2}+\dots;$$

put $x=\frac{\pi}{6}$, and we get $\pi^2=9\left\{1+\frac{1}{5^2}+\frac{1}{7^2}+\frac{1}{11^2}+\dots\right\}$.

These series, among others, were given by Glaisher (*Quart. Journ. Math.*, vol. xii.).

Sums of certain series.

We have $\sinh\pi x=\pi xP\left(1+\frac{x^2}{n^2}\right)$, $\cosh\pi x=P\left(1+\frac{x^2}{\overline{2n+1}|^2}\right)$; if we differentiate these formulæ after taking logarithms, we obtain the series

$$\frac{\pi}{2x}\coth\pi x-\frac{1}{2x^2}=\frac{1}{1^2+x^2}+\frac{1}{2^2+x^2}+\frac{1}{3^2+x^2}+\dots,$$

$$\frac{\pi}{2x}\tanh\pi x=\frac{1}{1^2+x^2}+\frac{1}{3^2+x^2}+\frac{1}{5^2+x^2}+\dots$$

These series were given by Kummer (in *Crelle's Journ.* vol. xvii.). The sum of the more general series $\frac{1}{1^{2n}+x^{2n}}+\frac{1}{2^{2n}+x^{2n}}+\frac{1}{3^{2n}+x^{2n}}+\dots$, has been found by Glaisher (*Proc. Lond. Math. Soc.*, vol. vii.).

Certain series for sine and cosine.

If in the series (12) and (13) we put $n=2x$, $\theta=\frac{\pi}{6}$, we get

$$\cos\frac{\pi x}{3}=1-\frac{x^2}{|\underline{2}}+\frac{x^2(x^2-1^2)}{|\underline{4}}-\frac{x^2(x^2-1^2)(x^2-2^2)}{|\underline{6}}+\dots$$

$$\sin\frac{\pi x}{3}=\sqrt{3}\left\{x-\frac{x(x^2-1)}{|\underline{3}}+\frac{x(x^2-1^2)(x^2-2^2)}{|\underline{5}}\dots\right\}.$$

These series were given by Schellbach (in *Crelle's Journ.*, vol. xlviii.).

If in the same series (12), (13) we put $\theta=\frac{\pi}{2}$, $n=\frac{2x}{\pi}$, we get

$$\cos x=1-\frac{4x^2}{1.2\pi^2}+\frac{4x^2(4x^2-2^2\pi^2)}{1.2.3.4\pi^4}-\frac{4x^2(4x^2-2^2\pi^2)(4x^2-4^2\pi^2)}{1.2.3.4.5.6\pi^6}+\dots,$$

$$\sin x=\frac{2x}{\pi}-\frac{2x(4x^2-\pi^2)}{1.2.3\pi^3}+\frac{2x(4x^2-\pi^2)(4x^2-3^2\pi^2)}{1.2.3.4.5\pi^5}-\dots$$

We have of course assumed the legitimacy of the substitutions made. These last series have been discussed by M. David (*Bull. Soc. Math. de France*, vol. xi.) and Glaisher (*Mess. of Math.*, vol. vii.).

Sums of powers of reciprocals of natural numbers.

If U_m denotes the sum of the series $\frac{1}{1^m}+\frac{1}{2^m}+\frac{1}{3^m}+\dots$, V_m that of the series $\frac{1}{1^m}+\frac{1}{3^m}+\frac{1}{5^m}+\dots$, and W_m that of the series $\frac{1}{1^m}-\frac{1}{3^m}+\frac{1}{5^m}-\frac{1}{7^m}+\dots$, we obtain by taking logarithms in the formulæ (25) and (26)

$$\log(x\operatorname{cosec} x)=U_2\left(\frac{x}{\pi}\right)^2+\frac{1}{2}U_4\left(\frac{x}{\pi}\right)^4+\frac{1}{3}U_6\left(\frac{x}{\pi}\right)^6+\dots,$$

$$\log(\sec x)=V_2\left(\frac{2x}{\pi}\right)^2+\frac{1}{2}V_4\left(\frac{2x}{\pi}\right)^4+\frac{1}{3}V_6\left(\frac{2x}{\pi}\right)^6+\dots;$$

and differentiating these series we get

$$\frac{1}{2}\cot x=\frac{1}{2x}-\frac{U_2}{\pi^2}x-\frac{U_4}{\pi^4}x^3-\frac{U_6}{\pi^6}x^5-\dots\dots\dots\dots(31),$$

$$\frac{1}{2}\tan x=\frac{V_2}{\pi^2}2^2x+\frac{V_4}{\pi^4}2^4x^3+\frac{V^6}{\pi_6}2^6x^5+\dots\dots\dots(32).$$

In (31) x must lie between $\pm\pi$ and in (32) between $\pm\frac{1}{2}\pi$. Write equation (30) in the form

$$\sec x=\Sigma(-1)^n\frac{(2n+1)\pi}{\left(\overline{2n+1}\frac{\pi}{2}\right)^2-x^2},$$

and expand each term of this series in powers of x^2, then we get

$$\sec x=\frac{2^2W_1}{\pi}+\frac{2^4W_3x^2}{\pi^3}+\frac{2^6W_5x^4}{\pi^5}+\dots\quad\dots\dots\dots(33),$$

where x must lie between $\pm\frac{1}{2}\pi$. By comparing the series (31), (32), (33) with the expansions of $\cot x$, $\tan x$, $\sec x$ obtained otherwise, we can calculate the values of U_2, $U_4\dots V_2$, $V_4\dots$, and W_1, $W_3\dots$. When U_n has been found, V_n may be obtained from the formula $2^nV_n=(2^n-1)U_n$.

Continued factors for π.

For Lord Brounker's series of π, see SQUARING THE CIRCLE (vol. xxii. p. 435). It can be got at once by putting $a=1$, $b=3$, $c=5\dots$ in Euler's theorem $=\frac{1}{a}-\frac{1}{b}+\frac{1}{c}-\dots=\frac{1}{a+}\,\frac{a^2}{b-a+}\,\frac{b^2}{c-b+}\dots$

Sylvester gave (*Phil. Mag.*, 1869) the continued fraction

$$\frac{\pi}{2}=1+\frac{1}{1+}\,\frac{1.2}{1+}\,\frac{2.3}{1+}\,\frac{3.4}{1+}\dots,$$

which is equivalent to Wallis's formula for π. This fraction was originally given by Euler (*Comm. Acad. Petropol.*, vol. xi.); it is also given by Stern (in *Crelle's Journ.*, vol. x.).

Continued fractions for trigonometrical functions.

It may be shown by means of a transformation of the series for $\cos x$ and $\frac{\sin x}{x}$ that $\tan x=\frac{x}{1-}\,\frac{x^2}{3-}\,\frac{x^2}{5-}\,\frac{x^2}{7-}\dots$ This may be also easily shown as follows. Let $y=\cos\sqrt{x}$, and let y', $y''\dots$ denote the differential coefficients of y with regard to x, then by forming these we can show that $4xy''+2y'+y=0$, and thence by Leibnitz's theorem we have

$$4xy^{(n+2)}+(4n+2)y^{(n+1)}+y^{(n)}=0.$$

Therefore $\frac{y}{y'}=-2-\frac{4x}{y'/y''}$, $\frac{y^{(n)}}{y^{(n+1)}}=-2(2n+1)-\frac{4x}{y^{(n+1)}/y^{(n+2)}}$;

hence $-2\sqrt{x}\cot\sqrt{x}=-2-\frac{4x}{-6-}\,\frac{4x}{-10-}\,\frac{4x}{-14-}\dots$

Replacing $\sqrt{x}$ by x we have $\tan x=\frac{x}{1-}\,\frac{x^2}{3-}\,\frac{x^2}{5-}\dots$

Euler gave the continued fraction

$$\tan nx=\frac{n\tan x}{1-}\,\frac{(n^2-1)\tan^2x}{3-}\,\frac{(n^2-4)\tan^2x}{5-}\,\frac{(n^2-9)\tan^2x}{7-}\dots;$$

this was published in *Mém. de l'Acad. de St Pétersb.*, vol. vi. Glaisher has remarked (*Mess. of Math.*, vol. iv.) that this may be derived by forming the differential equation

$$(1-x^2)y^{(m+2)}-(2m+1)xy^{(m+1)}+(n^2-m^2)y^{(m)}=0,$$

where $y=\cos(n\operatorname{arc}\cos x)$, then replacing x by $\cos x$, and proceeding as in the former case. If we put $n=0$, this becomes

$$x=\frac{\tan x}{1+}\,\frac{\tan^2x}{3+}\,\frac{4\tan^2x}{5+}\,\frac{9\tan^2x}{7+}\dots$$

whence we have

$$\operatorname{arc}\tan x=\frac{x}{1+}\,\frac{x^2}{3+}\,\frac{4x^2}{5+}\,\frac{9x^2}{7+}\dots+\frac{n^2x^2}{2n+1+}\dots$$

It is possible to make the investigation of the properties of the simple circular functions rest on a purely analytical basis. The sine of x would be defined as a function such that, if $x=\int_0^y \frac{dy}{\sqrt{1-y^2}}$, then $y=\sin x$; the quantity $\frac{\pi}{2}$ would be defined to be the complete integral $\int_0^1 \frac{dy}{\sqrt{1-y^2}}$. We should then have $\frac{\pi}{2}-x=\int_y^1 \frac{dy}{\sqrt{1-y^2}}$. Now change the variable in the integral to z, where $y^2+z^2=1$, we then have $\frac{\pi}{2}-x=\int_0^z \frac{dz}{\sqrt{1-z^2}}$, and z must be defined as the cosine of x, and is thus equal to $\sin\left(\frac{\pi}{2}-x\right)$, satisfying the equation $\sin^2 x+\cos^2 x=1$.

Next consider the differential equation

$$\frac{dy}{\sqrt{1-y^2}}+\frac{dz}{\sqrt{1-z^2}}=0.$$

This is equivalent to

$$d(y\sqrt{1-z^2}+z\sqrt{1-y^2})=0\,;$$

hence the integral is

$$y\sqrt{1-z^2}+z\sqrt{1-y^2}=\text{a constant}.$$

The constant will be equal to the value u of y when $z=0$; whence

$$y\sqrt{1-z^2}+z\sqrt{1-y^2}=u.$$

The integral may also be obtained in the form

$$yz-\sqrt{1-y^2}\sqrt{1-z^2}=\sqrt{1-u^2}.$$

Let $\alpha=\int_0^y \frac{dy}{\sqrt{1-y^2}}$, $\beta=\int_0^z \frac{dz}{\sqrt{1-z^2}}$, $\gamma=\int_0^u \frac{du}{\sqrt{1-u^2}}$;

we have $\alpha+\beta=\gamma$, and

$$\sin\gamma=\sin\alpha\cos\beta+\cos\alpha\sin\beta,$$
$$\cos\gamma=\cos\alpha\cos\beta-\sin\alpha\sin\beta,$$

the addition theorems. By means of the addition theorems and the values $\sin\frac{\pi}{2}=1$, $\cos\frac{\pi}{2}=0$ we can prove that $\sin\left(\frac{\pi}{2}+x\right)=\cos x$, $\cos\left(\frac{\pi}{2}+x\right)=-\sin x$; and thence by another use of the addition theorems that $\sin(\pi+x)=-\sin x \cos(\pi+x)=-\cos x$, from which the periodicity of the functions $\sin x$, $\cos x$ follows.

We have also $\int\frac{dy}{\sqrt{1-y^2}}=-\iota\log_e(\sqrt{1-y^2}+\iota y)$;

whence $\log_e(\sqrt{1-y^2}+\iota y)+\log_e(\sqrt{1-z^2}+\iota z)=\text{a constant}$.

Therefore $(\sqrt{1-y^2}+\iota y)(\sqrt{1-z^2}+\iota z)=\sqrt{1-u^2}+\iota u$,

since $u=y$ when $z=0$; whence we have the equation

$$(\cos\alpha+\iota\sin\alpha)(\cos\beta+\iota\sin\beta)=\cos(\alpha+\beta)+\iota\sin(\alpha+\beta),$$

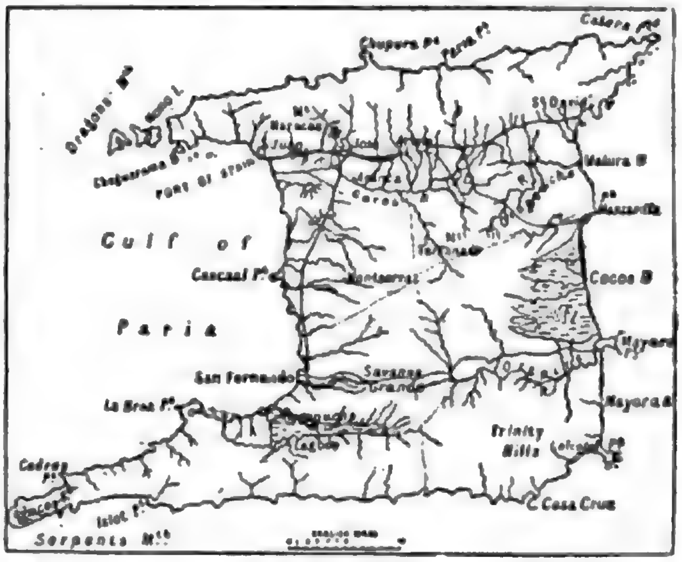
from which De Moivre's theorem follows. (E. W. H.)

TRILOBITES. See CRUSTACEA, vol. vi. p. 659 *sq.*

TRINCOMALEE, a town and naval station in the island of Ceylon, is situated on the north-east coast—which is bold, rocky, and picturesquely wooded—by road 113 miles north-north-east of Kandy, in 8° 33″ 30″ N. lat. and 81° 13′ 10″ E. long. It is built on the north side of the Bay of Trincomalee, on the neck of a bold peninsula separating the inner from the outer harbour. There is a lighthouse on the extremity of Foul Point at the southern side of the bay, and another on the summit of Round Island. The inner harbour is landlocked, with a safe anchorage and deep water close to the principal wharves; the outer harbour has an area of about 4 square miles, with a depth of about 70 fathoms. There is an admiralty dockyard, and the town is the principal naval station in the Indian seas. The breadth of the streets and esplanades somewhat atones for the mean appearance of the houses, but the town generally has a gloomy and impoverished aspect. Pearl oysters are found in the lagoon of Tambalagam to the west of the bay. The Government buildings include the barracks, the public offices and residences of the civil and naval authorities, and the official house of the officer commanding-in-chief in the Indian seas. There is an hospital and outdoor dispensary, and also a friend-in-need society. The population of Trincomalee in 1881 was 10,180.

The town was one of the earliest settlements of the Malabar race in Ceylon, who at a very early period erected on a height at the extremity of the peninsula, now crowned by Fort Frederick, a temple dedicated to Kouatha, or Konasir, named the "temple of a thousand columns." The building was desecrated and destroyed in 1622, when the town was taken by the Portuguese, who made use of the materials for the erection of the fort. The town was successively held by the Dutch (1639), the French (1673), the Dutch (1674), the French (1782), and the Dutch (1783). After a siege of three weeks it surrendered to the British fleet in 1795, and with other Dutch possessions in Ceylon was formally ceded to Great Britain by the treaty of Amiens in 1801. Its fortifications have lately been strengthened.

TRINIDAD, a West Indian island, lying north-east of Venezuela, between 10° 3′ and 10° 50′ N. lat. and 61° 39′ and 62° W. long., being the most southern of the chain of islands separating the Atlantic from the Caribbean Sea. Its area is 1754 square miles, or nearly 1,123,000 acres. In shape the island is almost rectangular, but from its north-west and south-west corners project two long horns towards Venezuela, enclosing the Gulf of Paria. The north-west horn terminates in several islands, in one of the channels between which (the Boca Grande) lies the small British island of Patos. The general aspect of Trinidad is level. But three parallel ranges, varying from 600 to 3100 feet in height and clothed with forests, run from east to west. The plains are watered by numerous streams, and the mountains are deeply furrowed by innumerable ravines. The rivers falling into the gulf are somewhat obstructed by shallows, especially the Caroni and the Couva. Geologically, as well as botanically and zoologically, Trinidad differs little from the adjacent mainland, with which at one time it probably was connected. The soil, which is fertile, consists of clay, loam, and alluvial deposits. The Moriche palm and mountain cabbage, as well as the cedar and the balata, are prominent objects. Poisonous and medicinal plants grow everywhere, and the woods contain an inexhaustible supply of timber. There are two mineral springs. The most curious natural feature of the island is the pitch lake[1] in La Brea, 90 acres in extent, which furnishes an important export. The climate is healthy, the mean temperature being in January 76° Fahr. and in September 79°; it occasionally reaches 90°.



Map of Trinidad.

The population, which numbered 109,638 in 1871, was returned in 1881 at 153,128 (83,716 males and 69,412 females), and in 1885 at 171,914. Of these about 100,000 are natives of the island, principally of African race, 50,000 are coolies introduced from India (an industrious and prosperous element of the population), while the remainder includes the English and other European settlers. About 2000 coolies are introduced annually. Many French families from other parts of the West Indies settled in Trinidad many years ago, and traces of this and of the Spanish occupation are obvious in laws, municipal arrangements, language, and population. The two principal towns are Port of Spain and San Fernando. The former (34,000 inhabitants), the capital of the island, is built on a gently inclined plain near the north-east angle of the Gulf of Paria, and is a fine and safe port. In the town there are two cathedrals (the Roman Catholic and the Anglican), and outside it a botanical garden. San Fernando, about 30 miles southward, with a population of 7000, is an important shipping place.

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[1] This is vividly described by Charles Kingsley in *At Last*.

Of the total area about 300,000 acres are cultivated. The principal productions of the island are sugar and cocoa; coffee is also becoming important. Trinidad has suffered much from the effect of foreign state bounties, especially the export premiums of Germany and France. The sugar production in 1871 was 53,000 tons, in 1881 44,000 tons, and in 1885 64,000 tons. The principal exports in 1885 were—sugar, 64,000 tons (value £684,675); rum, 72,525 galls. (£7878); molasses, 2,416,761 galls. (£45,885); cocoa, 14,904,840 lbs. (£421,974); coffee, 20,270 lbs.; asphalt, 28,505 tons raw and 6731 tons boiled; cocoa-nuts, 9,645,700; bitters (Angostura and others) and liquors, 32,240 galls.; the total value was £2,246,664, including £707,421 specie and bullion. The imports in 1885 (including bullion and specie) were £2,241,478. Among the principal items are cottons, linens, woollens, and textiles generally (largely from the United Kingdom), £235,895; fish, flour, and provisions (principally from the United States), £270,000; lumber (from Canada), £43,075; rice (half from India), £113,940; hardware and machinery (principally from the United Kingdom), £116,894; gold (principally from Venezuela in transit), £651,398. The sailing vessels entering Trinidad ports in 1885 had a burden of 150,219 tons, the steamers a burden of 385,950 tons. The total public revenue in 1885 was £429,307, of which £240,444 was for customs and excise. The total expenditure was £443,920. There are 145 public schools, of which 61 are Government and 61 assisted, with a total attendance of 13,282 scholars. The principal towns are connected by railway lines.

Trinidad was discovered by Columbus on 31st July 1496. It remained in Spanish possession (although its principal town, San José de Oruña, was burnt by Sir Walter Raleigh in 1595) until 1797, when a British expedition from Martinique caused its capitulation, and it was finally ceded to Great Britain in 1802 by the treaty of Amiens. Its real starting-point as a productive country was in 1781, when the Madrid Government began to attract foreign immigrants. Trinidad is still strictly a crown colony of Great Britain. The legislative council includes the governor as president, and six official and eight unofficial members, all appointed by the crown. During the labour crisis caused by emancipation and the subsequent equalization of the British duties on free and slave-grown sugar, the colony was greatly assisted by the skilful administration of Lord Harris, governor from 1846 to 1851.

See De Verteuil, *Trinidad*; *Colonial Office List*; Guppy, *Trinidad Almanac*; and *Government Geological Survey*.

TRINITARIANS (*Ordo Sanctæ Trinitatis et Captorum*), a religious order instituted about the year 1197 by Innocent III., at the instance of John de Matha (1160-1213) and Felix de Valois (*ob.* 1212), for the ransom of captives among the Moors and Saracens. The rule was the Augustinian, the dress white with a red and blue cross. De Matha was the first general and De Valois the first abbot of the mother house at Cerfroid near Meaux, where the idea of the institution had originated in a miraculous apparition. By 1200 as many as 200 Christians had been redeemed out of slavery in Morocco by the order, which accordingly spread rapidly not only in France but also in Italy and Spain. Further favoured by Honorius III. and Clement IV., the Trinitarians spread into Portugal, the United Kingdom, Bohemia, Saxony, Poland, and Hungary, and even into America. In the 18th century they had in all about 300 houses; but the order is now almost extinct. About the middle of the 17th century it was stated that in France the "redemptions" up to that time had numbered 246, the number of prisoners bought off being 30,720; for Castile and Leon the corresponding figures were 362 and 11,809. The order is sometimes spoken of as the "ordo asinorum" from the circumstance that originally its members were not permitted to use any other beast of burden. In France they were known as Mathurins from the chapel of St Mathurin or Mathelin in Paris, which belonged to them.

TRINITY HOUSE, CORPORATION OF. An association of English mariners, which originally had its head-quarters at Deptford in Kent. In its first charter, received from Henry VIII. in 1514, it was described as the "guild or fraternity of the most glorious and undividable Trinity of St Clement," the court being made to consist of master, wardens, and assistants, numbering thirteen in all and elected annually by the brethren. Deptford having been made a royal dockyard by Henry VIII., and being the station where outgoing ships were supplied with pilots, the corporation rapidly developed its influence and usefulness. By Henry VIII. it was entrusted with the direction of the new naval dockyard. From Elizabeth, who conferred on it a grant of arms in 1573, it received authority to erect beacons and other marks for the guidance of navigators along the coasts of England. It was also recognized as the authority in the construction of vessels for the royal navy. In 1604 a select class was constituted called elder brethren, the other members being called younger brethren. By the charter of 1609 the sole management of affairs was conferred on the elder brethren, the younger brethren, however, having a vote in the election of master and wardens. The practical duties of the fraternity are discharged by the acting elder brethren, who have all had experience in naval affairs; but as a mark of honour persons of rank and eminence are admitted as elder brethren and now form a large proportion of the members. In 1647 the corporation was dissolved by parliament, but it was reconstructed in 1660, and the charter was renewed by James II. in 1685. A new hall and almshouses were erected at Deptford in 1765; but for some time the offices of the corporation had been transferred to London, and in 1798 their headquarters were removed to Trinity House, Tower Hill, built from the designs of Wyatt. By an Act of 1836 they received powers to purchase from the crown, as well as from private proprietors, all interests in coast lights. For the maintenance of lights, buoys, &c., they had power to raise money by tolls, the surplus being devoted to the relief of old and indigent mariners or their near relatives. In 1853 the control of the funds collected by the corporation was transferred to the Board of Trade, and the money over which the brethren were allowed independent control was ultimately reduced to the private income derived from funded and trust property. Their practical duties in the erection of lighthouses, buoys, and beacons remain as important as ever, the number of persons employed in their service being over 800. They also examine navigating lieutenants in the royal navy, and act as nautical advisers in the High Court of Admiralty.

TRINITY SUNDAY, which immediately follows Whitsunday, was in the older liturgies regarded merely as the "Octave" of Pentecost. The habit of keeping it as a distinct festival seems to have sprung up about the 11th century. According to Gervase of Canterbury, it was Thomas Becket who introduced it into England in 1162. The universal observance of it was established by Pope John XXII. in 1334.

TRIPOLI, a North African state, bounded by the Mediterranean on the north, by the desert of Barca (or Libyan Desert), which separates it from Egypt, on the east, by the Sahara and Fezzan on the south-east, south, and south-west, and by Tunis on the north-west. The country is made up of a strip of fertile soil adjacent to the sea, with vast sandy plains and parallel chains of rocky mountains, which finally join the Atlas range near Kairwán in Tunis. It is naturally divided into five parts, viz.,—Tripoli proper, to the north-east of which is the plateau of Barca and Jebel al-Akhdar, to the south the oasis of Fezzan, to the south-east that of Aujala, and to the south-west that of Ghadámes.[1] It is very badly watered: the rivers are small and the desert wells and watering places are often dry. As regards the coast, it is extremely difficult to fix the exact border between Egypt and Tripoli. The seaboard of the Libyan Desert is so little known to Europeans that the spacious harbours of Tebruk (Tabraca and Tabarka) and Bomba (Bombæa) have almost escaped notice. The land bordering the sea to the west of Cape Rás al-Tín does not partake of the sterile character of the wastes of Barca. The district of Jebel al-Akhdar ("the Green Mountain"), which intervenes between Rás al-Tín and Bengházi, abounds in wood, water, and other resources; but its ports are scarcely worthy of the name, except Derna (Darnis), where vessels from Alexandria call to embark honey, wool, and wax. From Mersá Suza (Apollonia, later Sozusa), now a mere boat cove, but once a powerful city of Cyrenaica, to Bengházi the coast abounds in extensive ruins. Bengházi itself, on the Bay of Sidra (Syrtis Major), is an insignificant fortified town trading in cattle and other produce. The principal products of the country are corn, barley, olives, saffron, figs, and dates,—these last being perhaps the finest in the whole of North Africa. Fruit also is abundant in certain parts, and so are many kinds of vegetables. The horses and mules, though small, are capable of much hard work. The native tissues and pottery are almost as good as those of Tunis. Great quantities of castor oil come from Tadjura. In consequence of recent events in Tunis, Tripoli has become the last surviving centre of the caravan trade to Northern Africa. It is at least 250 miles nearer the great marts of the interior than either Tunis or Algiers. A large proportion of the commerce of Tripoli is in the hands of British merchants or dealers in British goods, who send cloth, cutlery, and cotton fabrics southwards and receive in return esparto grass, ivory, and ostrich feathers. The sirocco blows with great force at times during the autumn, and the heat is as a rule much greater than in Tunis. The climate is very variable; cold nights often succeed warm days; storms are of frequent occurrence; and rain is at times wanting for many months. In addition to the capital TRIPOLI (see below), called Tarábulus al-Gharb to distinguish it from the town of the same name in Syria, the only important places are Murzuk and Ghadámes in the interior and Bengházi (Berenice) on the coast. The population of the country consists of Moors, Arabs, Kabyles, Kuluglis (descendants of Turkish fathers and Moorish mothers), Turks, Jews, Europeans, and Negroes. Nothing like a census has ever been attempted, and the number of inhabitants is purely a matter of conjecture. In the interior the population is very scattered, and it is not probable that the total exceeds from 800,000 to a million. The Europeans (2500 or 3000) on the coast are nearly all Maltese. There is a Jewish colony of about 4000 in the capital, and the trade is almost entirely in their hands and in those of the Maltese.[1]

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[1] Concerning the last-named districts full information can be found in *Sahara und Sudan* (Berlin, 1879-81) by Dr Nachtigal, who continued the explorations of southern Tripoli commenced by Barth and Rohlfs. Consult also *Narrative of Travels and Discoveries in Northern and Central Africa*, by Denham, Clapperton, and Oudney, London, 1826.

Since 1835 Tripoli has lost the semi-independent character of a regency which it formerly enjoyed in common with Tunis, and has become a vilayet or outlying province of the Turkish empire. For administrative purposes it is divided into five districts, which are again subdivided into twenty-five cantons, the former being governed by motasarrifs and the latter by caimacams. Each village has its sheikh, who is assisted by a sort of municipal council. Since the invasion of Tunis by the French, the Turkish garrison of Tripoli has been considerably reinforced, and many new fortifications are partially erected on the coast. The chief judge or *cadi* is nominated by the Porte; the *muftis* are subject to his authority. There are also a criminal court and a commercial tribunal. The taxes are collected by a receiver-general, also nominated from Constantinople, and they press very heavily on all classes of the inhabitants. The principal sources of revenue are the usual Mohammedan taxes. The constant succession of Turkish governors, each of whom invariably follows a different policy from that of his predecessor, has been fatal to the material progress of the country. There are few elementary schools in the capital, and instruction in the interior is entirely limited to the Koran.

History.—After falling successively into the hands of the Phœnicians, Romans (a four-sided triumphal arch, erected in honour of Aurelius Antoninus and Aurelius Pius, still stands near the Marina gate), Vandals, and Greeks, Tripoli was finally conquered by the Arabs twelve centuries ago, and has remained a Moslem state ever since. In 1510 Ferdinand the Catholic of Spain took it, and thirteen years later it was given to the Knights of St John, who were expelled in 1553 by the Turkish corsairs Dragut and Sinan. Dragut, who afterwards fell in Malta, lies buried in a much venerated *kubba* close to one of the mosques. After his decease the connexion between Tripoli and Constantinople seems to have been considerably weakened. But the Tripolitan pirates soon became the terror and scourge of the Mediterranean; half the states of Europe seem at some time or other to have sent their fleets to bombard the capital. In 1714, when Hosain ibn 'Alí founded the present line of the beys of Tunis,[2] Ahmed Pasha Caramanli achieved independence, and his descendants governed Tripoli until 1835. In that year the Turks took advantage of a civil war to reassert their authority, and since that date Tripoli has been governed by representatives of the sultan.

The *khouan* (*ikhwán*) or semi-religious semi-political fraternities which exercise such considerable influence in Tunis, Algeria, and Morocco are perhaps still more powerful in Tripoli. The most remarkable is that of the *Senúsiya*, the centre of whose authority is Jaghbub or Jerabub, north-west of the oasis of Síwa. The sectaries of Senúsiya are found in all parts of North Africa, but exist in unusual force in Tripoli, and particularly in Ghadámes and Murzuk. A certain halo of romance surrounds the history of this powerful sect; but its chief has, up to the present time (1887), not played any conspicuous part in the affairs of the Soudan or in those of the North African littoral. Mohammed el-Senúsí came originally in 1830 from Mostaghánem in Algeria. He acquired a high reputation for sanctity at Fez in Morocco. After a visit to Mecca and the holy places he started a *záwiya* or convent-college at Alexandria, but, being excommunicated by the sheikh al-Islam at Cairo, he fled across the Libyan Desert to the Jebel al-Akhdar near Bengházi. He afterwards removed to Jaghbub, which has never been visited by any European traveller. Here he established his záwiya in the midst of palm-groves and soon gathered nearly a thousand followers. His austere doctrines are received with enthusiasm in the Moslem states of Northern and Central Africa. He established some one hundred sanctuaries in every considerable place between Morocco and Mecca, and appointed mukaddemín or lieutenants in nearly every part of Islam. Senúsí the elder died in 1860 and was succeeded by his son, who bore the title of Al-Mahdí. Under his rule the prosperity of the záwiya at Jerabub is said to have greatly increased. Pilgrims to Mecca from North Africa, as well as those coming from Bornou and the Saharan provinces, flock there to seek his blessing. He not only receives caravans of ivory and ostrich feathers from the different sultans of the interior, but cargoes of arms and ammunition often arrive for him at the almost unknown harbours of the coast. Rohlfs, Nachtigal, and Duveyrier found their passage barred by Senusian agents. It was confidently expected Senúsí would make some demonstration at the beginning of the 14th century of the Hijra (November 1882). His followers were, however, doomed to disappointment. Most of the Tripolitan sheikhs are affiliated to the Senúsiya confraternity.

From an archæological point of view Tripoli possesses an interest equal to, if not greater than, that which attaches to Tunis. On this subject the fullest information is afforded by the book of the Beecheys, and in a less degree by that of Mr Rae. The former is illustrated by numerous plans and engravings and still affords the safest guide to the antiquities of Tripoli. (A. M. B.)

TRIPOLI, the capital of the above country, is situated in 32° 53′ 40″ N. lat. and 13° 11′ 32″ E. long., on a promontory stretching out into the Mediterranean and forming a small bay. Its crenellated *enceinte* wall has the form of an irregular pentagon. A line of small half-ruined forts is supposed to protect one side of the harbour, and the castle of the governor the other. The desert almost touches the western side of the city, while on the east is the verdant oasis of Meshiga, where are still to be seen the tombs of the Caramanlian sultanas and the twelve-domed *marabout* of Sy Hamonda. In the town itself there are seven principal mosques, six of them possessing lofty minarets in the Turkish style. The streets are narrow, dirty, and unpaved; there is no European quarter properly so called: Tripoli is still a typical Moorish city. Its population numbers about 20,000.

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[1] The best known English work on Tripoli is F. W. and H. W. Beechey's *Proceedings of the Expedition to Explore the Northern Coast of Africa from Tripoli Eastwards*, London, 1828. Admiral W. H. Smyth's *Mediterranean*, London, 1854, contains a description of the coast. See also Rae, *Country of the Moors*, London, 1877, and Broadley, *Tunis Past and Present*, London and Edinburgh, 1882.

[2] The *Letters* (London, 1819) of Richard Tully, who was consul at Tripoli from 1783 to 1793, throw a strange and vivid light on Tripolitan life during the 18th century.

TRIPOLI (*Ṭarábulus*), a town of Syria, capital of Liwá, on the river Ḳadisha or Abú 'Alí, in 34° 26′ N. lat. and 35° 50′ E. long., is situated in a fertile maritime plain covered with orchards and dominated by a castle overhanging a gorge of the river, some parts of which are, perhaps, the work of the crusaders. The port (Al-Míná) is about two miles distant, on a small peninsula. The population is estimated at 17,000, with the port at 24,000 or a little more. Nearly half of these are Christians, the Maronites preponderating. There is a considerable export of silk cocoons and a native silk manufacture; the sponge fishery is a large industry; tobacco is exported; and soap is made from the olive oil of the district. There are eighteen churches, and several monasteries, nunneries, and large kháns.

The ancient Phœnician city which we know only by its Greek name of Tripolis was the seat in Persian times of the federal council of Sidon, Tyre, and Aradus, each of which cities had its separate quarter in the "triple town" (see vol. xviii. p. 809). In the second and first centuries B.C. it struck coins, on which it is designated a "holy and autonomous" city. These are succeeded by imperial coins ranging from 32 B.C. to 221 A.D. About 450, and again in 550, it was destroyed by earthquake. The Arabs took it in 638 after a prolonged siege, the inhabitants withdrawing by sea. It appears from Beládhorí (p. 127) that at this time the city still consisted of three fortified places. Mo'áwiya recruited the population by a colony of Jews and gave it fortifications and a garrison against the naval attacks of the Greeks, who, notwithstanding, retook it for a brief space in the time of Abdalmalik (Beládh., *ut sup.*). It was again taken by the Greeks in the war of 966-69 and was besieged by Basil II. in 995, after which date it was held by a garrison in the pay of the Fatimite caliphs of Egypt, who treated the city with favour and maintained in it a trading fleet. At this time, according to the description of Násiri Khosrau (ed. Schefer, p. 40 *sqq.*), who visited it in 1047, it lay on the peninsula of Al-Míná, bathed on three sides by the sea, and had about 20,000 inhabitants and important industries of sugar and paper-making. Of the great sea-walls and towers there are still imposing remains. From this date till it was taken by the crusaders, after a five years' siege, in 1109, the ruling family was that of 'Ammār, who founded a library of over 100,000 volumes. Under the crusaders Tripoli continued to flourish, exported glass to Venice, and had 4000 looms (Quatremère, *Hist. des Sultans Mamlouks*, ii. 103). In 1289 it was taken and destroyed by the sultan Kalaún of Egypt, and a new city was begun on the present site, which rapidly rose to importance (Ibn Batúta, i. 137). Its mediæval prosperity has obliterated most relics of remoter antiquity.

See Renan, *Mission de Phénicie*, p. 120 *sqq.*

TRIPOLITZA, officially TRIPOLIS, a town of Greece, capital of the nomarchy of Arcadia, is situated in a plain 3000 feet above sea-level, 22 miles south-west of Argos. The name has reference to the three ancient cities of Mantinea, Pallantium, and Tegea, of which Tripolitza is the modern representative. Before the war of independence it was the capital of the Morea and the seat of a pasha, with about 20,000 inhabitants; but in 1821 it was taken and sacked by the insurgents, and in 1825 its ruin was completed by Ibrahim Pasha. The town has since been rebuilt, and now (1887) contains about 10,000 inhabitants.

TRISMEGISTUS. See HERMES TRISMEGISTUS.

TRISTAN. See ROMANCE, vol. xx. p. 644 *sq.*

TRISTAN DA CUNHA, a group of three small volcanic islands, situated in the South Atlantic nearly midway between the Cape of Good Hope and the coast of South America, the summit of the largest being in 37° 5′ 50″ S. lat. and 12° 16′ 40″ W. long. They rise from the low submarine elevation which runs down the centre of the Atlantic and on which are likewise situated Ascension, St Paul's Rocks, and the Azores; the average depth on this ridge is from 1600 to 1700 fathoms, while depths of 3000 fathoms are found on each side of it. The depth between the islands is in some places over 1000 fathoms. Tristan, the largest and northernmost island, is nearly circular in form, about 7 miles in diameter, with a volcanic cone in the centre (7640 feet). Precipitous cliffs, 1000 to 2000 feet in height, rise directly from the ocean on all sides, except on the north-west, where there is an irregular plain, 100 feet above the sea, and 2½ miles in length and ½ mile in breadth. The crater of the central cone is said to be filled with a freshwater lake which never freezes. Inaccessible Island, the westernmost of the group, is about 20 miles from Tristan. It is quadrilateral in form, the sides being about 2 miles long. The highest point (1840 feet) is on the west side; all round there are perpendicular cliffs 1000 feet in height. At the base of these are in some places narrow fringes of beach a few feet above the sea-level. Nightingale Island, the smallest and most southern of the group, is 10 miles from Inaccessible Island. Its coasts, unlike those of the other two islands, are surrounded by low cliffs, from which there is a gentle slope up to two peaks, the one 1100 feet, the other 960 feet high. There are two small islets—Stoltenkoff (325 feet) and Middle (150 feet)—and several rocks adjacent to the coast. The rocks are feldspathic basalt, dolerite, augite-andesite, sideromelane, and palagonite; some specimens of the basalt have porphyritic augite. The caves in Nightingale Island indicate that it has been elevated several feet. On almost all sides the islands are surrounded by a broad belt of kelp, the gigantic southern sea-weed (*Macrocystis pyrifera*), through which a boat may approach the rocky shores even in stormy weather. There is no good or safe anchorage. The beaches and lower lands are covered with a dense growth of tussock grass (*Spartina arundinacea*), 8 to 10 feet in height, which shelters millions of penguins (*Eudyptes chrysocoma*), which there form their rookeries. There is one small tree (*Phylica nitida*), which grows in detached patches on the lower grounds. Independently of introduced plants, fifty-five species have been collected in the group, twenty-nine being flowering plants and twenty-six ferns and lycopods. A majority of the species are characteristic of the present general flora of the south temperate zone rather than any particular part of it: botanically the group is generally classed with the islands of the Southern Ocean. A finch (*Nesospiza acunhæ*), a thrush (*Nesocichla eremita*), and a water hen (*Gallinula nesiotis*) are the only land birds—the first two being peculiar to the islands. In addition to the penguins numerous other sea birds nest on the islands, as petrels, albatrosses, terns, skuas, and prions. One or two land shells, a few spiders, several *Coleoptera*, a small lepidopter, and a few other insects are recorded, but no *Orthoptera* or *Hymenoptera*. The prevailing winds are westerly. December to March is the fine season. The climate is mild and on the whole healthy, the temperature averaging 68° Fahr. in summer, 55° in winter,—sometimes falling to 40°. Rain is frequent; hail and snow fall occasionally on the lower grounds. The sky is usually cloudy. The islands have a cold and barren appearance The tide rises and falls about four feet.

The islands were discovered and named by the Portuguese in 1506. The Dutch described them in 1643. D'Etcheverri landed on them in the year 1767, when he gave Nightingale and Inaccessible Islands their names. Their exact geographical position was determined by Captain Denham in 1852, and the "Challenger" completed the exploration of the group in 1873. When first discovered the islands were uninhabited. Towards the end of the 18th and in the beginning of the 19th century several sealers resided on them for longer or shorter periods. In 1816 the islands were taken possession of by Great Britain. In 1817 the garrison was withdrawn, but Corporal William Glass, his wife and family, and two men were allowed to remain. This small colony received additions from time to time from shipwrecks, from whalers, and from the Cape of Good Hope. In 1826 there were 7 men and 2 women

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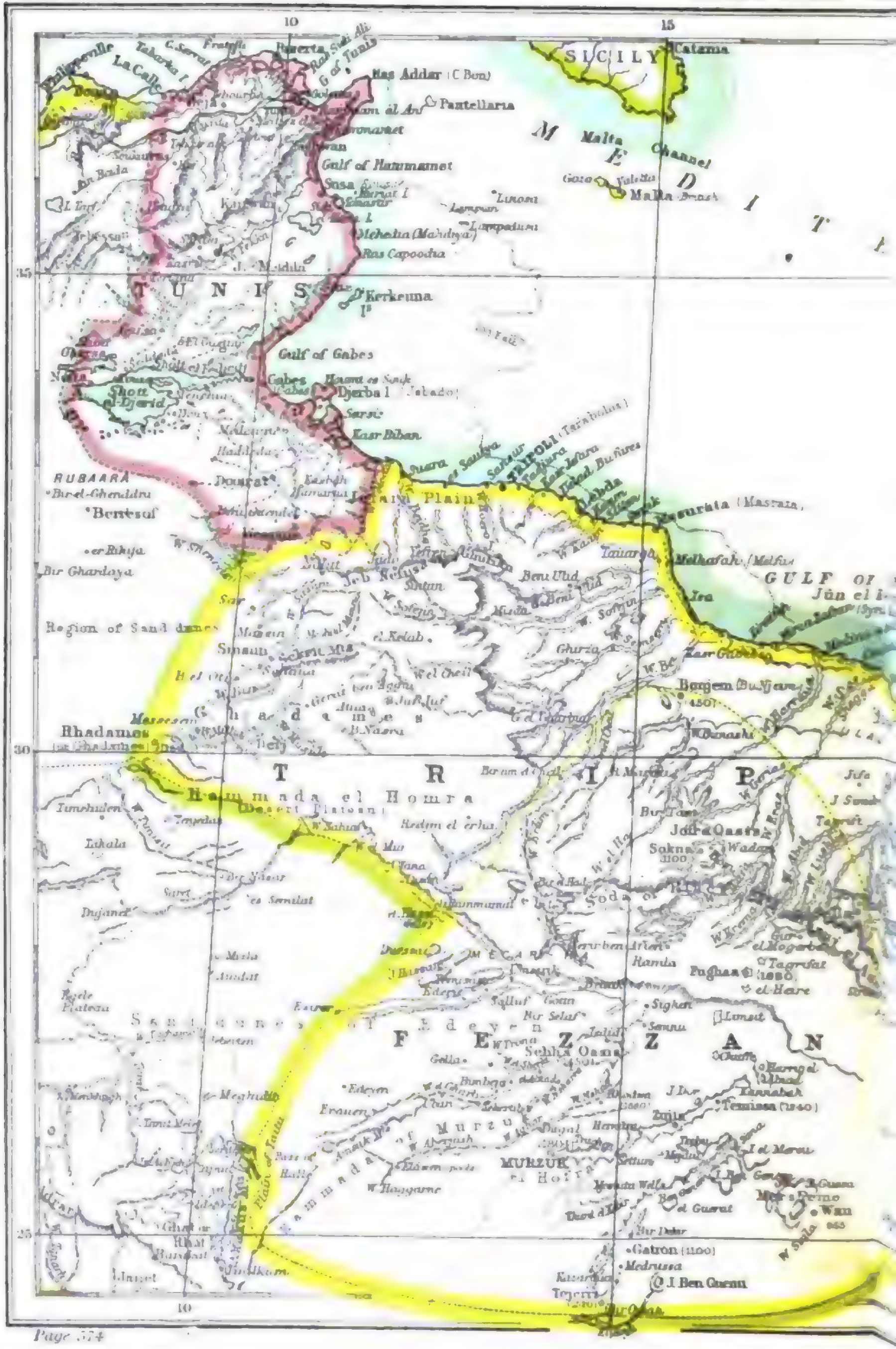
TRIPOLI A


SICILY
Catania
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Pantellaria
Malta Channel
Malta
Gozo
Linosa
Lampedusa
Gulf of Hammamet
Susa
Mehedia (Mahdiya)
Ras Capoodia
Kerkenna Is
Gulf of Gabes
Gabes
Djerba I (Jebado)
Kasr Biban
TUNIS
Shott el-Djerid
La Calle
Tabarka I.
Bona
Tebessa
RUBAARA
Bir-el-Ghendiru
Berresof
Bir Ghandaya
Region of Sand dunes
TRIPOLI (Tarabulus)
Misurata (Masrata)
GULF OF
Jûn el i
Melhafah (Melfa)
Taiurgha
Beni Ulid
Jeb Nefusa
Gharia
Bonjem (Bu Njem)
Ghadames
Rhadames
Sinaun
Derj
TRIPOLI
Hammada el Homra (Desert Plateau)
Timeluden
Sokna
Hun
Wadan
Soda
Fughaa
Tagrifat
el Hare
FEZZAN
Sebha Oasis
Edeyen
Murzuk
MURZUK
Hammada of Murzuk
Plain of Taita
Ghat
Gatron (1100)
Medrussa
J. Ben Ghenni
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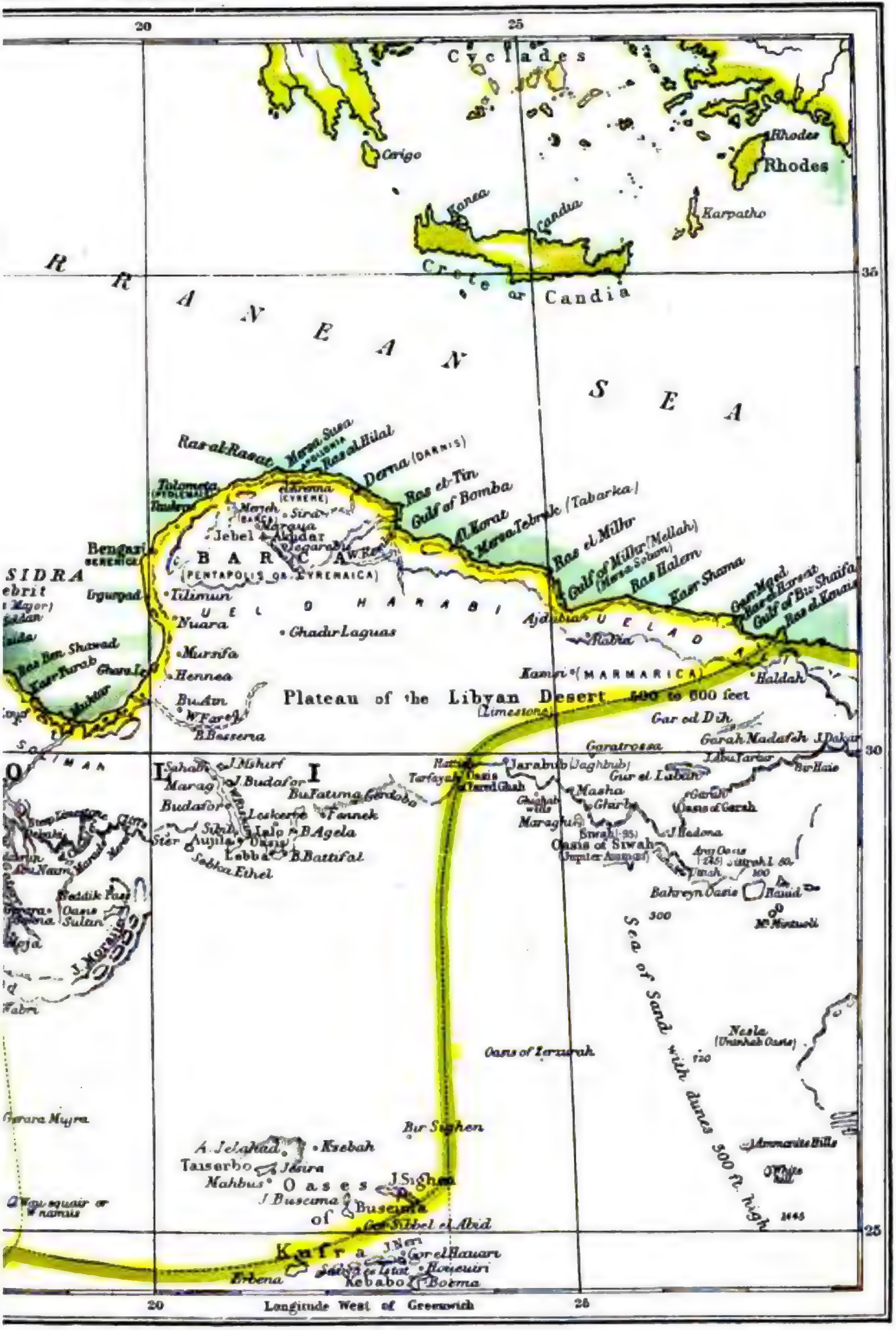
ND TUNIS PLATE V.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Cyclades
Cerigo
Kanea
Candia
Crete or Candia
Rhodes
Karpatho
RRANEAN SEA
Ras al Rasat
Marsa Susa
Ras al Hilal
Derna (DARNIS)
Ras et Tin
Gulf of Bomba
Tolometa (PTOLEMAIS)
Ghrenna (CYRENE)
Merjeh (BARCA)
Jebel Akhdar
Bengazi (BERENICE)
BARCA (PENTAPOLIS OR CYRENAICA)
Marsa Tebruk (Tabarka)
Ras el Millhr
Gulf of Millhr (Mellah)
Ras Halem
Kasr Shama
Gulf of Bu Shaifa
Ras el Kanais
SIDRA
Tilimun
UEL DHARABI
Nuara
Ghadir Laguas
Ajdabia
UELAD
Marsifa
Hennea
Ras Ben Shawad
Kasr Turab
Plateau of the Libyan Desert 500 to 600 feet (Limestone)
Kamsi (MARMARICA)
Haldah
Gar ed Dih
Garah Madafeh
Garatrossa
Jarabub (Jaghbub)
Gur el Laban
Masha
Garah
Oasis of Garah
Oasis of Siwah (Jupiter Ammon)
Bahreyn Oasis
Maraghi
Budafor
J. Budafor
Bu Fatuma
Tarfayah Oasis
Aujila
Jalo
B. Agela
Lebba
B. Battifal
Sebkha Ethel
Sea of Sand with dunes 500 ft. high
Oasis of Zerzurah
Nesla (Unkhah Oasis)
Ammonite Hills
Bir Sighen
A. Jelahad
Kesbah
Taiserbo
Jesira
Mahbus
Oases of Kufra
J. Sighen
J. Buseima
Buseima
Gor Silbel el Abid
J. Neri
Gor el Hauari
Hoseuiri
Kebabo
Boema
Erbena
Longitude West of Greenwich

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besides children. In 1873 there were 84 inhabitants, in 1886 97. They possess cattle, sheep, and geese. There are usually good potato crops. The settlement has always been on the flat stretch of land on the north-west of Tristan, and is called Edinburgh. Two Germans lived for several years on Inaccessible Island, but with this exception there have been no settlements either on this or on Nightingale Island.

TRITON. The genus *Triton* was constituted by Laurenti, in his *Synopsis Reptilium*, and the name was adopted by nearly all writers on *Amphibia*. In *Brit. Mus. Cat.: Batrachia Gradientia*, by G. A. Boulenger, the genus is expanded and called by the name *Molge*, which was used by Merrem in his *Tentamen Syst. Amphibia*, 1820. The genus belongs to the division *Mecodonta* of the family *Salamandrida* in Strauch's classification (see Amphibia, vol. i. p. 771). The definition of *Molge* given by Boulenger, which closely agrees with that of Triton adopted by Strauch, is as follows. Tongue free along the sides, adherent or somewhat free posteriorly. Palatine teeth in two straight or slightly curved series. Fronto-squamosal arch present (except in *M. cristatus*), ligamentous or bony. Toes five. Tail compressed. In Bell's *British Reptiles*, 2d ed., 1849, four species were described as occurring in Britain. According to Boulenger, there are only three British species, *Molge cristata*, Boul. (Laurenti), *M. vulgaris*, Boul. (Linn.), and *M. palmata*, Boul. (Schneider). We give a short account of these under the names *Triton cristatus*, *T. vulgaris*, and *T. palmatus* respectively.

The name *Triton cristatus* for the first species has been used by a great number of authoritative writers on *Amphibia*, including Laurenti, Tschudi, Bonaparte, Duméril and Bibron, and Strauch, and also by Bell and Fleming among students of British fauna.[1] The diagnosis of *T. cristatus* is as follows:—The males have a dorsal crest which is toothed; the fronto-squamosal arch is absent; the colour of the ventral surface is orange with black spots. This species is commonly known as the great water-newt. The average length of the adult is 6 inches. The colours are most brilliant in the male, and more developed in the breeding season—spring and summer—than in winter. The back is blackish or yellowish brown, with round black spots; the sides of the tail are white. The dorsal crest of the male is separated entirely from the tail crest, and both disappear in winter. The skin is covered with warty tubercles. There are no parotids; but glandular pores are present over the eyes and in a longitudinal series along each side. The species is pretty common in ponds and ditches in most parts of Britain, but more abundant in the south than in the north; in the neighbourhood of London it is found in great numbers. Its food consists of aquatic insects and other small animals; in the spring it devours the young tadpoles of the frog with avidity, and occasionally it feeds on the smaller species, *T. vulgaris*. In winter it hibernates, either quitting the water and hiding under stones or remaining torpid at the bottom of the water. It breeds chiefly in May and June. As in all *Salamandrida*, a true copulation takes place and the fertilization of the ova is internal. The female deposits each egg separately in the fold of a leaf, which she bends by means of her hind feet; the adhesive slime surrounding the vitellus keeps the leaf folded. The tadpole when first hatched is much more fish-like in form than that of the frog, the body diminishing in thickness gradually to the end of the tail. A continuous median fin runs along the back from the head, round the end of the tail, along the ventral median line, to the region of the gills, thus extending, as in many fish larvæ, in front of the anus. The larva possesses three pairs of branched external gills, and in front of these a pair of processes by which it can adhere to fixed objects in the water. *T. cristatus* is abundant throughout Europe, ranging from Sweden and Russia southwards to Greece, and from Britain to the Caucasus.

The diagnosis of *T. vulgaris*, the *Lissotriton punctatus* of Bell, is:—Males with a dorsal crest continuous with the caudal, and festooned; belly not brilliantly coloured; back spotted. This species, often called the common or small newt, has a smooth skin, no glandular pores on the sides, but two patches on the head. It is as abundant in Britain as the former, or more so, but differs somewhat in habits, in autumn and winter being almost entirely terrestrial, and only living in water during the breeding season. Like the former species it is carnivorous. It is found in most parts of Britain, and throughout Europe, except in the south of France, Spain, and Portugal; it also extends into temperate Asia.

T. palmatus Tschudi (Schneider), the *Lissotriton palmipes* of Bell, is thus distinguished:—Male with dorsal crest, which is low with an even margin and continuous with the caudal; fronto-squamosal arch long; toes in male webbed. Other less distinctive features are that the back is flattened, with a raised line on each side, and the tail in the male truncate, terminating in a short slender filament. This species is not so common in Britain as the other two; it is widely distributed throughout Europe. It was first discovered in Britain in 1843.

Boulenger recognizes nineteen species of *Molge*, of which nine besides those found in Britain are European. Only two species occur in America. Strauch gives twenty species.

TRIUMPH, an honour awarded to generals in ancient Rome for decisive victories over foreign enemies; for victories in civil war or over rebels a triumph was not allowed. The power of granting a triumph rested with the senate; and it was a condition of granting it that the victorious general, on his return from the war, should not have entered the city until he entered it in triumph. Lucullus on his return from Asia waited outside of Rome three years for his triumph. The triumph consisted of a solemn procession, which, starting from the Campus Martius outside the city walls, passed through the city to the Capitol. Rome was *en fête*, the streets gay with garlands, the temples open. The procession was headed by the magistrates and senate, who were followed by trumpeters and then by the spoils, which included not only arms, standards, statues, &c., but also representations of battles, and of the towns, rivers, and mountains of the conquered country, models of fortresses, &c. Next came the victims destined for sacrifice, especially white oxen with gilded horns. They were followed by the prisoners who had not been sold as slaves but kept to grace the triumph; they were put to death when the procession reached the Capitol. The chariot which carried the victorious general (*triumphator*) was crowned with laurel and drawn by four horses. The general was attired like the Capitoline Jupiter in robes of purple and gold borrowed from the treasury of the god; in his right hand he held a laurel branch, in his left an ivory sceptre with an eagle at the point. Above his head the golden crown of Jupiter was held by a slave who reminded him in the midst of his glory that he was a mortal man. Last came the soldiers shouting *Io triumphe* and singing songs both of a laudatory and scurrilous kind. On reaching the temple of Jupiter on the Capitol, the general placed the laurel branch (in later times a palm branch) on the lap of the image of the god, and then offered the thank-offerings. A feast of the magistrates and senate, and sometimes of the soldiers and people, concluded the ceremony, which in earlier times lasted one day but in later times occupied several. A naval or maritime triumph was sometimes celebrated for victories at sea. Generals who were not allowed a regular triumph by the senate had a right to triumph at the temple of Jupiter Latiaris on the Alban Mount.

TRIVANDRUM, a town of India, capital of the native state of Travancore (*q.v.*), is situated in 8° 29′ 3″ N. lat. and 76° 59′ 9″ E. long., near the coast, not far from Cape Comorin. It is the residence of the maharajah, and contains an observatory and a museum, besides several other fine buildings. Commercially it is inferior in importance to Aleppi, the trade centre of the state. In 1881 it had a population of 37,652.

Geographical definition.

TROAD AND TROY. The Troad (ἡ Τρῳάς), or land of Troy, is the north-western promontory of Asia Minor. The name "Troad" is never used by Homer,—who calls the land, like the city, Τροίη,—but is already known to Herodotus. The Troad is bounded on the north by the Hellespont and the westernmost part of the Propontis, on the west by the Ægean Sea, and on the south by the Gulf of Adramyttium. The eastern limit was variously defined by ancient writers. In the widest acceptation, the Troad was identified with the whole of western and south-western Mysia, from the Æsepus, which flows into the

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[1] The species of Triton are called in English efts, evets, or newts.

Propontis a little west of Cyzicus, to the Caicus, which flows into the Ægean south of Atarneus. But the true eastern boundary is undoubtedly the range of Ida, which, starting from near the south-east angle of the Adramyttian Gulf, sends its north-western spurs nearly to the coast of the Propontis, in the region west of the Æsepus and east of the Granicus. Taking Ida for the eastern limit, we have the definition which, as Strabo says, best corresponds with the actual usage of the name Troad. Ida is the key to the physical geography of the whole region; and it is the peculiar character which this mountain-system imparts to the land west of it that constitutes the real distinctness of the Troad from the rest of Mysia. Nature has here provided Asia Minor with an outwork against invaders from the north-west; and as in the dawn of Greek legend the Troad is the scene of the struggle between Agamemnon and Priam, so it was in the Troad that Alexander won the battle which opened a path for his further advance.

Natural divisions. The length of the Troad from north to south—taking a straight line from the north-west point, Cape Sigeum (Yeni Shehr), to the south-west point, Cape Lectum (Babà-Calessi)—may be roughly given as forty miles. The breadth, from the middle point of the west coast to the main range of Ida, is not much greater. The whole central portion of this area is drained by the Mendere (the ancient Scamander), which rises in Ida and is by far the most important river of the Troad. The basin of the Mendere is divided by hills into two distinct parts, a southern and a northern plain. The southern—anciently called the Samonian plain—is the great central plain of the Troad, and takes its modern name from Bairamitch, the chief Turkish town, which is situated in the eastern part of it near Ida. It is of an elongated form, the extent from north to south being large in proportion to the average width, and is enclosed by hills which, especially towards the south, are low and undulating. From the north end of the plain of Bairamitch the Mendere winds in large curves through deep gorges in metamorphic rocks, and issues into the northern plain, stretching to the Hellespont. This is the plain of Troy, which has an average length of seven or eight miles from north to south, with a breadth of some two or three from east to west. The hills which enclose it on the south and east are quite low, and towards the east the acclivities are in places so gentle as to leave the limits of the plain somewhat indefinite. Next to the basin of the Mendere, with its two plains, the best marked feature in the river-system of the Troad is the valley of the Touzla, the ancient Satniois. The Touzla rises in the western part of Mount Ida, south of the plain of Bairamitch, from which its valley is divided by hills; and, after flowing for many miles almost parallel with the south coast of the Troad, from which, at Assus, it is less than a mile distant, it enters the Ægean about ten miles north of Cape Lectum. Three alluvial plains are comprised in its course. The easternmost of these, into which the river issues from rugged mountains of considerable height, is long and narrow. The next is the broad plain, which is overlooked by the lofty site of Assus, and which was a fertile source of supply to that city. The third is the plain at the embouchure of the river on the west coast. This was anciently called the Halesian (Ἀλήσιον) plain, partly from the maritime salt-works at Tragasæ, near the town of Hamaxitus, partly also from the hot salt-springs which exist at some distance from the sea, on the north side of the river, where large formations of rock-salt are also found. Maritime salt-works are still in operation at the mouth of the river, and its modern name (Touzla = salt) preserves the ancient association. **Coasts.** A striking feature of the southern Troad is the high and narrow plateau which runs parallel with the Adramyttian Gulf from east to west, forming a southern barrier to the valley of the Touzla, and walling it off from a thin strip of seaboard. This plateau seems to have been formed by a volcanic upheaval which came late in the Tertiary period, and covered the limestone of the south coast with two successive flows of trachyte. The lofty crag of Assus, washed by the sea, is like a tower standing detached from this line of mountain-wall. The western coast is of a different character. North of the Touzla extends an undulating plain, narrow at first, but gradually widening. Much of it is covered with the valonia oak (*Quercus Ægilops*), one of the most valuable products of the Troad. Towards the middle of the west coast the adjacent ground becomes higher, with steep acclivities, which sometimes rise into peaks; and north of these, again, the seaboard subsides towards Cape Sigeum into rounded hills, mostly low.

Natural products. The timber of the Troad is supplied chiefly by the pine-forests on the slopes of Mount Ida. But nearly all the plains and hills are more or less well wooded. Besides the valonia oak, the elm, willow, cypress, and tamarisk shrub abound. Lotus, galingale, and reeds are still plentiful, as in Homeric days, about the streams in the Trojan plain. The vine, too, is cultivated, the Turks making from it a kind of syrup and a preserve. In summer and autumn water-melons are among the abundant fruits. Cotton, wheat, and Indian corn are also grown. The Troad is, indeed, a country highly favoured by nature—with its fertile plains and valleys, abundantly and continually irrigated from Ida, its numerous streams, its fine west seaboard, and the beauty of its scenery. Under a good government, it could not fail to be exceedingly prosperous. Under Turkish rule, the natural advantages of the land suffice to mitigate the poverty of the sparse population, but have scarcely any positive result.

Early history; Priam's kingdom. In the Homeric legend, with which the story of the Troad begins, the people called the Troes are ruled by a king Priam, whose realm includes all that is bounded by "Lesbos, Phrygia, and the Hellespont" (*Il.*, xxiv. 544), *i.e.*, the whole "Troad," with some extension of it, beyond Ida, on the north-west. According to Homer, the Achæans under Agamemnon utterly and finally destroyed Troy, the capital of Priam, and overthrew his dynasty. But there is an Homeric prophecy that the rule over the Troes shall be continued by Æneas and his descendants. From the "Homeric" Hymn to Aphrodite, as well as from a passage in the 20th book of the *Iliad* (75-353)—a passage undoubtedly later than the bulk of the book—it is certain that in the seventh or sixth century B.C. a dynasty claiming descent from Æneas reigned in the Troad, though the extent of their sway is unknown. The Homeric tale of Troy is a poetic creation, for which the poet is the sole witness. The analogy of the French legends of Charlemagne warrants the supposition that an Achæan prince once held a position like that of Agamemnon. We may suppose that some memorable capture of a town in the Troad had been made by Greek warriors. But we cannot regard the *Iliad* in any closer or more exact sense as the historical document of a war. The geographical compactness of the Troad is itself an argument for the truth of the Homeric statement that it was once united under a strong king. How that kingdom was finally broken up is unknown. Thracian hordes, including the Treres, swept into Asia Minor from the north-west about the beginning of the seventh century B.C., and it is probable that, like the Gauls and Goths of later days, these fierce invaders made havoc in the Troad. The Ionian poet Callinus has recorded the terror which they caused further south.

A new period in the history of the Troad begins with the foundation of the Greek settlements. The earliest

Greek settlement.

and most important of these were Æolic. Lesbos and Cyme in Æolis seem to have been the chief points from which the first Æolic colonists worked their way into the Troad. Commanding positions on the coast, such as Assus and Sigeum, would naturally be those first occupied; and some of them may have been in the hands of Æolians as early as the 10th century B.C. It appears from Herodotus (v. 95) that about 620 B.C. Athenians occupied Sigeum, and were resisted by Æolic colonists from Mytilene in Lesbos, who had already established themselves in that neighbourhood. Struggles of this kind may help to account for the fact noticed by Strabo, that the earlier colonies had often migrated from one site in the Troad to another. Such changes of seat have been, he observes, frequent causes of confusion in the topography; and the fact has an important bearing on attempted identifications of the more obscure ancient sites.

Greek Ilium.

Among the Greek towns in the Troad, three stand out with especial prominence—Ilium in the north, Assus in the south, and Alexandria Troas in the west. The site of the Greek Ilium is marked by the low mound of Hissarlik ("place of fortresses") in the Trojan plain, about three miles from the Hellespont. The early Greek settlers in the Troad naturally loved to take Homeric names for their towns. The fact that Homer places the town of Dardania far inland, on the slopes of Ida, did not hinder the founders of the Æolic Dardanus from giving that name to their town on the shores of the Hellespont. The site of the historical Thymbra, again, cannot be reconciled with that of the Homeric Thymbra. Similarly, the choice of the name Ilion in no way justifies the assumption that the Greek settlers found that spot identified by tradition with the site of the town which Homer calls Ilios. It does not even warrant the hypothesis that they found a shrine of Athene Ilias existing there. For them, it would be enough that the sounding name could be safely appropriated,—the true site of Homeric Ilias being forgotten or disputed,—and that their town was at least in the neighbourhood of the Homeric battlefields. The Greek Ilium may have been founded about 700 B.C. It is noticeable that no ancient writer suggests a later date than the time of Crœsus (*c.* 550 B.C.); and Strabo says that the establishment of the colony at Hissarlik—after previous occupation of a different site—took place "in the time of the Lydians" (ἐπὶ Λυδῶν). It would be reasonable to infer that the Greek Ilium preserved some well-marked traces of Lydian influence, perhaps in architecture or art, perhaps in manners or traditions. The traces of Lydian workmanship found in the excavations at Hissarlik are thus easily explained, without recourse to the shadowy hypothesis of a distinct Lydian settlement on the spot. When Xerxes visited the Trojan plain, he "went up to the Pergamon of Priam," and afterwards sacrificed to the Ilian Athene (Herod., vii. 42). It is doubtful whether the "Pergamon" meant was at the Greek Ilium, or at another site (to be mentioned presently), Bunárbashi; strong reasons in favour of the latter have lately been adduced by Mr George Nikolaides, in his Ἰλιάδος Στρατηγικὴ Διασκευή. In the 4th century Ilion is mentioned among the towns of the Troad which yielded to Dercyllidas (399 B.C.), and as captured by Charidemus (359 B.C.). It possessed walls, but was a petty place, of little strength. In 344 B.C. Alexander, on landing in the Troad, visited Ilium. In their temple of Athene the Ilians showed him arms which had served in the Trojan war, including the shield of Achilles. Either then, or after the battle of Granicus, Alexander directed that the town should be enlarged, and should have the rank of "city," with political independence, and exemption from tribute. The battle of Ipsus (301 B.C.) added north-western Asia Minor to the dominions of Lysimachus, who executed the intentions of Alexander. He gave Ilium a wall 5 miles in circumference, incorporating with it some decayed towns of the neighbourhood, and built a handsome temple of Athene. In the 3d century B.C. Ilium was the head of a federal league (κοινόν) of free Greek towns, which probably included the district from Lampsacus on the Hellespont to Gargara on the Adramyttian Gulf. Twice in that century Ilium was visited by Gauls. On the first occasion (278 B.C.) the Gauls, under Lutarius, sought to establish a stronghold at Ilium, but speedily abandoned it as being too weak for their purpose. Forty years later (218 B.C.) Gauls were brought over by Attalus I. to help him in his war against Achæus. After deserting his standard they proceeded to pillage the towns on the Hellespont, and finally besieged Ilium, from which, however, they were driven off by the troops of Alexandria Troas. At the beginning of the 2d century B.C. Ilium was in a state of decay. As Demetrius of Scepsis tells us, the houses "had not even roofs of tiles," but merely of thatch. Such a loss of prosperity is sufficiently explained by the incursions of the Gauls and the insecure state of the Troad during the latter part of the 3d century. The temple of the Ilian Athene, however, retained its prestige. In 192 B.C. Antiochus the Great visited it before sailing to the aid of the Ætolians. In 190 B.C., shortly before the battle of Magnesia, the Romans came into the Troad. At the moment when a Roman army was entering Asia, it was politic to recall the legend of Roman descent from Æneas. Lucius Scipio and the Ilians were alike eager to do so. He offered sacrifice to the Ilian Athene; and after the peace with Antiochus (189 B.C.) the Romans annexed Rhœteum and Gergis to Ilium, "not so much in reward of recent services, as in memory of the source from which their nation sprang." The later history of Ilium is little more than that of Roman benefits. A disaster befell the place in 85 B.C., when Fimbria took it, and left it in ruins; but Sulla presently caused it to be rebuilt. Augustus, while confirming its ancient privileges, gave it new territory. Caracalla (211-217 A.D.) visited Ilium, and like Alexander paid honours to the tomb of Achilles. The latest coins found on the site are those of Constantius II. (337-361). In the 4th century, as some rhetorical "Letters" of that age show, the Ilians still did a profitable trade in attracting tourists by their pseudo-Trojan memorials. After the 4th century the place is lost to view. But we find from Constantine Porphyrogenitus (911-959) that in his day it was one of the places in the Troad which gave names to bishoprics

Assus.

While the Greek Ilium at Hissarlik owed its importance to a sham pretension, which amused sight-seers and occasionally served politicians, Assus, on the south coast, has an interest of a more genuine kind, and is, indeed, a better type of ancient town-life in the Troad. Its situation is one of the most magnificent in all the Greek lands. The seaward faces of the isolated and sea-washed rock on which Assus stood are carved to south and south-west into terraces. The natural cleavage of the trachyte into joint planes had already scarped out shelves which it was comparatively easy for human labour to shape; and so, high up on this cone of trachyte, the Greek town of Assus was built, with its colonnades, baths, theatre, its public walks and its monuments of the dead, mounting tier above tier, till the summit of the crag was crowned with a Doric temple of Athene. The view from the summit is not only very beautiful but also of great historical interest. In front is Lesbos, one of whose towns, Methymna, is said to have sent forth the founders of Assus, as early, perhaps, as 1000 or 900 B.C. The whole south coast-line of the Troad is seen, and in the south-east the ancient territory of Pergamum, from whose masters the possession of Assus passed to Rome by the bequest of Attalus III. (133 B.C.). The great heights of Ida rise in the east. Northward the Touzla is seen winding through its rich valley from a rocky defile in the east to the oak-forests in the western hills. This valley was traversed by the road which St Paul must have followed when he came overland from Alexandria Troas to Assus, leaving his fellow-travellers to proceed by sea. The north-west gateway of Assus, to which this road led, is still flanked by two massive towers, of Hellenic work, and of an age which leaves no doubt that they are the same between which St Paul entered the town. On the shore below, the ancient mole at which he embarked for Mytilene with his companions can still be traced by large blocks under the clear water. Assus affords the only harbour on the 50 miles of coast between Cape Lectum and the east end of the Adramyttian Gulf; hence it must always have been the chief shipping-place for the exports of the southern Troad. Too much off the highways to become a centre of import trade, it was thus destined to be a commercial town, content with a modest provincial prosperity. The great natural strength of the site protected it against petty assailants; but, like other towns in that region, it has known many masters,—Lydians, Persians, the kings of Pergamum, Romans, and Ottoman Turks. From the Persian wars to about 350 B.C. Assus enjoyed at least partial independence. It was about 348-345 B.C. that Aristotle spent three years at Assus with Hermeas, an ex-slave who had succeeded his former master Eubulus as despot of Assus and Atarneus. Aristotle has left some verses from an invocation to Arete (Virtue), commemorating the worth of Hermeas, who had been seized by Persian treachery and put to death. Under its Turkish name of Beihram, Assus[1] is still the commercial port of the southern Troad, being the place to which loads of valonia (acorn-cups for tanning) are conveyed by camels from all parts of the country. The recent excavations at Assus, conducted by explorers representing the Archæological Institute of America, have yielded results far more valuable for the history of Greek art and architecture than any excavations yet undertaken in the Troad. The sculptures form one of the most important links yet discovered between Oriental and early Greek art, especially in respect of the types of animals. The later Hellenic town-walls of Assus also well repay the new study which they have received. With their ramparts, towers, and posterns they form the finest and most instructive extant specimen of Greek military engineering. The director of the exploration, Mr J. T. Clarke, published in 1882 an excellent report on the work so far as it had then been carried.

Alexandria Troas.

Alexandria Troas stood on the west coast at nearly its middle point, a little south of Tenedos. It was built by Antigonus, perhaps about 310 B.C., and was called by him Antigonia Troas. Early in the next century the name was changed by Lysimachus to Alexandria Troas, in honour of Alexander's memory. As the chief port of north-west Asia Minor, the place prospered greatly in Roman times, and the existing remains sufficiently attest its former importance. The site is now covered with valonia oaks; but the circuit of the old walls can be traced, and in several places they are fairly well preserved. They had a circumference of about 6 English miles, and were fortified with towers at regular intervals. Remains of some ancient buildings, including a bath and gymnasium, can be traced within this area. The harbour had two large basins, now almost choked with sand. A Roman colony was sent to the place, as Strabo mentions, in the reign of Augustus. The abridged name "Troas" (Acts xvi. 8) was probably the current one in later Roman times. The site is now called Eski Stambul.

Other ancient sites.

Many classical sites of less note in the Troad have been identified with more or less certainty. Neandria seems to be rightly fixed by Mr F. Calvert at Mount Chigri, a hill not far from Alexandria Troas, remarkable for the fine view of the whole Troad which it commands. Cebrene has been conjecturally placed in the eastern part of the plain of Bairamitch, Palæscepsis being further east on the slopes of Ida, while the new Scepsis was near the site of Bairamitch itself. The evidence for this, however, is ambiguous. At the village of Kulaklee, a little south of the mouth of the Touzla, some Corinthian columns and other fragments mark the temple of Apollo Smintheus and (approximately) the site of the Homeric Chryse. Colonæ was also on the west coast, opposite Tenedos. Scamandria occupied the site of Eneh, in the middle of the plain of Bairamitch, and Cenchreæ was probably some distance north of it. The shrine of Palamedes, mentioned by ancient writers as existing at a town called Polymedium, has been discovered by Mr J. T. Clarke on a site hitherto unvisited by any modern traveller, between Assus and Cape Lectum. It proves to have been a sacred enclosure (*temenos*) on the acropolis of the town; the statue of Palamedes stood on a rock at the middle of its southern edge. Another interesting discovery has been made by Mr Clarke,—viz., the existence of very ancient town walls on Gargarus, the highest peak of Ida.

Site of Homeric Troy.

The modern discussion as to the site of Homeric Troy may be considered as dating from Lechevalier's visits to the Troad in 1785-86. Homer describes Troy as "a great town," "with broad streets," and with a high acropolis, or "Pergamus," rising above it, from which precipitous rocks descend abruptly to the plain beneath. These are the precipices over which the Trojans proposed to hurl the wooden horse, "when they had dragged it to the summit." Homer marks the character of the acropolis by the epithets "lofty," "windy," and more forcibly still by "beetling." One site in the Trojan plain, and one only, satisfies this most essential condition. It is the hill at its southern edge called the Bali Dagh, above the village of Bunárbashi. It has a height of about 400 feet, with sheer precipices descending on the south and south-west to the valley of the Scamander (Mendere). Remains found upon it—though it has never yet been thoroughly explored—show it to have been the site of an ancient city. Homer describes two natural springs as rising a little to the north-west of Homeric Troy. A little to the north-west of Bunárbashi these springs still exist. "This pair of rivulets are the immutable mark of nature by which the height towering above is recognized as the citadel of Ilium" (E. Curtius).

Rejection of Ilian claims

The low mound of Hissarlik—the site of the Greek Ilium—stands only 112 feet above the level of the open plain in which it is situated. To call it "beetling" (ὀφρυόεσσα) would have been a travesty of poetical licence on which no poet could have ventured, and to describe it as "lofty" or "windy" would have been not less strange. There are no natural springs near it, such as Homer mentions. The Æolic settlers, having called the place Ilion, naturally persisted in maintaining its identity with Troy. Polemon, a native of the Greek Ilium, who lived about 200 B.C., declared that his fellow-townsmen could show the very stone on which Palamedes had given lessons in the game of draughts. The only other ancient writer who is known to have admitted the Ilian claim is Hellanicus of Lesbos (*c.* 482-397 B.C.), who, as Strabo remarks, wished "to gratify the Ilians, as is his wont." Like the Ilians, Hellanicus was of Æolian origin; and in compiling the local legends of various places he is known to have been wholly uncritical, merely repeating what was told to him as he had heard it. On the other hand, the claim of the Greek Ilium to stand on the site of Troy was decisively rejected by the general consent of those ancient writers who had any claim to critical authority. The orator Lycurgus (*c.* 332 B.C.) speaks of the site of Troy as desolate, and this at a moment when the recent visit of Alexander the Great to the Greek Ilium (334 B.C.) had drawn attention to the claim made by its inhabitants. Demetrius, a native of Scepsis in the Troad, who flourished about 160 B.C., wrote a book entitled Τρωϊκὸς Διάκοσμος ("The Marshalling of the Trojans"), an exhaustive commentary on the catalogue of the Trojan forces in the second book of the *Iliad.* Demetrius knew the topography of the Troad as thoroughly as he knew the text of Homer. The extant notices of his work, which had a great reputation in antiquity, warrant the belief that he was not only learned but acute. In the *Diacosmus,* which was the chief work of his life, he must have bestowed much thought on the question as to the site of Homeric Troy,—the central point of his subject. He pronounced decidedly, as we know from Strabo, against the claim of the Greek Ilium. It has been suggested that Demetrius rejected the Ilian claim because, as a native of Scepsis, he was jealous of Ilium,—a suggestion which is not only absurd in itself, since it assumes that such a motive would have induced Demetrius to mar his life's work, but also betrays ignorance of Strabo's text. Scepsis was not a possible claimant of the contested honour, since it was not in the plain of Troy but in the plain of Bairamitch; and further, Demetrius had already provided in another manner for the Homeric dignity of Scepsis by making it the royal seat of Æneas on the strength of its position relatively to Lyrnessus. The verdict of Demetrius against the Ilian claim was also the general verdict of the other ancient writers consulted by Strabo, as the latter's language shows. From the passage in which Strabo notices the various definitions of the Troad (xiii. § 4) it appears that among such writers were the following historians and geographers:—Charon of Lampsacus (flor 500 B.C.), Damastes of Sigeum (400 B.C.), Scylax of Caryanda (350 B.C.), Ephorus of Cyme (340 B.C.), Eudoxus of Cyzicus (130 B.C.). It is to such writers as these that Strabo refers when he indicates the general consent of his authorities. In favour of the claim of the Greek Ilium, on the other hand, there are only two literary witnesses, and these, as we have seen, are alike worthless. Equally valueless from a critical point of view is the fact that the Ilian claim was sometimes allowed by soldiers or statesmen who wished to utilize Trojan memories. They required an official Troy, and they cared not where they found it. Nothing could more curiously illustrate the extreme poverty of the case for the Greek Ilium than the fact that some of its advocates have been reduced to arguing as if Alexander and Lucius Scipio, when they led their armies through the Troad, had been conducting archæological excursions, and as if their acquiescence in a convenient local myth had the weight of independent critical testimonies.

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[1] The name Assus probably means "dwelling," "town," being connected with the Sanskrit *vas*, "to dwell," which appears in the Greek *astu*, and also in the ending of such names as Mylasa and Larissa, where in Greek the *s* is alternatively single or double—an ending which, as Fligier has shown, is found in old town names from India to Dacia. Homer supplies an example in his "steep Pedasus" on the Satniois, and it has been suggested by Mr J. T. Clarke that Pedasus may have been identical in site with the later Assus.

In negativing the Ilian claim the conclusion of ancient criticism has been confirmed by a great preponderance of modern opinion. Since Lechevalier visited the Troad in 1785-86 an overwhelming majority of competent judges have favoured his belief that the Bali Dagh above Bunárbashi was the Pergamus of the Homeric poet's conception. Before Leake's visit this opinion had been expressed by Choiseul-Gouffier, Morritt, Hawkins, Gell, and Hamilton. Leake spoke with a decision which derives additional weight from the habitual sobriety of his acute judgment, and from the care with which, in this case, he had examined the alleged objections to the view which he finally adopted. He remarks that no one accustomed to observe the sites of ancient Greek towns could fail to fix on Bunárbashi "for the site of the chief place of the surrounding country." So Mr Tozer, in his *Highlands of Turkey,* says: "A person accustomed to observe the situation of Hellenic cities would at once fix on this as far more likely to have recommended itself to the old inhabitants of the country than any other in the neighbourhood." Count von Moltke has expressed the same opinion, that "he knew no other site in the Trojan plain for a chief town of ancient time." Another supporter of Bunárbashi is Forchhammer. Another is Kiepert. The opinion of Ernst Curtius has been already cited. But space precludes more names; it is enough to say that the correspondence of the Bali Dagh with the Homeric Pergamus—a correspondence absolutely unique in the Trojan plain—has been recognized with virtual unanimity by modern travellers who have patiently inspected the scenery of the *Iliad,* having competent knowledge, and being free from bias in favour of a theory formed before their visit. Partial excavations on the summit of the Bali Dagh have been more than once undertaken, with the result of discovering ancient walls. Pottery, too, has been found there, part of which is allowed on all hands to be probably as old, at least, as 900 B.C. But the Bali Dagh has never yet been explored with any approach to thoroughness.

The remains at Hissarlik.

The result of the excavations conducted by Dr Schliemann on the mound of Hissarlik has been to lay bare the remains of the Greek Ilium, and also, below these, some prehistoric remains of a rude and poor kind. In *Troy,* his first book on the subject, the explorer held that the remains of the Greek Ilium ceased at a depth of 6 feet below the surface, and that all the other remains, down to 52½ feet, were prehistoric He distinguished the latter into five groups, representing five prehistoric "cities" which had succeeded each other on the site; and in his second work, *Ilios,* he added to these a sixth prehistoric city, on the strength of some scanty vestiges of supposed Lydian workmanship, found at a depth of 6½ feet. In both books, Homeric Troy was identified with the third prehistoric city from the bottom, which was supposed to have been destroyed, though not totally, by fire. Professor Jebb was the first to show (1) that the lines of demarcation between the alleged prehistoric strata, as drawn in *Ilios* could not be accurate, and (2) that, if any part of the prehistoric remains could be supposed to represent Homeric Troy, it must be that part which Dr Schliemann had called the second city from the bottom, and the destruction of which by fire appeared to have been total. In 1882 the architects employed by Dr Schliemann proved that the stratification given in *Ilios* had in fact been incorrect. The errors, too, affected precisely that region of the deposit which was most important to the Trojan hypothesis, viz., the lower strata. In Dr Schliemann's third volume, *Troja,* these errors were admitted; and Troy was now identified, no longer with the third city, but with the second, of which the supposed area was now enlarged. Another fact to which the English critic had drawn attention was that the remains of the Greek Ilium must extend to a considerably greater depth than 6 feet below the surface. Further examination confirmed this view also. It showed that the remains on the mound at Hissarlik belong to the following periods or groups. (1) At the top, the remains of the Greek Ilium as it existed in the Roman age, *i.e.,* as rebuilt after its destruction by Fimbria in 85 B.C. (2) A city which, like the former, extended beyond the mound of Hissarlik (its acropolis) over the adjacent plain. This corresponds with the Greek Ilium of the Macedonian age, as embellished and enlarged by Lysimachus, *c.* 300 B.C. (3) A smaller city, probably confined to the mound. Here we may recognize the Greek Ilium as it existed before the Macedonian age. It was a small and poor place, as appears from the known incidents of its history in the 5th and 4th centuries B.C., owing its chief importance to the shrine of Athene Ilias. (4) A petty town or village, confined to the mound, and poorly built. The evidence of architecture fails to decide whether it was Hellenic or not; if Hellenic, it might represent the primitive settlement of the Æolic colonists, perhaps *c.* 700 B.C. It was a small house in this village that Dr Schliemann at first identified with Priam's palace. The ground-plan shows four rooms, of which the largest measured 24 feet 4 inches by 12 feet. (5) A large town, to which the mound was only acropolis, and which extended to some distance south and south-east over the plain. These remains are unquestionably prehistoric. (6) A few remains of a small settlement which, if indeed distinct from No. 5, preceded it. The reason for distinguishing 6 from 5 is that some of the acropolis buildings of 5 are above those of 6, and seem to have been built on carefully levelled ground. Apart from architectural evidence, objects found in the excavations prove that the remains of the historical age extend much below 6 feet. One of these was a terra-cotta disk, stamped with the head of a warrior, in an advanced style of workmanship, found at 26 feet 3 inches below the surface (*Troy*, p. 294). Another is a terra-cotta ball, found at 26 feet, which cannot be older than *c.* 360 B.C. Then, at 20 feet, was found another terra-cotta, marked with the Greek letter P. A piece of ivory, belonging to a seven-stringed lyre, and therefore not older than *c.* 660 B.C., was found at 26 feet. Thus we have at Hissarlik the remains of the Greek Ilium in three successive phases,—Roman, Macedonian, and Æolic, and below these the remains of at least one prehistoric settlement, the age and origin of which are unknown.

Their relation to Homer.

Homeric conception of Troy.

We can no longer either prove or disprove that these prehistoric remains are those of a town which was once taken after a siege, and which originally gave rise to the legend of Troy. But most certainly it is not the "lofty" Troy of which the Homeric poet was thinking when he embodied the legend in the *Iliad*. The conception of Troy which dominates the *Iliad* is based on the site at Bunárbashi, and suits no other. The sole phrase in the epic which favours Hissarlik occurs in book xx. (216 *sq.*), where Dardania is said to have been built on the spurs of Ida, when Ilios "had not yet been built in the plain"; and this phrase occurs in a passage which, as the best recent critics agree, is one of the latest interpolations in the *Iliad*, having been composed after the Greek Ilium had actually arisen "in the plain." Its purpose was the same as that which appears in the Hymn to Aphrodite, viz., to glorify reputed descendants of Æneas, and it probably belongs to the same age, the 7th century B.C. The tactical data of the *Iliad*—those derived from the incidents of the war—cannot be treated with such rigour as if the poem were a military history. But Nikolaides has shown that they can at least be brought into general agreement with the site at Bunárbashi, while they are hopelessly incompatible with Hissarlik. The *Iliad* makes it clear that the general description of the Trojan plain was founded on accurate knowledge. At this day all the essential Homeric features can be recognized. And it is probable that the poet who created the Troy of the *Iliad* knew, personally or by description, a strong town on the Bali Dagh above Bunárbashi. The legend of the siege may or may not have arisen from an older town at Hissarlik, which had then disappeared. The poet might naturally place his Troy in a position like that of the existing strong city on the Bali Dagh, giving it a "beetling" acropolis and handsome buildings, while he also reproduced the general course of the rivers and that striking feature,—an indelible mark of the locality,—the natural springs at the foot of the hill, just beyond the city gates on the north-west. But, while he thus imagined his Troy in the general likeness of the town on the Bali Dagh, he would retain the privilege of a poet who was adorning an ancient legend, and whose theme was a city that had long ago vanished. Instead of feeling bound to observe a rigorous accuracy of local detail, he would rather feel impelled to avoid it; he would use his liberty to introduce some traits borrowed from other scenes known to him, or even from imagination. To this extent, and in this sense, his topography would be eclectic. Such a consideration might suffice to explain the fact, well known to those who have studied this question on the spot, that neither Bunárbashi nor any other one site can be harmonized with every detail of the poem. The recommendations of Bunárbashi are, first, that it satisfies the capital and essential conditions, while no other site does so, and secondly, that the particular difficulties which it leaves unsolved are relatively slight and few. This character of Homeric topography becomes still easier to understand, if, as most critics would now concede, our *Iliad* contains work of various hands and ages. Few questions, perhaps, of equal literary interest have been so much confused by inattention to the first conditions of the problem. The tale of Troy, as the *Iliad* gives it, is essentially a poetical creation; and we have no evidence other than the *Iliad*. That is, our sole data are (1) of the mythical class, (2) of inadequate precision, and (3) of uncertain origin. But they show a general knowledge of the ground; and the question is how far particular features of the ground can be recognized in the poem. It may be doubted whether the case admits of any solution more definite than that which has been indicated above.

Bibliography.—1. Works dealing with the Troad generally,—Strabo, bk. xiii. ch. 1, is the principal source for the ancient Troad. Of books by modern travellers in Asia Minor the following may be mentioned:—Philip Barker Webb, in the Italian *Biblioteca Acerbi*, June and July, 1821, whose studies are better known through the French edition, *Topographie de la Troade*, 1844; W. M. Leake, *Journal of a Tour in Asia Minor*, London, 1824; P. de Tchihatchef, *Asie Mineure*, &c., Paris, 1853-69; R. Virchow, "Beiträge zur Landeskunde der Troas," in *Trans.* of Berlin Acad., 1879; H. F. Tozer, *The Highlands of Turkey*, 1869; H. Schliemann, *Reise der Troas im Mai*, 1881; Joseph T. Clarke, *Report on the Investigations at Assos*, Boston, U.S.A., and London, 1882, including "Notes on the Geology and Topography of the Troad" by J. S. Diller, and on "Bunárbashi," &c., by W. C. Lawton and C. H. Walker. J. T. Clarke's "Notes on Greek Shores," in the *Report* of the Archæological Institute of America for 1880, are also valuable.

2. For the question as to the site of Troy, see—Lechevalier, *Voyage de la Troade*, Paris, 1802; Gustave D'Eichthal, *Le Site de Troie selon Lechevalier*, &c., Paris, 1875; H. Schliemann's *Troy* (1875), *Ilios* (1880), *Troja* (1884), which contain many good plans and illustrations; E. Brentano, *Zur Lösung der troianischen Frage*, Heilbronn, 1881, and *Troia und Neu-Ilion*, *ibid.*, 1882; R. C. Jebb, "Schliemann's Ilios," in *Edinb. Rev.*, No. cccxiv., April, 1881; Id., "Homeric and Hellenic Ilium," in *Journ. of Hellenic Studies*, vol. ii. pp. 7-43, 1881; Id., "The Ruins at Hissarlik," *ibid.*, iii. 185-217, 1882; Id., "Homeric Troy," in *Fortnightly Review*, April, 1884; G. Nikolaides, Ἰλιάδος Στρατηγικὴ Διασκευή, Athens, 1883; P. W. Forchhammer, *Erklärung der Ilias, auf Grund der in der beigegebenen Original-Karte von Spratt and Forchhammer dargestellten topischen und physischen Eigenthümlichkeiten der Troischen Ebene*, Kiel, 1884; and W. J. Stillman, "Les Découvertes de Schliemann," in the journal *L'Homme*, Paris, October, 1884. (R. C. J.)

LEGEND OF TROY.

According to Greek legend, the oldest town in the Troad was that founded by Teucer, who was a son of the river Scamander and the nymph Idæa. Tzetzes says that the Scamander in question was the Scamander in Crete, and that Teucer was told by an oracle to settle wherever the "earth-born ones" attacked him. So when he and his company were attacked in the Troad by mice, which gnawed their bow-strings and the handles of their shields, he settled on the spot, thinking that the oracle was fulfilled. He called the town Sminthium and built a temple to Apollo Sminthius, the Cretan word for a mouse being *sminthius*. In his reign Dardanus, son of Zeus and the nymph Electra, daughter of Atlas, in consequence of a deluge, drifted from the island of Samothrace on a raft or a skin bag to the coast of the Troad, where, having received a portion of land from Teucer and married his daughter Batea, he founded the city of Dardania or Dardanus on high ground at the foot of Mount Ida. On the death of Teucer, Dardanus succeeded to the kingdom and called the whole land Dardania after himself. He begat Erichthonius, who begat a son Tros by Astyoche, daughter of Simois. On succeeding to the throne, Tros called the country Troy and the people Trojans. By Callirrhoe, daughter of Scamander, he had three sons,—Ilus, Assaracus, and Ganymede. From Ilus and Assaracus sprang two separate lines of the royal house,—the one being Ilus, Laomedon, Priam, Hector; the other Assaracus, Capys, Anchises, Æneas. Ilus went to Phrygia, where, being victorious in wrestling, he received as a prize from the king of Phrygia a spotted cow, with an injunction to follow her and found a city wherever she lay down. The cow lay down on the hill of the Phrygian Até; and here accordingly Ilus founded the city of Ilios. It is stated that Dardania, Troy, and Ilios became one city. Desiring a sign at the foundation of Ilios, Ilus prayed to Zeus and as an answer he found lying before his tent the Palladium, a wooden statue of Pallas, three cubits high, with her feet joined, a spear in her right hand, and a distaff and spindle in her left. Ilus built a temple for the image and worshipped it. By Eurydice, daughter of Adrastus, he had a son Laomedon. Laomedon married Strymo, daughter of Scamander, or Placia, daughter of Atreus or of Leucippus. It was in his reign that Poseidon and Apollo, or Poseidon alone, built the walls of Troy. In his reign also Hercules besieged and took the city, slaying Laomedon and his children, except one daughter Hesione and one son Podarces. The life of Podarces was granted at the request of Hesione; but Hercules stipulated that Podarces must first be a slave and then be redeemed by Hesione; she gave her veil for him; hence his name of Priam (from *priasthai* to buy). Priam married first Arisbe and afterwards Hecuba and had fifty sons and twelve daughters. Among the sons were Hector and Paris, and among the daughters Polyxena and Cassandra. To recover Helen, whom Paris carried off from Sparta, the Greeks under Agamemnon besieged Troy for ten years. (See ACHILLES, AGAMEMNON, AJAX, HECTOR, HELEN, PARIS.) At last they contrived a wooden horse, in whose hollow belly many of the Greek heroes hid themselves. Their army and fleet then withdrew to Tenedos, feigning to have raised the siege. The Trojans conveyed the wooden horse into Troy; in the night the Greeks stole out, opened the gates to their returning friends, and Troy was taken.

See Homer, *Il.*, vii. 452 *sq.*, xx. 215 *sq.*, xxi. 446 *sq.*; Apollodorus, ii. 6, 4, iii. 12; Diodorus, iv. 75, v. 48; Tzetzes, *Schol. on Lycophron*, 29, 72, 1302; Conon, *Narrat.*, 21; Dionysius Halicarn., *Antiq. Rom.*, i. 68 *sq.* The Iliad deals with a period of fifty-one days in the tenth year of the war. For the wooden horse, see Homer, *Od.*, iv. 271 *sq.*; Virgil, *Æn.*, ii. 13 *sq.*

TROGLODYTES (τρωγλοδύται), a Greek word meaning "cave-dwellers." Caves have been widely used as human habitations both in prehistoric and in historic times (see CAVE), and ancient writers speak of Troglodytes in various parts of the world, as in Mœsia near the lower Danube (Strabo, vii. 5, p. 318), in the Caucasus (Id., xi. 5, p. 506), but especially in various parts of Africa from Libya (Id., xvii. 3, p. 828) to the Red Sea. Herodotus (iv. 183) tells of a race of Troglodyte Ethiopians in inner Africa, very swift of foot, living on lizards and creeping things, and with a speech like the screech of an owl. The Garamantes hunted them for slaves. It has been supposed that these Troglodytes may be Tibbus, who still in part are cave-dwellers. Aristotle also (*Hist. An.*, vii. 12) speaks of a dwarfish race of Troglodytes on the upper course of the Nile, who possessed horses and were in his opinion the Pygmies of fable. But the best known of these African cave-dwellers were the inhabitants of the "Troglodyte country" on the coast of the Red Sea, who reached as far north as the Greek port of Berenice, and of whose strange and savage customs an interesting account has been preserved by Diodorus and Photius from Agatharchides.[1] They were a pastoral people, living entirely on the flesh of their herds, or, in the season of fresh pasture, on mingled milk and blood. But they killed only old or sick cattle (as indeed they killed old men who could no longer follow the flock), and the butchers were called "unclean"; nay, they gave the name of parent to no man, but only to the cattle of which they had their subsistence. This last point seems to be a confused indication of totemism. They went almost naked; the women wore necklaces of shells as amulets. Marriage was unknown, except among the chiefs, —a fact which agrees with the prevalence of female kinship in these regions in much later times. They practised circumcision or a mutilation of a more serious kind. The whole account, much of which must be here passed by, is one of the most curious pictures of savage life in ancient literature.

The Biblical Horim, who inhabited Mount Seir before the Edomites, bore a name which means cave-dwellers, and may probably have been a kindred people to the Troglodytes on the other side of the Red Sea. Jerome, on Obadiah 5, speaks of this region as containing many cave-dwellings, and such habitations are still sometimes used on the borders of the Syro-Arabian desert.

TROGON, a word apparently first used as English[2] by Shaw (*Mus. Leverianum*, p. 177) in 1792, and now for many years accepted as the general name of certain birds forming the Family *Trogonidæ* of modern ornithology, the species *Trogon curucui* of Linnæus being its type. But, since doubts exist as to whether this is that which was subsequently called by Vieillot *T. collaris* or the *T. melanurus* of Swainson, though evidence is in favour of the former (*cf.* Cabanis, *Mus. Heineanum*, iv. p. 177, and Finsch, *Proc. Zool. Society*, 1870, p. 559), several recent writers have dropped the Linnæan specific term.

The Trogons are birds of moderate size: the smallest is hardly bigger than a Thrush and the largest less bulky than a Crow. In most of them the bill is very wide at the gape, which is invariably beset by recurved bristles. They seize most of their food, whether caterpillars or fruits, on the wing, though their alar power is not exceptionally great, their flight being described as short, rapid, and spasmodic. Their feet are weak and of a unique structure, the second toe, which in most birds is the inner anterior one, being reverted, and thus the Trogons stand alone, since in all other birds that have two toes before and two behind it is the outer toe that is turned backward. The plumage is very remarkable and characteristic. There is not a species which has not beauty beyond most birds, and the glory of the group culminates in the QUEZAL (*q.v.*). But in others golden green and steely blue, rich crimson[3] and tender pink, yellow varying from primrose to amber, vie with one another in vivid coloration, or contrasted, as happens in many species, with a warm tawny or a sombre slaty grey—to say nothing of the delicate freckling of black and white, as minute as the markings of a moth's wing—the whole set off by bands of white, producing an effect hardly equalled in any group. It is impossible within brief space to describe its glowing tints; but the plumage is further remarkable for the large size of its contour-feathers, which are extremely soft and so loosely seated as to come off in scores at a touch, and there is no down. The tail is generally a very characteristic feature, the rectrices, though in some cases pointed, being often curiously squared at the tip, and when this is the case they are usually barred ladder-like with white and black.[1] According to Gould, they are larger and more pointed in the young than in the old, and grow squarer and have the white bands narrower at each succeeding moult. He also asserts that in the species which have the wing-coverts freckled, the freckling becomes finer with age. So far as has been observed, the nidification of these birds is in holes of trees, wherein are laid without any bedding two roundish eggs, generally white, but certainly in one species (Quezal) tinted with bluish green.

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[1] See also Artemidorus in Strabo, xvi. 17, p. 785 *sq.*

[2] *Trogonem* (the oblique case) occurs in Pliny (*H. N.*, x. 16) as the name of a bird of which he knew nothing, save that it was mentioned by Hylas, an augur, whose work is lost; but some would read *Trygonem* (Turtle-Dove). In 1752 Möhring (*Av. Genera*, p. 85) applied the name to the "Curucui" (pronounced "Suruquá" *fide* Bates, *Nat. Amazons*, i. p. 254) of Marcgrave (*Hist. Nat. Brasiliæ*, p. 211), who described and figured it in 1648 recognizably. In 1760 Brisson (*Ornithologie*, iv. p. 164) adopted *Trogon* as a generic term, and, Linnæus having followed his example, it has since been universally accepted.

[3] M. Anatole Bogdanoff determined the red pigment of the feathers

The Trogons form a very well-marked Family, belonging to the multifarious group treated in the present series of articles as *Picariæ*; but, instead of being (so far as is known) like all the rest of them and, as Prof. Huxley believed, "desmognathous," they have been shown by W. A. Forbes (*Proc. Zool. Society*, 1881, p. 836) to be "schizognathous"—thus demonstrating, in the words of the latter, "that the structure of the palate has not that unique and peculiar significance that has been claimed for it in the classification of birds." Perhaps the explanation of this anomaly may lie in the fact that the Trogons are a very old form. The remains of one, *T. gallicus*, have been recognized by Prof. A. Milne-Edwards (*Ois. foss. de la France*, ii. p. 395, pl. 177, figs. 18-22) from the Miocene of the Allier, and it may not be too much to suppose that the schizognathous structure was more ancient than the desmognathous. Again too this fortunate discovery of that eminent palæontologist seems to account for the remarkable distribution of the Trogons at the present day. While they chiefly abound, and have developed their climax of magnificence, in the tropical parts of the New World, they yet occur in the tropical parts of the Old. The species now inhabiting Africa, forming the group *Hapaloderma*, can hardly be separated generically from those of the Neotropical *Trogon*, and the difference between the Asiatic forms, if somewhat greater, is still comparatively slight. It is plain then that the Trogons are an exceptionally persistent type; indeed in the whole Class few similar instances occur and perhaps none that can be called parallel. The extreme development of the type in the New World just noticed also furnishes another hint. While in some of the American Trogons (*Pharomacrus*, for instance) the plumage of the females is not very much less beautiful than that of the males, there are others in which the hen birds retain what may be fairly deemed a more ancient livery, while the cocks flaunt in brilliant attire. Now the plumage of both sexes in all but one[2] of the Asiatic Trogons, *Harpactes*, resembles rather that of the young and of those females of the American species which are modestly clothed. The inference from this fact would seem to be that the general coloration of the Trogons prior to the establishment, by geographical estrangement, of the two types was a russet similar to that now worn by the adults of both sexes in the Indian region, and by a portion only of the females in the Neotropical. The Ethiopian type, as already said, very closely agrees with the American, and therefore would be likely to have been longer in connexion therewith. Again, while the adults of most of the American Trogons (*Pharomacrus* and *Euptilotis* excepted) have the edges of the bill serrated, their young have them smooth or only with a single notch on either side near the tip, and this is observable in the Asiatic Trogons at all ages. At the same time the most distinctive features of the whole group, which are easily taken in at a glance, but are difficult to express briefly in words, are equally possessed by both branches of the Family, showing that they were in all likelihood—for the possibility that the peculiarities may have been evolved apart is not to be overlooked—reached before the geographical sundering of these branches (whereby they are now placed on opposite sides of the globe) was effected.

It remains to say that about sixty species of Trogons are recognized, which Gould in the second edition of his *Monograph* of the Family (1875) divides into seven genera; but their characters are hardly laid down. *Pharomacrus*, *Euptilotis*, and *Trogon* inhabit the mainland of tropical America, no species passing to the northward of the Rio Grande nor southward of the forest district of Brazil, while none occur on the west coast of Peru or Chili. *Prionotelus* and *Temnotrogon*, each with one species, are peculiar respectively to Cuba and Hispaniola. The African form *Hapaloderma* has two species, one found only on the west coast, the other of more general range. The Asiatic Trogons, *Harpactes* (with eleven species according to the same authority), occur from Nepal to Malacca, in Ceylon, and in Sumatra, Java, and Borneo, while one species is peculiar to some of the Philippine Islands. (A. N.)

TROGUS, Cn. Pompeius, a Roman historian, nearly contemporary with Livy. Although the epitome of his historical writings by Justin, and a few fragments, are all that have come down to us, there is abundant reason to believe that he deserved a place in the history of Roman literature by the side of Sallust, Livy, and Tacitus. Of his life little is known. He was almost certainly of Greek descent. His grandfather served with Pompey in the war against Sertorius, and received through the influence of that general the Roman citizenship; hence the name Pompeius, which was adopted as a token of gratitude to the benefactor. The father of Trogus was an officer of Cæsar. Trogus himself seems to have been a man of encyclopædic knowledge. He wrote, after Aristotle and Theophrastus, books on the natural history of animals and plants, used by the elder Pliny, who calls Trogus "one of the most precise among authorities" (*auctor ipse e severissimis*). But the principal work of Trogus consisted of forty-four *Libri Historiarum Philippicarum*. This was a great history of the world, or rather of those portions of it which came under the sway of Alexander and his successors. The tale began with Ninus, the founder of Nineveh, and ceased at about the same point as Livy's great work, viz., 9 A.D. The last event recorded by the epitomator Justin (*q.v.*) is the recovery of the Roman standards captured by the Parthians (20 B.C.). The history of Rome was treated as merely subsidiary to that of Greece and the East. The work was based upon the writings of Greek historians, such as Theopompus, Ephorus, Timæus, Polybius. It has been contended that Trogus did not gather together the information from the leading Greek historians for himself, but that it was already combined into a single book by some Greek, whom Trogus followed closely with some superficial errors. But the assumption appears improbable in itself, merely on a review of the remains of the historical writings, and is moreover inconsistent with what we know of the works in natural history, for which Trogus certainly went back to what were regarded in his time as first-hand authorities. It is generally admitted that Trogus had genuine qualifications for writing history, though he could not rid himself entirely of the faults of his authorities. His idea of history was more severe and less rhetorical than that followed by Sallust and Livy, whom he blamed for putting elaborate speeches in the mouths of the characters of whom they wrote. Yet his own Latin style had a vivid force which is still to be recognized in the extracts made by Justin. For the ancient history of the East, Trogus, even in the present mutilated state of his historical work, often proves to be an authority of great importance.

The chief modern editions are those of Gronovius (Leyden, 1719 and 1760); Frotscher (Leipsic, 1827-30); and Jeep (Leipsic, 1859 and 1862). In Engelmann's *Bibliotheca Scriptorum Classicorum*, ii., under Justin and Trogus, will be found a large number of references to scattered modern articles. Perhaps the most important is that of A. v. Gutschmid on the sources of the history of Trogus, in the second supplementary vol. of the *Jahrbb. f. class. Philol.* (Leipsic, 1857).

TROITSK, a district town of Russia, in the government of Orenburg, situated in a fertile steppe 392 miles to the

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of *Pharomacrus auriceps* to be a substance which he called "zooxanthine" (*Comptes Rendus*, 2d November 1857, xlv. p. 690).

[1] In the Trogon of Cuba, *Prionotelus*, they are most curiously scooped out, as it were, at the extremity, and the lateral pointed ends diverge in a way almost unique among birds.

[2] Or two species if *H. macloti* be more than a local form of *H. reinwardti*.

north-east of Orenburg, on the Siberian highway, is one of those towns which have grown rapidly of late in the south-east of Russia. The Troitskiy fort, erected in 1743, became a centre for the exchange trade with the Kirghiz steppe and Turkestan, and in that trade Troitsk is now second only to Orenburg. Cotton, silk, and especially horses and cattle are imported, while leather, cotton, and woollen and metal wares are exported. An active trade in corn for the Ural gold-mines is carried on. The population in 1884 was 13,000.

TROLLOPE, ANTHONY (1815-1882), English novelist, was born in Keppel Street, Russell Square, London, according to most authorities, on 24th April 1815; in his own *Autobiography* he merely gives the year. His father, a barrister, who had been fellow of New College, Oxford, brought himself and his family into the sorest straits by unbusiness-like habits, by quarrelling with his profession, or at least with the attorneys, and by injudicious speculations, especially in farming. Trollope's mother, Frances Milton, according to her son, was nearly thirty when she married in 1809. By her husband's wish she made a strange journey to America in 1827, for the purpose of setting up a kind of fancy shop in Cincinnati, which failed utterly. Her visit, however, furnished her with the means of writing *The Domestic Manners of the Americans*. This at once brought her in a considerable sum, and thenceforward she continued to be the mainstay of her family. Her husband being obliged at last actually to fly the country from his creditors, his wife maintained him by her pen, at Bruges, till his death there in 1835. For some time Mrs Trollope wrote chiefly travels; but she soon became known as a novelist, and was very industrious. Her novels, the best of which are probably *The Vicar of Wrexhill* and *The Widow Barnaby*, are now rarely read, and indeed were never at their best above good circulating library level: they are written with cleverness indeed, and a certain amount of observation, but with many faults of taste, and with an almost total want of artistic completeness and form. Her late beginning, her industrious career (for she wrote steadily for more than thirty years, till her death in October 1863, at Florence), and the entire absence in her of any blue-stocking or *femme-savante* weakness would have made her remarkable, even if she had not transmitted, as she undoubtedly did transmit, her talent, much increased, to her children.

Anthony Trollope was the third son. By his own account few English men of letters have had an unhappier childhood and youth. He puts down his own misfortunes, at Harrow, at Winchester, at Harrow again, and elsewhere, to his father's pecuniary circumstances, which made his own appearance dirty and shabby, and subjected him to various humiliations. But it is permissible to suspect that this was not quite the truth, and that some peculiarities of temper, of which in after life he had many, contributed to his unpopularity. At any rate he seems to have reached the verge of manhood as ignorant as if he had had no education at all. While living abroad he tried ushership; but at the age of nineteen he was pitchforked by favour (for he could not pass even the ridiculous examination then usual) into the post-office. Even then his troubles were not over. He got into debt; he got into ridiculous entanglements of love affairs, which he has very candidly avowed; he was in constant hot water with the authorities; and he seems to have kept some very queer company, which long afterwards stood him in stead as models for some of his novel pictures. At last in August 1841 he obtained the appointment of clerk to one of the post-office surveyors in a remote part of Ireland, with a very small nominal salary. This salary, however, was practically quadrupled by allowances; living was cheap; and the life suited Trollope exactly, being not office work, which he always hated, but a kind of travelling inspectorship. And here he not only began that habit of hunting which (after a manner hardly possible in the stricter conditions of official work nowadays) he kept up for many years even in England, but within three years of his appointment engaged himself to Miss Rose Heseltine, whom he had met in Ireland but who was of English birth. They were married in June 1844. His headquarters had previously been at Banagher; he was now transferred to Clonmel.

Trollope had always dreamt of novel-writing, and his Irish experiences seemed to supply him with promising subjects. With some assistance from his mother he got his first two books, *The Macdermots of Ballycloran* and *The Kellys and the O'Kellys*, published, the one in 1847, the other the next year. But neither was in the least a success, though the second perhaps deserved to be; and a third, *La Vendée*, which followed in 1850, besides being a much worse book than either, was an equal failure. Trollope made various other literary attempts, but for a time ill fortune attended all of them. Meanwhile he was set on a new kind of post-office work, which suited him even better than his former employment—a sort of roving commission to inspect rural post deliveries and devise their extension, first in Ireland, then throughout the west of England and South Wales. That he did good work is undeniable; but his curious conception of official duty (on his discharge of which he prided himself immensely) is exhibited by his confessions that he "got his hunting out of it," and that he felt "the necessity of travelling miles enough [he was paid by mileage] to keep his horses." It was during this work that he struck the vein which gave him fortune and fame—which might perhaps have given him more fame and not much less fortune if he had not worked it so hard—by conceiving *The Warden*. This was published in 1855. It brought him little immediate profit, nor was even *Barchester Towers*, which followed, very profitable, though it contains his freshest, his most original, and, with the exception of *The Last Chronicle of Barset*, his best work. The two made him a reputation, however, and in 1858 he was able for the first time to sell a novel, *The Three Clerks*, for a substantial sum, £250. A journey on post-office business to the West Indies gave him material for a book of travel, *The West Indies and the Spanish Main*, which he frankly and quite truly acknowledges to be much better than some subsequent work of his in the same kind. From this time his production (mainly of novels) was incessant, and the sums which he received were very large, amounting in one case to as much as £3525 for a single book, and to nearly £70,000 in the twenty years between 1859 and 1879. All these particulars are given with great minuteness by himself, and are characteristic. The full high tide of his fortunes began when the *Cornhill Magazine* was established in the autumn of 1859. He was asked at short notice to write a novel, and wrote *Framley Parsonage*, which was extremely popular; two novels immediately preceding it, *The Bertrams* and *Castle Richmond*, had been much less successful.

As it will be possible to notice few of his subsequent works in detail, the list of them, a sufficiently astonishing one, may be given here:—*Tales of All Countries* (3 series, 1861-1870); *Orley Farm*, *North America* (1862); *Rachael Ray* (1863); *The Small House at Allington*, *Can You Forgive Her?* (1864); *Miss Mackenzie* (1865); *The Claverings*, *Nina Balatka*, *The Last Chronicle of Barset* (1867); *Linda Tressel* (1868); *Phineas Finn*, *He Knew He Was Right* (1869); *Brown, Jones, and Robinson*, *The Vicar of Bullhampton*, *An Editor's Tales*, *Cæsar* (1870); *Sir Harry Hotspur of Humblethwaite*, *Ralph the Heir* (1871); *The Golden Lion of Granpere* (1872); *The Eustace Diamonds*, *Australia and New Zealand* (1873); *Phineas Redux*, *Harry Heathcote of Gangoil*, *Lady Anna* (1874); *The Way We Live Now* (1875); *The Prime Minister* (1876); *The American Senator* (1877); *Is He Popenjoy?* *South Africa* (1878); *John Caldigate*, *An Eye for* an *Eye*, *Cousin Henry*, *Thackeray* (1879); *The Duke's Children*, *Cicero* (1880); *Ayala's Angel*, *Dr Wortle's School* (1881); *Frau Frohmann*, *Lord Palmerston*, *The Fixed Period*, *Kept in the Dark*, *Marion Fay* (1882); *Mr Scarborough's Family*, *The Land Leaguers* (1883); and *An Old Man's Love* (1884).

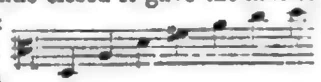
How this enormous total was achieved in spite of official work (of which, lightly as he took it, he did a good deal, and which he did not give up for many years), of hunting three times a week in the season, of whist-playing, of not a little going into general society, he has explained with his usual curious minuteness. He reduced novel-writing to the conditions of regular mechanical work—so much so that latterly he turned out so many words in a quarter of an hour, and wrote at this rate so many hours a day. He divided every book beforehand into so many days' work and checked off the tallies as he wrote.

A life thus spent could not be very eventful, and its events may be summed up rapidly. In 1858 he went to Egypt also on post-office business, and at the end of 1859 he got himself transferred from Ireland to the eastern district of England. Here he took a house at Waltham. He took an active part in the establishment of *The Fortnightly Review* in 1865; he was editor of *St Paul's* for some time after 1867; and at the end of that year he resigned his position in the post-office. He stood for Beverley and was defeated; he received from his old department special missions to America and elsewhere (he had already gone to America in the midst of the Civil War). He went to Australia in 1871, and before going broke up his household at Waltham. When he returned he established himself in London, and lived there till 1880, when he removed to Harting on the confines of Sussex and Hampshire. He had visited South Africa in 1877 and travelled elsewhere. On 3rd November 1882 he was seized with paralysis, and died on 6th December.

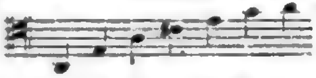
Of Trollope's personal character it is not necessary to say much. Strange as his conception of official duty may seem, it was evidently quite honest and sincere, and, though he is said to have been as an official popular neither with superiors nor inferiors, he no doubt did much good work. Privately he was much liked and much disliked,—a great deal of real kindness being accompanied by a blustering and overbearing manner, and an egotism, not perhaps more deep than other men's, but more vociferous. His literary work needs more notice. Nothing of it but the novels is remarkable for merit. His *Cæsar* and the *Cicero* are curious examples of a man's undertaking work for which he was not in the least fitted. *Thackeray* exhibits (though Trollope appears to have both admired Thackeray as an artist and liked him as a man) grave faults of taste and judgment and a complete lack of real criticism. The books of travel are not good, and of a kind not good. *Nina Balatka* and *Linda Tressel*, published anonymously and as experiments in the romantic style, have been better thought of by the author and by some competent judges than by the public or the publishers. *Brown, Jones, and Robinson* was still more disliked, and is certainly very bad as a whole, but has touches of curious originality in parts. The rest of the novels have been judged very differently by different persons. There is no doubt that their enormous volume prejudiced readers against them even long before the author let the public into the secret of their manufacture, which has made the prejudice deeper. There is also no doubt that Trollope seldom or never creates a character of the first merit (Mr Crawley in the *Last Chronicle of Barset* is the one possible exception), and that not one of his books can be called a work of genius. At the same time no one probably has produced anything like such a volume of anything like such merit. He claims for himself that his characters are always more or less alive, and they are. After his first failures he never produced anything that was not a faithful and sometimes a very amusing transcript of the sayings and doings of possible men and women. His characters are never marionettes, much less sticks. He has some irritating mannerisms, notably a trick of repetition of the same form of words. He is sometimes absolutely vulgar,—that is to say, he does not deal with low life, but shows, though always robust and pure in morality, a certain coarseness of taste. He is constantly rather trivial, and perhaps nowhere out of the Barset series (which, however, is of itself no inconsiderable work) has he produced books that will live. The very faithfulness of his representation of a certain phase of thought, of cultivation, of society, uninformed as it is by any higher spirit, in the long run damaged, as it had first helped, the popularity of his work. But, allowing for all this, it may and must still be said that he held up his mirror steadily to nature, and that the mirror itself was fashioned with no inconsiderable art. (G. SA.)

TROMBONE, a musical instrument of brass. It has a cupped mouthpiece, and is formed of two principal parts—the bell, the bore of which gradually widens, and the slide, which is composed of two cylindrical tubes parallel to each other, upon which two other tubes, communicating at their lower extremities by a pipe curved in a half-circle, glide without loss of air. The mouthpiece is adapted to one of the upper ends of the slide and the bell to the other end. When the slide, which is moved by the right hand, is closed, the instrument is at its highest pitch; the note is lowered in proportion as the column of air is lengthened by drawing out the slide.

Formerly the trombone was known as the *sackbut*; its modern designation—great trumpet—comes from the Italian. The Germans call it *posaune*. It is difficult to say where or at what epoch the instrument was invented. In a manuscript of the 9th century, preserved at Boulogne, there is a drawing of an instrument which bears a great resemblance to a trombone deprived of its bell. Virdung[1] says little about the trombone, but he gives an engraved representation of it, under the name of *busaun*, which shows that early in the 16th century it was almost the same as that employed in our day. By that time the trombone had come into vogue in England: the band of musicians in the service of Henry VIII. included ten sackbut players, and under Elizabeth, in 1587, there were six. English instrumentalists then enjoyed a certain reputation and were sought for by foreign courts; thus in 1604 Charles III. of Lorraine sought to recruit his sackbut players from English bands. Prætorius[2] classes the trombones in a complete family, the relative tonalities of which were thus composed:—1 *alt-posaun*, 4 *gemeine rechte posaunen*, 2 *quart-posaunen*, 1 *octav-posaun*,—8 in all. The alt-posaun was in D With the slide closed it gave the first of the accompanying harmonics:



The gemeine rechte posaunen, or ordinary trombones, were in A. Without using the slide they gave the subjoined sounds:



The quart-posaun was made either in E, the fourth below the gemeine rechte posaun, or in D, the lower fifth. In the latter case it was exactly an octave below the alt-posaun. The octav-posaun was in A. It was constructed in two different fashions: either it had a length double that of the ordinary trombone, or the slide was shortened, the length of the column of air being still maintained by the adaptation of a crook. The first system, which was invented by Hans Schreiber four years before the work of Prætorius appeared, gave the instrumentalist a slide by which he could procure in the lower octave all the sounds of the ordinary trombone. The second system, which Prætorius had known for years, was distinguished from the first, not only by modifications affecting the form, but also by a larger bore. Mersenne[3] calls the trombone *trompette harmonique*, but he does not appear to have made himself acquainted with its construction, for we can scarcely find an allusion in the confused text of his work to the tonality of the trombone then in vogue. He established this fact, however, that it was customary in France to lower the instrument a fourth below the pitch of the ordinary trombone by means of a *tortil*, a kind of crook with a double turn that was fitted between the bell and the slide, "in order," he said, "to make the bass to hautbois concerts."

The compass of the trombone is not limited to the mere harmonics obtained by leaving the instrument at its shortest length—that is, with the slide close up; it in fact comprises seven positions, which are obtained by shifting the slide as many lengths and in such a way that each of these produces a series of harmonics a semitone lower than the length which has preceded. This system, so simple and rational, might have been expected always to serve for the basis of the technique of the instrument; but from the middle of the 18th century the art of playing the trombone became the object of purely empiric teaching. Only four positions were made use of.[1] By the first—that is, with the slide close up—there was obtained from the ordinary trombone, then called the tenor trombone, the first series of the subjoined harmonics (the numerals indicating the order):

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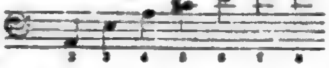
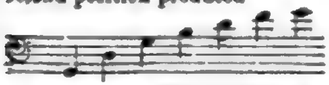
[1] *Musica getutscht und ausgezogen*, Basel, 1511.

[2] *Organographia*, Wolfenbuttel, 1619.

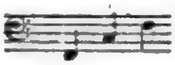
[3] *Harmonie Universelle*, Paris, 1627.



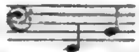
the fundamental or first note being difficult to obtain; the second position produced



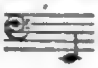
the third position produced



and the fourth



In thus lowering by semitones, the sounds furnished by the four positions gave the tenor trombone a diatonic scale from



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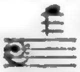
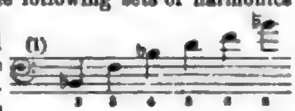
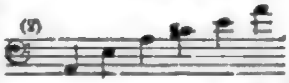
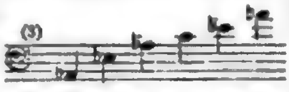


This scale was formed with notes that could be perfectly just, but the result would have been less satisfactory to the ear if the player had strictly observed the rules laid down by the teaching of that period for the production of the chromatic intervals. Thus to pass from a note furnished by one of the four positions to another a semitone lower it was necessary to lengthen the slide by two fingers; if the semitone higher was required the slide had to be shortened to the same extent.[2] A consideration of the laws affecting lengths of pipes will show the viciousness of that rule.

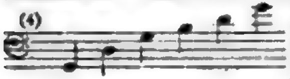
Of all wind instruments the trombone has perhaps been least modified in form; changes have occasionally been attempted, but for the most part with only trifling success. The innovation which has had the most vogue dates from the end of the 18th century; it consisted in bending the tube of the bell in a half circle above the head of the executant, which produced a very bizarre effect. It also gave rise to very serious inconveniences: by destroying the regularity of the proportions of the bell it prejudicially affected the quality of tone and intonation of the instrument. For a long time the curved bell with its serpent's mask was maintained in military music, and it is only about twenty years ago that it was completely given up. By giving a half turn more to the bell tube its opening was directed to the back of the executant; but this form, in fashion for a little while about 1830, was not long adhered to, and the trombone reassumed its primitive form, which is still maintained. As appears from a patent deposited by Stölzel and Blümel at Berlin on 12th April 1818, the application of ventils or pistons was then made for the first time.[3] The ventils, at first two in number, effected a decided lengthening of the instrument. The first augmented the length of the tube by a tone, lowering by as much the natural harmonics. The second produced a similar effect for a semitone, and the simultaneous employment of the two pistons resulted in the depression of a tone and a half. The principle, therefore, of the employment of ventils or pistons is the same as that which governs the use of slides. For instance, a trombone is provided with three pistons, and without their help it produces the first of the following sets of harmonics (the numbers indicating the order).



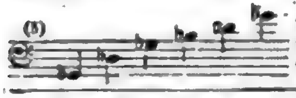




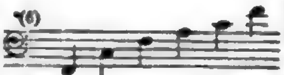
Then by pressing down the second piston we obtain a lengthening of the column of air that lowers the instrument by a semitone and makes it produce the second set of harmonics here shown; with the aid of the first piston we relengthen the column, so as to get a whole tone lower, producing the third set of sounds; the third piston, in the same way, lowers the instrument a tone and a half, as in



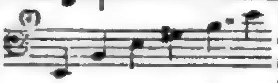
(4); by the simultaneous employment of the second and third pistons we arrive at two tones, as in (5);



the combination of the first and third pistons lowers the instrument two tones and a half, as shown in (6);



finally, uniting the three pistons lowers the trombone three tones and a half, as shown in (7).



Notwithstanding the increased facility obtained by the use of pistons, they are very far from having gained the suffrages of all players: many prefer the slide, believing that it gives a facility of emission that they cannot obtain with a piston trombone. For this illustration of the use of pistons, we have taken a tenor trombone in B♭; the flat tonalities having been preferred for military music since the commencement of the 19th century, the pitch of each variety of trombones has been raised a semitone. At present six trombones are more or less in use, viz., the alto trombone in F, the alto in E♭ (formerly in D), the tenor in B♭ (formerly in A), the bass in G, the bass in F (formerly in E), the bass in E♭ (formerly in D). This transposition has no reference to the number of vibrations that may be officially or tacitly adopted as the standard pitch of any country or locality. A trombone an octave lower than the tenor has recently been reintroduced into the orchestra, principally by Wagner. The different varieties just cited are constructed with pistons or slides, as the case may be. (V. M.)

TROMP, the name of two famous Dutch admirals.

I. Martin Harpertzoon Tromp (1597-1653) was born at Brielle, South Holland, in 1597. At the age of eight he made a voyage to the East Indies in a merchantman, but was made prisoner and spent several years on board an English cruiser. On making his escape to Holland he entered the navy in 1624, and in 1637 was made lieutenant-admiral. In February 1639 he surprised, off the Flemish coast near Gravelines, a large Spanish fleet, which he completely destroyed, and in the following September he defeated the combined fleets of Spain and Portugal off the English coast—achievements which placed him in the first rank of Dutch naval commanders. On the outbreak of war with England Tromp appeared in the Downs in command of a large fleet and anchored off Dover. On the approach of Blake he weighed anchor and stood over towards France, but suddenly altered his course and bore down on the English fleet, which was much inferior to his in numbers. In the engagement which followed (19th May 1652) he had rather the worst of it and drew off with the loss of two ships. In November he again appeared in command of eighty ships of war, and a convoy of 300 merchantmen, which he had undertaken to guard past the English coast. Blake resolved to attack him, and, the two fleets coming to close quarters near Dungeness on the 30th November, the English, after severe losses, drew off in the darkness and anchored off Dover, retiring next day to the Downs, while Tromp anchored off Boulogne till the Dutch merchantmen had all passed beyond danger. The statement that he sailed up the Channel with a broom at his masthead in token of his ability to sweep the seas is probably mythical. In the following February (1653), while in charge of a large convoy of merchantmen, he maintained a running fight with the combined English fleets under Blake, Penn, and Monk off Portland to the sands of Calais, and, though baffling to some extent the purposes of the English, had the worst of the encounter, losing nine ships of war and thirty or forty merchantmen. On 3d June he fought an indecisive battle with the English fleet under Dean in the Channel, but the arrival of reinforcements under Blake on the following day enabled the English to turn the scale against him and he retired to the Texel with the loss of seventeen ships. Greatly discouraged by the results of the battle, the Dutch sent commissioners to Cromwell to treat for peace, but the proposal was so coldly received that war was immediately renewed, Tromp again appearing in the Channel towards the end of July 1653. In the hotly-contested conflict which followed with the English under Monk on the 29th Tromp was shot by a musket bullet through the heart. He was buried with great pomp at Delft, where there is a monument to his memory in the old church.

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[1] *Der sich selbst informirende Musicus*, Augsburg, 1762, by Johann Jacob Lotter.

[2] It need hardly be remarked that the higher semitone cannot be produced in the first position.

[3] This was mentioned in the Leipsic *Allgemeine musikalische Zeitung* in 1815, the merit of the invention being assigned to Heinrich Stölzel of Pless in Silesia.

II. Cornelius Tromp (1629-1691), the second son of the preceding, was born at Rotterdam on 9th September 1629. At the age of nineteen he commanded a small squadron charged to pursue the Algerian pirates. In 1652 and 1653 he served in Van Galen's fleet in the Mediterranean, and after the action with the English fleet off Leghorn, 13th March 1653, in which Van Galen was killed, Tromp was promoted to be rear-admiral. On 13th July 1665 his squadron was by a hard stroke of ill fortune defeated by the English under the duke of York. In the following year Tromp served under De Ruyter, and on account of De Ruyter's complaints of his negligence in the action of 5th August he was deprived of his command. He was, however, reinstated in 1673 by the stadtholder William, afterwards king of England, and in the actions of 7th and 14th June, against the allied fleets of England and France, manifested a skill and bravery which completely justified his reappointment. In 1675 he visited England, when Charles II. created him a baron. In the following year he was named lieutenant-admiral of the United Provinces. He died at Amsterdam, 29th May 1691, shortly after he had been appointed to the command of a fleet against France. Like his father he was buried at Delft.

See H. de Jager, *Het Geslacht Tromp*, 1883.

TROMSÖ, a town of Norway, capital of the amt of the same name and an episcopal see, stands on the eastern shore of a low fertile islet of the same name between Hvaloe and the mainland, in 69° 38′ N. lat. and 18° 55′ E. long. It consists principally of one wide street of wooden houses; the chief public buildings are the town-hall, the national church, the Roman Catholic church, and the museum, which contains a good zoological collection. The town has a high school and a normal seminary. The main specialty of the place is bears' skins and other kinds of fur. The herring fishery of Tromsö is very productive, and the activity of the town is further increased by the circumstance that it is the port of call for ships making for the seal fishing and walrus hunting on Spitzbergen and Nova Zembla. Tromsö was founded in 1794. The population, which in 1816 did not exceed 300, was 5409 in 1882.

TRONDHJEM. See Throndhjem.

TROPIC-BIRD, so called of sailors from early times,[1] because, as Dampier (*Voyages*, i. p. 53) among many others testifies, it is "never seen far without either Tropick," and hence, indulging a pretty fancy, Linnæus bestowed on it the generic term, continued by modern writers, of *Phaethon*, in allusion to its attempt to follow the path of the sun.[2] There are certainly three well-marked species of this genus, but their respective geographical ranges have not yet been definitely laid down. All of them can be easily known by their totipalmate condition, in which the four toes of each foot are united by a web, and by the great length of the two middle tail-quills, which project beyond the rest, so as to have gained for the birds the names of "Rabijunco," "Paille-en-queue," and "Pijlstaart" among mariners of different nations. These birds fly to a great distance from land and seem to be attracted by ships, frequently hovering round or even settling on the mast-head.

The Yellow-billed Tropic-bird, *P. flavirostris* or *candidus*, appears to have habitually the most northerly, as well, perhaps, as the widest range, visiting Bermuda yearly to breed there, but also occurring numerously in the southern Atlantic, the Indian, and a great part of the Pacific Ocean. In some islands of all these three it breeds, sometimes on trees, which the other species are not known to do. However, like the rest of its congeners, it lays but a single egg, and this is of a pinkish white, mottled, spotted, and smeared with brownish purple, often so closely as to conceal the ground colour. This is the smallest of the group, and hardly exceeds in size a large Pigeon; but the spread of its wings and its long tail make it appear more bulky than it really is. Except some black markings on the face (common to all the species known), a large black patch partly covering the scapulars and wing-coverts, and the black shafts of its elongated rectrices, its ground colour is white, glossy as satin, and often tinged with roseate. Its yellow bill readily distinguishes it from its larger congener *P. æthereus*, but that has nearly all the upper surface of the body and wings closely barred with black, while the shafts of its elongated rectrices are white. This species has a range almost equally wide as the last; but it does not seem to occur in the western part of the Indian Ocean. The third and largest species, the Red-tailed Tropic-bird, *P. rubricauda* or *phœnicurus*, not only has a red bill, but the elongated and very attenuated rectrices are of a bright crimson red, and when adult the whole body shows a deep roseate tinge. The young are beautifully barred above with black arrow-headed markings. This species has not been known to occur in the Atlantic, but is perhaps the most numerous in the Indian and Pacific Oceans, in which last great value used to be attached to its tail-feathers to be worked into ornaments.[3]

That the Tropic-birds form a distinct family, *Phaethontidæ*, of the *Steganopodes* (the *Dysporomorphæ* of Prof. Huxley), was originally maintained by Brandt, and is now generally admitted, yet it cannot be denied that they differ a good deal from the other members of the group[4]; indeed Prof. Mivart in the Zoological *Transactions* (x. p. 364) will hardly allow *Fregata* and *Phaethon* to be steganopodous at all; and one curious difference is shown by the eggs of the latter, which are in appearance so wholly unlike those of the rest. The osteology of two species has been well described and illustrated by Prof. Alph. Milne-Edwards in M. Grandidier's fine *Oiseaux de Madagascar* (pp. 701-704, pls. 279-281a). (A. N.)

TROPPAU (Slavonic *Opava*), the chief town of Austrian Silesia, is a busy commercial place on the right bank of the Oppa, close to the Prussian border. A well-built town with extensive suburbs, it has two market-places and contains six churches, an old town-house recently restored in the Gothic style, and numerous educational, benevolent, and commercial institutions. The site of the former fortifications is laid out in pleasant promenades. Troppau manufactures large quantities of cloth, especially for the army; and its industrial establishments include a large sugar-refinery and manufactories of machines and stoves. In 1880 the population was 20,562. German is spoken in the town proper, but a dialect of Polish prevails in the suburbs.

Troppau was founded in the 13th century; but almost its only claim to historical mention is the fact that in 1820 the monarchs of Austria, Russia, and Prussia met here to deliberate on the tendencies of the Neapolitan revolution. This congress of Troppau, however, left nearly the whole matter to be considered and decided at Laibach. The former principality of Troppau is now divided between Austria and Prussia, the latter holding the lion's share.

TROTZENDORFF, or Trocedorfius, Valentin Friedland (1490-1556), called Trotzendorff from his birthplace, near Görlitz, in Prussian Silesia, was born on 14th February 1490, of parents so poor that they could not keep him at school. The boy taught himself to read and write while herding cattle; he made paper from birch bark, and ink from soot. When difficulties were overcome and he was sent for education to Görlitz, his mother's last words were "stick to the school, dear son." The words determined his career: he refused all ecclesiastical promotion, and lived and died a schoolmaster. He became a distinguished student, learned Ciceronian Latin from Peter Mosellanus and Greek from Richard Croke, and after graduation was appointed assistant master in the school at Görlitz. There he also taught the rector and other teachers. When Luther began his attack on indulgences, Trotzendorff resigned his position and went to study under Luther and Melanchthon, supporting himself by private tuition. Thence he was called to be a master in the school at Goldberg in Silesia, and in 1524 became rector. There he remained three years, when he was sent to Liegnitz. He returned to Goldberg in 1531 and began that career which has made him the typical German schoolmaster of the Reformation period. His system of education and discipline speedily attracted attention. He made his best elder scholars the teachers of the younger classes, and insisted that the way to learn was to teach. He organized the school in such a way that the whole ordinary discipline was in the hands of the boys themselves. Every month a "consul," twelve "senators," and two "censors" were chosen from the pupils, and over all Trotzendorff ruled as "dictator perpetuus." One hour a day was spent in going over the lessons of the previous day. The lessons were repeatedly recalled by examinations, which were conducted on the plan of academical disputations. Every week each pupil had to write two "exercitia styli," one in prose and the other in verse, and Trotzendorff took pains to see that the subject of each exercise was something interesting. The fame of the Goldberg school extended over all Protestant Germany, and a large number of the more famous men of the following generation were taught by Trotzendorff. He died on 20th April 1556.

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[1] More recently sailors have taken to call it "Boatswain-bird"—a name probably belonging to a very different kind (*cf.* Skua).

[2] Occasionally, perhaps through violent storms, Tropic-birds wander very far from their proper haunts. In 1700 Leigh, in his *N. H. Lancashire* (i. pp. 164, 195, Birds, pl. i., fig. 3), described and figured a "Tropick Bird" found dead in that county. Another is said by Mr Lees (*Zoologist*, ser. 2, p. 2666) to have been found dead at Cradley near Malvern—apparently before 1856 (J. H. Gurney, jun., *op. cit.*, p. 4766)—which, like the last, would seem (W. H. Heaton, *op. cit.*, p. 5086) to have been of the species known as *P. æthereus*. Naumann was told (*Rhea*, i. p. 25) of its supposed occurrence at Heligoland, and Col. Legge (*B. Ceylon*, p. 1174) mentions one taken in India 170 miles from the sea. The case cited by MM. Degland and Gerbe (*Ornith. Européenne*, ii. p. 363) seems to be that of an Albatros.

[3] A fourth species, *P. indicus*, has been described from the Gulf of Oman, but doubt is expressed as to its validity (*cf.* Legge, *ut supra*, pp. 1173, 1174).

[4] *Sulidæ* (Gannet), *Pelecanidæ* (Pelican), *Plotidæ* (Snake-bird), *Phalacrocoracidæ* (Cormorant), and *Fregatidæ* (Frigate-bird).

See Herrmann, *Merkwürdige Lebensgeschichte eines berühmten Schulmans, V. F. Trotzendorffs*, 1727; Frosch, *V. F. Trotzendorff, Rektor zu Goldberg*, 1818; Pinzger, *V. F. Trotzendorff* (with the Goldberg portrait, and a complete list of his writings), 1825; Koehler, *V. F. Trotzendorff, ein biographischer Versuch*, 1848. These biographies appear to take *all* their facts from a funeral or memorial oration delivered by Balthasar Rhau in the university of Wittenberg on 15th August 1564, and published in an edition of Trotzendorff's *Rosarium*, 1565.

TROUBADOURS. See Provençal Literature, vol. xx. p. 873, and France, vol. ix. p. 646.

TROUGHTON, Edward (1753-1835), instrument maker, was born in the parish of Corney in Cumberland in October 1753. He joined his elder brother John in carrying on the business of mathematical instrument makers in Fleet Street, London, and continued it alone after his brother's death, until he in 1826 took W. Simms as a partner. He died in London on 12th June 1835.

Troughton was very successful in improving the mechanical part of most nautical, geodetic, and astronomical instruments. He was completely colour-blind, which prevented him from attempting experiments in optics. The first modern transit circle (see Roemer) was constructed by him in 1806 for Groombridge; but Troughton was dissatisfied with this form of instrument, which a few years afterwards was brought to great perfection by Reichenbach and Repsold (*qq.v.*), and designed the mural circle in its place. The first instrument of this kind was erected at Greenwich in 1812, and ten or twelve others were subsequently constructed for other observatories; but they were ultimately superseded by Troughton's earlier design, the transit circle, by which the two coordinates of an object can be determined simultaneously. He also made transit instruments, equatorials, &c.; but his failure to construct an equatorial mounting of large dimensions, and the consequent lawsuit with Sir James South, embittered the last years of his life.

TROUT. See Salmonidæ; also Angling, vol. ii. p. 41.

TROUVILLE, a fashionable seaside town of France, chef-lieu of the department of Calvados, and a port of the English Channel, is situated at the mouth of the river Touques, on the right bank, 136 miles west-north-west of Paris and 34 north-east of Caen by rail. The climate is mild, and the neighbourhood well wooded; there are villas in all styles of architecture, a casino, and vast stretches of sand where the visitors (15,000 in 1881) bathe and walk. With Havre, which lies on the other side of the estuary of the Seine, 8 or 10 miles off, there is continual steamer communication. In 1886 the population was 5750 (commune 6300). Deauville, on the left bank of the Touques, opposite Trouville, is remarkable for its casino, terrace, and fine mansions, but, except during the race-week in August, is comparatively deserted. In 1886 its population was 2100 (commune 2220). In 1866 a dock, 985 feet in length by 262 in breadth, with 24 feet of depth at high water, was constructed between Trouville and Deauville; in 1882 292 vessels (54,391 tons) entered and 283 (53,510 tons) cleared.

TROVER, or trover and conversion, the name of a form of action in English law no longer in use, corresponding to the modern action of conversion. It was brought for damages for the detention of a chattel, and differed from detinue in that the latter was brought for the return of the chattel itself. The name trover is due to the action having been based on the fictitious averment in the plaintiff's declaration that he had lost the goods and that the defendant had found them. The necessity for this fictitious averment was taken away by the Common Law Procedure Act, 1852. An action of trover lay (as an action of conversion still lies) in every case where the defendant was in possession of a chattel of the plaintiff and refused to deliver it up on request, such refusal being *prima facie* evidence of conversion. The damages recoverable are usually the value of the chattel converted. In an action for detention of a chattel (the representative of the old action of detinue), the plaintiff may have judgment and execution by writ of delivery for the chattel itself or for its value at his option. An action for conversion or detention must be brought within six years. The corresponding action in Scotch law is the action of spuilzie. It must be brought within three years in order to entitle the pursuer to violent profits, otherwise it prescribes in forty years.

TROWBRIDGE, an ancient town of Wilts, England, is situated on the river Mere or Biss, a feeder of the Avon, and on a branch of the Great Western Railway, 33 miles north-west of Salisbury and 97½ west of London. The parish church of St James is an ancient stone structure in the Gothic style, with a west square tower, surmounted by a spire 159 feet in height, and a baptistery (1885). The site of the ancient castle was at the mound called Courthill, but all traces of it have long disappeared, it having been demolished before the reign of Henry VIII. Among the charitable institutions are the Edward and Yerbury almshouses (1698), the old men's almshouses, and the cottage hospital (1886). There are a market house and a town hall. Public gardens 4 acres in extent were opened in 1884. A water company (incorporated in 1873) supplies the town with water from the chalk hills in the neighbourhood of Biss. The principal industry is the manufacture of kerseymere and of broad and other woollen cloths, established as early as the reign of Henry VIII. The town is governed by a local board of health of twenty-one members. The population of the urban sanitary district (area 2080 acres) in 1871 was 11,508, and in 1881 it was 11,040.

The town was defended in behalf of Matilda against Stephen by Humphrey de Bohun. By Leland it is called Throughbridge or Thoroughbridge. Anciently it was a royal manor forming part of the duchy of Lancaster, having been granted by the crown to John of Gaunt. Afterwards it reverted to the crown and was given by Henry VIII. in the 28th year of his reign to Sir Edward Seymour. It again lapsed to the crown under Elizabeth, and in the 24th year of her reign was assigned to Edward, earl of Hertford. By marriage it passed to the Rutland family, who, however, eventually sold it. It formerly gave the title of baron to the Seymour family. The poet Crabbe was rector of the parish from 1814 to 1832.

TROY. See Troad.

TROY, a city of the United States, county seat of Rensselaer county, New York, is situated in 42° 44′ N. lat. and 73° 41′ W. long., upon the east bank of the Hudson river, at the head of tide water. It is nearly north of New York City (147 miles) and somewhat north of west from Boston (136 miles). The city, which has a length of about 4 miles, with an average breadth of 1 mile, is built mainly upon a level terrace slightly elevated above the river, but of late years the residence portion has extended up the hills (rising to 400 feet) which limit this plain on the east. It is in the main regularly laid out, and is traversed by street railways. Troy is situated at what is practically the terminus of the Erie Canal, connecting the Hudson river (here navigable for vessels of 8 to 10 feet draught) with Lake Erie, and of the Champlain Canal. It has three railroads, by which it is connected with New York on the south, Buffalo on the west, and also with the east and north. The principal industries, which in 1880 gave employment to 22,434 persons, are metal-working, especially in iron and steel, and the making of stoves and linen goods. The value of the products was $26,497,163. The city is the seat of the Rensselaer Polytechnic Institute, which was for many years the leading engineering school of the United States, and still maintains a high reputation. The population, which in 1810 was only 3895, had in 1830 risen to 11,556, and by 1880 to 56,747 (27,154 males and 29,593 females, the excess of the latter being explained by the large number of women employed as factory operatives). The proportion of foreign born (16,938) was large.

The city was founded in 1787 by the Dutch, under the name of Vanderheyden, and two years later the present name was adopted. In 1794 it was incorporated as a village, and in 1816 it received a city charter. The opening of the Erie and the Champlain Canals in 1823 insured its prosperity and rapid growth.

TROY, Jean François de (1679-1752), a French painter, highly endowed by nature, was born at Paris in 1679. He received his first lessons from his father, himself a skilful portrait-painter, who afterwards sent his son to Italy. There his amusements occupied him fully as much as his studies; but his ability was such that on his return he was at once made an official of the Academy and obtained a large number of orders for the decoration of public and private buildings, executing at the same time a quantity of easel pictures of very unequal merit. Amongst the most considerable of his works are thirty-six compositions painted for the hotel of De Live (1729), and a series of the story of Esther, designed for the Gobelins whilst De Troy was director of the school of France at Rome (1738-51),—a post which he resigned in a fit of irritation at court neglect. He did not expect to be taken at his word, but found himself forced to return to France, and was making ready to leave when he died suddenly (24th January 1752) of an attack on the lungs.

His desire to make a figure in the world led him to neglect his more serious duties and injured his professional reputation. The life-size painting (Louvre) of the First Chapter of the Order of the Holy Ghost held by Henry IV., in the church of the Grands Augustins, is one of his most complete performances, and his dramatic composition, the Plague at Marseilles, is widely known through the excellent engraving of Thomassin. The Cochins, father and son, Fessard, Galimard, Beauvarlet, Herisset, and the painters Boucher and Parrocel have engraved and etched the works of De Troy.

TROY, West. See West Troy.

TROYES, a town of France, formerly the capital of Champagne, and now chef-lieu of the department of Aube, and an episcopal see, is 104 miles south-east of Paris by the railway to Belfort, at the junction of the line from Orleans to Châlons. Several arms of the Seine and also the Haute-Seine Canal run through the town. The cathedral of St Peter and St Paul, the building of which lasted from 1206 till the 16th century, still wants the south tower. The choir, the end chapels, and the sacristry were restored in 1849-1866. The 16th-century façade, with mutilated bas-reliefs and statues, is surmounted by the tower of St Peter (230 feet). The choir, one of the most beautiful in France, belongs to the 13th century, as does also its remarkable glass. The treasury contains gospels of the 11th and 12th centuries, precious stones brought from the East at the time of the crusades, and ancient and beautiful lace. The unfinished church of St Urban, begun in 1262 at the expense of Urban IV., is a charming specimen of the best period of Gothic architecture, the side portals being remarkably light and delicate. The church of St Madeleine, built at the beginning of the 12th century, enlarged in the 16th, and recently restored, contains a rich rood-screen by Jean de Gualde (1508). In 1420 the treaty of Troyes was signed in the church of St John, where Henry V. of England and Catherine of France were subsequently married. The church of St Remy, with a Romanesque tower, the churches of St Nizier and St Nicholas, both of the 16th century, and that of St Pantaléon, of the 16th and 17th, should also be noticed. There are some curious fireplaces in the town hall (17th century), and the municipal archives contain the correspondence of the dukes of Lorraine and Guise. The old abbey of St Loup is occupied by the library (80,000 volumes and 2720 manuscripts) and a museum containing numerous collections; that relating to natural history is rich in ornithology and entomology, and has many aerolites. Most of the old houses of Troyes are of wood, but some of stone of the 16th century are remarkable for their beautiful and original architecture. The chief industry of Troyes and the surrounding district is the manufacture of cotton and woollen hosiery, which is woven almost entirely by hand, and is exported to America and Switzerland. One-fourth of the population live by subsidiary industries. There are 14 cotton mills with 10,000 spindles, bleaching, dressing, and dye works, workshops for making looms, needle factories, iron and copper foundries, 8 flour mills, and nursery and market gardens. A trade is carried on in pork and cheese. A few miles from the town stands the curious church of St Andrew (16th century), with a remarkable portal. The population in 1886 was 46,972 (46,067 in 1881).

At the beginning of the Roman period Troyes (*Augustobona*) was the principal settlement of the Tricassi. It was christianized in the 3rd century, and its bishop St Loup (426-479) founded renowned schools, and averted the fury of Attila. In 484 Troyes passed into the hands of Clovis, and belonged sometimes to Neustria, sometimes to Austrasia, till all Gaul was united under Charles Martel. In 878 Pope John VIII. presided at a council in Troyes. The town was fired and sacked by the Saracens in 720, and by the Normans in 889 and 905. In 1229 Theobald IV., besieged in his capital, was delivered by king Louis IX., and in 1230 he granted the inhabitants a municipal charter. From this time the fairs of Troyes became celebrated. During the captivity of King John in England, Troyes resisted all attacks, and after Agincourt took the part of the Burgundians. In 1417 the rule of Queen Isabeau of Bavaria was established in Troyes, where in 1418 the parlement of Paris met; and on 21st May 1420 Henry V. of England, Charles VI. of France, Isabeau, and Philip of Burgundy signed the famous treaty of Troyes. On 9th July 1429 the town capitulated to Joan of Arc. In the 16th century Protestantism made rapid progress, but in 1562 the Huguenots were forced to retire to Bar-sur-Seine; after the massacre of St Bartholomew in Paris, the Calvinists in the prisons of Troyes met the same fate. In 1577 the inhabitants joined the League, and only opened their gates to Henry IV. in 1594. In 1787 the parlement of Paris again met here. In 1814 both the allied and the imperial armies occupied Troyes; and in 1870 the town was occupied by the Germans.

TROYES, Chrestien de. See Chrestien de Troyes, and Romance, vol. xx. p. 645.

TRUCE OF GOD. The orderly administration of justice and the universal peace, which the Roman empire established from the Euphrates to the Atlantic, did not long survive the inroads of the Teutonic tribes who in western Europe divided the inheritance of the Latin world. All the early Teutonic codes, being based, however remotely, on the right of private war and private vengeance, might discourage, but were powerless to abolish, the instinct which impels the members of half-civilized communities to avenge their own wrongs. Hence the *pax Romana* died with the empire; nor could the splendid organization of Charlemagne do more than effect a very partial resuscitation of it. Throughout the 9th and 10th centuries, as the life-benefices of the later Carolingian kings became gradually transformed into hereditary fiefs, the insecurity of life and property grew greater; for there was no central power to curb the injustice of the petty dukes and counts who warred and pillaged at their will. At this moment, when western Europe threatened to sink back into the chaos from which it had been won by Rome, the church came forward to arrest the process of its dissolution. Speaking at first in her own interest and in that of the poor, whose great protector she claimed to be, she decreed a special peace for the unarmed clerk and the industrious husbandman. The council of Charroux in Poitou led the way in 989. With the opening of the next century the movement spread over Aquitaine and the rest of France. Everywhere the bishops set themselves to exact from the whole diocese, noble and simple alike, a novel oath to abstain from violence and to respect the sanctity of churches. William V. of Aquitaine, the most powerful lord of southern France, lent his influence to the cause at the councils of Limoges (994) and Poitiers (999). The latter council prescribed the methods by which all who violated their solemn engagement should be punished. The times, however, were hardly ripe for the inauguration of an era of peace. Gerard of Soissons, perhaps, was not the only bishop who eyed this dream of universal harmony askance, as tending to encroach on the king's prerogative (see Bouquet, x. 201); and, on the whole, it may be said that the "Peace of God" was at best but a somewhat ineffectual protection to churches, priests, and labourers. If there was any hope of restraining the mutual feuds of the barons it must be by other means. And here the church again, recognizing the impossibility of absolutely stopping all feudal warfare, endeavoured to limit it. This limitation of the right of perpetual warfare, reduced to writing, sanctioned by an oath, and confirmed by the decrees of councils, assumed the name of the "Truce of God" (*treva* or *treuga Dei*). The truce of God seems to have been first established at the synod of Tuluges, near Perpignan in Roussillon, on 16th May 1027. In accordance with its decrees all warfare was to be suspended from noon on Saturday till prime on Monday; and the peace of God was permanently extended to all monks, clerks, bishops, and churches. Like the *pax ecclesiæ*, this laudable example was soon followed elsewhere. About 1041 it extended itself over Aquitaine and all France; in 1042 the council of Caen, under the sanction of Duke William, established it in Normandy—a country in which, according to a contemporary writer (Rodolph Glaber, v. 1), it was not at first accepted. By this time its terms had been much enlarged; and we may perhaps take the provisions of a second synod at Tuluges (1041) as representing its normal form. According to this synod the *treuga Dei* was to last from the Wednesday evening to the Monday morning in every week, from the beginning of Advent to the octave of the Epiphany, from the beginning of Lent till the octave of Pentecost, for the feasts of the Holy Cross, the three great feasts of the Virgin, and those of the twelve apostles and a few other saints. More usually the interval between the Epiphany octave and Lent and that from Easter to Rogations were left subject to the weekly truce only. Thus from being a mere local institution it spread rapidly over all France, and seems to have crossed into Germany, Italy, Spain, and England. It had also its special courts and methods of procedure. Excommunication and banishment for seven or thirty years were its penalties. Before long both the *pax ecclesiæ* and the *treuga Dei* were sanctioned by the holy see. Special clauses were added to protect pilgrims, women, merchants, monks, and clerks; while the cattle and agricultural implements of the peasant—his ox, horse, plough, and even his olive-trees—were covered by the ægis of the church. The first clause of the council of Clermont (1095), at which Urban II. preached the first crusade, proclaimed the weekly truce for all Christendom, and perhaps enjoined it in its most extended form, adding also a clause by which the oath was to be renewed every three years by all men above the age of twelve, whether noble, burgess, villain, or serf.[1] The same council seems to have accorded safety to all who took refuge at a wayside cross (cap. 29) or at the plough (*homines ad carrucas fugientes*). The truce of God was most powerful in the 12th century, during which period it was sanctioned both by local and papal councils, such as that held at Rheims by Calixtus II. in 1119, and the Lateran councils of 1139 and 1179. With the 13th century its influence began to decline, as the power of the king gradually led to the substitution of the king's peace for that of the church.

For an exhaustive account of the whole question, see M. Semichon's book, to which the above article is largely indebted.

TRUCK SYSTEM. See Labour, vol. xiv. p. 172, and Wages.

TRUFFLE, the name of several different species of subterranean fungi which are used as food. The species sold in English markets is *Tuber æstivum*; the commonest species of French markets is *T. melanosporum*, and of Italian the garlic-scented *T. magnatum*. Of the three, the English species is the least excellent, and the French is possibly the best. The truffle used for Perigord pie (*pâté de foie gras*) is *T. melanosporum*. When, however, the stock of *T. melanosporum* happens to be deficient, some manufacturers use inferior species of *Tuber*, such as the worthless or dangerous *Chœromyces meandriformis*. Even the rank and offensive *Scleroderma vulgare* (one of the puff-ball series of fungi) is sometimes used for stuffing turkeys, sausages, &c. Indeed, good truffles, and then only *T. æstivum*, are seldom seen in English markets. The taste of *T. melanosporum* can be detected in Perigord pie of good quality. True and false truffles can easily be distinguished under the microscope.

Tuber æstivum, the English truffle, is roundish in shape, covered with coarse polygonal warts, black in colour outside and brownish and veined with white within; its average size is about that of a small apple. It grows from July till autumn or winter, and prefers beech, oak, and birch woods on argillaceous or calcareous soil, and has sometimes been observed in pine woods. It grows gregariously, often in company with *T. brumale* and (in France and Italy) *T. melanosporum*, and sometimes appears in French markets with these two species, as well as with *T. mesentericum*. The odour of *T. æstivum* is very strong and penetrating; it is generally esteemed powerfully fragrant, and its taste is considered agreeable. Its price in England is two or three shillings a pound. The common French truffle, *T. melanosporum*, is a winter species. The tubers are globose, bright brown or black in colour, and rough with polygonal warts; the mature flesh is blackish grey, marbled within with white veins. It is gathered in autumn and winter in beech and oak woods, and is frequently seen in Italian markets, where it is sometimes sold for 12s. 6d. a pound. The odour of *T. melanosporum* is very pleasant, especially when the tubers are young, then somewhat resembling that of the strawberry; with age the smell gets very potent, but is never considered really unpleasant. The common Italian truffle, *T. magnatum*, is pallid ochreous or brownish buff in colour, smooth or minutely papillose, irregularly globose, and lobed; the interior is a very pale brownish liver colour veined with white. It grows towards the end of autumn in plantations of willows, poplars, and oaks, on clayey soil. Sometimes it occurs in open cultivated fields. The odour of the mature fungus is very potent, and is like strong garlic, onion, or decaying cheese. *T. brumale*, referred to above, grows in Britain. It is a winter truffle, and is found chiefly under oaks and abele trees from October to December. It is black in colour, globose, more or less regular in shape, and is covered with sharp polygonal warts; the mature flesh is blackish grey marbled with white veins. The odour is very strong and lasts a long time; the taste is generally esteemed agreeable. *Chæromyces meandriformis*, which occurs in Britain, is sometimes sold for *T. magnatum*, the colour of the flesh of both species being somewhat similar. *Scleroderma vulgare*, the "false truffle," is extremely common on the surface of the ground in woods, and is gathered by Italians and Frenchmen in Epping Forest for the inferior dining-rooms of London where Continental dishes are served. It is a worthless, offensive, and possibly dangerous fungus. A true summer truffle, *T. mesentericum*, found in oak and birch woods on calcareous clay soil, is frequently eaten on the Continent. It is esteemed equal to *T. æstivum*. It probably grows in Britain. Another edible species, *T. macrosporum*, also grows in Britain, in clayey places under young beeches and oaks, on the borders of streams and roads, and sometimes in fields; more rarely it grows in plantations of willow and poplar. It has a strong scent of onions or garlic. *Terfezia leonis*, a famous truffle of Italy, Algeria, Sardinia, &c., resembles externally a potato. It grows in March, April, and May. Some persons eat it in a raw state, sliced, and dipped in oil or egg. It is not scented, and its taste is generally considered insipid or soapy. Sometimes an ally of the puff-balls, and therefore (like *Scleroderma*) not a true truffle, *Melanogaster variegatus*, is eaten in England and France. It has been, and possibly still is, occasionally sold in England under the name of "red truffle." It is a small ochreous brown species with a strong aromatic and pleasant odour of bitter almonds. When the plant is eaten raw the taste is sweet and sugary, but when cooked it is hardly agreeable. The odour belonging to many truffles is so potent that their places of growth can be readily detected by the odour exhaled from the ground. Squirrels, hogs, and other animals commonly dig up truffles and devour them, and pigs and dogs have long been trained to point out the places where they grow. Pigs will always eat truffles and dogs will do so occasionally; it is therefore usual to give the trained pig or dog a small piece of cheese or some little reward each time it is successful. Truffles are reproduced by spores, bodies which serve the same purpose as seeds in flowering plants; in true truffles the spores are borne in transparent asci or sacs, from four to eight spores in each ascus. The asci are embedded in vast numbers in the flesh of the truffle. In false truffles the spores are free and are borne on minute spicules or supports. The spores of the chief European truffles, true and false, enlarged five hundred diameters, are shown in the accompanying illustration. Many references to truffles occur in classical authors. The truffle *Elaphomyces variegatus* was till quite recent times used, under the name of Hart's nut or Lycoperdon nut, on account of its supposed aphrodisiac qualities.

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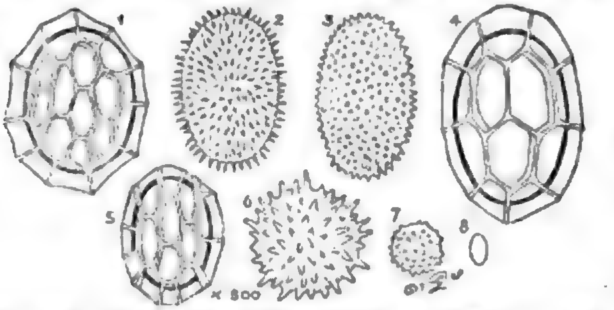
[1] Labbe's *Concilia*, xx. 816; with which *cf.* Semichon, *La Paix et la Trêve de Dieu*, Paris, 1869, p. 125,



Spores of the chief European truffles. Enlarged 500 diameters. 1, *Tuber æstivum*; 2, *T. brumale*; 3, *T. melanosporum*; 4, *T. mesentericum*; 5, *T. magnatum*; 6, *Chæromyces meandriformis*, 7, *Scleroderma vulgare*; 8, *Melanogaster variegatus.*

TRUMBULL, the surname of more than one individual of note in the literature, art, and politics of America.

1. **Benjamin Trumbull** was born at Hebron, Connecticut, on 19th December 1735, and died at North Haven, Connecticut, on 2d February 1820. He graduated at Yale in 1759, and entered the ministry. His literary work was considerable, the most important being the standard *History of Connecticut* to 1764.

2. **John Trumbull** was born at Waterbury, Connecticut, on 24th April 1750, and died at Detroit, Michigan, on 12th May 1831. He graduated at Yale in 1767, and became a lawyer and author of high reputation. His best work is *M'Fingal*, a Hudibrastic poem, intended to serve the Whig side in the American Revolution.

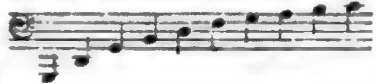
3. **John Trumbull**, son of the following, was born at Lebanon, Connecticut, on 6th June 1756, and died at New York City, on 10th November 1843. He graduated at Harvard in 1773, studied painting with Benjamin West in London, and left at his death a number of historical works. The earlier of these are the better; the later and larger were painted for the capitol at Washington.

4. **Jonathan Trumbull** was born at Lebanon, Connecticut, on 10th June 1710, and died at the same place on 17th August 1785. He graduated at Harvard in 1727, and became a lawyer and colonial politician. His place in American history was gained as governor of Connecticut from 1769 until 1783, through the whole period of the American Revolution. He was a trusted supporter and confidential adviser of Washington, who was accustomed to speak of him as "brother Jonathan," and the term has since passed into popular use as equivalent to the people of the United States.

5. **Jonathan Trumbull**, son of the preceding, was born at Lebanon, Connecticut, on 26th March 1740, and died at the same place on 7th August 1809. He graduated at Harvard in 1759, and served as member of congress, 1789-95 (being speaker of the house of representatives during the last two years of his term), as United States senator, 1795-96, and as governor of Connecticut, 1798-1809.

TRUMPET, a musical instrument, consisting of a long, narrow brass tube, cylindrical for the greater part of its length: the fusiform development which terminates in the bell or opening of the lower end only begins at a point that varies from a third to a fourth of the total length from that extremity. The air inside is set in vibration by the lips (which act as true reeds) applied to the edges of a basin-like mouthpiece fitted to the upper part of the instrument. The material has nothing to do with the production of that brilliant quality of tone by which the trumpet is so easily distinguished from every other mouthpiece instrument: the difference is partly due to the distinct form given to the basin of the mouthpiece, but principally to the proportions of the column of air determined by the conical or cylindrical form of its envelope.

The possibility of producing sonorous disturbance of a mass of air through a mouthpiece, or more simply through the orifice of the tube, has been known from a very early period,—a shell bored at its extremity, or a horn with the point removed, being without doubt the most ancient instrument for producing sound. Nearly all the nations of antiquity had mouthpiece instruments; but the greater number of these, though grouped under the general designation of trumpets, have only a very distant relationship to the modern instrument. The Romans had four such instruments,—the *tuba*, *buccina*, *cornu*, and *lituus*. The tuba, represented in the bas-reliefs of the triumphal arch of Titus, was a kind of straight bronze clarion, with a conical column of air. It is ordinarily designated the Roman trumpet, and was about 39 inches long; its compass should not go beyond the first six proper notes of the harmonic scale. The Roman tuba and the Greek salpinx are supposed to be one and the same instrument. The buccina was also of bronze, with a tube measuring fully 11 feet in length. The tube is only slightly conical, and the quality of tone bears a striking resemblance to that of the bass trombone in G; the proper tones for harmonics were those subjoined.[1] The cornu was often made of a bullock's horn, but bronze was also employed,



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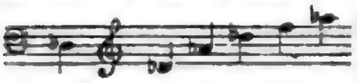
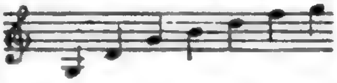
[1] The difficulty of producing the fundamental or first proper note increases with the length and narrowness of the tube. The proportions of the buccina render the production of this note very difficult.



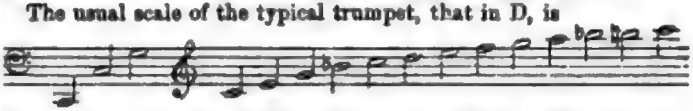


as in a specimen in the British Museum. This instrument measured 4 feet 6 inches in length, and the scale was that herewith shown. The Roman cornu was probably like the Greek keras. The three preceding instruments were used in giving signals to the infantry. The cavalry calls were given with the lituus, a specimen of which exists in the museum of the Vatican, found in 1827 in a tomb at Cerveteri (Cære). The tube is cylindrical for the greater part of its length, its conical development beginning only at the lower end, where the instrument begins to curve. The lituus easily produces the accompanying proper notes; its quality of tone is like that of a trumpet in G. In Ireland and Denmark numerous mouthpiece instruments in bronze have been found, sixteen different specimens being preserved in the museum of the Royal Irish Academy at Dublin, and six (of which facsimiles exist in South Kensington Museum) in the museum at Copenhagen. But none of these have the proportions of a trumpet; all, by the conical development of the tube as well as by the curved form, recall their first model, the horn, successive transformations of which have given rise to the clarion and the numerous family of bugles.

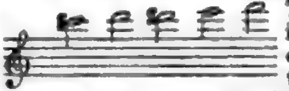
We have no precise information as to the form which the lituus, the ancestor of the modern trumpet, assumed during the Middle Ages. A miniature in the Bible[1] presented in 850 to Charles the Bald places the lituus in the hands of one of the companions of King David, but we are not warranted in concluding from this that the Etruscan instrument was in use in the 9th century. The earliest representation of the trumpet with its present proportions of tube and form of bell seems to belong to the 15th century. Fra Angelico (d. 1455) has painted angels with trumpets having either straight or zigzag tubes, the shortest being about 5 feet long. The perfect representation of the details, the exactness of the proportions, the natural pose of the angel players, suggest that the artist painted the instruments from real models.

The credit of having bent the tube of the trumpet in three parallel branches, thus creating its modern form, has usually been claimed for a Frenchman named Maurin (1498-1515). But the transformation was really made in Italy about the middle of the 15th century, as is proved by the bas-reliefs of Luca della Robbia intended to ornament the organ chamber of the cathedral of Florence (see vol. xx. p. 588); there a trumpet having the tube bent back as just described is very distinctly figured. From the beginning of the 16th century we have numerous sources of information. Virdung[2] cites three kinds of mouthpiece instruments—the *felttrumet*, the *clareta*, and the *thurner horn*; unfortunately he does not mention their distinctive characters, and it is impossible to make them out by examination of his engravings. Probably the felttrumet and the clareta closely resembled each other; but the compass of the former, destined for military signals, hardly went beyond the 8th proper tone, while the latter, reserved for high parts, was like the clarino (see below). The thurner horn was probably a kind of clarino or clarion used by watchmen on the towers. The *trummet* and the *jäger trommet* are the only two mouthpiece instruments of the trumpet kind cited by Prætorius.[3] The first was tuned in D at the chamber pitch or "kammerton," but with the help of a shank it could be put in C, the equivalent of the "chorton" D, the two differing about a tone. Sometimes the trummet was lowered to B and even B♭. The jäger trommet, or "trompette de chasse," was composed of a tube bent several times in circles, like the posthorn, to make use of a comparison employed by Prætorius himself. His drawing does not make it clear whether the column of air was like that of the trumpet; there is therefore some doubt as to the true character of the instrument. The same author further cites a wooden trumpet (*hölzern trommet*), which is no other than the Swiss alpen-horn or Norwegian luur. Mersenne's[4] information is not very instructive; but he gives a description of the *sourdine*, a kind of mute or damper introduced into the bell, already employed in his time, and still made use of to weaken the sound. The shape of the trumpet, as seen in the bas-reliefs of Luca della Robbia, was retained for more than three hundred years: the first alterations destined to revolutionize the whole technique of the instrument were made about the middle of the 18th century. Notwithstanding the imperfections of the trumpet during this long period, the performers upon it acquired an astonishing dexterity.

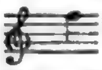
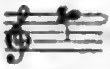
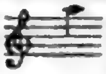
The usual scale of the typical trumpet, that in D, is



Prætorius exceeds the limits of this compass in the higher range, for he says a good trumpeter could produce the subjoined notes.



This opinion is shared by Bach, who, in a trumpet solo which ends the cantata "Der Himmel lacht," wrote up to the twentieth of these sounds. So considerable a compass could not be reached by one instrumentalist: the trumpet part had therefore to be divided, and each division was designated by a special name.[5] The fundamental or first proper note was called *flattergrob*, the second *grobstimme*, the third *faulstimme*, the fourth *mittelstimme*. The part that was called principal went from the fifth to the tenth of these tones. The higher region, which had received the name of "clarino," was again divided into two parts: the first began at the eighth proper tone and mounted up towards the extreme high limit of the compass, according to the skill of the executant; the second, beginning at the sixth proper tone, rarely went beyond the twelfth. Each of these parts was confided to a special trumpeter, who executed it by using a larger or a smaller mouthpiece.

Playing the clarino differed essentially from playing the military trumpet, which corresponded in compass to that called principal. Compelled to employ very small mouthpieces to facilitate the emission of very high sounds, clarino players could not fail to alter the tone of the instrument, and instead of getting the brilliant and energetic quality of tone of the mean register they were only able to produce more or less doubtful notes without power and splendour. Apart from this inconvenience, the clarino presented numerous deviations from just intonation. Hence the players of that time failed to obviate the bad effects inevitably resulting from the natural imperfection of the harmonic scale of the trumpet in that extreme part of its compass; in the execution, for instance, of the works of Bach, where the trumpet should give sometimes , and sometimes  the instrumentalist could only command the eleventh proper tone, which is neither the one nor the other of these. Further, the thirteenth proper tone, for which  is written, is really too flat, and it is absolutely impossible to remedy this defect, since it entirely depends upon the laws of resonance affecting columns of air.

Since the abandonment of the clarino (about the middle of the 18th century) our orchestras have been enriched with trumpets that permit the execution of the old clarino parts, not only with perfect justness of intonation, but with a quality of tone that is not deficient in character when compared with the mean register of the old principal instrument. The introduction of the clarinet or little clarino is one of the causes which led to the abandonment of the older instrument and may explain the preference given by the composers of that epoch to the mean register of the trumpet. The clarino having disappeared before Mozart's day, he had to change the trumpet parts of Handel and Bach to allow of their execution by the performers of his own time. It was now that crooks began to be frequently used. Trumpets were made in F instead of in D, furnished with a series of shanks of increasing length for the tonalities of E, E♭, D, D♭, C, B, B♭, and sometimes even A.

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[1] In the Bibliothèque Nationale at Paris.

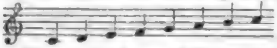
[2] *Musica getutscht und ausgezogen*, Basel, 1511.

[3] *Organographia*, Wolfenbüttel, 1619.

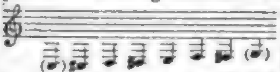
[4] *Harmonie Universelle*, Paris, 1636.

[5] *Der sich selbst informirende Musicus*, Augsburg, 1762, by Lotter.

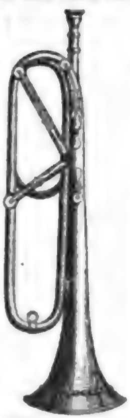
The first attempts to extend the limited resources of the instrument in its new employment arose out of Hampel's idea of lowering the harmonic sounds by introducing the hand into the bell. But, instead of fixing the shanks between the mouthpiece and the upper extremity, they were adapted to the body of the instrument itself by a double slide, upon the two branches of which tubes were inserted bent in the form of a circle and gradually lengthened as required. This modified instrument became known as the "invention horn." This system was applied to the trumpet by Michel Woegel (born at Rastatt in 1748), whose "invention trumpet" had a great success, notwithstanding the unavoidable imperfection of a too great disparity in quality of tone between the open and the closed sounds. The idea of applying the trombone slide to the trumpet is obvious. The slide trumpet is mentioned by T. E. Altenburg,[1] who compares it, and with reason, to the alto trombone; and there are grounds for identifying it with the "tromba da tirarsi" employed by J. S. Bach in some of his compositions. The slide trumpet is still used in England in a somewhat modified form. About 1760, Kolbel, a Russian musician, applied a key to the horn, and soon afterwards the trumpet received a similar addition. By opening this key, which is placed near the bell, the instrument was raised a diatonic semitone, and by correcting errors of intonation by the pressure of the lips in the mouthpiece the following diatonic succession was obtained.



This invention was improved in 1801 by Weidinger, trumpeter to the imperial court at Vienna, who increased the number of keys and thus made the trumpet chromatic thoughout its scale. The instrument shown in the accompanying figure is in G; the keys are five in number, and as they open one after another or in combination it is possible to connect the second proper tone with the third by chromatic steps, and thus produce the following succession.



The number of keys was applied to fill up the gaps between the extreme sounds of the interval of a fifth; and a like result was arrived at more easily for the intervals of the fourth, the major third, &c., furnished by the proper tones of 3, 4, 5, &c. But, though the keyed trumpet was a notable improvement on the invention trumpet, the sounds obtained by means of the lateral openings of the tube did not possess the qualities which distinguish sounds caused by the resonance of the air-column vibrating in its entirety. But in 1815 Stölzel made a genuine chromatic trumpet by the invention of the ventile or piston; for this ingenious mechanism, see Trombone. The simple trumpet is now no longer employed except in cavalry regiments. It is usually in E♭. The bass trumpet in E♭, which is an octave lower, is sometimes, but rarely, used. Trumpets with pistons are generally constructed in F, with crooks in E and E♭. In Germany trumpets in the high B♭ with a crook in A are very often used in the orchestra. They are easier for cornet à piston players than the trumpet in F. The present writer has recently constructed for the concerts of the Conservatoire at Brussels trumpets in the high D, an octave above the old trumpet in the same key. They permit the execution of the high trumpet parts of Handel and J. S. Bach. The bass trumpet with pistons used for Wagner's tetralogy is in E♭, in unison with the ordinary trumpet with crooks of D and C; but, when constructed so as to allow of the production of the second proper tone as written by this master, this instrument belongs rather to the trombones than to the trumpets. (V. M.)



Keyed trumpet.

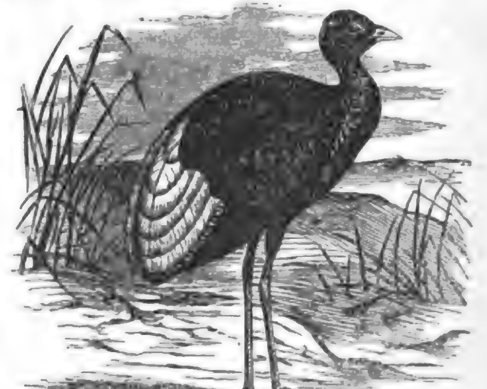
TRUMPET, Speaking and Hearing. The speaking trumpet, though some instrument of the kind appears to have been in earlier use in more than one part of the world, is connected in its modern form with the name of Athanasius Kircher and that of Sir Samuel Morland, who in 1670 proposed to the Royal Society of London the question of the best form for a speaking trumpet. Lambert, in the *Berlin Memoirs* for 1763, seems to have been the first to give a theory of the action of this instrument, based on an altogether imaginary analogy with the behaviour of light. In this theory, which is still commonly put forward, it is assumed that sound, like light, can be propagated in rays. This, however, is possible only when the aperture through which the wave-disturbance passes into free air is large compared with the wave-length. If the fusiform mouth of the speaking trumpet were half a mile or so in radius, Lambert's theory might give an approximation to the truth. But with trumpets whose aperture is only a foot in diameter at most the problem is one of diffraction; and it has not yet been seriously studied from this point of view.

In the case of the hearing trumpet, the disturbance is propagated along the converging tube much in the same way as the tide-wave is propagated up the estuary of a tidal river.

Until the theory has been rigorously worked out the only safe course to adopt in manufacturing either class of instruments is to be guided by the results of varied trials.

The theoretical foundations of the subject will be found in Lord Rayleigh's *Sound* and in Sir G. Airy's *Tides and Waves*, respectively. In speaking and hearing trumpets alike all reverberation of the instrument should be avoided by making it thick and of the least elastic materials, and by covering it externally with cloth.

TRUMPETER, or Trumpet-Bird, the literal rendering in 1747, by the anonymous English translator of De la Condamine's travels in South America (p. 87), of that writer's "Oiseau trompette" (*Mém. de l'Acad. des Sciences*, 1745, p. 473), which he says was called "Trompetero" by the Spaniards of Maynas on the upper Amazons, from the peculiar sound it utters. He added that it was the "Agami" of the inhabitants of Para and Cayenne,[2] wherein he was not wholly accurate, since those birds are specifically distinct, though, as they are generically united, the statement may pass. But he was also wrong, as had been Barrere (*France Equinoxiale*, p. 132) in 1741, in identifying the "Agami" with the "Macucagua" of Marcgrave, for that is a Tinamou (*q.v.*); and both still more wrongly accounted for the origin of the peculiar sound just mentioned, whereby Barrere was soon after led (*Ornith. Spec. Novum*, pp. 62, 63) to apply to the bird the generic and vulgar names of *Psophia* and "Petteuse," the former of which, being unfortunately adopted by Linnæus, has ever since been used, though in 1766 and 1767 Pallas (*Miscellanea*, p. 67, and *Spicilegia*, iv. p. 6), and in 1768 Vosmær (*Descr. du Trompette Américain*, p. 5), showed that the



White-winged trumpeter (*Psophia leucoptera*). After Mitchell.

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[1] *Versuch einer Anleitung zur heroisch-musikalischen Trompeter- und Pauker-Kunst*. Halle, 1795.

[2] Not to be confounded with the "Heron Agami" of Buffon (*Oiseaux*, vii. p. 382), which is the *Ardea agami* of other writers.

notion it conveys is erroneous. Among English writers the name "Trumpeter" was carried on by Latham and others so as to be generally accepted, though an author may occasionally be found willing to resort to the native "Agami," which is that almost always used by the French.

Messrs Sclater and Salvin in their *Nomenclator* (p. 141) admit 6 species of Trumpet-Birds—(1) the original *Psophia crepitans* of Guiana; (2) *P. napensis* of eastern Ecuador (which is very likely the original "Oiseau trompette" of De la Condamine); (3) *P. ochroptera* from the right bank of the Rio Negro; (4) *P. leucoptera* from the right bank of the upper Amazons; (5) *P. viridis* from the right bank of the Madeira; and (6) *P. obscura* from the right bank of the lower Amazons near Para. And they have remarked in the Zoological *Proceedings* (1867, p. 592) on the curious fact that the range of the several species appears to be separated by rivers, a statement confirmed by Mr Wallace (*Geogr. Distr. Animals*, ii. p. 358); and in connexion therewith it may be observed that these birds have short wings and seldom fly, but run, though with a peculiar gait, very quickly. A seventh species, *P. cantatrix*, from Bolivia, has since been indicated by Prof. W. Blasius (*Journ. f. Ornith.*, 1884, pp. 203-210), who has given a monographic summary of the whole group very worthy of attention. The chief distinctions between the species lie in colour and size, and it will be here enough to describe briefly the best known of them, *P. crepitans*. This is about the size of a large barndoor Fowl; but its neck and legs are longer, so that it is a taller bird. The head and neck are clothed with short velvety feathers; the whole plumage is black, except that on the lower front of the neck the feathers are tipped with golden green, changing according to the light into violet, and that a patch of dull rusty brown extends across the middle of the back and wing-coverts, passing into ash-colour lower down, where they hang over and conceal the tail. The legs are bright pea-green. The habits of this bird are very wonderful, and it is much to be wished that fuller accounts of them had appeared. The curious sound it utters, noticed by the earliest observers, has been already mentioned, and by them also was its singularly social disposition towards man described; but the information supplied to Buffon (*Oiseaux*, iv. pp. 496-501) by Manoncour and De la Borde, which has been repeated in many works, is still the best we have of the curious way in which it becomes semi-domesticated by the Indians and colonists and shows strong affection for its owners as well as for their living property—poultry or sheep—though in this reclaimed condition it seems never to breed.[1] Indeed nothing can be positively asserted as to its mode of nidification; but its eggs, according to Mr E. Bartlett, are of a creamy white, rather round, and about the size of Bantams'. Waterton in his *Wanderings* (Second Journey, chap. iii.) speaks of falling in with flocks of 200 or 300 "Waracabas," as he called them, in Demerara, but added nothing to our knowledge of the species; while the contributions of Trail (*Mem. Wern. Society*, v. pp. 523-532) and Dr Hancock (*Mag. Nat. History*, ser. 2, ii. pp. 490-492) as regards its habits only touch upon them in captivity.

To the Trumpeters must undoubtedly be accorded the rank of a distinct Family, *Psophiidæ*; but like so many other South-American birds they seem to be the less specialized descendants of an ancient generalized group —perhaps the common ancestors of the *Rallidæ* and *Gruidæ*—and they are therefore rightly placed in Prof. Huxley's *Geranomorphæ*.[2] The structure of the syrinx is stated by Trail (*ut supra*) to be quite unique; but his description of it is unsatisfactory, and he clearly had not an adult male to dissect or he would have hardly failed to notice the curious arrangement of the trachea in that sex made known by Hancock (*ut supra*). This, though different from that described in any CRANE (*q.v.*), suggests an early form of the structure which in some of the *Gruidæ* is so marvellously developed, for in *Psophia* the windpipe runs down the breast and belly immediately under the skin to within about an inch of the anus, whence it returns in a similar way to the front of the sternum, and then enters the thorax. Analogous instances of this formation occur in several other groups of birds not at all allied to the *Psophiidæ*. The skeleton and some of the detached bones are figured in Eyton's *Osteol. Avium* (pls. xxix. and 5 K). (A. N.)

TRURO, a city, municipal borough, and port of Cornwall, England, is situated on a kind of peninsula formed by the rivers Allen and Kenwyn, which below the town unite with a branch of Falmouth harbour called Truro creek or river. Truro is 300 miles south-west of London by the Great Western Railway, and 11 north of Falmouth, to which there is a branch line. The town is regularly built, chiefly of granite, with spacious streets, through the principal of which there flows a stream of water. The new cathedral of St Mary by Mr Pearson, R.A., one of the most important modern ecclesiastical buildings in England, is a fine example of Early English at its best period. The old south aisle of the church previously existing is ingeniously incorporated in the new edifice. The secular buildings include the town-hall and market-house in the Italian style (1846), the corn exchange, the theatre, the public rooms, the music-hall, and the county library (1792). There is also a theological library, presented by Bishop Phillpotts in 1856 and largely augmented by a bequest of books in 1883. Among the educational and benevolent institutions are the grammar-school (founded by a member of the Borlase family, and having two exhibitions at Exeter College, Oxford), the cathedral divinity schools, the Wesleyan middle schools, the literary institution, the royal Cornwall infirmary, the dispensary, and a hospital for ten widows. There is sufficient depth of water in the channel of Truro creek to permit vessels of 70 tons burden to come up to the town quay. The principal imports are coal from Wales and timber from Norway, and the exports consist of tin, iron ores, lead, and zinc, from the mines in the neighbourhood. The population of the municipal borough (area 1171 acres) in 1871 was 11,049, and 10,619 in 1881.

Truro is one of the oldest towns in England. It is the seat of the stannary and other courts connected with the duchy of Cornwall (see CORNWALL, vol. vi. p. 427). It was one of the ancient privileged tin coinage towns. Anciently it was called Tueura, Treura, and Truruburgh. It was a borough by prescription, but was incorporated by Reginald, earl of Cornwall. In the 12th century it belonged to Richard de Lucy. In a charter of Henry VII. it is called the "ville de Teuro." The government was vested in a mayor and burgesses by Elizabeth, who gave the corporation jurisdiction over the port of Falmouth, the port dues of that town being collected by them until its incorporation by Charles II. Norden, writing of Truro in 1574, says, "there is not a towne in the west part of the shire more commendable for neatness of buyldinges, nor more discommendable for the pride of the people." In 1642 Sir Ralph Hopton levied here a large body of men for the king. By the Municipal Act Truro was divided into two wards, and is governed by a mayor, six aldermen, and eighteen councillors. The corporation act as the urban sanitary authority. Truro sent two representatives to parliament from the 23d year of Edward I., but ceased to be separately represented in 1885. By Act 39 and 40 Vict. c. 54 it was constituted the head of a new diocese comprising the archdeaconry of Cornwall.

TRUST. In Roman and English law alike that legal relation between two or more persons implied in the word *trust* was of comparatively late growth. The trust of English law is probably based upon a combination of the Roman conceptions of *usus* and *fideicommissum*. To *usus* is perhaps due the name as well as the idea of that right over property, coordinate with the right of the nominal owner, possessed by the person having the use. To *fideicommissum* appears to be due the name as well as the idea of that confidence reposed in another which is the essence of the modern trust. *Usus* was in Roman law a personal servitude, or right of one person over the land of another, confined to his personal wants and without the right to the produce and profits which *ususfructus* carried. It has little in common with the use of English law but the name and the conception of a dual ownership. The *fideicommissum* is more important; see ROMAN LAW, vol. xx. p.

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[1] In connexion herewith may be mentioned the singular story told by Montagu (*Orn. Dict.*, Suppl. Art. "Grosbeak, White-winged"), on the authority of the then Lord Stanley, afterwards president of the Zoological Society, of one of these birds, which, having apparently escaped from confinement, formed the habit of attending a poultry-yard. On the occasion of a pack of hounds running through the yard, the Trumpeter joined and kept up with them for nearly three miles!

[2] *Cf.* Parker, *Trans. Zool. Soc.*, x. p. 502 *sq.*

707. By the legislation of Justinian the law of *legata* was practically assimilated to that of *fideicommissa*. The only thing that distinguished the one from the other was the mode in which the gift was made: if by words of direct bequest, it was a *legatum*, if by precatory words, a *fideicommissum*. It may be noticed, as an illustration of the course afterwards taken by the law in England, that *fideicommissa* in favour of the church were so far favoured over others that if paid over by mistake they could not be recovered. In addition to *usus* and *fideicommissum*, the Roman division of ownership into quiritary and bonitary (to use words invented at a later time) may perhaps to some extent have suggested the English division into legal and equitable estate. The two kinds of ownership were amalgamated by Justinian. Legal and equitable estate are still distinct in England, though attempts have been made in the direction of amalgamation. The gradual manner in which the beneficiary became subject to the burdens attaching to the property of which he enjoyed the benefit was a feature common to both the Roman and the English system.

Uses in Early English Law.—The use or trust[1] is said to have been the invention of ecclesiastics well acquainted with Roman law, the object being to escape the provisions of the laws against MORTMAIN (*q.v.*) by obtaining the conveyance of an estate to a friend on the understanding that they should retain the use, *i.e.*, the actual profit and enjoyment of the estate. Uses were soon extended to other purposes. They were found valuable for the defeat of creditors, the avoiding of attainder, and the charging of portions. A use had also the advantage of being free from the incidents of feudal tenure: it could be alienated *inter vivos* by secret conveyance, and could be devised by will. In many cases the feoffee[2] to uses, as he was called, or the person seised to the use of another, seems to have been specially chosen on account of his rank and station, which would enable him to defy the common law and protect the estate of his *cestui que use*, or the person entitled to the beneficial enjoyment. The Act of 1 Ric. II. c. 9 was directed against the choice of such persons. This alienation of land in use was looked upon with great disfavour by the common law courts, in whose eyes the cestui que use was only a tenant at will. Possibly the ground of their refusal to recognize uses was that the assizes of the king's court could only be granted to persons who stood in a feudal relation to the king. The denial of the right followed the denial of the remedy. The use was on the other hand supported by the Court of Chancery, and execution of the confidence reposed in the feoffee to uses was enforced by the court in virtue of the general jurisdiction which as a court of conscience it claimed to exercise over breach of faith. Jurisdiction was no doubt the more readily assumed by ecclesiastical judges in favour of a system by which the church was generally the gainer. A double ownership of land thus gradually arose, the nominal and ostensible ownership,—the only one acknowledged in the courts of common law,—and the beneficial ownership protected by the Court of Chancery. The reign of Henry V. to a great extent corresponds with that of Augustus at Rome, as the point of time at which legal recognition was given to what had previously been binding only in honour. The means of bringing the feoffee to uses before the court was the writ of *subpœna*, said to have been invented by John de Waltham, bishop of Salisbury and master of the rolls in the reign of Richard II. By means of this writ the feoffee to uses could be compelled to answer on oath the claim of his cestui que use. The doctrine of the Court of Chancery as to the execution of a use varied according as there was transmutation of possession or not. In the former case it was unnecessary to prove consideration; in the latter, generally a case of bargain and sale, the court would not enforce the use unless it was executed in law,—that is, unless there was a valuable consideration, even of the smallest amount. Where no consideration could be proved or implied, the use resulted to the feoffor. This theory led to the insertion up to a recent date in deeds (especially in the lease of the lease and release period of conveyancing) of a nominal consideration, generally five shillings. Lands either in possession, reversion, or remainder could be granted in use. Most persons could be feoffees to uses. The king and corporations aggregate were, however, exceptions, and were entitled to hold the lands discharged of the use. On the accession of Richard III., who from his position of authority had been a favourite feoffee, it was necessary to pass a special Act (1 Ric. III. c. 5), vesting the lands of which he had been feoffee either in his co-feoffees or, in the absence of co-feoffees, in the cestui que use. The practical convenience of uses was so obvious that it is said that by the reign of Henry VII. most of the land in the kingdom was held in use. The freedom of uses from liability to forfeiture for treason must have led to their general adoption during the Wars of the Roses.[3] The secrecy with which a use could be transferred, contrary as it was to the publicity required for livery of SEISIN (*q.v.*) at common law, led to the interference of the legislature on several occasions between the reigns of Richard II. and Henry VIII., the general tendency of the legislation being to make the cestui que use more and more subject to the burdens incident to the ownership of land. One of the most important statutes was the Statute of Mortmain (15 Ric. II. c. 5), forbidding evasion of the Statute *De Religiosis* of Edward I. by means of feoffments to uses. Other Acts enabled the cestui que use to transfer the use without the concurrence of the feoffee to uses (1 Ric. III. c. 1), made a writ of *formedon* maintainable against him (1 Hen. VII. c. 1), rendered his heir liable to wardship and relief (4 Hen. VII. c. 17), and his lands liable to execution (19 Hen VII. c. 15). At length in 1535 the famous Statute of Uses (27 Hen. VIII. c. 10) was passed.[4] The preamble of the statute enumerates the mischiefs which it was considered that the universal prevalence of uses had occasioned, among others that by fraudulent feoffments, fines, recoveries, and other like assurances to uses, confidences, and trusts lords lost their feudal aids, men their tenancies by the curtesy, women their dower, manifest perjuries in trials were committed, the king lost the profits of the lands of persons attainted or enfeoffed to the use of aliens, and the king and lords their rights of year, day, and waste, and of escheats of felons' lands. To remedy this state of things it was enacted, *inter alia*, that, where any person was seised of any hereditaments to the use, confidence, or trust of any other person by any means, the person having such use, confidence, or trust should be seised, deemed, and adjudged in lawful seisin, estate, and possession of such hereditaments. Full legal remedies were given to the cestui que use by the statute. He was enabled to distrain for a rent charge, to have action, entry, condition, &c. The effect of this enactment was to make the cestui que use the owner at law as well as in equity (as had been done once before under the exceptional circumstances which led to 1 Ric. III. c. 5), provided that the use was one which before the statute would have been enforced by the Court of Chancery. For some time after the passing of the statute an equitable as distinct from a legal estate did not exist. But the somewhat narrow construction of the statute by the common law courts in Tyrrel's case[5] (1557) enabled estates cognizable only in equity to be again created. In that case it was held that a use upon a use could not be executed; therefore in a feoffment to A and his heirs to the use of B and his heirs to the use of C and his heirs only the first use was executed by the statute. The use of B being executed in him, that of C was not acknowledged by the common law judges; but equity regarded C as beneficially entitled, and his interest as an equitable estate held for him in trust, corresponding to that which B would have had before the statute. The position taken by the Court of Chancery in trusts may be compared with that taken in MORTGAGE (*q.v.*). The Judicature Act, 1873, while not going as far as the Statute of Uses and combining the legal and equitable estates, makes equitable rights cognizable in all courts. From the decision in Tyrrel's case dates the whole modern law of uses and trusts. In modern legal language use is restricted to the creation of legal estate under the Statute of Uses, trust is confined to the equitable estate of the cestui que trust or beneficiary.

Uses since 1535.—The Statute of Uses is still the basis of conveyancing. A grant in a deed is still, after the alterations in the law made by the Conveyancing Act, 1881, made to and to the use of A." The statute does not, however, apply indiscriminately to all cases, as only certain uses are executed by it. It does not apply to leaseholds or copyholds, or to cases where the grantee to uses is anything more than a mere passive instrument, *e.g.*, where there is any direction to him to sell the property. The seisin, too, to be executed by the statute, must be in another than him who has the use, for where A is seised to the use of A it is a common law grant. The difference is important as far as regards the doctrine of POSSESSION (*q.v.*). Constructive possession is given by a deed operating under the statute even before entry, but not by a common law grant (at any rate sufficient to entitle the grantee to be registered as a voter), until actual receipt of rent by the grantee. The operation of the Statute of Uses was supplemented by the Statute of Inrolments and that of Wills. (See WILL.) The Statute of Inrolments (27 Hen. VIII. c. 16) enacted that no bargain and sale should pass a freehold unless by deed indented and inrolled within six months after its date in one of the courts at Westminster or with the *custos rotulorum* of the county. As the statute referred only to freeholds, a bargain and sale of a leasehold interest passed without inrolment. Conveyancers took advantage of this omission (whether intentional or not) in the Act, and the practical effect of it was to introduce a mode of secret alienation of real property, the lease and release, which was the general form of conveyance up to 1845. (See REAL ESTATE, SALE.) Thus the publicity of transfer, which it was the special object of the Statute of Uses to effect, was almost at once defeated. In addition to the grant to uses there were other modes of conveyance under the statute which are now obsolete in practice, viz., the covenant to stand seised and the bargain and sale. Under the statute, as before it, the use has been found a valuable means of limiting a remainder to the person creating the use and of making an estate take effect in derogation of a former estate by means of a shifting or springing use. At common law a freehold could not be made to commence *in futuro*; but this end may be attained by a shifting use, such as a grant (common in marriage settlements) to A to the use of B in fee simple until a marriage, and after the celebration of the marriage to other uses. An example of a springing use would be a grant to A to such uses as B should appoint and in default of and until appointment to C in fee simple. The difficulty of deciding where the seisin was during the suspension of the use led to the invention of the old theory of *scintilla juris*, or continued possibility of seisin in the grantee to uses. This theory was abolished by 23 and 24 Vict. c. 38, which enacted that all uses should take effect by force of the estate and seisin originally vested in the person seised to the uses. The most frequent instances of a springing use are powers of appointment, usual in wills and settlements. There has been much legislation on the subject of powers, the main effect of which has been to give greater facilities for their execution, release, or abandonment, to aid their defective execution, and to abolish the old doctrine of illusory appointments.

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[1] Use seems to be an older word than trust. Its first occurrence in statute law is in 7 Ric. II. c. 12, in the form *aps*. In Littleton "confidence" is the word employed. The Statute of Uses seems to regard use, trust, and confidence as synonymous. According to Bacon, it was its permanency that distinguished the use from the trust.

[2] Feoffment, though the usual, was not the only mode of conveyance to uses. The preamble of the Statute of Uses mentions fines and recoveries, and other assurances.

[3] The use, as in later times the trust, was, however, forfeited to the crown on attainder of the feoffee or trustee for treason.

[4] It was adopted in Ireland exactly a century later by 10 Car. I. c. 1 (Ir.). The law of uses and trusts in Ireland is practically the same as that in England, the main differences being in procedure rather than in substantive law.

[5] Dyer's *Reports*, 155a.

Trusts.—A trust in English law is defined by Mr Lewin, adopting Coke's definition of a use, as "a confidence reposed in some other, not issuing out of the land, but as a thing collateral, annexed in privity to the estate of the land, and to the person touching the land, for which *cestui que trust* has no remedy but by *subpœna* in Chancery." The term *trust* or *trust estate* is also used to denote the beneficial interest of the cestui que trust. The term *truster* is not used, as it is in Scotland, to denote the creator of the trust. A trust has some features in common with CONTRACT (*q.v.*); but the great difference between them is that a contract can only be enforced by a party or one in the position of a party to it, while a trust can be, and generally is, enforced by one not a party to its creation. It has more resemblance to *fideicommissum*. But the latter could only be created by a testamentary instrument, while a trust can be created either by will or *inter vivos*; nor was there any trace in Roman law of that permanent legal relation which is suggested by the position of trustee and cestui que trust. The heir, too, in Roman law was entitled, from 70 A.D. to the reign of Justinian, to one-fourth of a *hereditas fideicommissaria* as against the beneficiary, while the very essence of the trust is its gratuitous character. Trusts may be divided in more than one way, according to the ground taken as the basis of division. One division, and perhaps the oldest, as it rests on the authority of Bacon, is into *simple* and *special*, the first being where the trust is simply vested in a trustee and the nature of the trust left to construction of law, the second where there is an act to be performed by the trustee. Another division is into *lawful* and *unlawful*, and corresponds to Bacon's division into intents or confidences and frauds, covins, or collusions. A third division is into *public* and *private*, the former being synonymous with charitable trusts. A division often adopted in modern text-books and recognized by parliament in the Trustee Act, 1850, is into *express*, *implied*, and *constructive*. An express trust is determined by the person creating it. It may be either *executed* or *executory*, the former where the limitations of the equitable interest are complete and final, the latter where such limitations are intended to serve merely as minutes for perfecting the settlement at some future period, as in the case of marriage articles drawn up as a basis of a marriage settlement to be in conformity with them. An implied trust is founded upon the intention of the person creating it; examples of it are a resulting trust, a precatory trust, and the trust held by the vendor on behalf of the purchaser of an estate after contract and before conveyance. In this case the vendor is sometimes called a trustee *sub modo* and the purchaser a cestui que trust *sub modo*. A constructive trust is judicially created from a consideration of a person's conduct in order to satisfy the demands of justice, without reference to intention. The distinction between an implied and a constructive trust is not always very consistently maintained. Thus the position of a vendor towards a purchaser after contract is sometimes called a constructive trust. The present law governing trusts rests upon the doctrines of equity as altered by legislation. Its great importance has led to its becoming one of the most highly developed departments of equity. The devolution of successive interests in wills and settlements is almost wholly attained by means of trusts.

Who may be a Trustee or Cestui que Trust.—The modern trust is considerably more extensive in its operation than the ancient use. Thus the crown and corporations aggregate can be trustees, and personalty can be held in trust. Provision is made by the Municipal Corporations Act, 1882, for the administration of charitable and special trusts by municipal corporations. The crown does not appear to be a trustee to as complete a degree as a subject may be. Unsuccessful attempts have recently been made to impress the crown, or a secretary of state as agent of the crown, with trusts of funds voted by parliament for the public service, of booty of war granted by royal warrant, and of money paid over by a foreign state in pursuance of a treaty. There are certain persons who for obvious reasons, even if not legally disqualified, ought not to be appointed trustees. Such are infants, lunatics, persons domiciled abroad, felons, bankrupts, and *cestuis que trustent*. The appointment of any such person, or the falling of any existing trustee into such a position, is generally ground for application to the court for appointment of a new trustee in his place. Any one may be a cestui que trust except a corporation aggregate, which cannot be a cestui que trust of real estate without a licence from the crown.

Creation and Extinction of the Trust.—A trust may be created either by act of a party or by operation of law. Where a trust is created by act of a party, the creation at common law need not be in writing. The Statute of Frauds (see FRAUD) altered the common law by enacting that all declarations or creations of trusts or confidences of any lands, tenements, or hereditaments shall be manifested and proved by some writing, signed by the party who is by law enabled to declare such trust, or by his last will in writing, or else they shall be utterly void and of none effect. Trusts arising or resulting by implication or construction of law are excepted, and it has been held that the statute applies only to real estate and chattels real, so that a trust of personal chattels may still be declared by parol. The declaration of a trust by the crown must be by letters patent. Trusts created by will must conform to the requirements of the Wills Act (see WILL). Except in the case of charitable trusts, the cestui que trust must be a definite person. A trust, for instance, merely for keeping up family tombs is void. Alteration of the trust estate by appointment of a new trustee could up to 1860 only be made where the instrument creating the trust gave a power to so appoint, or by order of the Court of Chancery. But now by the Conveyancing Act, 1881 (superseding Lord St Leonards's Act of 1860), the surviving or continuing trustee or trustees, or the personal representative of the last surviving or continuing trustee, may nominate in writing a new trustee or new trustees. On such appointment the number of trustees may be increased. Existing trustees may by deed consent to the discharge of a trustee wishing to retire. Trust property may be vested in new or continuing trustees by a simple declaration to that effect. By the Conveyancing Act, 1882, a separate set of trustees may be appointed for any part of the property held on distinct trusts. Trusts created by operation of law are either those which are the effect of the application of rules of equity or those which have been constituted by a judicial authority. They include resulting and constructive trusts. A resulting trust is a species of implied trust, and consists of so much of the equitable interest as is undisposed of by the instrument creating the trust, which is said to result to the creator and his representatives. An example is the purchase of an estate in the name of the purchaser and others, or of others only. Here the beneficial interest is the purchaser's. An example of a constructive trust is a renewal of a lease by a trustee in his own name, where the trustee is held to be constructively a trustee for those interested in the beneficial term. An instance of a constructive trust upon which the courts have often been called upon to decide is the fiduciary relation between the promoter of a proposed joint-stock company and the members of the company when formed. The other trusts falling under the head of trusts by operation of law would be those imposed upon a trustee by order of a court, even though they are imposed in pursuance of provisions contained in a trust created by a party. Such would be the trusts which have come within the cognizance of the court by virtue of the Trustee Act, 1850, or in any other way. The powers of the court over trusts have been much extended by legislation. The Act of 1850 (13 and 14 Vict. c. 60) enabled the Court of Chancery to appoint new trustees where expedient, and to make vesting orders in many cases where such orders could not previously have been made, as where a trustee was a lunatic, or an infant, or refused to convey. This Act was extended by the Trustee Extension Act, 1852 (15 and 16 Vict. c. 55). By the Conveyancing Act, 1881, a trustee appointed by the Chancery Division is to have the same powers as if he had been originally appointed a trustee by the instrument creating the trust. The Bankruptcy Act, 1883, enables the court to appoint a new trustee in the place of a bankrupt trustee. Besides being duly created, it is necessary for the validity of the trust that it should be a lawful one. An unlawful trust is one which contravenes the policy of the law in any respect. Examples of such trusts are trusts for a corporation without licence, for a perpetuity, and for purposes subversive of morality, such as trusts for illegitimate children to be hereafter born. Superstitious uses (see Roman Catholic Church, vol. xx. p. 632) also fall under this head. There are also certain trusts which are avoided by statute under particular circumstances, such as settlements in fraud of creditors (see Bankruptcy, Settlement). The law cannot be evaded by attempting to constitute a secret trust for an unlawful purpose. If an estate be devised by words *prima facie* carrying the beneficial interest, with an understanding that the devisee will hold the estate in trust for such a purpose, he may be compelled to answer as to the secret trust, and on acknowledgment or proof of it there will be a resulting trust to the heir-at-law. In the case of an advowson suspected to be held for the benefit of a Roman Catholic patron, there is a special enactment to the same effect (see Quare Impedit). The rules of equity in charitable trusts (which include all those mentioned in the preamble to 43 Eliz. c. 4)[1] are less strict than those adopted in private trusts. Charitable trusts must be lawful, *e.g.*, they must not contravene the Statutes of Mortmain; but a wider latitude of construction is allowed in order to carry out the intentions of the founder, and they will not be allowed to fail for want or uncertainty of objects to be benefited. The court, applying the doctrine of *cy près*, will, on failure of the original ground of the charity, apply the funds as nearly as possible in the same manner. On this principle gifts originally made for purely charitable purposes have been extended to educational purposes. Further, trustees of a charity may act by a majority, but ordinary trustees cannot by the act of a majority (unless specially empowered so to do) bind a dissenting minority or the trust property. A trust estate is subject as far as possible to the rules of law applicable to a legal estate of a corresponding nature, in pursuance of the maxim, "Equity follows the law." Thus trust property is assets for payment of debts, may be taken in execution, passes to creditors in bankruptcy, and is subject to dower and curtesy, to the rules against perpetuities, and to the Statutes of Limitation. This assimilation of the legal and equitable estates has been produced partly by judicial decisions, partly by legislation. A trust is extinguished, as it is created, either by act of a party or by operation of law. An example of the former mode of extinction is a release by deed, the general means of discharge of a trustee when the purposes of the trust have been accomplished. Extinction by operation of law takes place when there is a failure of the objects of the trust: *e.g.*, if the cestui que trust die intestate without heirs or next of kin, the trustee retains the property discharged of the trust if it be real estate, if it be personalty it falls to the crown. Equitable interests in real estate abroad are as a rule subject to the *lex loci rei sitæ*, and an English court has no jurisdiction to enforce a trust or settle a scheme for the administration of a charity in a foreign country. An English court has, however, jurisdiction to administer the trusts of a will as to the whole real and personal estate of a testator, even though only a very small part of the estate, and that wholly personal, is in England. This was decided by the House of Lords in a well-known case in 1883.[2]

Rights and Duties of the Trustee.—The principal general properties of the office of trustee, as given by Mr Lewin, are these:—(1) A trustee having once accepted the trust cannot afterwards renounce. (2) He cannot delegate it. (3) In the case of co-trustees the office must be exercised by all the trustees jointly. (4) On the death of one trustee there is survivorship: that is, the trust will pass to the survivors or survivor. (5) One trustee shall not be liable for the acts of his co-trustee. (6) A trustee shall derive no personal benefit from the trusteeship. The office cannot be renounced or delegated, because it is one of personal confidence. It can, however, be resigned, and recent legislation, as has been already stated, has given a retiring trustee large powers of appointing a successor. In the case of the death of a single or last surviving trustee of real estate, the trust estate by the Conveyancing Act, 1881, now devolves upon his personal representative instead of upon his heir or devisee. The liability of one trustee for the acts or defaults of another often raises very difficult questions. A difference is made between trustees and executors. An executor is liable for joining in a receipt *pro forma*, as it is not necessary for him to do so, one executor having authority to act without his co-executor; a trustee can show that he only joined for conformity, and that another received the money. A trustee's receipt in writing is, under the Conveyancing Act, 1881 (superseding Lord St Leonards's Act of 1860), a sufficient discharge, and exonerates the person paying from seeing that the money paid is duly applied according to the trust. If one trustee be cognizant of a breach of trust committed by another, and conceal it or do not take active measures to protect the cestui que trust's interests, he will be liable for the breach of trust. An indemnity clause is now implied by statute in every trust deed, but this does not protect a trustee against liability which would attach at law. A trustee, if he commit a breach of trust at the request of his cestui que trust, may secure himself by an indemnity, provided that the cestui que trust has been fully informed of the facts of the case, and is not under any disability to consent, such as infancy. The rule that a trustee is not to benefit by his office is subject to some exceptions. He may do so if the instrument creating him trustee specially allows him remuneration, as is usually the case where a solicitor is appointed. Where the trust entirely fails, as has been said above, the trustee is indirectly remunerated by his right to retain the trust estate. The main duties of trustees are to place the trust property in a proper state of security, to keep it (if personalty) in safe custody, and to properly invest and distribute it. A trustee must be careful not to place himself in a position where his interest might clash with his duty. As a rule he cannot safely purchase from his cestui que trust while the fiduciary relation exists between them. In all purchases with trust money he is bound to obtain the best price, unless where an Act of Parliament, like the Housing of the Working Classes Act, 1885, specially authorizes sale at an under value. Investments by trustees demand special notice. The general rule is that a trustee must take as much care of the trust property as of his own. He is, therefore, justified in following the usual course of business adopted by prudent men in making investments, *e.g.*, by employing a stock-broker in the ordinary way. At the same time he has not an uncontrolled power of investment, for (unless authorized by the instrument creating the trust) he cannot lend trust money on personal security or invest in shares of a private company. A trustee of shares may be liable as a beneficial owner, even though his name appears on the register of the company as a trustee. By recent legislation trustees, where not expressly forbidden by the instrument creating the trust, have either an absolute or qualified right to invest in certain securities. They have an absolute right to invest in real securities in the United Kingdom (but not on a second mortgage), in charges or mortgages under the Improvement of Land Act, 1864, in consols, exchequer bills, or any security the interest whereon is guaranteed by parliament, in Bank of England, Bank of Ireland, East India, and Metropolitan Board of Works stock. They have a qualified power of investment (that is, an extension of powers already given in the instrument) in debentures or debenture stock of railway and other companies, and of corporations and local authorities under the Local Loans Act, 1875, in mortgage debentures under the Mortgage Debenture Acts of 1865 and 1870, and in securities of the Isle of Man Government. Trustees under the Settled Land Act, 1882, have somewhat larger powers as to railway stock. In many cases there are restrictions on investment in stock certificates payable to bearer, although in authorized securities. A power of varying investments is generally implied, though not expressly given by statute, as in Scotland. The duties of trustees in the distribution of trust funds have been made less onerous by the Trustee Relief Acts of 1847 and 1849, which enabled trustees or a majority of them to pay into the Bank of England to the account of the particular trust any moneys belonging to the trust, thus bringing the property within the jurisdiction of the court, from which it can only be obtained on petition. Similar powers were conferred upon trustees of charities by 18 and 19 Vict. c. 124. By more recent Acts (22 and 23 Vict. c. 35, 23 and 24 Vict. c. 38) application for advice may be made by a trustee to a judge of the Chancery Division on a petition or summons. The liability of a trustee to his cestui que trust on any claim for property held on an express trust or in respect of breach of such trust is not barred by any statute of limitations, 36 and 37 Vict. c. 66, s. 26 (2). The powers of trustees have lately been considerably extended by the Conveyancing Act, 1881, and the Settled Land Act, 1882, in other matters besides those that have been already noticed. One of the most important of the new powers is that of compounding, compromising, or abandoning claims relating to the trust. For the trustee in bankruptcy, see Bankruptcy. The trustee to preserve contingent remainders, at one time common in conveyancing, has ceased to be necessary (see Remainder, Term). A bare trustee is one to whose office no duties were originally attached, or who, though such duties were attached, would on the requisition of the cestui que trust be compellable to convey the estate to him or by his direction. The term is used in some Acts of Parliament, for instance the Vendor and Purchaser Act, 1874.[3]

Rights and Duties of the Cestui que Trust.—These may be to a great extent deduced from what has been already said as to the correlative duties and rights of the trustee. The cestui que trust has a general right to the due management of the trust property, to proper accounts, and to enjoyment of the profits. He can as a rule only act with the concurrence of the trustee, unless he seeks a remedy against the trustee himself. Thus the trustee must be a party to an action brought in respect of the trust estate, and must join in presenting a petition in bankruptcy on account of a debt due to the estate, but the cestui que trust on giving indemnity can require the trustee to lend his name as a party. He may also require the trustee to execute conveyances of the legal estate according to his directions. Trust property, if parted with by the trustee in fraud of the trust may be followed by the cestui que trust, even into the hands of a purchaser for value with notice of the trust. The cestui que trust may lose his rights by fraud, by laches, and by concurrence or acquiescence in a breach of trust. Though no lapse of time bars his remedy against the trustee personally, he cannot, by the terms of the Real Property Limitation Act, 1874, recover land or rent vested in a trustee upon an express trust after twelve years from the time when the right accrued or six years after the cesser of any disability. The equitable right of the cestui que trust has sometimes been recognized by statute in cases where it would be manifestly unjust that he should suffer disability by virtue of his having merely an equitable interest. The cestui que trust has the right of voting for members of parliament, and is qualified to serve as a juror. On bankruptcy of the trustee the trust estate is not affected. Nor was it affected even before the Felony Act, 1870, by the conviction and attainder of the trustee for felony. Attainder of the trustee for treason involved, however, forfeiture of a trust estate of inheritance. (See TREASON.) The recognition of the cestui que trust as owner is still not complete. Thus no notice of a trust is recognized in certain public documents, as the books of the Bank of England and the registers kept under the Merchant Shipping Act, 1854, the Companies Act, 1862, the Land Transfer Act, 1875, and the Colonial Stock Act, 1877.

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[1] See Charities, where the preamble of the statute is set out in full.

[2] Ewing v. Orr-Ewing, *Law Reports*, 9 Appeal Cases, 34.

[3] The phrase "bare trust" occurs as long ago as 1686, Nevil v. Saunders, 1 *Vernon's Rep.*, 415.

Procedure.—This is regulated almost entirely by legislation. Proceedings relating to a trust may be brought in different courts of first instance,—(1) the Chancery Division of the High Court of Justice or the Chancery Court of the County Palatine of Lancaster, (2) a court of bankruptcy, (3) a county court, (4) a criminal court. (1) By the Judicature Act, 1873, § 34, the execution of trusts, charitable or private, is assigned to the Chancery Division. The rules of the Supreme Court, 1883, provide for special indorsement in an action on a trust, for the parties to the action, for interrogatories and pleading, and for proceeding by originating summons. (See SUMMONS.) Forms of pleading are given in the appendix to the rules. An injunction rather than an action may sometimes be the proper remedy, as in the case of threatened breach of trust. The Trustee Relief Acts, the Trustee Act, and Lord St Leonards's Act of 1859 provide for proceeding by petition or summons. Applications under the Conveyancing Act must be in chambers in the first instance, and so must applications under the Trustee Relief Acts where the money or securities in court do not exceed £1000 or £1000 nominal value. The procedure in charitable trusts differs to some extent from that in use in private trusts. The most usual course of proceeding is by information in the name of the attorney-general. Another mode is by petition under Sir Samuel Romilly's Act, 52 Geo. III. c. 101, superseding the cumbrous procedure by commission which had been previously in use under 43 Eliz. c. 4. A third mode is under the powers of the Charitable Trusts Acts, the first of which was passed in 1853. No proceeding under these Acts can be taken without the authority of the charity commissioners. (2) The equitable debt due from the trustee to the cestui que trust will support a petition in bankruptcy, and is a debt provable in bankruptcy. An order of discharge in bankruptcy does not release the bankrupt from any debt or liability incurred by means of fraudulent breach of trust, nor does it release a co-trustee of the bankrupt. (3) The County Courts Equitable Jurisdiction Act, 1865, confers on county courts the authority of the High Court in the execution of trusts and proceedings under the Trustee Acts where the trust estate does not exceed £500 in amount or value. By the County Courts Act, 1867, applications may be made at chambers for transfer to a county court of an action pending in the High Court where the property does not exceed £500 in amount or value. The same Act allows trust funds not exceeding that limit to be paid into the post office savings bank in a county court town in the name of the registrar. A county court has jurisdiction in charitable trusts where the income of a charity does not exceed £50. The county court rules, 1886, contain orders regulating the practice with respect to both private and charitable trusts. Powers similar to those given to county courts in England have been conferred upon the civil bill courts in Ireland. (4) At common law trustees committing a fraudulent breach of trust could not be punished criminally. This was altered by the Fraudulent Trustees Act of 1857, now superseded by the Larceny Act, 1861, under which a trustee on an express trust, whether public or private, created by deed, will, or instrument in writing, who with intent to defraud converts to his own use or benefit or the use or benefit of any other person than the cestui que trust, or for any purpose other than the public or charitable purpose, or otherwise disposes of or destroys such property or any part thereof, is guilty of misdemeanour and punishable with penal servitude for a term not exceeding seven years. No prosecution is to be commenced without the sanction of the attorney-general or—where civil proceedings have been already taken against the trustee—without the sanction of the civil court. The offence cannot be prosecuted at quarter sessions.[1]

Scotland.—The history of the law differs considerably from that of England, though perhaps the position of the Scotch trustee is now not very different from that of the trustee in England. The Statute of Uses did not apply to Scotland, since neither that nor any similar legislation was necessary in a system in which law and equity were administered by the same tribunals. Trusts seem to have existed from time immemorial, and have been frequently regulated by statute. The policy of the English Statute of Frauds was no doubt intentionally imitated in the Act 1696, c. 25, enacting that no action of declarator of trust should be sustained as to any deed of trust made for thereafter, except upon a declaration or back-bond of trust lawfully subscribed by the person alleged to be trustee and against whom or his heirs or assignees the declarator should be intended, or unless the same were referred to the oath of the party *simpliciter*. The Act does not apply to all cases, but only to those in which by the act of parties documents of title are in the name of a trustee, but the beneficial interest in another. The person creating the trust is called the *truster*, a term unknown in England. On the other hand the term *cestui que trust* is unknown in Scotland. The office of trustee is *prima facie* gratuitous, as in England, it being considered to fall under the contract of mandate. Some of the main differences between English and Scotch law are these. There is no presumption in Scotland of a resulting trust in favour of a purchaser. A trust which lapses by the failure of a beneficiary goes to the crown as *ultimus heres*, not to the trustee. The office of trustee is not a joint office, therefore there is no right of survivorship, and on the death of a trustee the survivors are incompetent to act, unless a certain number be declared or presumed to be a *quorum*, or the office be conferred on trustees and the accedors and survivors of them. Sometimes the concurrence of one trustee is rendered absolutely necessary by his being named *sine quo non*. The Court of Session may appoint new trustees, but generally appoints a judicial factor. There has been a considerable amount of recent legislation, chiefly in the direction of extending the powers of trustees and of the court, in trust matters. By 24 and 25 Vict. c. 84 (amended by 26 and 27 Vict. c. 115) an appointment of gratuitous trustees by deed or local act was to be held to include certain provisions usually included in deeds of appointment, *i.e.*, powers of resignation and of assumption of new trustees, and provisions that the majority of trustees accepting and surviving should be a *quorum*, and that each trustee should only be liable for his own acts and intromissions and should not be liable for omissions. The Trusts Act, 1867 (30 and 31 Vict. c. 97), added to the common law powers of trustees by giving them authority to appoint factors and law agents, to discharge trustees who have resigned, to grant leases for a limited period, to uplift, discharge, or assign debts, to compromise claims, to grant all necessary deeds, and to pay debts due by the truster or the trust estate. It also gave the Court of Session power (exercisable by the lord ordinary in the first instance) beyond what it possessed by its *nobile officium*, in cases of expediency, of selling the trust estate, of granting feus or long leases, and of borrowing and excambion. Power was given to trustees to appoint additional trustees by deed of assumption, and where such assumption could not be made the court might appoint. Authority was conferred upon the beneficiary of a lapsed trust to complete title on petition. The powers of investment given to trustees have since been largely increased by the Trusts Amendment Act, 1884. They are now much the same as those allowed in England. The principal differences are that in Scotland there is a statutory power to vary securities, and that statutory investment by a Scotch trustee is not allowed in Bank of Ireland stock or on real security in Ireland. The Titles to Land Consolidation Act, 1868 (31 and 32 Vict. c. 101), contained provisions as to the mode of completing title by a judicial factor on a trust estate and by trustees in sequestration and as to the vesting in trustees of heritable property conveyed for religious or educational purposes. The Conveyancing Act, 1874 (37 and 38 Vict. c. 94), dealt with compositions payable by trustees on the death of a vassal, and with completion of title by the heir of a sole or last surviving trustee, by a successor of an *ex officio* trustee, and by trustees where words of conveyance are not expressed to be in favour of such trustees. Forms of documents relating to trust property will be found in Juridical Styles and in the schedules to the Acts of 1867, 1868, and 1874. A conveyance in trust may be either absolute with a back-bond or in form a conveyance in trust. A trustee is responsible for the due execution of the trust, subject to the limitations contained in 24 and 25 Vict. c. 84. The provision of the Companies Act, 1862, that no trust is to be entered on the register, does not apply to Scotland. A trustee, a member of a joint-stock company, though entered on the register as a trust disponee, may incur personal liability as a partner, unless the contrary be expressed. Liability under such circumstances was established in the litigation which followed the suspension of the City of Glasgow Bank in 1878.[1] A sheriff court has jurisdiction over actions of declarator, relating to questions of heritable right or title, where the value of the subject in dispute does not exceed £50 by the year or £1000 in value (40 and 41 Vict. c. 50). A judicial factor may be appointed by the sheriff court where the yearly value of the estate does not exceed £100 (43 and 44 Vict. c. 4). Fraudulent trustees are criminally liable at common law, not by statutory enactment, as in England. Adjudication on a trust bond is a mode of obtaining the decision of the Court of Session on a bond by a fictitious creditor, for the purpose of giving title to the heir, by preventing his liability to possible passive representation. It is regulated by 1695, c. 24.[2]

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[1] The principal authority is Lewin's *Law of Trusts* (8th ed., 1885). The powers of trustees under the Conveyancing and Settled Land Acts will be found summarized in the treatises on these acts by Wolstenholme and Turner. The principal authorities on charitable trusts are Shelford and Tudor (1862). For the history may be consulted Bacon, *Law Tracts*; Reading, *On the Statute of Uses*; Gilbert, *On Uses*; Sanders, *On Uses and Trusts*; Spence, *Equitable Jurisdiction*, vol. i. p. 435; Digby, *Hist. of the Law of Real Property*, chaps. vi. vii.

United States.—In New York and some other States uses and trusts have been abolished (with certain exceptions), and every estate, subject to those exceptions, is deemed a legal right cognizable in courts of law. The exceptions are in New York implied trusts and express trusts to sell land for the benefit of creditors, to sell, mortgage, or lease lands for the benefit of legatees, or for the purpose of satisfying any charge thereon, to receive the rents and profits of lands and apply them to the use of any person during the life of such person or any shorter term, or to receive such rents and profits, and accumulate the same within the limits allowed by the law. Trusts of personalty for public purposes are very generally allowed in States where private trusts do not exist. Provisions similar to those of the English Statute of Frauds have been generally adopted by the States which recognise private trusts. Some States go further than the statute and allow the creation of trusts (other than those arising by implication or operation of law) only by means of will or deed. Where the trust is of real estate, the deed must generally be registered (see REGISTRATION). Forms of deeds of trust are given in the Statutes of Virginia and other States. The English doctrine of *cy près* seems to have been adopted only in Pennsylvania. Conveyances in trust for the settlor are generally void against creditors by the policy of the Acts of Elizabeth. By the legislation of some States a freehold may commence *in futuro* without the operation of the Statute of Uses. Societies of professional trustees, receiving a percentage of the income of the property as payment for their trouble and liability, are frequently recognized by law. Such societies are generally under an obligation to make periodical returns of their receipts and expenditure. A public trustee as a corporation sole exists in some States. Trustee process in the New England States is what is generally known as garnishee process in England, that is, a means of reaching property and credits of a debtor in the hands of third persons for the benefit of an attaching creditor.[3] (J. Wt.)

TSARITSYN, a district town of the government of Saratoff, Russia, situated on the right bank of the lower Volga where it suddenly turns towards the south-east, only 40 miles distant from the Don. It is the terminus of a railway line which begins at Riga and, running south-eastwards, crosses all the main lines which radiate from Moscow to the south. It is also connected by rail with Kalatch on the Don, where merchandise from the Sea of Azoff is disembarked and transported by rail to Tsaritsyn, to be sent thence by rail or steamer to different parts of Russia. Corn from Middle Russia for Astrakhan is transferred from the railway to boats at Tsaritsyn; timber and wooden wares from the upper Volga are unloaded here and sent by rail to Kalatch; and fish, salt, and fruits sent from Astrakhan by boat up the Volga are here unloaded and despatched by rail to the interior of Russia. The town has grown rapidly since the completion of the railway system, and has a large trade in naphtha from Baku, which is shipped up the Volga to Tsaritsyn and sent thence by rail to the interior of Russia. The railway between the Baskunchak salt lakes of Astrakhan and the Volga has made Tsaritsyn also a depôt for the salt trade. In 1882 10,000,000 cwts. of merchandise, valued at one million sterling, were landed at Tsaritsyn, and since then the figures have notably increased. In addition Tsaritsyn is the centre of the trade connected with the mustard plantations of Sarepta, Dubovka, and the neighbourhood; 170,000 cwts. of mustard seed are either ground or converted into oil annually, the exports being 70,000 cwts. of mustard and half the corresponding quantity of oil (valued at £250,000). The fisheries of the place are also important. The population (6750 in 1861) numbered 31,220 in 1882. It is still larger in summer, Tsaritsyn having become the gathering-place of poor people in search of work, and the misery and filth in its poorer quarters are very great. The buildings of the town do not improve proportionately with the increase of wealth. They include a (wooden) theatre, a public library, and two gymnasia for boys and girls. The old church of St John (end of 16th century) is a fine specimen of the architecture of its period.

Tsaritsyn was founded in the 16th century, when a fort was erected to prevent the incursions of the free Cossacks and runaway serfs who gathered on the lower Volga, as also those of the Kalmucks and Circassians. In 1606 Tsaritsyn took part in the rising in favour of the false Demetrius, and Razin took the town in 1670. The Kalmucks and Circassians of the Kubañ attacked it repeatedly in the 17th century, so that it had to be fortified by a strong earthen and palisaded wall, traces of which are still visible.

TSARSKOYE SELO, a district town of Russia, in the government of St Petersburg, and an imperial residence, 18 miles to the south of the capital, is situated on the Duderhof Hills and consists of the town proper, surrounded by several villages and a German colony, which are summer resorts for the inhabitants of St Petersburg, and the imperial parks and palaces. The town is built according to a regular plan, and its houses, a great number of which have been erected by the crown, are nearly all surrounded by gardens. The cathedral of St Sophia is a miniature copy of that at Constantinople. The town has two gymnasia for boys and girls. The imperial parks and gardens cover 1680 acres; the chief of them is the "old" garden containing the "old palace," built by Rastrelli, the gallery of Cameron adorned with fine statues, and numerous pavilions and kiosks. The population numbered 15,000 in 1885.

When Peter I. took possession of the mouth of the Neva a Finnish village, Saari-mois, stood on the site now occupied by the town, and its Russified name Sarskaya was changed into Tsarskoye when Peter I. presented it to his wife Catherine. It was especially embellished by Elizabeth. Under Catherine II., a town, Sophia, was built close by, but its inhabitants were transferred to Tsarskoye Selo under Alexander I. The railway connecting the town with St Petersburg (1838) was the first to be constructed in Russia.

TSCHUDI, or SCHUDY, the name of one of the oldest and most distinguished families of the land of Glarus, Switzerland. From 1029 to 1253 a member of the clan held the office of steward of the abbess of Säckingen on the Rhine, the lady of the manor; and after Glarus joined the Swiss Confederation in 1352 various members of the family held high political offices at home, and were distinguished abroad as soldiers and in other ways. In literature, its most eminent member was GILES or ÆGIDIUS TSCHUDI (1505-1572), who, after having served his native land in various offices, in 1558 became the chief magistrate or "landammann." Originally inclined to moderation, he became later in life more and more devoted to the cause of the counter-Reformation. It is, however, as the historian of the Swiss Confederation that he is best known; by incessant wanderings and unwearied researches amongst original documents he collected material for three great works, which therefore can never wholly lose their value, though his researches have been largely supplemented and corrected by those of more recent students. In 1538 his book on Rhætia, written in 1528, was published in Latin and in German—*De prisca ac vera Alpina Rhætia*, or *Die uralt wahrhafftig Alpisch Rhätia*.

His other works were not published until long after his death.

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[1] The principal case was Muir *v.* City of Glasgow Bank, *Law Reports*, 4 Appeal Cases, 337.

[2] See G. J. Bell, *Principles*, §§ 1991-2001; R. Bell, *Law Dict.*, s.v. "Trust" and "Trustee."

[3] See Washburn, *Real Property*, vol. ii., bk. ii., chaps. ii, iii.; Stimson, *American Statute Law*, §§ 1700-1754.

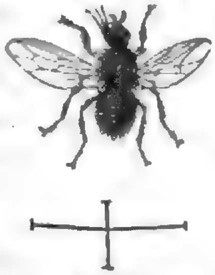
The *Beschreibung Galliæ Comatæ* appeared under Gallati's editorship in 1758, and is mainly devoted to a topographical, historical, and antiquarian description of ancient Helvetia and Rhætia, the latter part being his early work on Rhætia revised and greatly enlarged. This book was designed practically as an introduction to his *magnum opus*, the *Chronicon Helveticum*, part of which (from 1100 to 1470) was published by J. R. Iselin in two stately folios (1734-36); the rest (to 1564) consists only of rough materials. The value of the work rests very largely on the constant use of original documents, no fewer than 750 being printed in Iselin's edition, though the transcripts do not always in point of accuracy come up to the standard demanded by the modern critical historian. Many ballads are incorporated and also many oral traditions, both being employed to give life and picturesqueness to his story, though often at the expense of historical truth, the stock instance of which is the manner in which he completed and elaborated the Tell legend (see Tell). In many ways his book, save in its flowing and quaint German, is rather like the work of a 14th-century chronicler than a critical history; but it has been the source from which all later Swiss writers have drawn their information, and in many cases preserves the evidence of original documents which have since disappeared. It is in short a history rather resembling that of Livy than that of Hallam or Stubbs.

Subjoined is a list of other prominent members of the family. Dominic (1596-1654) was a Benedictine monk at Muri and wrote a painstaking work, *Origo et genealogia gloriosissimorum comitum de Habsburg* (1651). Joseph, a Benedictine monk at Einsiedeln, wrote a useful history of his abbey (1823). The family, which became divided in religious matters at the Reformation, also includes several Protestant ministers,—John Henry (1670-1729), who wrote *Beschreibung des Lands Glarus* (1714); John Thomas (1714-1788), who left behind him several elaborate MSS. on the local history of Glarus; and John James (1722-1784), who compiled an elaborate family history from 900 to 1500, and an account of other Glarus families. John Louis (d. 1784), who settled in Metz and contributed to the *Encyclopédie*, and Friedrich (1820-1886), the author of *Das Thierleben der Alpenwelt*, were distinguished naturalists. Among the soldiers may be mentioned Christopher (1571-1629), a knight of Malta and an excellent linguist, who served in the French and Spanish armies; while the brothers Louis Leonard (1700-1779) and Joseph Anthony (1703-1770) were in the Neapolitan service. Valentine (1499-1555), the cousin of Giles, was, like the latter, a pupil of Zwingli, whom he afterwards succeeded as pastor of Glarus, and by his moderation gained so much influence that during the thirty years of his ministry his services were attended alike by Catholics and Protestants.

TSE-NAN FOO, the capital city of the province of Shantung in China, stands in 36° 40′ N. lat. and 117° 1′ E. long. It is situated in one of the earliest settled districts of the empire, and figures repeatedly in the records of the wars which troubled the country during the six centuries that preceded the Christian era. On the establishment of the Han dynasty (B.C. 206) it had the name which it now bears; but during the next 200 years it was known at different periods as P'ing-yuen, Ts'ien-sh'ing, and Po-hai. In the 4th century its name was changed to Tse; and by the founder of the T'ang dynasty (618-907) it was christened Lin-tsze, by which name it was known until the overthrow of the Mongol dynasty in the 14th century, when the name of Tse-nan was restored to it. The city, which lies in the valley of the present channel of the Yellow river (Hoang-Ho), and at a short distance from its banks, is surrounded by a triple line of defence. First is the city wall, strongly built and carefully guarded, outside this a granite wall, and beyond this again a mud rampart. The streets are full of good shops, among which book, picture, and flower shops are conspicuous. There are two fine examination halls, one for bachelors of arts and the other for doctors of law, several handsome temples, and a metropolitan "drum" tower. The most noticeable feature about the city is three springs outside the west gate, which throw up as many streams of tepid water to a height of about 2 feet. This water, which is pleasant to the taste, and is highly prized for its healing qualities, flows in such abundant quantities that it fills the moat and forms a fine lake in the northern quarter of the city. With the taste which Chinamen always show in such matters, the lake is divided into a number of water avenues by floating banks, on which flowers and trees are skilfully arranged, and is further adorned with several picturesque summer houses, which form points of attraction to picnic parties and pleasure-seekers during the warmer months. Its waters abound with many species of edible fish. The population of the town is reckoned at about 100,000, among whom are 2000 Mohammedan families. The city is the centre of a Roman Catholic see, and has opened its gates to several Protestant missionary bodies.

See Williamson, *Journeys in North China*, London, 1870.

TSETSE FLY (*Glossina morsitans*). The tsetse fly, so much dreaded by the traveller in South Africa, belongs to the sub-family *Muscinæ* and is closely allied to *Stomoxys*. It is scarcely larger than the common house fly, which it resembles in its general shape. It can, however, be easily distinguished by its colour and the position of its wings. These are longer than the abdomen, and when at rest they project behind it, overlapping one another at their tips. This gives the fly a longer and narrower outline than that of the house fly. The colour is somewhat like that of the honey bee: the thorax is chestnut brown with four longitudinal black stripes, the abdomen light yellow with transverse bars of dark brown on its dorsal surface. The proboscis, with which the fly inflicts its sting, is grooved and contains two long styles; and it is guarded by a pair of setose palps. At the base of the proboscis is a dilated horny bulb, and in this swelling it is supposed that the poison is secreted. The bite of the tsetse is innocuous to man and is not more painful than that of a gnat. Large game, goats, and apparently all animals whilst suckling, are also unaffected by it. But to the horse, ox, and dog it is fatal. The poison may take effect after a few days, or the animal may remain apparently unaffected for some months; but eventually symptoms of poisoning appear. These symptoms seem to be rather variable; as a rule swellings arise under the jaws and around the navel, the eyes and nose begin to run, and, although the animal continues to graze, it becomes more and more emaciated, suffers violently from purging, and at length succumbs to extreme exhaustion. Post-mortem examination shows that the muscles, and especially the heart, are in a very soft and flabby condition. The lungs and liver are affected, the gall bladder distended with bile. The fat is of a greenish yellow colour and oily consistency, the blood small in quantity and very thin, with hardly any power of staining. At present no cure is known for the bite, nor does inoculation seem to afford any protection. The fly is said to avoid animal excreta, and in some parts a paste composed of milk and manure is smeared on cattle which are about to pass through the "fly-belts." This affords a certain amount of protection. Lion's fat is used in the same way, and is said to be efficacious.



Tsetse fly (*Glossina morsitans*).

The fly is found as a rule in the neighbourhood of water, and its habitat is usually sharply defined. Often it occurs on one side of a stream but not on the other. The limits of the "fly-belts" are well known to the natives, and travellers can ensure comparative safety to their cattle by passing through these districts after sundown. The northern limits of the area inhabited by the tsetse are not known. It is found throughout the valley of the Limpopo river, but does not come much south of this, except in the eastern borders of the Transvaal. Here it extends far south of Delagoa Bay, and infests the Lobombo Mountains and the Amatonga country, reaching to the confines of Santa Lucia Bay. It appears to be gradually retreating northwards, following the big game.

The fly is figured in *Proc. Zool. Soc.*, 1850, and by Frank Oates, *Matabele Land and the Victoria Falls*, 1881.

TUAM, a market town and episcopal city of Galway, Ireland, is the terminus of the Athenry and Tuam Railway, and lies 20 miles north-east of Galway and 129 west of Dublin. An abbey was founded here towards the end of the

5th century, and in the beginning of the 6th an episcopal see by St Jarlath. The new Protestant cathedral of St Mary occupies the site of the original cathedral, built in 1130, and includes the chancel-arch of the ancient building, now forming the great doorway,—a very fine specimen of the old Romanesque. The Roman Catholic cathedral in the later Early English style is one of the finest modern Catholic churches in Ireland. Adjoining it is the Roman Catholic college of St Jarlath, usually called the "New College," founded in 1814 for the education of candidates for the priesthood. To the west are the archbishop's palace and a convent of Presentation nuns. The other public buildings are the workhouse, the dispensary, and the market-house. The town has a considerable retail trade, and is a centre for the disposal of agricultural produce. From 4223 in 1871 the population decreased to 3567 in 1881.

The see of Tuam was raised to an archbishopric about 1152. Under the Church Temporalities Act of 1839 it was reduced to a bishopric, but is still the seat of a Roman Catholic archbishop. It received its first charter in the 11th year of James I. It formerly returned two members to parliament, but was disfranchised at the Union.

TUAMOTU ARCHIPELAGO,[1] a broad belt of seventy coral islands lying between 14° 5′ and 23° 22′ S. lat. and 134° 25′ and 148° 40′ W. long., and now under the protection of France. They trend in irregular lines in a north-west and south-east direction, and cover 1500 miles of the Pacific, the easternmost Tuamotus being 3600 miles from Peru.[2] With the exception of a few insignificant islands the archipelago consists of atolls (see CORALS and PACIFIC OCEAN), mostly chains of low islets that crown the reefs and sometimes also obstruct the deep lagoons which they encircle. The largest island, Nairsa (Dean's Island), with a lagoon 45 miles long by 15 wide, is made up of twenty islets. Fakarava, the next in size, consists of fifteen islets, and its oblong lagoon affords the best anchorage in the group. Hao has fifty islets, and its lagoon is dangerously studded with coral. The symmetrically placed eleven islets of Anao suggested to Captain Cook the name of Chain Island. Matahiva, Niau, and Mururoa are good specimens of the horse-shoe-shaped atoll. Nengonengone, Fangataufa, and Marutea, true lagoon islands, form unbroken rings round their lake-like lagoons. In a few of the smaller atolls the lagoons have been completely silted up. To the south-east lie the Gambier Islands, a cluster of four larger and many smaller volcanic islets, enclosed in one wide reef. The wooded crags of Mangareva, the largest islet, 5 miles in length, rise to a height of 1300 feet and are covered with a rich vegetation, quite Tahitian in character; but, as in the other Tuamotus, there is a dearth of animal life. This group was discovered by Captain Wilson of the London Missionary Society in 1797. Tahitian teachers were sent thither in 1834; but Catholic missionaries followed in 1836, and converted the entire population. The natives, once very numerous, now number less than a thousand, and are still decreasing. Cannibalism was formerly prevalent. In physique, language, religion, and custom the Gambier Islanders closely resemble the Rarotongans. Beechey surveyed the group in 1826, and D'Urville in 1838. Pitcairn Island and a few uninhabited rocks lie still farther to the south-east. The Tuamotus are healthy and as a rule have a lower mean temperature than Tahiti. The easterly trade winds prevail. Rain and fogs occur even during the dry season. The stormy season lasts from November to March, when devastating hurricanes are not uncommon and a south-westerly swell renders the western shores dangerous. Plants and animals are very meagrely represented, even more so than in the atolls of Micronesia. Cocoa-palms and the pandanus thrive on many of the islets, and the bread-fruit, banana, pine-apple, and arum have been introduced from Tahiti into the western islands. Mammals are represented by a rat; among land-birds a parakeet, a thrush, and a dove are noticeable; and of reptiles there is only one lizard. Insects are scarce. But the sea and lagoons teem with turtle, fish, mollusks, crustaceans, and zoophytes. Coral grows luxuriantly everywhere. From the abundance of pearl-oysters the archipelago gets its name of Pearl Islands; pearl-fishing indeed is the only remunerative industry. Under French control the newest appliances for obtaining shells have now mostly superseded the laborious diving of the natives. The Tuamotus are very thinly inhabited by a fine strong Polynesian race, more muscular and mostly darker-skinned than that inhabiting Tahiti. In the west considerable intermixture with other races has taken place. Of the habits of the people little is known, and many of the islands are still marked "hostile inhabitants" on the English Admiralty charts. In the eastern islands cannibalism existed. Tattooing is not universal. Clothing and ornaments are very scanty. The huts are mean square buildings, often mere shelters of leaves. Good outrigger and single and double canoes are built, the larger ingeniously stitched together of small pieces of drift wood. Fishing with net and hook is much practised. Food besides fish consists almost exclusively of cocoa-nuts and pandanus fruit. Water is scarce.

Magellan's first discovery of land after reaching the Pacific in 1520 was one of the Tuamotus. Various portions of the archipelago were in turn crossed by Queiros (1605), Lemaire and Schouten (1616), Roggeween (1722), Byron (1765), Wallis (1767), Bougainville (1768), Cook (1769), the "Duff" (1797), Krusenstern (1803), Kotzebue (1816), Fitzroy (1835), D'Urville (1838), and Belcher (1840). The first systematic survey was instituted in 1818 by Bellinghausen, and was continued in 1823 by Duperry, in 1826 by Beechey, and in 1839 by Wilkes. Thanks to these many explorers, the islands have been christened and rechristened with a chaos of Spanish, Dutch, English, French, German, and Russian names.

See the narratives of the various explorers cited above, and Meinicke, *Inseln des stillen Oceans* (Leipsic, 1876); for general statistics and an account of the pearl-fisheries, see *Notices Coloniales*, Paris, 1886.

TUBERCLE. See PATHOLOGY, vol. xviii. p. 405, and PHTHISIS.

TUBEROSE. The cultivated tuberose (*Polianthes tuberosa*) is allied to the Mexican agaves and is a native of the same country. The tuberous root-stock sends up a stem 3 feet in height, with numerous lanceolate leaves and terminal racemes of white funnel-shaped, very fragrant flowers. Each flower is about 1½ inches long, with a long tube and a six-parted limb. The stamens are six in number, emerging from the upper part of the tube, and bear linear anthers. The ovary is three-celled; but the mature fruit and seed are not botanically known. The plant is largely grown in the United States and at the Cape of Good Hope for export to England, as it is found that imported bulbs succeed better than those grown in the United Kingdom. The cultivated plants have double flowers and require a rich soil, considerable heat, and, at first, abundance of water.

TÜBINGEN, the university town of Würtemberg, is picturesquely situated on the hilly and well-wooded banks of the Neckar, at the junction of the Ammer and Steinlach, 18 miles south of Stuttgart, and on the S.E. border of the Black Forest. The older town is irregularly built and unattractive, but the newer suburbs, the chief of which is the Wilhelmsstrasse, are handsome. The most conspicuous building is the old ducal castle of Hohentübingen, built in 1507-1540 on a hill overlooking the town, and now containing the university library, observatory, chemical laboratory, &c. Among the other chief buildings are the quaint old Stiftskirche (1469-83), and the new aula and numerous institutes of the university, all of which are modern. A monument was erected in 1873 to the poet Uhland (1787-1862), who was born and is buried here. Tübingen's chief claim to attention lies in its famous university, founded in 1477 by Duke Eberhard. The university adopted the Reformed faith in 1534, and in 1536 a Protestant theological seminary—the so-called Stift—was incorporated with it. In 1817 a Roman Catholic theological faculty (the "Convict") and a faculty of politics and economics were added, and in 1863 a faculty of science. The leading faculty has long been that of theology, and an advanced school of theological criticism, the founder and chief light of which was F. C. BAUR (*q.v.*), is known as the Tübingen school. Melanchthon was lecturer at Tübingen before he was summoned to Wittenberg. The university is attended by about 1400 students, a considerable proportion of whom are foreigners, and has a teaching staff of 53 professors, 17 extraordinary professors, and 10 lecturers. The commercial and manufacturing industries of the town are slight. Printing, book-selling, the manufacture of surgical and philosophical instruments, and the cultivation of hops, fruit, and vines are among the leading occupations of the inhabitants. The population in 1885 was 12,660 (11,708 in 1880). The country in the neighbourhood of Tübingen is very attractive; one of the most interesting points is the former Cistercian monastery of Bebenhausen, founded in 1185, and now a royal hunting-chateau.

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[1] There is no collective name for the archipelago among the Tuamotuans themselves, but the Tahitians call it Paumotu (*i.e.*, Cloud of Islands). The group is Bougainville's Dangerous Archipelago, Fleurieu's Bad Sea, Krusenstern's Low Islands, and the Pearl Islands of traders.

[2] Distinct names have been given to eight clusters of the archipelago,—Disappointment Islands, King George's Islands, Palliser Islands, Raeffsky Islands, Two Groups, Duke of Gloucester Islands, Actæon or Amphitrite group, and Gambier Islands.

Tübingen is mentioned as a strong fortress in 1078. In 1342 it was purchased by the count of Würtemberg, whose descendants afterwards acquired the title of duke. The treaty of Tübingen is the name given in German history to an arrangement made in 1514 between Duke Ulrich and his subjects, by which the latter acquired various rights and privileges on condition of relieving the former of his debts. The town was captured by the Swabian League in 1519, by Turenne in 1647, and again in 1688 by the French, who destroyed the fortifications. Tübingen was made a garrison town in 1875.

TUCKER, ABRAHAM (1705-1774), holds a place of his own among the English moralists of the 18th century. He was born in London, of a Somerset family, on 2d September 1705. His father, a wealthy city merchant, died in his son's infancy, leaving him to the guardianship of his uncle, Sir Isaac Tillard, a man of a rare integrity of character, to whom Tucker never failed to acknowledge a deep debt of gratitude. In 1721 Tucker entered Merton College, Oxford, as a gentleman commoner. Here he devoted himself chiefly to philosophical and mathematical studies, but also found leisure to master French and Italian, and to acquire considerable proficiency in music. He afterwards studied law at the Inner Temple, but as his fortune made him independent of a profession he was never called to the bar. In 1727 he bought Betchworth Castle, near Dorking, where he passed the remainder of his life, occupied, in addition to his favourite studies, with the usual pursuits of a well-to-do country gentleman. He took no part in politics, however, and even wrote a pamphlet, *The Country Gentleman's Advice to his Son on the Subject of Party Clubs* (1755), cautioning young men against the dangers of rashly pledging themselves to political principles and measures of which their riper judgment may disapprove. In 1736 Tucker married Dorothy Barker, the daughter of a neighbouring landed proprietor. His wife, to whom he was fondly attached, died in 1754, leaving him with two daughters. "As soon as the first excess of his grief was somewhat mitigated," we are told, "he occupied himself in collecting together all the letters that had passed between them at periods when they were accidentally separated from each other, which he transcribed twice over, under the title of 'The Picture of Artless Love.' One copy he gave to Mr Barker, his father-in-law, and the other he kept, and frequently read over to his daughters." He took an active part in the education of his daughters, and from this time onward began to occupy himself with the composition of the work by which he is known—*The Light of Nature Pursued*. He made several sketches of the plan of his work, one of which—in dialogue—he went the length of printing before finally deciding on the method he should pursue. He also sought to qualify himself for authorship by the study of the most elegant Greek and Latin classics and by translating the most admired passages of Cicero, Demosthenes, and Pliny several times over. Moreover, after his work was written, he twice transcribed it with his own hand. In 1763 he published a specimen under the title of "Free Will." The strictures of a critic in the *Monthly Review* of July 1763 drew from him a pamphlet called *Man in Quest of Himself, by Cuthbert Comment*. This, as its sub-title states, is "a defence of the individuality of the human mind or self"; it has been reprinted in Parr's *Metaphysical Tracts* (1837). In 1765 the first four volumes of his work were published under the pseudonym of Edward Search. The remaining three volumes did not appear till after his death. His eyesight failed him completely in 1771, but his cheerfulness did not leave him. He contrived an ingenious apparatus which enabled him to write so legibly that the result could easily be transcribed by his daughter. In this way he completed the later volumes, which were ready for publication when he was seized by his last illness. He died on 20th November 1774.

A second edition of *The Light of Nature* appeared in 1805, with a short life of the author by his grandson, Sir H. P. St John Mildmay, which forms the sole biographical source. The work has since been repeatedly re-published in two large closely printed volumes. A useful abridgment was published (anonymously) by Hazlitt in 1807; for, as he truly says, it is "swelled out with endless repetitions of itself. The author was a private gentleman, who wrote at his ease, and for his own amusement. When a subject presented itself to him, he exhausted all he had to say upon it, and then dismissed it for another. If the same subject recurred again in a different connexion, he turned it over in his thoughts afresh; as his ideas arose in his mind, he committed them to paper; he repeated the same things over again or inserted any new observation or example that suggested itself to him in confirmation of his argument; and thus by the help of a new title, and by giving a different application to the whole, a new chapter was completed. By this means, as he himself remarks, his writings are rather a tissue of loose essays than a regular work." In spite of Tucker's elaborate care in composition, there is no doubt that this fairly characterizes the rambling prolixity of his book; but it may be questioned whether an epitome can convey the *real* merits of such a style and treatment—qualities which have earned for Tucker from Sir James Mackintosh the designation of a "metaphysical Montaigue." These are his sound hearty common sense, the originality of a man who looks at everything for himself completely untrammelled by system, a remarkable aptness in illustration, and occasional gleams of a mild humour. Though the *The Light of Nature* embraces in its scope many psychological and more strictly metaphysical discussions, it is chiefly in connection with ethics that Tucker's speculations are remembered. This is the subject which the author puts into the foreground himself; from his earliest youth, he tells us, his thoughts took a turn "toward searching into the foundations and measures of right and wrong." In some important points Tucker anticipates the utilitarianism shortly afterwards systematized by Paley, and Paley, it may be noted, expresses in the amplest terms his obligations to his predecessor. "Every-man's own satisfaction" Tucker holds to be the ultimate end of action; and satisfaction or pleasure is one and the same in kind, however much it may vary in degree. This universal motive is further connected, as by Paley, through the will of God, with the "general good, the root where out all our rules of conduct and sentiments of honour are to branch." Tucker adopts from Hartley the principle of association, or, as he calls it, "translation," to explain the formation of the moral sentiments and the phenomena of disinterested action generally. In his general analysis of the mind he professes to follow Locke, though with great latitude in details, and even in much that is not matter of detail.

TUCKER, Josiah (1711-1799), dean of Gloucester from 1758, a sagacious and candid writer on politics and political economy. See POLITICAL ECONOMY (vol. xix. p. 365).

TUCSON, a city in Pima county, Arizona Territory, United States, is situated in 32° 13′ N. lat. and 110° 53′ W. long. at an elevation of 2403 feet above the sea, upon the Santa Cruz river and on the Southern Pacific Railroad, about 70 miles from the Mexican frontier. The surrounding country is arid and barren, except where it has been fertilized by irrigation. The climate is exceedingly hot and dry. The principal industries of Tucson, besides stock-rearing, are connected with mining, as it is a supply point for mining districts in the neighbouring mountains and has several smelting works. The population, which in 1860 was 915, in 1870 3224, had grown by 1880 to 7007, and in 1887 was estimated to number nearly 10,000. About one-half are of foreign birth, a large proportion being Mexicans. Tucson is one of the oldest settlements in the United States, having been founded as a Jesuit mission by the Spaniards in the 17th century.

TUCUMAN, or, more fully, **SAN MIGUEL DE TUCUMAN**, capital of the province of Tucuman, in the Argentine Republic, is a straggling town, on the right bank of the Tala (a subtributary of the Rio Salado), at the eastern base of the Sierra de Aconquija, in 26° 50′ S. lat. and 64° 35′ W. long. It is connected by rail with Cordova and Rosario. The surrounding district is fertile, and also produces excellent timber. Leather and sugar are the principal objects of industry. The population was recently estimated at 17,000.

TUDELA, a city of Spain, in the province of Navarre, is situated on the right bank of the Ebro where it is joined by the Queyles, and on the railway from Zaragoza to Pamplona, about 50 miles to the north-west of the former city. The Ebro is here crossed by a fine old bridge, 400 yards in length, consisting of seventeen arches. The only building within the town of any interest is the fine church of Santa Maria, founded in 1135 and consecrated in 1188, the doorways and cloisters being specially rich in sculptural ornamentation. The manufactures of the place (cloth, silk, pottery) are unimportant. There is some trade in wine and oil. The population within the municipal boundaries in 1877 was 10,086.

Tudela, anciently *Tutela*, was the birthplace of the celebrated mediæval traveller BENJAMIN (*q.v.*) of Tudela. It was made an episcopal see in 1783, which was suppressed in 1851.

TUDOR, House of. See HENRY VII. and LANCASTER, HOUSE OF, vol. xiv. p. 257.

TUKE, Samuel (1784-1857), English philanthropist, son of Henry Tuke, born at York in 1784, greatly advanced the cause of the amelioration of the condition of the insane, and devoted himself largely to the York Retreat, the methods of treatment pursued in which he made more widely known by his *Description of the Retreat near York*, &c. (York, 1813). His writings on the construction of asylums and on other subjects connected with the insane are well known. He died in 1857.

TUKE, William (1732-1822), English philanthropist, was born at York in 1732. He devoted himself to many philanthropic objects, but his name is more especially known in connexion with the humane treatment of the insane, for whose care he projected in 1792 the Retreat at York, which became famous both abroad and in Great Britain as an institution in which a bold attempt was made to manage lunatics without the excessive restraints then regarded as essential. Not less remarkable was the departure from the beaten track of treatment in regard to copious bleedings and the frequent administration of emetics and depressing remedies. The asylum was entirely under the management of the Society of Friends, and remains so at the present time, but there are a large number of inmates not connected in any way with this body. The original character of the methods pursued at the Retreat attracted much attention, and its marked success led to comparisons being made between it and other establishments, the abuses in some of which became so notorious as to be brought under the notice of parliament, and led to more stringent legislation in the interests of the insane. The condition of this unfortunate class became greatly improved in consequence. William Tuke did not live to see the most important of the Acts passed, but when he died, in 1822, the superiority of the treatment adopted at the Retreat was fully acknowledged.

See *Report of the Select Committee of the House of Commons*, 1815-1816; Dr Conolly, *Treatment of the Insane without Mechanical Restraints*, 1856; Dr Hack Tuke, *Chapters in the History of the Insane in the British Isles*, 1882.

HENRY TUKE (1756-1814), son of the preceding and father of Samuel Tuke, co-operated with his father in the reform at the York Retreat. He was the author of several moral and theological treatises, which have been translated into German and French.

TULA, a government of central Russia, bounded by Moscow on the N., Ryazañ on the E., Tamboff and Orel on the S., and Kaluga on the W., has an area of 11,950 square miles. It is intersected from south-west to north-east by a gently undulating plateau, from 950 to 1020 feet in height, which separates the drainage area of the Oka from that of the Don. The average elevation of Tula is about 800 feet, and its surface is an undulating plain; but the rivers flow in valleys so deeply cut and so scored with ravines that in their neighbourhood the country assumes the aspect of a hilly region. Devonian limestones, dolomites, and sandstones appear chiefly in the south-west; Lower and Middle Carboniferous limestones and clays occupy the remainder of the area. The former contain deposits of coal, which are now worked (chiefly at Malevka and Novoselsk) to the extent of nearly one and a half million cwts. annually. Jurassic clays are found in patches here and there. Glacial boulder clay covers most of the region, while Lacustrine deposits are widely spread in the valleys and depressions. Iron-ore is found all over the government; limestone, fire-clay, and pottery clay are also obtained. The soil is black earth in the south and east and clay or sandy clay in the north-west. Tula is watered chiefly by the Oka and its tributaries (Upa, Zusha, Osetr, and Pronya). The Don rises in Lake Ivan-Ozero (which feeds also a tributary of the Oka), and has a course of 35 miles within Tula. It is not navigable, and Peter I.'s attempt to connect it with the Oka by means of a canal was never carried out. Lakes and marshes (chiefly in the north-west) are few. Forests (8 per cent. of the area) are rapidly disappearing. The climate is less rigorous than that of Moscow, the average yearly temperature being 40°·2 Fahr. (January, 13°·8; July, 67°·5).

The flora of Tula deserves some attention as marking the transition from that of the south-east steppes to that of north-west Russia. A line drawn on the northern slope of the water-parting already mentioned (a few miles to the south of the city of Tula) divides the province into two parts, of which the southern is a black earth region and the other is chiefly covered with boulder clay. The boundary is marked by a series of crown forests—formerly a means of defence against the nomad tribes, whence their name Zasyeka—which at the same time constitute a line that is not passed by several species characteristic of the steppe region, such as the *Lilia* of the steppes, *Lilium Martagon*, *Linum flavum*, *Lathyrus pisiformis*, *Geranium sanguineum*, *Pyrethrum corymbosum*, and *Serratula heterophylla*. On the other hand, several northern species, which are quite common in the marshes of Moscow, do not penetrate into Tula, and several others, such as *Linnæa borealis*, *Viola palustris*, *Cirsium palustre*, *Pedicularis palustris*, do not cross the Zasyeka. The same forests shelter several northern species which do not appear either in northern or southern Tula, as also several southern herbaceous plants which are now only occasionally met with in the black earth steppes of south Russia. Several West-European plants (*Sanicula europæa*, *Carex remota*, *Cephalanthera ensifolia*, *Allium ursinum*) find their eastern limits in Tula. Another interesting feature is the extension down the valley of the Oka, not only of pine-forests, which are not found elsewhere within the province, but also of many herbaceous plants originally from the south or south-west. The steppe flora of Tula is being rapidly impoverished in consequence of the spread of agriculture: many steppe plants are now found only in their last retreats on the dry uncultivated limestone crags.

The population of the government (750,000 in 1777) in 1883 was 1,360,000, of whom 115,770 were urban. They are all Great Russians, and either Orthodox Greeks or Raskolniks. Their chief occupation is agriculture, 70 per cent. of the area being arable. Nearly one-half of the soil belongs to landlords and merchants, and the other half to the peasant communities (53 per cent. of the area, and 58 per cent. of the land under culture). The crops for 1883-85 averaged 7,574,200 quarters of grain and 10,172,000 bushels of potatoes, largely used for distilleries. Beet-root culture is increasing (8520 acres in 1885, yielding 59,800 cwts. of sugar). The growth of tobacco is also spreading (10,000 cwts. in 1885). There were in 1883 380,620 horses, 203,500 cattle, and 786,000 sheep. Manufactures are rapidly developing; their aggregate production was valued at £1,649,720 in 1883 (distilleries £293,956, sugar-works £601,827, tanneries £148,356, iron works, brass works, &c., about £150,000). Petty trades, especially the manufacture of tea-urns, small brass ware, and harmoniums, and also weaving, are extensively carried on and support a lively export trade; timber, raw metals, and various manufactured wares are imported. The government is traversed by the Moscow and Sebastopol and the Ryazhsk and Vyazemsk Railways, as well as by the Oka. The government is divided into twelve districts, the chief towns of which, with their population in 1882, are TULA (see below), Alexin (4960), Bogoroditsk (8030), Byeleff (9300), Epifañ (3820), Efremoff (7770), Kashira (4610), Krapivna (1560), Novosil (4660), Odoeff (5140), and Tcherñ (2675). Byeleff, Alexin, and Kashira are important loading places on the Oka. The villages Malevka (coal-mines) and Nikitino have more than 5000 inhabitants each.

History.—Before the Slavonic immigration, the territory of Tula was inhabited by the Mordves on the north and the Mestchera in the south. The Slavs who occupied the Oka belonged to the branch of the Vyatichis, who were soon compelled to pay a tribute to the Khazars. Subsequently the territory on the Oka belonged to the principality of Tchernigoff, thus maintaining its connexion with south-west Russia. In the 14th century part of it fell under the rule of Ryazañ and Moscow, while the remainder was under Lithuanian dominion till the 15th century. Several of the towns of Tula were founded in the 12th century, but the colonization of this fertile region went on slowly on account of the raids of the Tatars.

TULA, capital of the above government, is situated on the Upa, 120 miles by rail to the south of Moscow. Other railway lines connect it with Ryazañ and Orel. It is built in the broad but low, marshy, and unhealthy valley of the Upa and is divided into three parts,—the Posad on the left bank, the Zaryetskaya or Oruzheinaya on the right bank, and Tchulkova between the Upa and the Tulitsa. It is an old town of Old Russia, but its growth began only towards the end of the 18th century after the manufacture of arms had commenced, and now (1887) its population has reached 65,100 (63,500 in 1882). They are employed chiefly either at the imperial gun factory or at numerous private factories (about 130, with 4350 men) and small workshops. The main branch of the industry is the making of rifles (from 20,000 to 30,000 annually). Next in importance comes the manufacture of *samovars* (tea-urns), in which more than 5000 persons are engaged. All sorts of cutlery and ironmongery are manufactured in the small workshops of Tula, which have a high repute in Russia. No fewer than 240,000 harmoniums are turned out annually; nearly 150,000 cwts. of steel, iron, and brass are imported every year for this industry alone.

The town of Tula is first mentioned in 1147; but its former site seems to have been higher up the Tulitsa. Its wooden fort was replaced in 1514-1521 by a stone "kreml," which still exists. Boris Godunoff founded a gun factory at Tula in 1595, and in 1632 a Dutchman, Winius, established an iron foundry. Michael Alexis and Peter I., especially the last-named, took great interest in the gun factories, and large establishments were built in 1705 and 1714, which soon turned out 15,000 rifles in a year. Catherine II. and Paul I. further improved the manufactures, which during the wars with France supplied more than half a million rifles.

TULIP (*Tulipa*), a genus of bulbous herbs belonging to the *Liliaceæ*. The species are found wild along the northern shores of the Mediterranean, in the Levant, Armenia, Caucasus, Persia, Central Asia, and Afghanistan. The cup-shaped flowers have six regular segments in two rows, as many free stamens, and a three-celled ovary with a sessile stigma, which ripens into a leathery many-seeded capsule. The species are numerous, and are distinguished one from another by the scales of the bulb being woolly or smooth on the inner surface, by the character of the flower-stalks, by the filaments being hairy or otherwise, and by other characters. Owing to the great beauty of the flowers they have been favourites in European gardens for two or three centuries, and have been crossed and recrossed till it has become almost impossible to refer the plants to their original types. The early flowering "Van Thol" tulips, the segments of which are mostly scarlet with yellow edges, are derived from *T. suaveolens*, a native of the Caspian region. *T. Gesneriana*, a native of Armenia and central Russia, is the origin of some of the later flowering varieties. *T. pubescens*, thought by Mr Baker to be a hybrid between the two species just named, is the source of some of the early flowering kinds known as "pottebakker," &c. *T. oculus solis* and *T. Clusiana* are lovely species, natives of southern France, and *T. silvestris*, with elegant yellow pendulous flowers, is a doubtful native of England. During the last few years, owing to the exertions of Russian naturalists, a large number of new species have been discovered in Turkestan, and introduced into Europe. Some of these are very beautiful, and render it probable that by intercrossing with the older species still further difficulties will be presented in the way of identification. These difficulties are further enhanced by the fact that, quite apart from any cross-breeding, the plants, when subjected to cultivation, vary so greatly in the course of two or three years from the original species from which they are directly descended that their parentage is scarcely recognizable. This innate power of variation has enabled the florist to obtain, and ultimately to "fix," so many remarkable varieties. At the present day tulips are less fashionable than they once were, and consequently the enormous prices given for new or improved varieties no longer obtain, though, even now, two and three guineas are asked for special bulbs. It must, however, be remembered that the "tulipomania" of the 17th century was really a form of gambling, in which admiration of the flower and interest in its culture were very secondary matters. Tulips were introduced into the Low Countries in the 16th century from Constantinople and the Levant by way of Vienna and Venice. There is a legend that an Antwerp merchant, to whom bulbs were sent, cooked them for onions; and to this day the natives of some parts of Persia and Afghanistan use the bulbs of *Tulipa chrysantha* for food. The mode of growth of a tulip bulb is worthy of attention. In spring, at the flowering period, each bulb is a composite structure. It consists, first, of the bulb of the year, which produces the flowers and the leaves. From the axil of one (or more) of the scales of the flowering bulb emerges a secondary bulb, destined to form leaves and flowers for the next season's growth. In like manner from the side of the second generation are produced tertiary bulbs, which flower in the third year after their formation. Each bulb, therefore, has an existence of three years, flowering in the third year, and dying afterwards, so that the bulb planted in the autumn is not the same one that flowered in the spring, but a second generation. For the cultivation of tulips, see HORTICULTURE, vol. xii. p. 259.

TULLE, a town of France, chef-lieu of the department of Corrèze and a bishop's see, is 61 miles east-north-east of Périgueux by the railway from Bordeaux to Clermont-Ferrand. The town rises picturesquely on both banks of the Corrèze, a sub-tributary of the Dordogne. The Corrèze, crossed by four bridges, flows between embankments, and the narrow streets on the steep left bank are connected by stairs. Of the 12th-century cathedral only the porch and the nave of six bays remain, the choir and transept having been destroyed in 1793; but there is a 14th-century tower, with a fine stone steeple. The neighbouring cloister (13th century) is being restored. The abbot's house (15th century) has a carved doorway and well-preserved windows; and some curious houses of the 12th, 13th, and 14th centuries still exist. Tulle possesses normal schools for male and female teachers, and is the headquarters of the Historical Society of Lower Limousin. The principal industry is the manufacture of firearms. The Government establishments employ from 1500 to 3000 workmen, and can turn out 70,000 guns annually. Manufactories for the variety of lace called "tulle" were first established here. There is a collection of the firearms of all nations. The population in 1886 was 10,635 (commune 16,275).

Tulle (*Tutela Lemovicum*) owed its importance in the Middle Ages to an abbey founded by St Martin, or, according to another authority, in the 7th century, which was raised to a bishopric in 1317. Mascaron was bishop in the 17th century. The town was taken by the English in 1346, and was subsequently ravaged by the Black Death. It was again conquered by the English in 1369; but, when the inhabitants succeeded in freeing themselves, they were exempted from all imposts by Charles V. The viscount of Turenne, leader of the Protestants, tried in vain to seize Tulle in 1577, but was successful in 1585.

TULLE, a term restricted in England to a fine bobbin-net of silk, used for veils, scarves, millinery purposes, and trimmings of ladies' dresses, &c. The French used the word to mean all machine-made lace the basis of which is the intertwisted net-work made on the bobbin-net machine. The word is derived from the town of Tulle in France (see above).

TULLOCH, JOHN (1823-1886), Scottish theologian, was born at Bridge of Earn, Perthshire, in 1823, went to school at Perth, and received his university education at St Andrews and Edinburgh. In 1845 he became minister of St Paul's, Dundee, and in 1849 of Kettins, in Strathmore, where he remained for six years. His literary gifts, shown in his contributions to various reviews, as well as his talent for society drew attention to him, and in 1854 he was appointed to the principalship of St Mary's College, St Andrews. The appointment was immediately followed by the appearance of his Burnet prize essay on *Theism*. At St Andrews, where he held along with the principalship the post of professor of systematic theology and apologetics, his work as a teacher was distinguished by several features which at that time were new. He lectured on comparative theology and treated doctrine historically, as being not a fixed product but a growth. From the first he secured the attachment and admiration of his students. In 1862 he was appointed one of the clerks of the General Assembly, and from that time forward he took a leading part in the councils of the Church of Scotland. In 1878 he was chosen moderator of the Assembly. No one, except perhaps Dr Robert Lee, has done more during the last generation to widen the national church. Two positions on which he repeatedly insisted in the Assembly have taken a firm hold of the mind of that church,—first, that it is of the essence of a church to be comprehensive of various views and tendencies, and that a national church especially should seek to represent all the elements of the life of the nation; secondly, that subscription to a creed can bind no one to all its details, but only to the sum and substance, or the spirit, of the symbol. For three years before his death he was convener of the church interests committee of the Church of Scotland, which had to deal with a great agitation for disestablishment. He was also deeply interested in the reorganization of education in Scotland, both in school and university, and acted as one of the temporary board which settled the primary school system under the Education Act of 1872. His death took place at Torquay on 13th February 1886.

Tulloch's best known works are collections of biographical sketches of the leaders of great movements in church history, such as the Reformation and Puritanism. His most important book, *Rational Theology and Christian Philosophy* (1872), is one in which the Cambridge Platonists and other leaders of dispassionate thought in the 17th century are similarly treated. He delivered the second series of the Croall lectures, on the *Doctrine of Sin*, which were afterwards published. He also published a small work, *The Christ of the Gospels and the Christ of History*, in which the views of Renan on the gospel history were dealt with; a monograph on *Pascal* for Blackwood's Foreign Classics series; and a little work, *Beginning Life*, addressed to young men, written at an earlier period. A *Life* of Tulloch by Mrs Oliphant is in preparation.

TULLUS HOSTILIUS, third legendary king of Rome, is represented as having reigned for thirty-two years (670-638 B.C.). His successful wars with Alba, Fidenæ, and Veii shadow forth the earlier conquests of Latian territory and the first extension of the Roman domain beyond the walls of Rome. See ROME, vol. xx. p. 733.

TUMKUR, or TOOMKOOR, a district of India, in the west of the Nandidrúg division of Mysore, situated between 12° 43′ and 14° 10′ N. lat. and 76° 10′ and 77° 30′ E. long., with an area of 3420 square miles. It is bounded on the north by the Bellary district, on the east by Kolar and Bangalore, on the south by Mysore, and on the west by Chitaldrúg and Hassan. Tumkur consists chiefly of elevated land intersected by river valleys. A range of hills rising to nearly 4000 feet crosses it from north to south, and forms the water-parting between the systems of the Krishna and the Káveri. The principal streams are the Jayamangala and the Shimsha. The mineral wealth of Tumkur is considerable: iron is obtained in large quantities from the hill sides; and excellent building stone is quarried. The slopes of the Devaráy-durga Hills, a tract of 18 square miles, are clothed with forests, in which large game are numerous, including tigers, leopards, bears, and wild hogs. The climate of Tumkur is generally considered as equable and healthy; the average annual rainfall amounts to nearly 33 inches. The Mysore State Railway enters the district at the south-east corner and traverses it to the west.

In 1881 the population of Tumkur numbered 413,183 (males 203,253, females 209,930), embracing 395,443 Hindus, 17,130 Mohammedans, and 603 Christians. Tumkur town, situated at the base of the Devaráy-durga Hills, 43 miles north-west of Bangalore, with a population of 9909, is the administrative headquarters. The cultivated products consist chiefly of *rági*, millet, wheat, sugar-cane, various pulses, and oil seeds. Of the total area 745 square miles are cultivated and 1544 cultivable. The chief industries are the making of coarse cotton cloths, woollen blankets, and ropes. The exports comprise *rági*, unhusked rice, cocoa-nuts, areca-nuts, earth salt, pulses, and vegetables; the imports include European piece goods, rice, spices, cotton, &c.

The history of Tumkur is common to the rest of Mysore. After the assumption of the administration of Mysore by the British in 1832 the district received its present name and limits.

TUMOUR. See PATHOLOGY, vol. xviii. p. 367, and SURGERY, vol. xxii. p. 687.

TUMULUS. See ARCHITECTURE, vol. ii. p. 384, and BARROWS, vol. iii. 397.

TUNBRIDGE, or TONBRIDGE, a town of Kent, England, is situated on rising ground above the Medway, and on the South-Eastern Railway, 41 miles (by rail) south-east of London and 33 north-west of Hastings. The Medway is crossed by a stone bridge, erected in 1775. The town consists chiefly of one long main street and a large number of suburban villas. The church of St Peter and St Paul, chiefly Decorated and Perpendicular with some portions of an earlier date, has lately been restored. The grammar school, founded by Sir Andrew Judd, an alderman of London, in the 1st year of Edward VI., was rebuilt in 1865, remodelled in 1880, and extended in 1887. Among other public buildings are the town hall and market house, the public hall, and the free library. Some traffic is carried on by the Medway, which has been made navigable for barges. Tunbridge ware, chiefly sold at Tunbridge Wells, is largely manufactured. There are gunpowder mills on the banks of the Medway; and wool-stapling, brewing, and tanning are carried on. The population of the urban sanitary district (area 1200 acres) in 1871 was 8209 and in 1881 it was 9317.

Tunbridge owed its early importance to the castle built by Richard, earl of Clare, in the reign of Henry I. The castle was besieged by William Rufus, was taken by John in the wars with the barons, and again by Prince Edward, son of Henry III. Subsequently it became the property of the Staffords, and on the attainder of the duke of Buckingham in the reign of Henry VIII. was taken possession of by the crown. It was dismantled during the Civil War. The remains now consist chiefly of a finely preserved gateway flanked by two round towers. Formerly it was defended by three moats, one of them formed by the Medway. The lords of the castle had the right of attending the archbishops of Canterbury on state occasions as chief butlers.

TUNBRIDGE WELLS, an inland watering-place of England, chiefly in Kent but partly in Sussex, is situated in the midst of charming and picturesque scenery, on the South-Eastern Railway and at the terminus of a branch line of the London, Brighton, and South Coast Railway, 46 miles (by rail) south-east of London and 5 south of Tunbridge. It owes its popularity to its chalybeate spring and its romantic situation The wells are situated near the Parade (or Pantiles), a walk associated with fashion since the time of their discovery. The houses and shops in the Parade somewhat resemble the Rows at Chester. It was paved with pantiles in the reign of Queen Anne. The town is built in a picturesquely irregular manner, and a large part of it consists of districts called "parks," occupied by villas and mansions. On Rusthall common, about a mile from the town, is the curiously shaped Toad Rock, and about a mile south-west the striking group called High Rocks. The principal public buildings are the pump-room, the town-hall, the corn exchange, the public hall, the mechanics' institute, the friendly society's hall, the dispensary and infirmary, and the provident dispensary. The Tunbridge Wells sanatorium is situated in grounds sixty acres in extent, and is capable of receiving 150 visiters. There is a large trade in Tunbridge ware, which is made chiefly at Tunbridge, and includes work tables, boxes, toys, &c., made of hard woods, such as beech, sycamore, holly, and cherry, and inlaid with mosaic. The town is governed by a local board of twenty-four members. The population of the urban sanitary district (area 3351 acres) in 1871 was 19,410 and in 1881 24,308.

The town owes its rise to the discovery of the medicinal springs by Dudley, Lord North, in 1606. Henrietta Maria, wife of Charles I., retired to drink the waters at Tunbridge after the birth of her eldest son Charles. Soon after the Restoration it was visited by Charles II. and Catherine of Braganza. It was a favourite residence of Anne previous to her accession, and from that time became one of the special resorts of London fashion. It reached the height of its comparative popularity in the latter half of the 18th century, and is specially associated with Colley Cibber, Samuel Johnson, Cumberland the dramatist, Garrick, Richardson, Reynolds, Beau Nash, Miss Chudleigh, and Mrs Thrale. The Tunbridge of that period is sketched with much graphic humour in Thackeray's *Virginians*. Though it still attracts an increasing number of visiters, its importance in reference to London society has considerably declined.

TUNG-CHOW, a sub-prefectural city in Chih-li, the metropolitan province of China, is situated on the banks of the Peiho in 39° 54′ N. lat. and 116° 41′ E. long., about 12 miles south-east of Peking. Like most Chinese cities, T'ung-Chow has appeared in history under various names. By the founder of the Han dynasty (206 B.C.) it was called Lu-Hien; with the rise of the T'ang dynasty (618 A.D.) its name was changed to Heuen-Chow; and at the beginning of the 12th century, with the advent of the Kin dynasty to power, Heuen-Chow became T'ung-Chow. The city marks the highest point at which the Peiho is navigable, and here merchandise for the capital is transferred to a canal, by which it reaches Peking. The city, which is faced on its eastern side by the river, and on its other three sides is surrounded by populous suburbs, is upwards of 3 miles in circumference. The walls are about 45 feet in height and about 24 feet wide at the top. They are being allowed to fall into decay. Two main thoroughfares run through the city, one connecting the north and south gates, and the other the east and west gates. The place derives its importance from the fact that it is the port of Peking. Its population was estimated at about 50,000 in 1887.

It was at T'ung-Chow that Sir Harry Parkes, Sir Henry Loch, and their escort were treacherously taken prisoners by the Chinese when they were sent forward by Lord Elgin to negotiate terms of peace after the troubles of 1860.

TUNGSTEN (Germ. *wolfram*, or, antiquated, *scheel*), one of the metallic elements of chemistry. The mineral tungsten (meaning in Swedish "heavy stone") used to be taken for a tin ore until this was disproved by Cronsted. Scheele showed in 1781 that it is a compound of lime with a peculiar acid, the metallic nature of which was recognized in the same year by Bergmann. It occurs only as a component of a number of relatively rare minerals, the most important of which are wolfram or wolframite, (Fe, Mn)O.WO$_3$, and scheelite (tungsten), CaOWO$_3$ (see MINERALOGY). The metal is prepared from the pure oxide WO$_3$ by reduction with hydrogen in a platinum tube at a high temperature. It forms resplendent tin-white or grey plates, or a dull black powder similar to hydrogen-reduced iron. Sp. gr. = 19·129, water of 4° C. = 1 (Roscoe). It is more difficult to fuse than even MANGANESE (*q.v.*). It is unalterable in ordinary air; oxygen and even chlorine act upon it only at a high temperature. Hydrochloric and sulphuric acid do not attack it. Nitric acid attacks it slowly, aqua regia readily, with formation of the trioxide WO$_3$. Impure tungsten is now being prepared industrially for the production of a peculiar kind of steel (see IRON, vol. xiii. p. 352).

Chlorides.—Tungsten forms four chlorides,—WCl$_2$, WCl$_4$, WCl$_5$, WCl$_6$. The highest, WCl$_6$, is obtained by heating the pure powdery metal in a current of absolutely pure chlorine. In the presence of moisture or air oxy-chlorides are produced. It sublimes off as a dark red liquid, freezing into crystals. These fuse at 275° C. and re-solidify at 270°; the liquid boils at 346°·7. The sp. gr. of the vapour is in accordance with the formula at 350°; at higher temperatures it dissociates into WCl$_5$ and free Cl$_2$ (Roscoe). When the vapour of WCl$_6$ is passed over heated trioxide, the two bodies unite, WO$_3$ with 2WCl$_6$ into 3WOCl$_4$, forming magnificent red needles, which fuse at 210°·4 and boil at 227°·5 C. (Wöhler). Both compounds, WCl$_6$ and WOCl$_4$, are decomposed by water, the oxy-chloride more readily, with formation of hydrochloric acid and trioxide. For other chlorides and oxy-chlorides, see the ordinary hand-books of chemistry.

Oxides, WO$_2$ and WO$_3$, and Compounds of These with Each Other.—The trioxide, popularly known as tungstic acid, is the more important. Impure trioxide is producible by treating scheelite (WO$_3$CaO) with hot hydrochloric acid. Wolframite is not so readily decomposed; but when fused with twice its weight of chloride of calcium it passes into lime salt, obtainable as an insoluble residue by lixiviation of the fuse with water. The oxide obtained forms a yellow powder insoluble in water and in hydrochloric acid. To purify it, it is washed, dissolved in aqueous ammonia, and the filtered solution evaporated, when an acid tungstate of ammonia separates out in scales of great purity. These, when heated in air, leave behind them a pseudo-morphose of pure yellow oxide. Trioxide of tungsten combines with basic oxides into tungstates; but the proportion in which it unites with a given base is subject to great variation: for instance, the quantity Na$_2$O of soda unites into so many definite tungstates with 1, 1⅓, 2, 2⅓, 2⅔, 2½, 4 times WO$_3$ and in each case more or less of water. To each of these soda salts corresponds theoretically a certain tungstic acid,—to the salt Na$_2$OW$_2$O$_6$, for instance, the acid H$_2$OW$_2$O$_6$ or H$_2$W$_2$O$_7$. But few of these hydrates actually exist, and they are not individual acids in the sense in which the three phosphoric acids are, except perhaps that remarkable substance known as metatungstic acid,

$H_2W_4O_{13}+7H_2O$. This acid forms crystals of the stated composition; it dissolves in water and the solution unites with bases into meta-tungstates. Most meta-tungstates are soluble in water; of the tungstates proper only the alkali salts are so soluble. The soda tungstate, $5Na_2O \, . \, 12WO_3+xH_2O$, known as para-tungstate of soda, is made industrially by fusing wolframite with carbonate of soda and lixiviating the fuse with water. The insoluble oxides of iron and manganese are filtered off; the filtrate, while still hot, is nearly neutralized with hydrochloric acid and allowed to crystallize. It forms large crystals containing twenty-one, twenty-five, or twenty-eight times H_2O according to the temperature at which they are formed. The salt has been recommended as a mordant in dyeing and calico-printing, but has not taken root in these industries. Oppenheim and Versmann recommended it before 1862 as the best means for rendering textile fabrics uninflammable. If a solution of the para-tungstate is boiled with hydrated tungstic acid (as obtained by precipitating any ordinary alkaline tungstate solution with hydrochloric acid in the heat), or is simply mixed with excess of acetic acid, the meta-tungstate is formed; in the latter case it separates out as a heavy oil. Meta-tungstate of soda forms octahedral crystals of the composition $Na_2O \, . \, 4WO_3+10H_2O$. If concentrated warm solutions of this salt and the equivalent quantity of chloride of barium are mixed and allowed to cool after addition of a little hydrochloric acid, meta-tungstate of barium crystallizes out as $BaO \, . \, 4WO_3+9H_2O$, in large quadratic pyramids which are very easily soluble in water. From this salt the free acid is easily produced by addition of the exact quantity of sulphuric acid required to precipitate the baryta, and from it any other meta-tungstate is easily produced. Meta-tungstic acid solution is a sensitive and characteristic precipitant for almost all alkaloids (strychnine, quinine, &c.). The alkaloid, whatever its name, goes down as a flocculent insoluble meta-tungstate. Tungstic acid combines with phosphoric acid and with silicic acids into highly complex phospho-tungstic acids and silico-tungstic acids. Of the former there is quite a series, each consisting of one P_2O_5 united with respectively fourteen, sixteen, eighteen, twenty, twenty-two, twenty-four times WO_3 and six H_2O of basic water. Of silico-tungstic acids three are known, namely, one $4H_2O \, . \, SiO_2 \, . \, 10WO_3+3Aq$ and two $SiO_2 \, . \, 12WO_3xH_2O$. All these complex acids (both kinds) are easily soluble in water. The phospho-acids are delicate precipitants for all alkaloids.

The binoxide, WO_2, is obtained when the trioxide is reduced by hydrogen at a dull red heat. This oxide is very prone to pass into trioxide or tungstate. An interesting and beautiful class of compounds of WO_3, WO_2, and bases are known as tungsten bronzes. The first of these was discovered by Wöhler. Normal tungstate of soda, Na_2OWO_3, is fused, and trioxide added to it as long as it dissolves. The product is then heated in hydrogen as long as water goes away, and the substance thus reduced is exhausted successively with water, hydrochloric acid, caustic potash ley, and again with water. A residue of the composition $Na_2O \, . \, W_2O_5+WO_3$ remains in the shape of magnificent gold-like lustrous cubes, of specific gravity 6·617, which conduct electricity like a metal. Only hydrofluoric acid dissolves this soda-tungsten bronze. There are a number of other tungsten bronzes, all distinguished by metallic lustre and magnificent purple, red, yellow, or blue colours.

Analysis.—Oxides of tungsten dissolve in fused microcosmic salt, $Na_2OP_2O_5$; the bead becomes blue in the reducing flame, in the presence of iron blood-red, and in the oxidizing flame colourless. When heated on charcoal with (not too much) carbonate of soda or cyanide of potassium in the reducing flame, they yield a grey heavy powder of metal, obtainable by elutriation. The process fails in the presence of too much alkali. Insoluble tungstates (*e.g.*, the ordinary tungsten minerals) are disintegrable by fusion with alkaline carbonate; the fuse, when treated with water, yields a solution of alkaline tungstate. This solution, when mixed with excess of hydrochloric acid, gives a white precipitate of hydrated trioxide, which on boiling becomes yellow by partial dehydration. The yellow unignited precipitate is soluble in aqueous ammonia. If tungstate of alkali solutions are mixed with hydrochloric acid and then treated with metallic zinc, they become blue through the formation of a compound of WO_3 and WO_2 or rather the respective chloride; this reaction gains in definiteness through the presence of phosphoric acid. (W. D.)

TUNGUSES, a wide-spread Asiatic people, forming a main branch of the Mongol division of the Mongol-Tatar family. They are the *Tung-hu* of the Chinese, probably a corrupt form of *tonki* or *donki*, that is, "men" or "people." The Russian form *Tungus*, wrongly supposed to mean "lake people," appears to occur first in the Dutch writer Massa (1612); but the race has been known to the Russians ever since they reached the Yenisei. The Tungus domain, covering many hundred thousand square miles in central and east Siberia and in the Amur basin, stretches from the Yenisei eastwards to the Pacific, where it occupies most of the seaboard between Corea and Kamchatka. It also reaches the Arctic Ocean at two points, in the Nisovaya tundra, west of the Khatanga river, and in a comparatively small enclosure in the Yana basin over against the Liakhoff (New Siberia) Archipelago. But the Tunguses proper are chiefly centred in the region watered by the three large eastern tributaries of the Yenisei, which from them take their names of the Upper, Middle or Stony, and Lower Tunguska. Here the Tunguses are known to the Samoyedes by the name of *Aiya* or "younger brothers," implying a comparatively recent immigration (confirmed by other indications) from the Amur basin, which appears to be the original home both of the Tunguses and of the closely-allied Manchus. The Amur is still mainly a Tungus river almost from its source to its mouth: the Oroches (Orochus), Daurians, Birars, Golds, Manegrs, Sanagirs, Ngatkons, Nigidals, and some other aboriginal tribes scattered along the main stream and its affluents,—the Shilka, Sungari, and Usuri,—are all of Tungus stock and speech. On the Pacific the chief subdivisions of the race are the Lamuts, or "sea people," grouped in small isolated hunting communities round the west coast of the Sea of Okhotsk, and further south the Yu-pi-ta-tze ("fish clad"), the Tazi of the Russians, between the Amur delta and Corea. The whole race, exclusive of Manchus, numbers probably about 80,000, of whom 15,000 are in the Amur basin, the rest in Siberia.

The Tungus type is essentially Mongolic, being characterized by broad flat features, small nose, wide mouth, thin lips, small black and somewhat oblique eyes, black lank hair, dark olive or bronze complexion, low stature, averaging not more than five feet four inches; they are distinguished from other Mongolic peoples by the square shape of the skull and the slim, wiry, well-proportioned figure. This description applies more especially to the Tunguska tribes, who may be regarded as typical Tunguses, and who, unlike most other Mongols, betray no tendency to obesity. They are classed by the Russians, according to their various pursuits, as Reindeer, Horse, Cattle, Dog, Steppe, and Forest Tunguses. A few have become settled agriculturists; but the great bulk of the race are still essentially forest hunters, using the reindeer both as mounts and as pack animals. Nearly all lead nomad lives, in pursuit of fur-bearing animals, whose skins they supply to Russian and Yakut traders, in exchange for provisions, clothing, and other necessaries of life. The picturesque and even elegant national costume shows in its ornamentation and general style decided Japanese influence, due no doubt to long-continued intercourse with that nation at some period previous to the spread of the race from the Amur valley to Siberia. Many of the Tungus tribes have been baptized, and are, therefore, reckoned as "Greek Christians"; but Russian orthodoxy has not penetrated far below the surface, and most of them are still at heart Shamanists and nature-worshippers, secretly keeping the teeth and claws of wild animals as idols or amulets, and observing Christian rites only under compulsion. But, whether Christians or pagans, all alike are distinguished above other Asiatics, perhaps above all other peoples, for their truly noble moral qualities. All observers describe them as "cheerful under the most depressing circumstances, persevering, open-hearted, trustworthy, modest yet self-reliant, a fearless race of hunters, born amidst the gloom of their dense pine-forests, exposed from the cradle to every danger from wild beasts, cold, and hunger. Want and hardships of every kind they endure with surprising fortitude, and nothing can induce them to take service under the Russians or quit their solitary woodlands" (Keane's *Asia*, p. 479). Their numbers are steadily decreasing owing to the ravages of small-pox, scarlet fever, and especially famine, their most dreaded enemy. Their domain is also being continually encroached upon by the aggressive Yakuts from the north and east, and from the south by the Slavs, now settled in compact bodies in the province of Irkutsk about the upper course of the Yenisei. It is remarkable that, while the Russians often show a tendency to become assimilated to the Yakuts, the most vigorous and expansive of all the Siberian peoples, the Tunguses everywhere yield before the advance of their more civilized neighbours or become absorbed in the surrounding Slav communities. In the Amur valley the same fate is overtaking the kindred tribes, who are disappearing before the great waves of Chinese migration from the south and Russian encroachments both from the east and west. In 1880 the Oroches were already reduced to about 260, and the Tazi to a little over 200. For the philological relations of the Tunguses, see vol. xviii. p. 779.

TUNICATA

THIS group of animals was formerly regarded as constituting along with the *Polyzoa* and the *Brachiopoda* the invertebrate class *Molluscoidea*. It is now known to be a degenerate branch of the *Chordata*, and to be more nearly related to the *Vertebrata* than to any group of the *Invertebrata*

HISTORY.[1]

Simple Ascidians. More than two thousand years ago Aristotle gave a short account of a Simple Ascidian under the name of *Tethyum*. He described the appearance and some of the more important points in the anatomy of the animal. From that time onwards to little more than a century ago, although various forms of Ascidians had been briefly described by writers on marine zoology, comparatively little advance was made upon the knowledge of Aristotle. **Compound Ascidians.** Schlosser and Ellis, in a paper containing a description of *Botryllus*, published in the *Philosophical Transactions* of the Royal Society for 1756, first brought the Compound Ascidians into notice; but it was not until the commencement of the 19th century, as a result of the careful anatomical investigations of Cuvier (*1*) upon the Simple Ascidians and of Savigny (*2*) upon the Compound, that the close relationship between these two groups of the *Tunicata* was conclusively demonstrated. **Cuvier and Savigny.** Up to 1816, the date of publication of Savigny's great work (*2*), the few Compound Ascidians then known had been generally regarded as *Alcyonaria* or as Sponges; and, although many new Simple Ascidians had been described by O. F. Müller (*4*) and others, their internal structure had not been investigated. **Lamarck.** Lamarck (*3*) in 1816, chiefly as the result of the anatomical discoveries of Savigny and Cuvier, instituted the class *Tunicata*, which he placed between the *Radiata* and the *Vermes* in his system of classification. The *Tunicata* included at that time, besides the Simple and the Compound Ascidians, the pelagic forms *Pyrosoma*, which had been first made known by Péron in 1804, and *Salpa*, described by Forskål in 1775.

Chamisso and alternation of generations. Chamisso in 1820 made the important discovery that *Salpa* in its life-history passes through the series of changes which were afterwards more fully described by Steenstrup in 1842 as "alternation of generations"; and a few years later Kuhl and Van Hasselt's investigations upon the same animal resulted in the discovery of the alternation in the directions in which the wave of contraction passes along the heart and in which the blood circulates through the body. **Circulation.** It has since been found that this observation holds good for all groups of the *Tunicata*. In 1826 H. Milne-Edwards and Audouin made a series of observations on living Compound Ascidians, and amongst other discoveries they found the free-swimming tailed larva, and traced its development into the young Ascidian. **Milne-Edwards.** Milne-Edwards (*5*) also founded the group of "Social" Ascidians, now known as the *Clavelinidæ*, and gave a classification of the Compound Ascidians which was universally accepted for many years. From the year 1826 onwards a number of new and remarkable forms were discovered, as, for instance, some of the *Bolteninæ* (Macleay), *Chelyosoma* (Broderip and Sowerby, and afterwards Eschricht), *Oikopleura* (Mertens), *Perophora* (Lister), *Pelonaia* (Forbes and Goodsir), *Chondrostachys* and *Diplosoma* (Denis Macdonald), *Diazona* (Forbes and Goodsir), and *Rhodosoma* (Ehrenberg, and afterwards Lacaze-Duthiers).

Carl Schmidt. In 1845 Carl Schmidt (*6*) first announced the presence in the test of some Ascidians of "tunicine," a substance very similar to cellulose, and in the following year Löwig and Kölliker (*7*) confirmed the discovery and made some additional observations upon this substance and upon the structure of the test in general. **Huxley.** Huxley (*8*), in an important series of papers published in the *Transactions* of the Royal and Linnean Societies of London from 1851 onwards, discussed the structure, embryology, and affinities of the pelagic Tunicates *Pyrosoma*, *Salpa*, *Doliolum*, and *Appendicularia*. These important forms were also investigated about the same time by Gegenbaur, Vogt, H. Müller, Krohn, and Leuckart. The most important epoch in the history of the *Tunicata* is the date of the publication of Kowalevsky's celebrated memoir upon the development of a Simple Ascidian (*9*). **Kowalevsky. Tailed larva.** The tailed larva had been previously discovered and investigated by several naturalists—notably H. Milne-Edwards (*5*), J. P. van Beneden (*10*), and Krohn (*11*); but its minute structure had not been sufficiently examined, and the meaning of what was known of it had not been understood. **Relationship to Vertebrates.** It was reserved for Kowalevsky in 1866 to demonstrate the striking similarity in structure and in development between the larval Ascidian and the vertebrate embryo. He showed that the relations between the nervous system, the notochord, and the alimentary canal are much the same in the two forms, and have been brought about by a very similar course of embryonic development. This discovery clearly indicated that the *Tunicata* are closely allied to *Amphioxus* and the *Vertebrata*, and that the tailed larva represents the primitive or ancestral form from which the adult Ascidian has been evolved by degeneration, and this led naturally to the view usually accepted at the present day, that the group is a degenerate side-branch from the lower end of the phylum *Chordata*, which includes the *Tunicata* (*Urochorda*), *Amphioxus* (*Cephalochorda*), and the *Vertebrata*. **Kupffer, Giard, &c.** Kowalevsky's great discovery has since been confirmed and extended to all other groups of the *Tunicata* by Kupffer (*12*), Giard (*13* and *15*), and others. **Gemmation.** Important observations upon the process of gemmation and the formation of colonies in various forms of Compound Ascidians have been made by Krohn, Metschnikoff, Kowalevsky, Ganin, Giard, Della Valle, and others, and have gradually led to the establishment of the general principle, that all the more important layers of the bud are derived more or less directly from the corresponding regions in the body of the parent.

Fol, &c. In 1872 Fol (*14*) added largely to the knowledge of the *Appendiculariidæ*, and Giard (*15*) to that of the Compound Ascidians. The latter author described a number of new forms and remodelled the classification of the group. The most important additions which have been made to the Compound Ascidians since Giard's work have been those described by Von Drasche (*16*) from the Adriatic and those discovered by the "Challenger" expedition (*17*). The structure and the systematic arrangement of the Simple Ascidians have been mainly discussed of recent years by Alder and Hancock (*18*), Heller (*19*), Lacaze-Duthiers (*20*), Traustedt (*21*), and Herdman (*17, 22*). **Sub-neural gland and dorsal tubercle.** In 1874 Ussoff (*23*) investigated the minute structure of the nervous system and of the underlying gland, which was first discovered by Hancock, and showed that the gland has a duct which communicates with the front of the branchial sac or pharynx by an aperture in the dorsal (or "olfactory") tubercle. In an important paper published in 1880 Julin (*24*) drew attention to the similarity in structure and relations between this gland and the *hypophysis cerebri* of the vertebrate brain, and insisted upon their homology. He suggests that they perform a renal function. The *Thaliacea*

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[1] Only the more important works can be mentioned here. For a more detailed account of the history of the group and a full bibliography, see (*17*) in the list of works at the end of this article.

Thaliacea.

Van Beneden and Julin.

have of late years been the subject of several very important memoirs. The researches of Todaro, Brooks (*25*), Salensky (*26*), and others have elucidated the embryology, the gemmation, and the life-history of the *Salpidæ*; and Grobben, Barrois (*27*), and more especially Uljanin (*28*) have elaborately worked out the structure and the details of the complicated life-history of the *Doliolidæ*. Finally, in an important work published in 1886 on the morphology of the *Tunicata*, E. van Beneden and Julin (*30*) have, mainly as the result of a close comparison of the embryology of Ascidians with that of *Amphioxus* and other *Chordata*, added considerably to our knowledge of the position and affinities of the *Tunicata*, and of the exact relations of their organs to the corresponding parts of the body in the *Vertebrata*.

ANATOMY.

Ascidia mentula.

As a type of the *Tunicata*, *Ascidia mentula*, one of the larger species of the Simple Ascidians, may be taken. This species is found in most of the European seas, generally in shallow water on a muddy bottom.

External characters.

It has an irregularly ovate form, and is of a dull grey colour. It is attached to some foreign object by one end (fig. 1). The opposite end of the body is usually narrow, and it has a terminal opening surrounded by eight rounded lobes. This is the mouth or branchial aperture, and it always indicates the anterior end[1] of the animal. About half-way back from the anterior end, and on a rounded projection, is the atrial or cloacal aperture—an opening surrounded by six lobes—which is always placed upon the dorsal region. When the Ascidian is living and undisturbed, water is being constantly drawn in through the branchial aperture and passed out through the atrial. If coloured particles be placed in the water near the apertures, they are seen to be sucked into the body through the branchial aperture, and after a short time some of them are ejected with considerable force through the atrial aperture. The current of water passing in is for respiratory purposes, and it also conveys food into the animal. The atrial current is mainly the water which has been used in respiration, but it also contains all excretions from the body, and at times the ova and spermatozoa or the embryos.

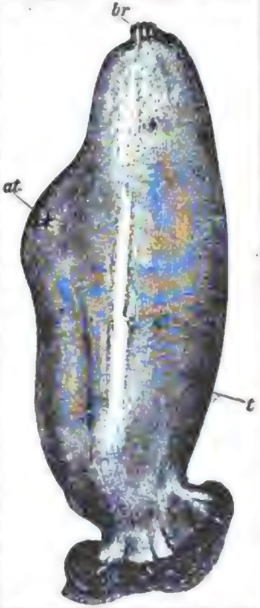

FIG. 1.—*Ascidia mentula* from the right side. *at*, atrial aperture; *br*, branchial aperture; *t*, test. (Original.)

The test.

The outer grey part of the body, which is attached at or near its posterior end and penetrated by the two apertures, is the "test." This is a firm gelatinous cuticular secretion from the outer surface of the ectoderm, which is a layer of flat cells lining its inner surface. Although at first produced as a cuticle, the test soon becomes organized by the migration into it of cells derived from the ectoderm (see fig. 2). These test cells may remain as rounded or fusiform or stellate cells imbedded in the gelatinous matrix, to which they are constantly adding by secretions on their surfaces; or they may develop vacuoles in their protoplasm, which become larger and fuse to form a huge ovate clear cavity (a "bladder cell"), surrounded by a delicate film of protoplasm and having the nucleus still visible at one point; or they may form pigment granules in the protoplasm; or, lastly, they may deposit carbonate of lime, so that one or several of them together produce a calcareous spicule in the test. Only the unmodified test cells and the bladder cells are found in *Ascidia mentula*. Calcareous spicules are found chiefly in the *Didemnidæ*, amongst Compound Ascidians; but pigmented cells may occur in the test of almost all groups of *Tunicata*. The matrix in which these structures are imbedded is usually clear and apparently homogeneous; but in some cases it becomes finely fibrillated, especially in the family *Cynthiidæ*. It is this matrix which contains tunicine. At one point on the left side near the posterior end a tube enters the test, and then splits up into a number of branches, which extend in all directions and finally terminate in rounded enlargements or bulbs, situated chiefly in the outer layer of the test. These tubes are known as the "vessels" of the test, and they contain blood. Each vessel is bounded by a layer of ectoderm cells lined by connective tissue (fig. 3, *B*), and is divided into two tubes by a septum of connective tissue. The septum does not extend into the terminal bulb, and consequently the two tubes communicate at their ends (fig. 3, *A*). The vessels are formed by an outgrowth of a blood sinus (derived originally from the blastocœle of the embryo) from the body wall (mantle) into the test, the wall of the sinus being formed by connective tissue and pushing out a covering of ectoderm in front of it (fig. 2, *s'*). The test is turned inwards at the branchial and atrial apertures to line two funnel-like tubes,—the branchial siphon leading to the branchial sac and the atrial siphon leading to the atrial or peribranchial cavity.

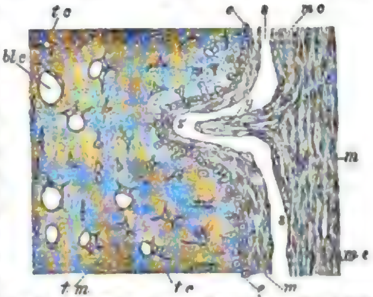

FIG. 2.—Diagrammatic section of part of mantle and test of an Ascidian, showing the formation of a vessel and the structure of the test. *m*, mantle; *e*, ectoderm; *tc* test cell; *tm*, matrix; *blc*, bladder cell; *s*, *s'*, blood sinus in mantle being drawn out into test; *mc*, mantle cells; *y*, septum of vessel. (From Herdman, *Challenger Report*.)

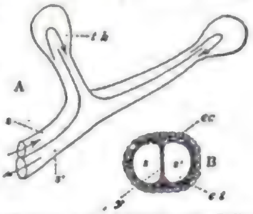

FIG. 3.—*A*, a vessel from the test. *B*, diagrammatic transverse section of a vessel. *ec*, ectoderm; *ct*, connective tissue; *s*, *s'*, the two tubes; *y*, septum; *tb*, terminal bulb. (Original.)

Mantle.

The body wall, inside the test and the ectoderm, is formed of a layer (the somatic layer of mesoderm) of connective tissue, inclosing muscle fibres, blood sinuses, and nerves. This layer (the mantle) has very much the shape of the test outside it, but at the two apertures it is drawn out to form the branchial and atrial siphons (fig. 4). In the walls of these siphons the muscle fibres form powerful circular bands, the sphincter muscles. Throughout the rest of the mantle the bands of muscle fibres form a rude irregular network. They are numerous on the right side of the body, and almost totally absent on the left. The muscles are all formed of very long fusiform non-striped fibres. The connective tissue of the mantle is chiefly a clear gelatinous matrix, containing cells of various shapes; it is frequently pigmented and is penetrated by numerous lacunæ, in which the blood flows. Inside the mantle, in all parts of the body, except along the ventral edge, there is a cavity,—the atrial or peribranchial cavity,—which opens to the exterior by the atrial aperture. This cavity is lined by a layer of cells derived originally from the ectoderm[1] and directly continuous with that layer through the atrial aperture (fig. 5); consequently the mantle is covered both externally and internally by ectodermal cells.

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[1] Some writers use a different nomenclature of regions; see (*17*).

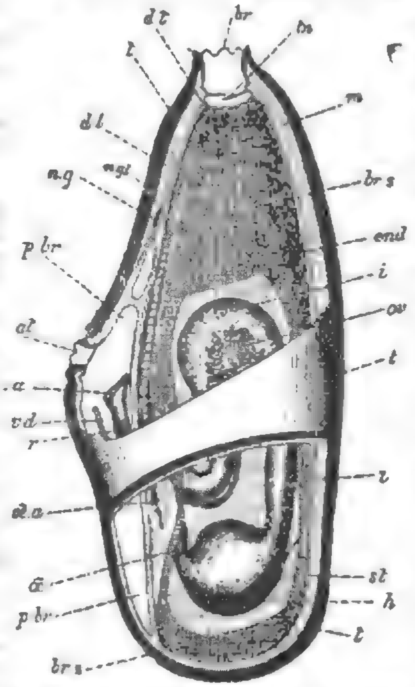

FIG. 4.—Diagrammatic dissection of *A. mentula* to show the anatomy. *at*, atrial aperture; *br*, branchial aperture; *a*, anus; *brs*, branchial sac; *dl*, dorsal lamina; *dt*, dorsal tubercle; *end*, endostyle; *h*, heart; *i*, intestine; *m*, mantle; *ng*, nerve ganglion; *œ*, œsophagus; *œa*, œsophageal aperture; *ov*, ovary; *pbr*, peribranchial cavity; *r*, rectum; *st*, stomach; *t*, test; *tn*, tentacles; *vd*, vas deferens; *ngl*, subneural gland. (Original.)

Branchial sac and neighbouring organs.

The branchial aperture (mouth) leads into the branchial siphon (buccal cavity or stomodæum), and this opens into the anterior end of a very large cavity (the branchial sac) which extends nearly to the posterior end of the body (see figs. 4 and 5). This branchial sac is an enlarged and modified pharynx, and is therefore properly a part of the alimentary canal. The œsophagus opens from it far back on the dorsal edge (see below, p. 612). The wall of the branchial sac is pierced by a large number of vertical slits,—the stigmata,—placed in numerous transverse rows. These slits place the branchial sac in communication with the peribranchial or atrial cavity, which lies outside it (fig. 5, *B*). Between the stigmata the wall of the branchial sac is traversed by blood-vessels, which are arranged in three regular series (fig. 6),—(1) the transverse vessels, which run horizontally round the wall and open at their dorsal and ventral ends into large longitudinal vessels, the dorsal and ventral sinuses; (2) the fine longitudinal vessels, which run vertically between adjacent transverse vessels and open into them, and which bound the stigmata; and (3) the internal longitudinal bars, which run vertically in a plane internal to that of the transverse and fine longitudinal vessels. These bars communicate with the transverse vessels by short side branches where they cross, and at these points are prolonged into the lumen of the sac in the form of hollow papillæ. The edges of the stigmata are richly set with cilia, which drive the water from the branchial sac into the peribranchial cavity, and so cause the currents that flow in through the branchial aperture and out through the atrial.

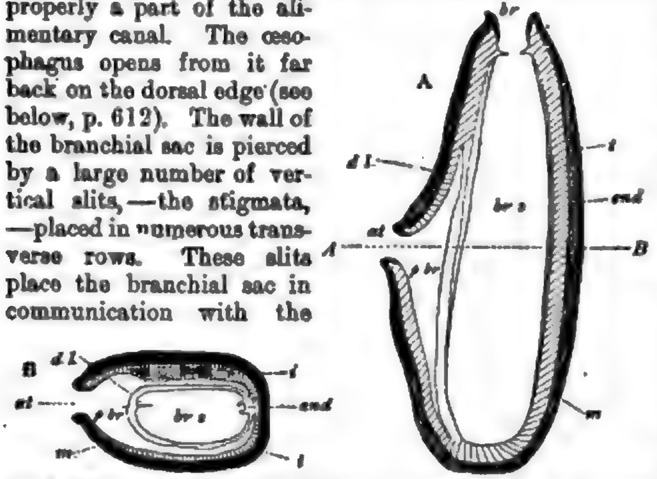

FIG. 5.—Diagrammatic longitudinal (A) and transverse (B) sections through *Ascidia* to show the position of the ectoderm and the relations of the branchial and peribranchial cavities. The lettering is the same as for fig. 4. B represents a section taken along the dotted line *A-B* in A. (Original.)

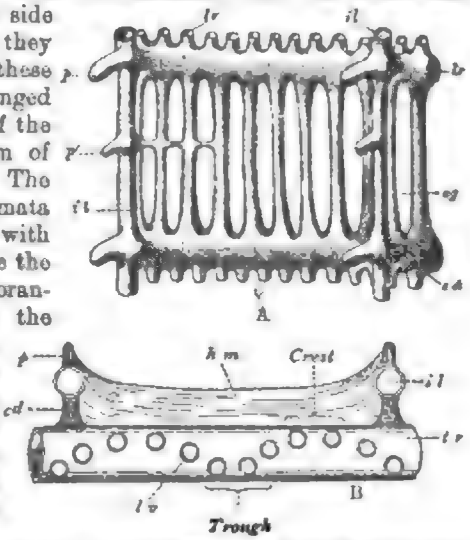

FIG. 6.—*A*. Part of branchial sac of *Ascidia* from inside. *B*. Transverse section of same. *tr*, transverse vessel; *cd*, connecting duct; *hm*, horizontal membrane; *il*, internal longitudinal bar; *lv*, fine longitudinal vessels; *p*, *p'*, papillæ; *sg*, stigmata. A and B are drawn to different scales. (From Herdman, Challenger *Report*.)

Endostyle.

Along its ventral edge the wall of the branchial sac is continuous externally with the mantle (fig. 5, *B*), while internally it is thickened to form two parallel longitudinal folds bounding a groove, the "endostyle," hypobranchial groove, or ventral furrow (figs. 4, 5, *end*). The endoderm cells which line the endostyle are greatly enlarged at the bottom and on parts of the sides of the furrow so as to form projecting pads, which bear very long cilia. It is generally supposed that this organ is a gland for the production of the mucous secretion which is spread round the edges of the branchial sac and catches the food particles in the passing current of water; but it has recently been pointed out that there are comparatively few gland cells in the epithelium of the endostyle, and that it is more probable that this furrow is merely a ciliated path along which the mucous secretion (produced possibly by the subneural gland) is conveyed posteriorly along the ventral edge of the branchial sac. At its anterior end the edges of the endostyle become continuous with the right and left halves of the posterior of two circular ciliated ridges,—the peripharyngeal bands,—which run parallel to one another round the front of the branchial sac. The dorsal ends of the posterior peripharyngeal band bend posteriorly (enclosing the epibranchial groove), and then join to form the anterior end of a fold which runs along the dorsal edge of the branchial sac as far as the œsophageal aperture. This fold is the dorsal lamina (figs. 4, 5, *dl*). It probably serves to direct the stream of food particles entangled in a string of mucus from the anterior part of the dorsal lamina to the œsophagus. In many Ascidians this organ, instead of being a continuous membranous fold as in *A. mentula*, is represented by a series of elongated triangular processes—the dorsal languets,—one attached in the dorsal median line opposite to each transverse vessel of the branchial sac. The anterior peripharyngeal band is a complete circular ridge, having no connexion with either the endostyle or the dorsal lamina. In front of it lies the prebranchial zone, which separates the branchial sac behind from the branchial siphon in front. The prebranchial zone is bounded anteriorly by a muscular band—the posterior edge of the sphincter muscle,—which bears a circle of long delicate processes, the tentacles (figs. 4, 7, 8, *tn*). These project inwards at right angles so as to form a network across the entrance to the branchial sac. Each tentacle consists of connective tissue covered with epithe-

Peripharyngeal bands.

Dorsal lamina.

Dorsal languets.

Tentacles.

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[1] According to E. van Beneden and Julin's recent investigations (30) only the outer wall of the atrium is lined with epiblast, the inner wall being derived from the hypoblast of the primitive branchial sac.

Subneural gland.

lium (endoderm), and contains two or more cavities which are continuous with blood sinuses in the mantle. In the dorsal median line near the anterior end of the body, and imbedded in the mantle on the ventral surface of the nerve ganglion, there lies a small glandular mass—the subneural gland—which, as Julin has shown (*24*), there is reason to regard as the homologue of the *hypophysis cerebri* of the vertebrate brain. Julin and E. van Beneden have suggested that the function of this organ may possibly be renal.[1] The subneural gland, which was first noticed by Hancock, communicates anteriorly, as Ussoff (*23*) pointed out, by means of a narrow duct with the front of the branchial sac (pharynx). The opening of the duct is enlarged to form a funnel-shaped cavity, which may be folded upon itself, convoluted, or even broken up into a number of smaller openings, so as to form a complicated projection, called the dorsal tubercle, situated in the dorsal part of the prebranchial zone (fig. 7). The dorsal tubercle in *A. mentula* is somewhat horse-shoe-shaped (fig. 8); it varies in form in most Ascidians according to the genus and species, and in some cases in the individual also. Possibly, besides being the opening of the duct from the subneural gland, it may be a sense-organ for testing the quality of the water entering the branchial sac.

Dorsal tubercle.

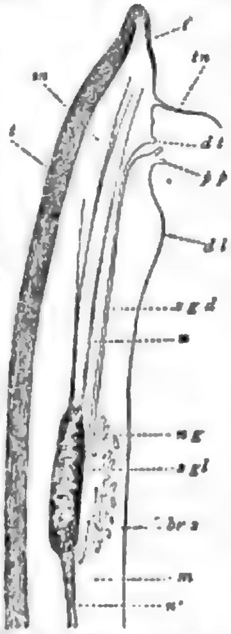

FIG. 7.—Diagrammatic section through anterior dorsal part of *A. mentula*, showing the relations of the nerve ganglion, subneural gland, &c. Lettering as for fig. 4; *n*, nerve; *n'*, myelon; *pp*, peripharyngeal band; *sgl*, subneural gland; *sgd*, its duct; *t'*, test lining branchial siphon. (Original.)

Nervous system.

The single elongated ganglion in the median dorsal line of the mantle between the branchial and atrial siphons is the only nerve-centre in *A. mentula* and most other *Tunicata*. It is the degenerate remains of the anterior part of the cerebro-spinal nervous system of the tailed larval Ascidian (see below, p. 614). The posterior or spinal part has entirely disappeared in most *Tunicata*. It persists, however, in the *Appendiculariidæ*, and traces of it are found in some Ascidians (*e.g.*, *Clavelina*; see Julin). The ganglion gives off distributory nerves at both ends, which run through the mantle to the neighbourhood of the apertures, where they divide and subdivide.

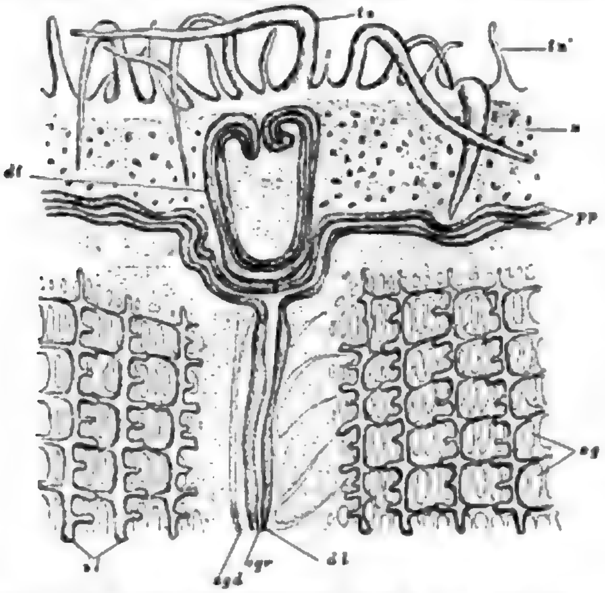

FIG. 8.—Dorsal tubercle and neighbouring organs of *A. mentula*. Lettering as before; *egr*, epibranchial groove; *s*, prebranchial zone. (Original.)

Sense organs.

The only sense-organs are the pigment spots between the branchial and atrial lobes, the tentacles at the base of the branchial siphon, and possibly the dorsal tubercle and the languets or dorsal lamina. These are all in a lowly developed condition. The larval Ascidians on the other hand have well-developed intra-cerebral optic and auditory sense-organs; and in some of the pelagic *Tunicata* otocysts and pigment spots are found in connexion with the ganglion.

Alimentary canal.

The mouth and the pharynx (branchial sac) have already been described. The remainder of the alimentary canal is a bent tube which in *A. mentula* and most other Ascidians lies imbedded in the mantle on the left side of the body, and projects into the peribranchial cavity. The œsophagus leaves the branchial sac in the dorsal middle line near the posterior end of the dorsal lamina (see fig. 4, *œa*). It is a short curved tube which leads ventrally to the large fusiform thick-walled stomach. The intestine emerges from the ventral end of the stomach, and soon turns anteriorly, then dorsally, and then posteriorly so as to form a curve—the intestinal loop—open posteriorly. The intestine now curves anteriorly again, and from this point runs nearly straight forward as the rectum, thus completing a second curve—the rectal loop—open anteriorly (see fig. 4). The wall of the intestine is thickened internally, to form the typhlosole, a pad which runs along its entire length. The anus opens into the dorsal part of the peribranchial cavity near to the atrial aperture. The walls of the stomach are glandular; and a system of delicate tubules with dilated ends, which ramifies over the outer wall of the intestine and communicates with the cavity of the stomach by means of a duct, is probably a digestive gland.

Excretory organs.

A mass of large clear vesicles which occupies the rectal loop, and may extend over the adjacent walls of the intestine, is a renal organ without a duct. Each vesicle is the modified remains of a part of the primitive cœlom or body-cavity, and is formed of cells which eliminate nitrogenous waste matters from the blood circulating in the neighbouring blood-lacunæ and deposit them in the cavity of the vesicle, where they form a concentrically laminated concretion of a yellowish or brown colour. These concretions contain uric acid, and in a large Ascidian are very numerous. The nitrogenous waste products are thus deposited and stored up in the renal vesicles in place of being excreted from the body. In other Ascidians the renal organ may differ from the above in its position and structure; but in no case has it an excretory duct, unless the subneural gland is to be regarded as a renal organ.

Blood-vascular system and cœlom.

The heart is an elongated fusiform tube placed on the ventral and posterior edge of the stomach, in a space (the pericardium) which is part of the original cœlom or body-cavity, the rest of which exists merely in the form of lacunæ and of the cavities of the reproductive organs and renal vesicles in the adult Ascidian. The wall of the heart is formed of a layer of epithelio-muscular cells, the inner ends of which are cross-striated; and waves of contraction pass along it from end to end, first for a certain number of beats in one direction and then in the other, so as to reverse the course of circulation periodically. At each end the heart is continued into a vessel (see fig. 9), a large sinus or lacuna lined with a delicate endothelial layer. The sinus leaving the ventral end of the heart is called the branchio-cardiac vessel,[2] and the heart itself is merely the differentiated posterior part of this sinus and is therefore a ventral vessel. The branchio-cardiac vessel, after giving off a branch which, along with a corresponding branch from the cardio-visceral vessel, goes to the test, runs along the ventral edge of the branchial sac externally to the endostyle, and communicates laterally with the ventral ends of all the transverse vessels of the branchial sac. The sinus leaving the dorsal end of the heart is called the cardio-visceral vessel, and this, after giving off to the test the branch above mentioned, breaks up into a number of sinuses, which ramify over the alimentary canal and the other viscera. These visceral lacunæ finally communicate with a third great sinus, the viscero-branchial vessel, which runs forward along the dorsal edge of the branchial sac externally to the dorsal lamina and joins the dorsal ends of all the transverse vessels of the branchial sac. Besides these three chief systems there are numerous lacunæ in all parts of the body, by means of which anastomoses are established between the different currents of blood. All these blood spaces and lacunæ are to be regarded as derived from the blastocœle of the embryo, and not, as has been usually supposed, from the cœlom (*30*). When the heart contracts ventro-dorsally, the course of the circulation is as follows: the blood which is flowing through the vessels of the branchial sac is collected in an oxygenated condition in the branchio-cardiac vessel, and, after receiving a stream of blood from the test, enters the heart. It is then propelled from the dorsal end of the heart into the cardio-visceral vessels, and so reaches the test and digestive and other organs; then, after circulating in the visceral lacunæ, it passes into the viscero-branchial vessel in an impure condition, and is distributed to the branchial vessels to be purified again. When the heart on the other hand contracts dorso-ventrally, this course of circulation is reversed. As the test receives a branch from each end of the heart, it follows that it has afferent and efferent vessels whichever way the blood is flowing. In some Ascidians the vessels in the test become very numerous and their end branches terminate in swollen bulbs close under the outer surface of the test. In this way an accessory respiratory organ[1] is probably formed in the superficial layer of the test. The blood corpuscles are chiefly colourless and amœboid; but in most if not all Ascidians there are also some pigmented corpuscles in the blood. These are generally of an orange or reddish brown tint, but may be opaque white, dark indigo-blue, or of intermediate colours. Precisely similarly pigmented cells are found throughout the connective tissue of the mantle and other parts of the body.

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[1] See also Herdman, *Nature*, vol. xxviii. p. 284.

[2] On account of the periodic reversal of the circulation none of the vessels can be called arteries or veins.

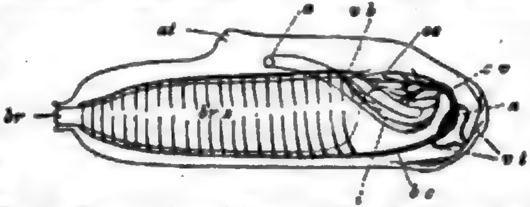

FIG. 9.—Diagram of circulation in *Ascidia*. Lettering as before; *bc*, branchio-cardiac or ventral vessel; *cv*, cardio-visceral vessels; *vb*, viscero-branchial or dorsal vessel; *vt*, vessels to test. (Original.)

A. mentula is hermaphrodite, and the reproductive organs lie, with the alimentary canal, on the left side of the body. The ovary is a ramified gland which occupies the greater part of the intestinal loop (see fig. 4). It contains a cavity which, along with the cavities of the testis, is derived from a part of the original cœlom, and the ova are formed from its walls and fall when mature into the cavity. The oviduct is continuous with the cavity of the ovary and leads forwards alongside the rectum, finally opening near the anus into the peribranchial cavity. The testis is composed of a great number of delicate branched tubules, which ramify over the ovary and the adjacent parts of the intestinal wall. Those tubules terminate in ovate swellings. Near the commencement of the rectum the larger tubules unite to form the vas deferens, a tube of considerable size, which runs forwards alongside the rectum, and, like the oviduct, terminates by opening into the peribranchial cavity close to the anus. The lumen of the tubules of the testis, like the cavity of the ovary, is a part of the original cœlom, and the spermatozoa are formed from the cells lining the wall. In some Ascidians reproductive organs are present on both sides of the body, and in others (*Polycarpa*) there are many complete sets of both male and female systems, attached to the inner surface of the mantle on both sides of the body and projecting into the peribranchial cavity.[2]

EMBRYOLOGY[3] AND LIFE HISTORY.

Embryology.

In most Ascidians the eggs are fertilized in the peribranchial cavity, and undergo most of their development before leaving the parent; in some cases, however, the eggs are laid, and fertilization takes place in the surrounding water. The segmentation is complete and regular (fig. 10, A) and results in the formation of a spherical blastula, which then undergoes invagination (fig. 10, B). The embryo elongates, and the blastopore or invagination opening comes to be placed on the dorsal edge near the posterior end (fig. 10, C). The hypoblast cells lining the archenteron are columnar in form, while the epiblast cells are more cubical (fig. 10, B, C, D). The dorsal surface of the embryo now becomes flattened and then depressed to form a longitudinal groove, extending forwards from the blastopore to near the front of the body. This "medullary groove" now becomes converted into a closed canal by its side walls growing up, arching over, and coalescing in the median dorsal line (fig. 10, D). This union of the *laminæ dorsales* to form the neural canal commences at the posterior end behind the blastopore and gradually extends forwards. Consequently the blastopore comes to open into the posterior end of the neural canal (fig. 10, D), while the anterior end of that cavity remains open to the exterior. In this way the archenteron communicates indirectly with the exterior. The short canal leading from the neural canal to the archenteron is known as the neurenteric canal (fig. 10,

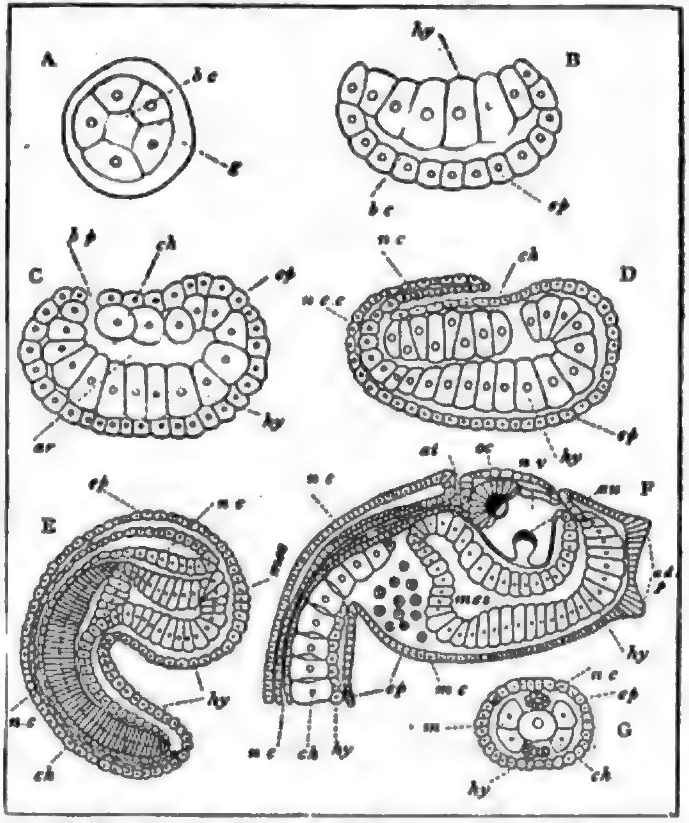

FIG. 10.—Stages in the embryology of a Simple Ascidian (after Kowalevsky) A to F. Longitudinal vertical sections of embryos, all placed with the dorsal surface uppermost and the anterior end at the right. A. Early blastula stage, during segmentation. B. Early gastrula stage. C. Stage after gastrula, showing commencement of notochord. D. Later stage, showing formation of notochord and of neural canal. E. Embryo showing body and tail and completely formed neural canal. F. Larva just hatched; end of tail cut off. G. Transverse section of tail of larva.

adp, adhering papillæ of larva; *at*, epiblastic (atrial) involution; *au*, auditory organ of larva; *ar*, archenteron; *bc*, blastocœle; *bp*, blastopore; *ch*, notochord; *ep*, epiblast; *hy*, hypoblast; *nc*, neural canal; *nec*, neurenteric canal; *oc*, ocular organ of larva; *g*, gelatinous investment of embryo; *m*, muscle cells of tail; *mes*, mesenteron; *mc*, mesoderm cells; *nv*, cerebral vesicle at anterior end of neural canal.

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[1] See Herdman, *Nature*, vol. xxxi. p. 247.

[2] For structure of other forms, see p. 614 *sq.* below.

[3] For reproduction by gemmation, see under "Classification," p. 614 *sq.* below.

D, *nec*). Previous to this stage some of the hypoblast cells at the front edge of the blastopore and forming part of the dorsal wall of the archenteron (fig. 10, C, *ch*) have become separated off, and then arranged to form an elongated band, two cells wide, underlying the posterior half of the neural canal (fig. 10, D, E, *ch.*). This is the origin of the notochord. Outgrowths from the sides of the archenteron give rise to laterally placed masses of cells, which are the origin of the mesoblast. These masses show no trace of metameric segmentation. The cavities (reproductive and renal vesicles) which are formed later in the mesoblast represent the cœlom. Consequently the body-cavity of the *Tunicata* is a modified form of enterocœle. The anterior part of the embryo, in front of the notochord, now becomes enlarged to form the trunk, while the posterior part elongates to form the tail (fig. 10, E). In the trunk the anterior part of the archenteron dilates to form the mesenteron, the greater part of which becomes the branchial sac; at the same time the anterior part of the neural canal enlarges to form the cerebral vesicle, and the opening to the exterior at the front end of the canal now closes. In the tail part of the embryo the neural canal remains as a narrow tube, while the remains of the wall of the archenteron—the dorsal part of which becomes the notochord—are converted into lateral muscle bands (fig. 10, G) and a ventral cord of cells, which eventually breaks up to form blood corpuscles. As the tail grows longer, it becomes bent round the trunk of the embryo inside the egg-membrane. About this period the epiblast cells begin to form the test as a cuticular deposit upon their outer surface. The test is at first devoid of cells and forms a delicate gelatinous investment, but it shortly afterwards becomes cellular by the migration into it of test cells formed by proliferation from the epiblast.[1]

Larval stage.

The embryo is hatched about two or three days after fertilization, in the form of a tadpole-like larva, which swims actively through the sea by vibrating its long tail. The anterior end of the body is provided with three adhering papillæ (fig. 10, F, *adp*) in the form of epiblastic thickenings. In the free-swimming tailed larva the nervous system, formed from the walls of the neural canal; becomes considerably differentiated. The anterior part of the cerebral vesicle remains thin-walled (fig. 10, F), and two unpaired sense organs develop from its wall and project into the cavity. These are a dorsally and posteriorly placed optic organ, provided with retina, pigment layer, lens, and cornea, and a ventrally placed auditory organ, consisting of a large spherical partially pigmented otolith, attached by delicate hair-like processes to the summit of a hollow *crista acoustica* (fig. 10, F, *au*). The posterior part of the cerebral vesicle thickens to form a solid ganglionic mass traversed by a narrow central canal. The wall of the neural canal behind the cerebral vesicle becomes differentiated into an anterior thicker region, placed in the posterior part of the trunk and having a superficial layer of nerve fibres, and a posterior narrower part which traverses the tail, lying on the dorsal surface of the notochord, and gives off several pairs of nerves to the muscles of the tail. Just in front of the anterior end of the nervous system a dorsal involution of the epiblast breaks through into the upturned anterior end of the mesenteron and thus forms the mouth opening. Along the ventral edge of the mesenteron, which becomes the branchial sac, the endostyle is formed as a narrow groove with thickened side walls. It probably corresponds to the median portion of the thyroid body of *Vertebrata*. A curved outgrowth from the posterior end of the mesenteron forms the alimentary canal (œsophagus, stomach, and intestine), which at first ends blindly. An anus is formed later by the intestine opening into the left of two lateral epiblastic involutions (the atria), which rapidly become larger and fuse dorsally to form the peribranchial cavity. Outgrowths from the wall of the branchial sac meet these epiblastic involutions and fuse with them to give rise to the first formed pair of stigmata, which thus come to open into the peribranchial cavity; and these alone correspond to the gill clefts of *Amphioxus* and the *Vertebrata*.

Metamorphosis to adult form.

After a short free-swimming existence the fully developed tailed larva fixes itself by its anterior adhering papillæ to some foreign object, and then undergoes a remarkable series of retrogressive changes, which convert it into the adult Ascidian. The tail atrophies, until nothing is left but some fatty cells in the posterior part of the trunk. The adhering papillæ disappear and are replaced functionally by a growth of the test over neighbouring objects. The nervous system with its sense organs atrophies until it is reduced to the single small ganglion, placed on the dorsal edge of the pharynx, and a slight nerve cord running for some distance posteriorly (Van Beneden and Julin). Slight changes in the shape of the body and a further growth and differentiation of the branchial sac, peribranchial cavity, and other organs now produce gradually the structure found in the adult Ascidian.

The most important points in connexion with this process of development and metamorphosis are the following. (1) In the Ascidian embryo all the more important organs (*e.g.*, notochord, neural canal, archenteron) are formed in essentially the same manner as they are in *Amphioxus* and other *Chordata*. (2) The free-swimming tailed larva possesses the essential characters of the *Chordata*, inasmuch as it has a longitudinal skeletal axis (the notochord) separating a dorsally placed nervous system (the neural canal) from a ventral alimentary canal (the archenteron); and therefore during this period of its life-history the animal belongs to the *Chordata*. (3) The Chordate larva is more highly organized than the adult Ascidian, and therefore the changes by which the latter is produced from the former may be regarded as a process of degeneration (*31*). The important conclusion drawn from all this is that the *Tunicata* are the degenerate descendants of a group of the primitive *Chordata* (see below p. 618).

CLASSIFICATION AND CHARACTERS OF GROUPS.

Order I.—LARVACEA.

Characters of *Larvacea*.

Free-swimming pelagic forms provided with a large locomotory appendage (the tail), in which there is a skeletal axis (the urochord). A relatively large test (the "Haus") is formed with great rapidity as a secretion from the ectoderm; it is merely a temporary structure, which is cast off and replaced by another. The branchial sac is simply an enlarged pharnyx with two ventral ciliated openings (stigmata) leading to the exterior. There is no separate peribranchial cavity. The nervous system consists of a large dorsally placed ganglion and a long nerve cord, which stretches backwards over the alimentary canal to reach the tail, along which it runs on the left side of the urochord. The anus opens ventrally on the surface of the body in front of the stigmata. No reproduction by gemmation or metamorphosis is known in the life-history.

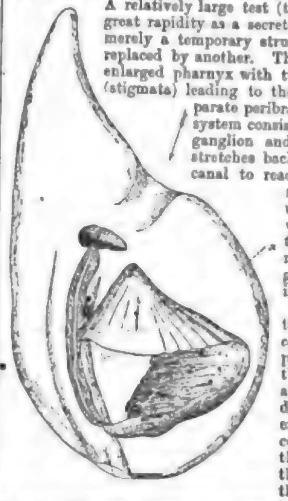

FIG. 11.—*Oikopleura cophocerca* in "Haus" (after Fol), seen from right side, magnified six times. The arrows indicate the course of the water; *x*, lateral articulated parts of "Haus."

This is one of the most interesting groups of the *Tunicata*, as it shows more completely than any of the rest the characters of the original ancestral forms. It has undergone little or no degeneration, and consequently corresponds more nearly to the tailed-larval condition than to the adult forms of the other groups. The order includes a single family, the APPENDICULARIIDÆ, all the members of which are minute and free-swimming. They occur on the surface of the sea in most parts of the world.

Structure of *Appendicularia*.

They possess the power to form with great rapidity an enormously large investing gelatinous layer (fig. 11), which corresponds to the test of other groups. This was first described by Von Mertens and by him named "Haus." It is only loosely attached to the body and is frequently thrown off soon after its formation. The tail in the *Appendiculariidæ* is attached to the ventral surface of the body (fig. 12), and usually

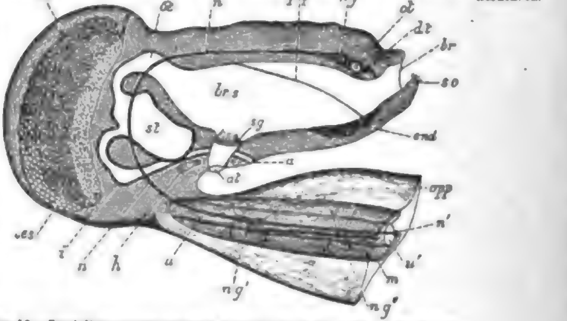

FIG. 12.—Semi-diagrammatic view of *Appendicularia* from the right. *a*, anus; *at*, one of the atrial apertures; *app*, tail; *br*, branchial aperture; *brs*, branchial sac; *dt*, dorsal tubercle; *end*, endostyle; *h*, heart; *i*, intestine; *m*, muscle band of tail; *n*, nerve cord in body; *n'*, nerve cord in the tail; *œ*, œsophagus; *ot*, otocyst; *ov*, ovary; *pp*, peripharyngeal band; *ng*, cerebral ganglion; *ng'*, caudal ganglion; *ng''*, enlargement of nerve cord in tail; *so*, sense organ (tactile) on lower lip; *sg*, ciliated aperture in pharynx; *st*, stomach; *tes*, testis; *u*, urochord; *u'*, its cut end. (Original.)

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[1] Some of the first test cells are also probably derived from the epithelium of the egg follicle.

points more or less anteriorly. It shows distinct traces of metameric segmentation, having its muscle bands broken up into myotomes, while the nerve cord presents a series of enlargements from which distributary nerves are given off (fig. 12, *ng″*). Near the base of the tail there is a distinct elongated ganglion (fig. 12, *ng′*). The anterior (cerebral) ganglion has connected with it an otocyst, a pigment spot, and a tubular process opening into the branchial sac and representing the dorsal tubercle and associated parts of an ordinary Ascidian. The branchial aperture or mouth leads into the branchial sac or pharynx. There are no tentacles. The endostyle is short. There is no dorsal lamina, and the peripharyngeal bands run dorsally and posteriorly. The wall of the branchial sac has only two ciliated apertures. They are homologous with the primary stigmata of the typical Ascidians and the gill clefts of Vertebrates. They are placed far back on the ventral surface, one on each side of the middle line, and lead into short funnel-shaped tubes which open on the surface of the body behind the anus (fig. 12, *at*). These tubes correspond to the right and left atrial involutions which, in an ordinary Ascidian, fuse to form the peribranchial cavity. The heart, according to Lankester, is formed of two cells, which are placed at the opposite ends and connected by delicate contractile protoplasmic fibrils. The large ovary and testis are placed at the posterior end of the body. The remainder of the structural details can be made out from fig. 12.

The family *Appendiculariidæ* comprises the genera,—*Oikopleura* (Mertens), and *Appendicularia* (Cham.), in both which the body is short and compact and the tail relatively long, while the endostyle is straight; *Fritillaria* (Q. and G.), in which the body is long and composed of anterior and posterior regions, the tail relatively short, the endostyle recurved, and an ectodermal hood is formed over the front of the body; and *Kowalevskia* (Fol), a remarkable form described by Fol (*14*), in which the heart, endostyle, and intestine are said to be absent, while the branchial sac is provided with four rows of ciliated tooth-like processes.

Order II.—THALIACEA.

Thaliacea.

Free-swimming pelagic forms which may be either simple or compound, and the adult of which is never provided with a tail or a notochord. The test is permanent and may be either well developed or very slight. The musculature of the mantle is in the form of more or less complete circular bands, by the contraction of which locomotion is effected. The branchial sac has either two large or many small apertures, leading to a single peribranchial cavity, into which the anus opens. Alternation of generations occurs in the life-history, and may be complicated by polymorphism. The *Thaliacea* comprises two groups, *Cyclomyaria* and *Hemimyaria*.

Sub-order 1.—**Cyclomyaria.**

Characters of *Cyclomyaria*.

Free-swimming pelagic forms which exhibit alternation of generations in their life-history but never form permanent colonies. The body is cask-shaped, with the branchial and atrial apertures at the opposite ends. The test is more or less well developed. The mantle has its musculature in the form of circular bands surrounding the body. The branchial sac is fairly large, occupying the anterior half or more of the body. Stigmata are usually present in its posterior part only. The peribranchial cavity is mainly posterior to the branchial sac. The alimentary canal is placed ventrally close to the posterior end of the branchial sac. Hermaphrodite reproductive organs are placed ventrally near the intestine.

This group forms one family, the DOLIOLIDÆ, including two genera, *Doliolum* (Quoy and Gaimard) and *Anchinia* (C. Vogt).

Structure of *Doliolum*.

Doliolum, of which several species are known from various seas, has a cask-shaped body, usually from 1 to 2 cm. in length. The terminal branchial and atrial apertures (fig. 13) are lobed, and the lobes are provided with sense organs. The test is very slightly developed and contains no cells. The mantle has eight or nine circular muscle bands surrounding the body. The most anterior and posterior of these form the branchial and atrial sphincters. The wide branchial and atrial apertures lead into large branchial and peribranchial cavities, separated by the posterior wall of the branchial sac, which is pierced by stigmata; consequently there is a free passage for the water through the body along its long axis, and the animal swims by contracting its ring-like muscle-bands, so as to force out the contained water posteriorly. Stigmata may also be found on the lateral walls of the branchial sac, and in that case there are corresponding anteriorly directed diverticula of the peribranchial cavity. There is a distinct endostyle on the ventral edge of the branchial sac and a peripharyngeal band surrounding its anterior end, but there is no representative of the dorsal lamina on its dorsal edge. The œsophagus commences rather on the ventral edge of the posterior end of the branchial sac, and runs backwards to open into the stomach, which is followed by a curved intestine opening into the peribranchial cavity. The alimentary canal as a whole is to the right of the middle line. The hermaphrodite reproductive organs are to the left of the middle line alongside the alimentary canal. They open into the peribranchial cavity. The ovary is nearly spherical, while the testis is elongated, and may be continued anteriorly for a long distance. The heart is placed in the middle line ventrally, between the posterior end of the endostyle and the œsophageal aperture. The nerve ganglion lies about the middle of the dorsal edge of the body, and gives off many nerves. Under it is placed the subneural gland, the duct of which runs forward and opens into the anterior end of the branchial sac by a simple aperture, surrounded by the spirally twisted dorsal end of the peripharyngeal band (fig. 13, *dl*).

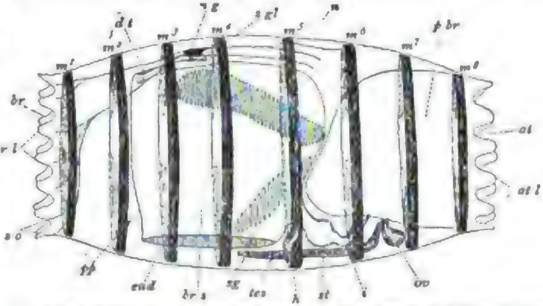

FIG. 13.—*Doliolum denticulatum*, sexual generation, from the left side. Lettering as for fig. 12; m^1—m^8, muscle bands; *ng*, nerve ganglion; *sg*, stigmata; *sgl*, subneural gland; *pbr*, peribranchial cavity; *atl*, atrial lobes; *so*, sense organs; *brl*, branchial lobes. (Original.)

Development of *Doliolum*.

The ova of the sexual generation produce tailed larvæ; these develop into forms known as "nurses" (blastozooids), which are asexual, and are characterized by the possession of nine muscle bands, an auditory sac on the left side of the body, a ventrally-placed stolon near the heart, upon which buds are produced, and a dorsal outgrowth near the posterior end of the body. The buds give rise eventually to the sexual generation, which is polymorphous, having three distinct forms, in two of which the reproductive organs remain undeveloped. The buds while still very young migrate from their place of origin on the stolon, divide by fission, and become attached to the dorsal outgrowth of the body of the nurse, where they develop. The three forms produced are as follows. (1) Nutritive forms (trophozooids), which remain permanently attached to the nurse and serve to provide it with food; they have the body elongated dorso-ventrally, and the musculature is very slightly developed. (2) Foster forms (phorozooids), which, like the preceding, do not become sexually mature, but, unlike them, are set free as cask-shaped bodies with eight muscle bands and a ventral outgrowth, which is formed of the stalk by which the body was formerly united to the nurse. On this outgrowth the (3) forms (gonozooids) which become sexually mature are attached while still young buds, and after the foster forms are set free these reproductive forms gradually attain their complete development, and are eventually set free and lose all trace of their connexion with the foster forms. They resemble the foster forms in having a cask-shaped body with eight muscle bands, but differ in having no outgrowth or process, and in having the reproductive organs fully developed.[1]

Anchinia.

Anchinia, of which only one species is known, *A. rubra*, from the Mediterranean, has the sexual forms permanently attached to portions of the dorsal outgrowth from the body of the unknown nurse. The body is elongated dorso-ventrally. The test is well developed and contains branched cells. The musculature is not so well developed as in *Doliolum*. There are two circular bands at the anterior end and two at the posterior, and two on the middle of the body. The stigmata are confined to the obliquely placed posterior end of the branchial sac. The alimentary canal forms a U-shaped curve. The reproductive organs are placed on the right side of the body. The life-history is still imperfectly known. As in the case of *Doliolum* the sexual generation is polymorphous, and has three forms, two of which remain in a rudimentary condition so far as the reproductive organs are concerned. In *Anchinia*, however, the three forms do not occur together on one stolon or outgrowth, but are produced successively, the reproductive forms of the sexual generation being independent of the "foster forms" (see Barrois, *27*).

Sub-order 2.—**Hemimyaria.**

Characters of *Hemimyaria*.

Free-swimming pelagic forms which exhibit alternation of generations in their life-history and in the sexual condition form colonies. The body is more or less fusiform, with the long axis antero-posterior, and the branchial and atrial apertures nearly terminal. The test is well developed. The musculature of the mantle is in the form of a series of transversely-running bands, which do not form complete independent rings as in the *Cyclomyaria*. The branchial and peribranchial cavities form a continuous space in the interior of the body, opening externally by the branchial and atrial apertures, and traversed obliquely from the dorsal and anterior end to the ventral and posterior by a long narrow vascular band, which represents the dorsal lamina, the dorsal blood-vessel, and the neighbouring part of the dorsal edge of the branchial sac of an ordinary Ascidian. The alimentary canal is placed ventrally. It may either be stretched out so as to extend for some distance anteriorly, or—as is more usual—be concentrated to form along with the reproductive organs a rounded opaque mass near the posterior end of the body, known as the visceral mass or "nucleus." The embryonic development is direct, no tailed larva being formed.

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[1] For further details see Uljanin (*15*).

This sub-order contains two very distinct families, the SALPIDÆ, which are the typical members, and the OCTACNEMIDÆ, including a single very remarkable form (*Octacnemus bythius*), which in some respects does not conform with the characters given above.

Salpidæ. The *Salpidæ* includes the single genus *Salpa* (Forskål), which, however, may be divided into two well-marked groups of species,—(1) those, such as *S. pinnata*, in which the alimentary canal is stretched out along the ventral surface of the body, and (2) those, such as *S. fusiformis* (fig. 14, A), in which the alimentary canal forms a compact globular mass, the "nucleus," near the posterior end of the body. About fifteen species altogether are known; they are all pelagic forms and are found in nearly all seas. Each species occurs in two forms—the solitary asexual (*proles solitaria*) and the aggregated sexual (*proles gregaria*)—which are usually quite unlike one another. The solitary form (fig. 14, B) gives rise by internal gemmation to a complex tubular stolon, which contains processes from all the more important organs of the parent body and which becomes segmented into a series of buds or embryos. As the stolon elongates, the embryos near the free end which have become advanced in their development are set free in groups, which remain attached together by processes of the test, each enclosing a diverticulum from the mantle so as to form "chains" (fig. 15). Each member of the chain is a *Salpa* of the sexual or aggregated form, and when mature may—either still attached to its neighbours or separated from them (fig. 14, A)—produce one or several embryos, which develop into the solitary *Salpa*. Thus the two forms alternate regularly. The more important points in the structure of a typical *Salpa* are shown in fig. 16. The branchial and atrial apertures are at opposite ends of the body, and each leads into a large cavity, the branchial and peribranchial sacs, which are in free communication at the sides of the obliquely-running dorsal lamina or "gill." The test is well developed and adheres closely to the surface of the mantle. The muscle bands of the mantle do not completely encircle the body. They are present dorsally and laterally, but the majority do not reach the ventral surface. In many cases neighbouring bands join in the median dorsal line, (fig. 14). The anterior end of the dorsal lamina is prolonged to form a prominent tentacular organ, the languet, projecting into the branchial sac. The nerve ganglion, subneural gland, dorsal lamina, peripharyngeal bands, and endostyle are placed in the usual positions. A pigment spot and an otocyst are found in connection with the ganglion. The large spaces at the sides of the dorsal lamina (often called the gill or branchia of *Salpa*), by means of which the cavity of the branchial sac is placed in free communication with the peribranchial cavity, are to be regarded as gigantic stigmata formed by the suppression of the lateral walls of the branchial sac. Fig. 16 represents an aggregated or sexual *Salpa* which was once a member of a chain, since it shows a testis and a developing embryo. The ova (always few in number, usually only one) appear at a very early period in the developing chain *Salpa*, while it is still a part of the gemmiparous stolon in the body of the solitary *Salpa*. This gave rise to the view put forward by Brooks (*25*), that the ovary really belongs to the solitary *Salpa*, which is therefore a female producing a series of males by asexual gemmation, and depositing in each of these an ovum, which will afterwards, when fertilized, develop in the body of the male into a solitary or female *Salpa*. This idea would of course entirely destroy the view that *Salpa* is an example of alternation of generations. The sexual or chain *Salpa*, although really hermaphrodite, is always protogynous: *i.e.*, the female elements or ova are produced at an earlier period than the male organ or testis. This prevents self-fertilization. The ovum is fertilized by the spermatozoa of an older *Salpa* belonging to another chain, and the embryo is far advanced in its development before the testis is formed. At an early period in its development a part of the embryo becomes separated off, along with a part of the wall of the cavity in which it lies, to form the "placenta," in which the embryonic and the maternal blood streams circulate in close proximity (or actually coalesce during one period) and so allow of the passage of nutriment to the developing embryo. At a somewhat later stage a number of cells placed at the posterior end of the body alongside the future nucleus become filled up with oil-globules to form a mass of nutrient material—the elæoblast—which is used up later on in the development. Many suggestions have been made as to the homology of the elæoblast. The most probable is that it is the disappearing rudiment of the tail found in the larval condition of most Ascidians.

Structure of *Salpa*

Development of *Salpa*.

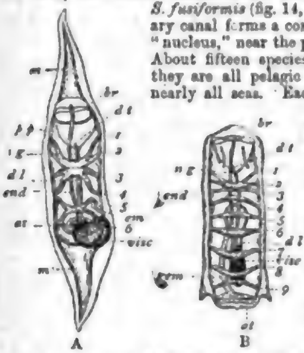


FIG. 14.—*Salpa runcinata-fusiformis*. A. Aggregated form. B. Solitary form. Lettering as before; 1-9, muscle bands; *em*, embryo; *gem*, gemmiparous stolon; *m*, mantle; *visc*, visceral mass (nucleus). (Original.)

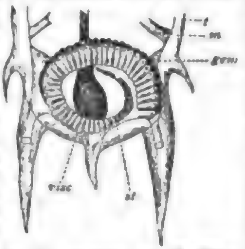


FIG. 15.—Posterior part of solitary form of *Salpa democratica-mucronata*, showing a chain of embryos nearly ready to be set free. *gem*, young aggregated *Salpæ* forming the chain; *st*, stolon; *m*, muscle band of the mantle. (Original.)

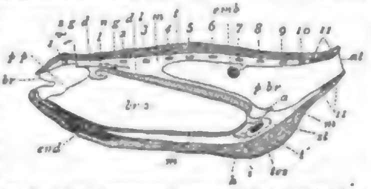


FIG. 16.—Semi-diagrammatic representation of *Salpa* from left side. Lettering as before; *emb*, embryo; *m*, mantle; *l*, languet; *sgd*, duct of subneural gland; 1-11, muscle bands of mantle; *t*, thickening of test over nucleus; *dl*, gill or branchia. (Original.)

Octacnemidæ. The family *Octacnemidæ* includes the single remarkable form *Octacnemus bythius*, found during the "Challenger" expedition, and first described by Moseley (*29*). It is apparently a deep-sea representative of the pelagic *Salpidæ*, and may possibly be fixed. The body is somewhat discoid, with its margin prolonged to form eight tapering processes, on to which the muscle bands of the mantle are continued. The alimentary canal forms a compact nucleus (fig. 17); the endostyle is very short; and the dorsal lamina is apparently absent. The reproduction and life-history are entirely unknown.

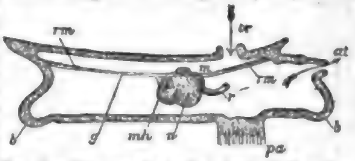


FIG. 17.—Diagrammatic vertical longitudinal section of *Octacnemus bythius* (after Moseley). *br*, branchial aperture; *m*, opening of œsophagus; *r*, rectum; *at*, atrial aperture; *rm*, *rm*, radiating muscles; *n*, nucleus; *mh*, muscles of nucleus; *g*, respiratory membrane; *b*, thickened margin of base of test; *pa*, pedicle of attachment.

Order III.—ASCIDIACEA.

Ascidiacea. Fixed or free-swimming Simple or Compound Ascidians which in the adult are never provided with a tail and have no trace of a notochord. The free-swimming forms are colonies, the Simple Ascidians being always fixed. The test is permanent and well developed; as a rule it increases with the age of the individual. The branchial sac is large and well developed. Its walls are perforated by numerous slits (stigmata) opening into the peribranchial cavity, which communicates with the exterior by the atrial aperture. Many of the forms reproduce by gemmation, and in most of them the sexually-produced embryo develops into a tailed larva.

The *Ascidiacea* includes three groups,—the Simple Ascidians, the Compound Ascidians, and the free-swimming colonial *Pyrosoma*.

Sub-order 1.—Ascidiæ Simplices.

Simple Ascidians. Fixed Ascidians which are solitary and very rarely reproduce by gemmation; if colonies are formed, the members are not buried in a common investing mass, but each has a distinct test of its own. No strict line of demarcation can be drawn between the Simple and the Compound Ascidians, and one of the families of the former group, the *Clavelinidæ* (the Social Ascidians), forms a transition from the typical Simple forms, which never reproduce by gemmation, to the Compound forms, which always do (see p. 618 below). The *Ascidiæ Simplices* may be divided into the following families:—

Family I.—CLAVELINIDÆ. Simple Ascidians which reproduce by gemmation to form small colonies in which each ascidiozooid has a distinct test, but all are connected by a common blood-system.

Buds formed on stolons which are vascular outgrowths from the posterior end of the body, containing prolongations from the ectoderm, mesoderm, and endoderm of the ascidiozooid. Branchial sac not folded; internal longitudinal bars usually absent; stigmata straight; tentacles simple. This family contains three genera: *Ecteinascidia* (Herdman), with internal longitudinal bars in branchial sac; *Clavelina* (Savigny), with intestine extending behind branchial sac; and *Perophora* (Wiegmann), with intestine alongside branchial sac.

Family II.—ASCIDIIDÆ. Solitary fixed Ascidians with gelatinous test; branchial aperture usually eight-lobed, atrial aperture usually six-lobed. Branchial sac not folded; internal longitudinal bars usually present; stigmata straight or curved; tentacles simple. This family is divided into three sections:—

Sub-family 1.—HYPOBYTHINÆ. Branchial sac with no internal longitudinal bars. One genus, *Hypobythius* (Moseley).

Sub-family 2.—ASCIDINÆ. Stigmata straight. Many genera, of which the following are the more important:—*Ciona* (Fleming), dorsal languets present; *Ascidia* (Linnæus, = *Phallusia*, Savigny), dorsal lamina present (see figs. 1 to 10); *Rhodosoma* (Ehrenberg), anterior part of test modified to form operculum; *Abyssascidia* (Herdman), intestine on right side of branchial sac.

Sub-family 3.—CORELLINÆ. Stigmata curved. Three genera:—*Corella* (Alder and Hancock), test gelatinous, body sessile; *Corynascidia* (Herdman), test gelatinous, body pedunculated; *Chelyosoma* (Brod. and Sow.), test modified into horny plates.

Family III.—CYNTHIIDÆ. Solitary fixed Ascidians, usually with leathery test; branchial and atrial apertures usually both four-lobed. Branchial sac longitudinally folded; stigmata straight; tentacles simple or compound. This family is divided into three sections:—

Sub-family 1.—STYELINÆ, not more than four folds on each side of branchial sac; tentacles simple. The more important genera are —*Styela* (Macleay), stigmata normal, and *Bathyoncus* (Herdman), stigmata absent or modified.

Sub-family 2.—CYNTHINÆ, more than eight folds in branchial sac; tentacles compound; body sessile. The chief genus is *Cynthia* (Savigny), with a large number of species.

Sub-family 3.—BOLTENINÆ, more than eight folds in branchial sac; tentacles compound; body pedunculated (fig. 18, A). The chief genera are—*Boltenia* (Savigny), branchial aperture four-lobed, stigmata normal; and *Culeolus* (Herdman), branchial aperture with less than four lobes, stigmata absent or modified (fig. 18, B). This last is a deep-sea genus discovered by the "Challenger" expedition (see *17*).

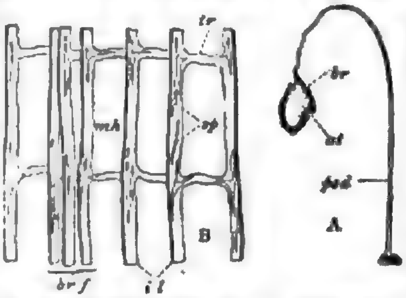


FIG. 18.—*Culeolus willemoesi*. A. Entire body, natural size. B. Part of branchial sac magnified. *at*, atrial aperture; *br*, branchial aperture; *ped*, peduncle; *br f*, slight fold of branchial sac; *i l*, internal longitudinal bar; *mh*, mesh; *sp*, calcareous spicules in vessels; *tr*, transverse vessels. (After Herdman, Challenger *Report*.)

Family IV.—MOLGULIDÆ. Solitary Ascidians, sometimes not fixed; branchial aperture six-lobed, atrial four-lobed. Test usually incrusted with sand. Branchial sac longitudinally folded; stigmata more or less curved, usually arranged in spirals; tentacles compound. The chief genera are—*Molgula* (Forbes), with distinct folds in the branchial sac, and *Eugyra* (Ald. and Hanc.), with no distinct folds, but merely broad internal longitudinal bars in the branchial sac. In some of the *Molgulidæ* (genus *Anurella*, Lacaze-Duthiers, *20*) the embryo does not become converted into a tailed larva, the development being direct, without metamorphosis. The embryo when hatched assumes gradually the adult structure, and never shows the features characteristic of larval Ascidians, such as the urochord and the median sense-organs.

Sub-order 2.—Ascidiæ Compositæ.

Compound Ascidians.

Fixed Ascidians which reproduce by gemmation, so as to form colonies in which the ascidiozooids are buried in a common investing mass and have no separate tests. This is probably a somewhat artificial assemblage formed of two or three groups of Ascidians which produce colonies in which the ascidiozooids are so intimately united that they possess a common test or investing mass. This is the only character which distinguishes them from the *Clavelinidæ*, but the property of reproducing by gemmation separates them from the rest of the *Ascidiæ Simplices*. The *Ascidiæ Compositæ* may be divided into the following families:—

Family I.—DISTOMIDÆ. Ascidiozooids divided into two regions, thorax and abdomen; testes numerous; vas deferens not spirally coiled. The chief genera are—*Distoma* (Gaertner); *Distaplia* (Della Valle); *Colella* (Herdman), forming a pedunculated colony (see fig. 19, A) in which the ascidiozooids develop incubatory pouches, connected with the peribranchial cavity, in which the embryos undergo their development (*17*); and *Chondrostachys* (Macdonald).

Family II.—CŒLOCORMIDÆ. Colony not fixed, having a large axial cavity with a terminal aperture. Branchial apertures five-lobed. This includes one species, *Cœlocormus huxleyi* (Herdman), which is a transition form between the ordinary Compound Ascidians (*e.g.*, *Distomidæ*) and the *Ascidiæ Salpiformes* (*Pyrosoma*).

Family III.—DIDEMNIDÆ. Colony usually thin and incrusting. Test containing stellate calcareous spicules. Testis single, large; vas deferens spirally coiled. The chief genera are—*Didemnum* (Savigny), in which the colony is thick and fleshy and there are only three rows of stigmata on each side of the branchial sac; and *Leptoclinum* (Milne-Edwards), in which the colony is thin and incrusting (fig. 19, B) and there are four rows of stigmata on each side of the branchial sac.

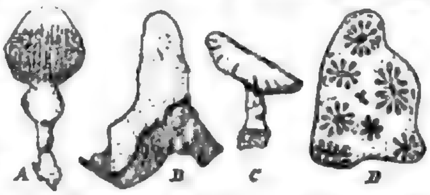


FIG. 19.—Colonies of *Ascidiæ Compositæ* (natural size). A. *Colella quoyi*. B. *Leptoclinum neglectum*. C. *Pharyngodictyon mirabile*. D. *Botryllus*, showing arrangement of ascidiozooids in circular systems each of which has a central common cloaca. (After Herdman, Challenger *Report*.)

Family IV.—DIPLOSOMIDÆ. Test reduced in amount, rarely containing spicules. Vas deferens not spirally coiled. In *Diplosoma* (Macdonald), the most important genus, the larva is gemmiparous.

Family V.—POLYCLINIDÆ. Ascidiozooids divided into three regions,—thorax, abdomen, and post-abdomen. Testes numerous; vas deferens not spirally coiled. The chief genera are—*Pharyngodictyon* (Herdman), with stigmata absent or modified, containing one species, *Ph. mirabile* (fig. 19, C), the only Compound Ascidian known from a depth of 1000 fathoms; *Polyclinum* (Savigny), with a smooth-walled stomach; *Aplidium* (Savigny), with the stomach wall longitudinally folded; and *Amaroucium* (Milne-Edwards), in which the ascidiozooid has a long post-abdomen and a large atrial languet.

Family VI.—BOTRYLLIDÆ. Ascidiozooids having the intestine and reproductive organs alongside the branchial sac. Dorsal lamina present; internal longitudinal bars present in branchial sac. The chief genera are—*Botryllus* (Gaertn. and Pall.), with simple stellate systems (fig. 19, D), and *Botrylloides* (Milne-Edwards), with elongated or ramified systems.

Family VII.—POLYSTYELIDÆ. Ascidiozooids not grouped in systems. Branchial and atrial apertures four-lobed. Branchial sac may be folded; internal longitudinal bars present. The chief genera are—*Thylacium* (Carus), with ascidiozooids projecting above general surface of colony; *Goodsiria* (Cunningham), with ascidiozooids completely imbedded in investing mass; and *Chorizocormus* (Herdman), with ascidiozooids united in little groups which are connected by stolons. The last genus contains one species, *Ch. reticulatus*, a transition form between the other *Polystyelidæ* and the *Styelinæ* amongst Simple Ascidians.

Reproduction by gemmation

The methods of reproduction by gemmation differ in their details in the various groups of Compound Ascidians; but in all cases the process is essentially a giving off from the parent body of groups of cells representing the ectoderm, the mesoderm, and the endoderm, which develop into the corresponding layers of the bud. The first ascidiozooid of the colony produced by the tailed larva does not form sexual reproductive organs, but reproduces by gemmation so as to make a colony. Thus there is alternation of generations in the life-history. In the most completely formed colonies (*e.g.*, *Botryllus*) the ascidiozooids are arranged in groups (systems or cœnobii), and in each system are placed with their atrial apertures towards one another, and all communicating with a common cloacal cavity which opens to the exterior in the centre of the system (fig. 19 D).

Sub-order 3.—Ascidiæ Salpiformes.

Ascidiæ Salpiformes.

Free-swimming pelagic colonies having the form of a hollow cylinder closed at one end. The ascidiozooids forming the colony are imbedded in the common test in such a manner that the branchial apertures open on the outer surface and the atrial apertures on the inner surface next to the central cavity of the colony. The ascidiozooids are produced by gemmation from a rudimentary larva (the cyathozooid) developed sexually.

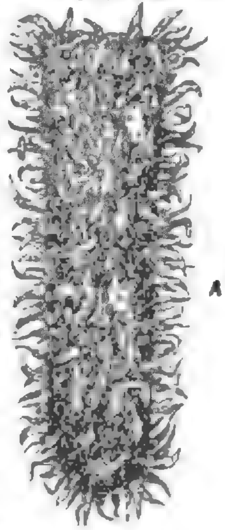


FIG. 20.—*Pyrosoma elegans*, natural size. A. Side view of entire colony. B. End view of open extremity. (Original.)

Structure of *Pyrosoma.*

This sub-order includes a single family, the PYROSOMIDÆ, containing one well-marked genus, *Pyrosoma* (Péron), with several species. They are found swimming near the surface of the sea, chiefly in tropical latitudes, and are brilliantly phosphorescent. A fully developed *Pyrosoma* colony may be from an inch or two to upwards of four feet in length. The shape of the colony is seen in fig. 20. It tapers slightly towards the closed end, which is rounded. The opening at the opposite end is reduced in size by the presence of a membranous prolongation of the common test (fig. 20, B). The branchial apertures of the ascidiozooids are placed upon short papillæ projecting from the general surface, and most of the ascidiozooids have long conical processes of the test projecting outwards beyond their branchial apertures (figs. 20, 21, and 22). There is only a single layer of ascidiozooids in the *Pyrosoma* colony, as all the fully developed ascidiozooids are placed with their antero-posterior axes at right angles to the surface and communicate by their atrial apertures with the central cavity of the colony (fig. 21). Their dorsal surfaces are turned towards the open end of the colony. The more important points in the structure of the ascidiozooid of *Pyrosoma* are shown in fig. 22. A circle of tentacles, of which one, placed ventrally (fig. 22, *tn*), is larger than the rest, is found just inside the branchial aperture. From this point a wide cavity, with a few circularly-placed muscle bands running round its walls, leads back to the large branchial sac, which occupies the greater part of the body. The stigmata are elongated transversely and crossed by internal longitudinal bars. The dorsal lamina is represented by a series of eight languets (*l*). The nerve ganglion (on which is placed a small pigmented sense organ), the subneural gland, the dorsal tubercle, the peripharyngeal bands, and the endostyle are placed in the usual positions. On each side of the anterior end of the branchial sac, close to the peripharyngeal bands, is a mass of rounded gland cells which are the source of the phosphorescence. The alimentary canal is placed posteriorly to the branchial sac, and the anus opens into a large peribranchial (or atrial) cavity, of which only the median posterior part is shown (*pbr*) in fig. 22. The reproductive organs are developed in a diverticulum of the peribranchial cavity, and consist of a lobed testis and a single ovum at a time.

Development of *Pyrosoma.*

The development takes place in a part of the peribranchial cavity (fig. 21, *em*). The segmentation is meroblastic, and an elongated embryo is formed on the surface of a mass of yolk. The embryo, after the formation of an alimentary cavity, a tubular nervous system, and a pair of laterally placed atrial tubes, divides into an anterior and a posterior part. The anterior part then segments into four pieces, which afterwards develop into the first ascidiozooids of the colony, while the posterior part remains in a rudimentary condition, and was called by Huxley the "cyathozooid"; it eventually atrophies. As the four ascidiozooids increase in size, they grow round the cyathozooid and soon encircle it (fig. 21, *asc* and *cy*). The cyathozooid absorbs the nourishing yolk upon which it lies, and distributes it to the ascidiozooids by means of a heart and system of vessels which have been meanwhile formed. When the cyathozooid atrophies and is absorbed, its original atrial aperture remains and deepens to become the central cavity of the young colony, which now consists of four ascidiozooids placed in a ring, around where the cyathozooid was, and enveloped in a common test. The colony gradually increases by the formation of buds from these four original ascidiozooids.

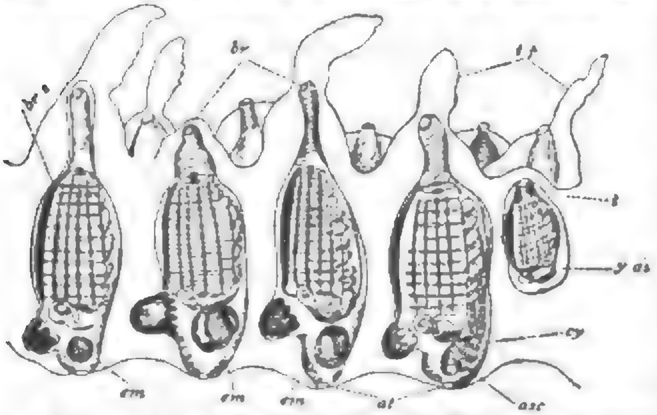


FIG. 21.—Part of a longitudinal section through wall of *Pyrosoma*, showing arrangement of ascidiozooids, magnified (partly after Savigny). *at*, atrial apertures; *br*, branchial apertures; *asc*, young ascidiozooid of a future colony produced by budding from *cy*, cyathozooid; *em*, embryos in various stages; *t*, test; *tp*, processes of test; *brs*, branchial sac; *yas*, young ascidiozooid.

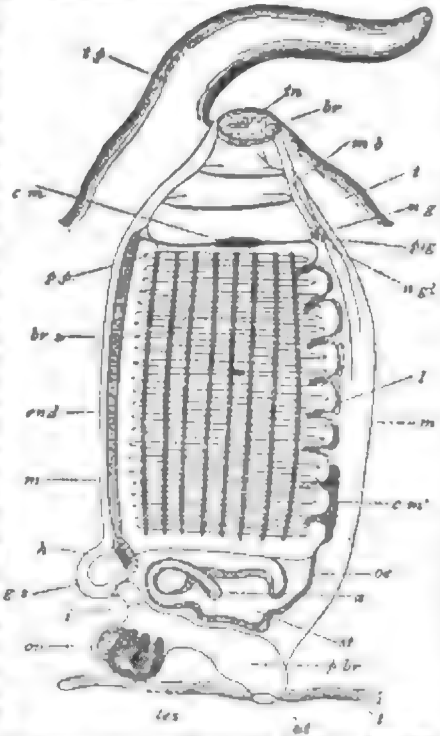
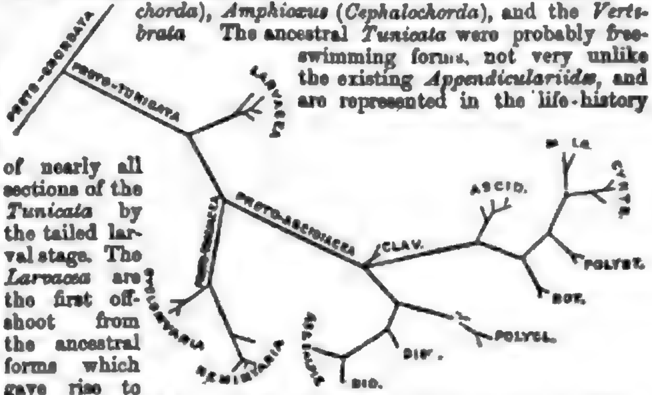


FIG. 22.—Mature ascidiozooid of *Pyrosoma*, from left side (partly after Keferstein). Lettering as before; *cm*, cellular mass, the seat of phosphorescence; *cm'*, posterior cellular mass; *gs*, gemmiparous stolon; *mb*, muscle band; *ngl*, subneural gland; *pig*, pigment spot on ganglion; *tp*, process of test.

PHYLOGENY.

Phylogeny.

The accompanying diagram shows graphically the probable origin and course of evolution of the various groups of *Tunicata*, and therefore exhibits their relations to one another much more correctly than any system of linear classification can do. The ancestral *Proto-Tunicata* are here regarded[1] as an offshoot from the *Proto-Chordata*—the common ancestors of the *Tunicata* (*Urochorda*), *Amphioxus* (*Cephalochorda*), and the *Vertebrata*. The ancestral *Tunicata* were probably free-swimming forms, not very unlike the existing *Appendiculariidæ*, and are represented in the life-history of nearly all sections of the *Tunicata* by the tailed larval stage. The *Larvacea* are the first offshoot from the ancestral forms which gave rise to the two lines of descendants, the *Proto-Thaliacea* and the *Proto-Ascidiacea*. The *Proto-Thaliacea* then split into the ancestors of the existing *Cyclomyaria* and *Hemimyaria*. The *Proto-Ascidiacea* gave up their pelagic mode of life and became fixed. This ancestral process is repeated at the present day when the free-swimming larva of the Simple and Compound Ascidians becomes attached. The *Proto-Ascidiacea*, after the change, are probably most nearly represented by the existing genus *Clavelina*. They have given rise directly or indirectly to the various groups of Simple and Compound Ascidians and the *Pyrosomidæ*. These groups form two lines, which appear to have diverged close to the position of the family *Clavelinidæ*. The one line leads to the more typical Compound Ascidians, and includes the *Polyclinidæ*, *Distomidæ*, *Didemnidæ*, *Diplosomidæ*, *Cœlocormidæ*, and finally the *Ascidiæ Salpiformes*. The second line gave rise to the Simple Ascidians, and to the *Botryllidæ* and *Polystyelidæ*, which are, therefore, not closely allied to the other Compound Ascidians. The later *Proto-Ascidiacea* were probably colonial forms, and gemmation was retained by the *Clavelinidæ* and by the typical Compound Ascidians (*Distomidæ*, &c.) derived from them. The power of forming colonies by budding was lost, however, by the primitive Simple Ascidians, and must, therefore, have been regained independently by the ancestral forms of the *Botryllidæ* and the *Polystyelidæ*. If this is a correct interpretation of the course of evolution of the *Tunicata*, we arrive at the following important conclusions. (1) The *Tunicata*, as a whole, form a degenerate branch of the *Proto-Chordata*; (2) the *Ascidiæ Salpiformes* (*Pyrosoma*) are much more closely related to the typical Compound Ascidians than to the other pelagic *Tunicata*, viz., the *Larvacea* and the *Thaliacea*; and (3) the *Ascidiæ Compositæ* form a polyphyletic group, the sections of which have arisen at several distinct points from the ancestral Simple Ascidians.



Bibliography.—(*1*) Cuvier, "Mém. s. les Ascidies," &c., in *Mém. d. Mus.*, vol. ii. p. 10, Paris, 1815; (*2*) Savigny, *Mémoires sur les Animaux sans Vertèbres*, pt. ii. fasc. 1., Paris, 1816; (*3*) Lamarck, *Hist. Nat. d. Anim. sans Vertèbres*, 1st ed., Paris, 1815-22; (*4*) O. F. Muller, *Zool. Danica*, vol. iv., 1806; (*5*) Milne-Edwards, "Observ. s. les Ascidies Composées," &c., in *Mém. Acad. Sci.*, Paris, vol. xviii., 1842; (*6*) Schmidt, *Zur vergl. Physiol. d. wirbellos. Thiere*, Bruns-

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[1] By Dohrn and others their point of origin is placed considerably further up on the stem of the *Chordata*, thus causing the *Tunicata* to be regarded as very degenerate *Vertebrata* (see 32).

wick, 1845; (7) Löwig and Kölliker, "De la Compos., &c., d. Envel. d. *Tun.*, in *Ann. Sc. Nat.*, ser. iii. (Zool.), vol. v., 1846; (8) Huxley, *Phil. Trans.*, 1851; (9) Kowalevsky, "Entwickel. d. einf. Ascid.," in *Mem. St Petersb. Acad. Sc.*, ser. vii., vol. x., 1866; (10) J. P. van Beneden, "Rech. s. l'Embryolog., &c., d. Asc. Simp.," in *Mém. Acad. Roy. Bel.*, vol. xx., 1847; (11) Krohn, in Wiegmann and Müller's *Archiv*, 1852; (12) Kupffer, *Arch. f. mikr. Anat.*, 1869, 1872; (13) Giard, "Étude d. trav. Embryolog. d. *Tun.*, &c.," in *Arch. Zool. Expér.*, vol. i., 1872; (14) Fol, "Études sur les Appendiculaires du Détroit de Messine," in *Mém. Soc. Phys. Hist. Nat. Genève*, vol. xxi.; (15) Giard, "Recherches s. l. Asc. Comp.," in *Arch. Zool. Expér.*, vol. i., 1872; (16) Von Drasche, *Die Synascidien der Bucht von Rovigno*, Vienna, 1883; (17) Herdman, "Report upon the *Tunicata* of the Challenger Expedition," pt. i. in *Zool. Chall. Exp.*, vol. vi., 1882; pt. ii. in *Zool. Chall. Exp.*, vol. xiv., 1886; pt. iii., not yet published; (18) Alder and Hancock, in *Ann. Mag. Nat. Hist.*, 1863, 1870; (19) Heller, "Untersuch. u. d. Tunic. d. Adriat. Meeres," in *Denkschr. d. k. Akad. Wiss.*, 1875-77; (20) Lacaze-Duthiers, "Asc. Simp. d. Côtes d. l. Manche," in *Arch. Zool. Expér.*, 1874, 1877; (21) Traustedt, in *Vidensk. Medd. Naturh. For.*, Copenhagen, 1881-84; (22) Herdman, "Notes on British *Tunicata*, &c.," in *Journ. Linn. Soc.*, *Zool.*, vol. xv., 1880; (23) Ussoff, in *Proc. Imp. Soc. Nat. Hist.*, Moscow, vol. xviii., 1876; (24) Julin, "Rech. s. l'Org. d. Asc. Simp.," in *Arch. d. Biol.*, vol. ii., 1881; (25) Brooks, "Development of *Salpa*," in *Bull. Mus. Comp. Zool.*, Harvard, vol. iii. p. 291; (26) Salensky, *Ztschr. f. wiss. Zool.*, 1877; (27) Barrois, *Journ. d. l'Anat. et Phys.*, vol. xxi., 1885; (28) Uljanin, *Fauna*, &c., *d. Golfes von Neapel*, vol. x., 1884; (29) Moseley, "On Deep-Sea Ascid.," in *Trans. Linn. Soc.*, ser. ii., vol. i., 1876; (30) E. van Beneden and Julin, "Morph. d. Tuniciers," in *Arch. d. Biol.*, vol. vi., 1886; (31) Lankester, *Degeneration* (Nature series), London, 1880; (32) Dohrn, "Stud. z. Urgesch. d. Wirbelth.," in *Mitth. Zool. Stat. Neapel*. (W. A. HE.)

TUNING FORK, a small bar of cast tool steel with tolerably defined edges, bent into a fork with two prongs. A handle of the same metal extending from the bend of the fork serves as a sound-post to transmit the vibrations of the fork to any resonance board or body convenient for reinforcing the sound. The fork is set in vibration by striking one of the prongs against any hard substance, by pressing the prongs together if the fork is a light one, or, if it is large, by drawing a double bass bow across one of the prongs. The larger forks are sometimes made with a worm upon the handle in order that they may be screwed into a resonance box, the dimensions of which should agree with the pitch of the fork. The ordinary use of a tuning fork is to serve as a pitch carrier or standard, for which it is particularly suited owing to the permanence with which it maintains the pitch to which it may be tuned. It is flattened by heat and sharpened by cold about 1 vibration in 20,000 for every degree Fahr., so that the exact pitch always depends upon the temperature. A tuning fork is tuned by filing the ends of the prongs or between them near the ends to make it sharper, or by filing between them near or at the bend to make it flatter. Less filing is required to flatten than to sharpen. It should be allowed to rest after tuning, on account of the disturbance of the molecular structure by the filing, and after a few days should be compared again with the pitch required, and corrected. The tuning fork is also of value in certain physical investigations, from the constancy of its rate of vibration. In England it is generally tuned to C in the treble clef, because organ-builders start their tuning from that note; in France it is tuned to A in the treble clef, which is the note of the third open string of the violin. The French diapason normal is tuned to A at 15° C. (= 59° Fahr.) and is fixed at 435 double vibrations in a second. The inventor of the tuning fork was John Shore, royal trumpeter in 1711, sergeant trumpeter at the entry of George I. in 1714, and lutanist to the chapel royal in 1715.

According to Chladni, whose analysis of the tuning fork has been generally accepted, it has two nodes or points of least vibration at the bend, with a ventral or vibrating loop between, by which its vibrations are transmitted to the handle. That this is not the case has been shown by Mr W. F. Stanley.[1] The fundamental note appears to be an octave below the note which the ear recognizes as the pitch of the fork. Helmholtz, Tyndall, and others accept the latter as the fundamental, and Helmholtz expressly says that each prong may be regarded as an elastic rod fixed at one end.[2] The fork is really a bent elastic rod vibrating at both ends, with a node at the bend, through which, and in the same way as with the bridge of any stringed instrument, the vibrations are conducted. As well as the second partial, the third and fourth are in large forks frequently distinguishable, but such partials above the octave are very weak. In addition to the lower harmonic partials it is generally easy to produce with a blow a very high inharmonic tinkle or ringing metallic note, that will continue to sound for some time without blending with the true note of the fork. The precise interval varies, but is usually two octaves and between a flat fifth and a major sixth above the recognized pitch of the fork. With ordinary tuning forks this tinkling note is to be found amongst the highest treble notes of the pianoforte. Theorists give other inharmonic proper tones in due ascending order; they are derived from calculation on the assumption that they proceed as the squares of the odd numbers, but are beyond practical verification owing to their extreme position in the scale of musical sounds and the variation of power in different ears to distinguish them.

The tuning fork was used by Scheibler (1777-1837) as the easiest means for correctly determining the pitch numbers of vibrations. To make a Scheibler tonometer, take a fork in which the octave can be easily heard and intercalate as many forks as, giving countable beats with each other, will fill up the octave. The addition of the whole number of beats and their fractions in the octave will be the vibrating number, in double vibrations per second, of the lower fork. In order to measure the fractions of vibrations accurately forks should be chosen that are audible for 40, or at least 20 seconds. For instance, 60 beats counted in 20 seconds would be 3 a second, and 65 in the same time 3·25. The forks should remain for three months after filing before their differences are finally determined, and the whole examination should be conducted in a known, uniform temperature. Scheibler considered four beats a second between two forks a good number for counting; but Mr A. J. Ellis, who has used Scheibler's invention as a basis for an exhaustive historical statement of musical pitch[3] and as the novel and exact means for determining the non-harmonic musical scales of various nations, especially Eastern nations,[4] considers three beats a second the best counting number. This would increase the number of intermediate forks.

Attempts have been made to use tuning forks instead of strings for key-board instruments, the object being to obtain permanence of tuning with the soft, unexciting quality of tone furnished by the fork. The inventions of Clagget, London, 1788, of Riffelsen (the melodikon), Copenhagen, 1803, and of Schuster (the adiaphonon), Vienna, 1819, were of this nature. The latest adaptation of a keyboard to tuning forks has been effected by Mr Machell of Glasgow; it was shown at the Inventions Exhibition, South Kensington, London, 1885.

Plate V.

TUNIS, REGENCY OF, formerly one of the Barbary states of north Africa, but since 1881 a dependency of France, whose resident-general exercises all real authority in the nominal dominions of the bey. Is bounded on the west by Algeria, on the north by the western basin of the Mediterranean, on the east from Cape Bon to the Gulf of Gabes (Kábis) by the eastern basin of the same sea, and on the south-east by the province of Tripoli. On the south the boundary is the Sahara and the frontier line is indefinite. The greatest breadth from east to west is about 150 miles, the length from north to south about 300 miles. The population does not exceed a million and a half.

Physical Features.—Tunis is formed by the prolongation towards the east of the two great mountain chains of ALGERIA (*q.v.*), and closely resembles that country in its physical features, products, and climate; see AFRICA, vol. i. p. 265. The northern Algerian chain (the Little Atlas) is prolonged through Tunis to Rás Sídi 'Alí al-Makkí, the highest summits never attaining an altitude of 4000 feet. It forms a picturesque, fertile, and well-watered region, with extensive cork woods in its western parts, and separated from the southern mountains by the valley (the ancient Zeugitana) of the Mejerda (the ancient Bagradas), the most important river of north Africa, which after a tortuous course of nearly 300 miles falls into the Gulf of Tunis at Porto Farina. The basin of the Mejerda, which is now traversed by the railway from Algiers to Tunis, is very fertile, and many important ruins testify to its prosperity in Roman times. The rich lacustrine deposits in the Dákhila, or plain of Bulla Regia, show that it was only in relatively recent times that its upper waters found a passage to the sea by cutting a deep gorge through the cretaceous barrier that shuts in this upland plain upon the east. The southern wall of the Mejerda valley and of the Gulf of Tunis is formed by a branch of the southern Algerian chain, connected with Jebel Aurás (Mount Aurès) by the plateau of Tebessa (Theveste) and running north-east to Cape Bon. Its highest summits (Zilk and Zaghwán) rise above 5000 feet. Another branch of the southern chain runs from the Sahara side of Mount Aurès south-east towards the head of the Lesser Syrtis or Gulf of Gabes. Between these two branches lies a mountainous plateau, whose waters descend eastward but do not reach the sea. Arrested by a line of hills running parallel to the coast, they form a chain of lakes and marshes, which for the most part dry up in summer. It is to this region of inland drainage (the ancient Byzacene) that the plain of Kairwan belongs. Its southern part from Sbeitla (Sobaitala) to the Syrtis is relatively sterile, and even in antiquity appears to have formed an exception to the general fertility of the country, which was one of the granaries of Rome. The upland district from Tebessa southward sinks into the desert by a step-like series of great plateaus, separated by rugged walls of variegated marls, sands, and alluvium, torn into fantastic shapes, and scored with deep ravines by streams which at some remote period of copious rainfall poured down into the Sahara. Farther east the plateaus disappear and the mountains rise like a rampart from the Sibákh (sing. *Sebkha*), or Saharian marshes and salt-flats. The depression to which the Sibákh belong terminates to the east in the Shott (Shaṭṭ) al-Jeríd, which is separated from the Lesser Syrtis only by a narrow isthmus; see SAHARA, vol. xxi. p. 151. Even the Sahara of Tunis abounds in fertile oases.

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[1] *Nature*, vol. xxvi. pp. 166, 243.

[2] *Sensations of Tone*; Eng. transl. by A. J. Ellis, 2d ed., 1885, p. 70.

[3] "On the History of Musical Pitch," in *Journ. Soc. of Arts*, 5th March and 2d April 1880; see also 7th January 1881.

[4] "On Musical Scales," *ibid.*, 27th March and 30th October 1885.

Climate.—The mean annual temperature at Súsa is 75° Fahr.; the mean of the winter or rainy season 60° and of the hot season 97°. At Tunis the temperature rarely exceeds 90°, except with a wind from the Sahara. The prevailing winds from May to September are east and north-east and during the rest of the year north-west and east. A rainy season of about two months usually begins in January; the spring season of verdure is over in May; summer ends in October with the first rains. Violent winds are common at both equinoxes.

Flora and Fauna.—Both are generally the same as those of ALGERIA (*q.v.*). The lion and panther are almost extinct, but the sportsman finds in abundance the wild boar, partridge, Carthage fowl, quail, and snipe. The African moufflon still exists in the southern mountains. Herds of buffaloes are found in the district of Mater. The stag occurs in the eastern districts. The camel, now so important, was hardly known here before the Roman sovereignty. Red mullet, tunny, and other fish abound around the coast; and fishing stations are numerous. The town of Bizerta and the Kerkenna Islands are mainly dependent on their fisheries. The coral and sponge fisheries, of which Sfax and the island of Jerba (Djerba) are centres, are also considerable. Of noxious creatures may be named the scorpion, much more formidable than that of Algiers, a venomous tree snake (*Echis carinata*), in the sandy lands between Kafsa and Sfax, and a species of python called *taguerga*, which infests some parts of the southern mountains.

Cork and "zen" trees cover about 860,000 acres towards the Algerian frontier, and the pine and deciduous oak almost as large an area south of the Mejerda; but the country is much less wooded than in antiquity. The richness of the grain crops is still remarkable, in spite of imperfect cultivation. Olives and many excellent fruits are largely produced, and vineyards have been much extended since the French occupation. Esparto grass abounds in the uplands. The oases of the Jeríd are devoted to the date palm and produce the best dates known in the European market.

Minerals.—The mineral wealth of Tunis, like that of Algeria, is considerable, but it has been imperfectly explored. The iron mines of the northern mountains and the argentiferous lead mines of Al-Reṣáṣ near Tunis were worked in antiquity, as were also the marble quarries of Simittu (Chemtou), on the upper Mejerda, which are now in the hands of a Belgian company. The thermal springs of Hammam al-Anf on the Bay of Tunis are supposed to have healing virtues; they are now connected with the capital by rail.

Inhabitants.—The industrious Berbers (Kabyles), the oldest stock in the country, are less sharply marked off from the Arabs than in Algeria, but are distinguishable by their lighter complexion and often fair hair. They form a large part of the population in the northern and eastern mountains, and in the island of Jerba (Jirba). They are organized in tribes with purely democratic self-government, and laws of their own, which are not those of the Koran. The pastoral Arab nomads are descended from the second Arab invasion, which began in the 11th century (see below). They have little agriculture and are still as indolent and unruly as their ancestors. The Arabs of the towns are usually known as Moors; among them the Spanish Moors, descendants of the Andalusian refugees, form an exclusive and aristocratic class. The pure Turks and the Kuluglis (sons of Turkish fathers by Moorish women or slave girls) are no longer numerous. Of Europeans there are some 10,000 Italians, 8000 Maltese, and 4000 French (exclusive of the army). The Jews number some 50,000, of whom perhaps half are in the capital. The trade of the country is largely in their hands.

Towns.—For the capital Tunis, see below. Of the coast towns SFAX and SUSA have separate notices; Bizerta (Benzert), the ancient Hippo Zarytus, is the chief place on the north coast, with 5000 inhabitants. It stands on a canal connecting the sea with a lake which might easily be converted into a magnificent land-locked harbour. On the east coast are Hammamet (Ḥamámát), with 3700 inhabitants; Monastir, with 5600 inhabitants and a trade in cereals and oils; Mahdíya (Mehedia), with 6800 inhabitants, the fallen city of the Fátimites, which since the French occupation has begun to rise again, and has a new harbour; and Gabes (Ḳábis) on the Syrtis, a group of small villages, with an aggregate population of 14,000, the port of the shott country and a depôt of the esparto trade. Of the inland towns the holy city of KAIRWAN (*q.v.*) is the most remarkable. Its fine mosques are now open to visitors. Sbeitla (Lat. Sufetula), in the mountains south-west of Kairwan, is remarkable for its magnificent Roman remains, the triumphal arch of Constantine, and the three temples which form the *hieron*. The principal towns of the Mejerda basin are Bedja (Bája), the ancient Vaga, an important corn market, and higher up, near the border, the fortress of Kéf (Sicca Veneria), with 4000 inhabitants, boldly perched on the steep slope of a volcanic mountain.

Commerce.—The total imports of the regency in 1885 were valued at £1,098,047, of which about 27 per cent were British goods, chiefly cotton fabrics. In 1884 the imports were valued at £1,157,182. The most important export is olive oil, and after it come wheat, esparto grass, barley, sponges. The value of the total exports in 1884 was £745,554, and in 1885 £882,946. In 1885 1,035 vessels (71,138 tons) entered the port of Goletta, and the entries at other ports were 3033 (55,050 tons).

History.—The history of Tunis begins for us with the establishment of the Phœnician colonies; see vol. xviii. p. 806, PHŒNICIA and CARTHAGE. The Punic settlers Semitized the coast, but left the Berbers of the interior almost untouched. The Romans entered into the heritage of the Carthaginians and of the vassal kings of Numidia, and Punic speech and civilization gave way to Latin, a change which from the time of Cæsar was helped on by Italian colonization. Rich in corn, in herds, and in later times also in oil, and possessing valuable fisheries, mines, and quarries, the province of Africa, of which Tunis was the most important part, attained under the empire a prosperity to which Roman remains in all parts of the country still bear witness. Carthage was the second city of the Latin part of the empire, "after Rome the busiest and perhaps the most corrupt city of the West, and the chief centre of Latin culture and letters." In the early history of Latin Christianity Africa holds a more important place than Italy. It was here that Christian Latin literature took its rise, and to this province belong the names of Tertullian and Cyprian, of Arnobius and Lactantius, above all of Augustine. Lost to Rome by the invasion of the Vandals, who took Carthage in 439, the province was recovered by Belisarius a century later (533-4), and remained Roman till the Arab invasion, for which see vol. xvi. p. 567. The conqueror 'Okba founded the city of Kairwán (*c.* 670), which was the residence of the governors of Africa under the Omayyads and thereafter the capital of the Aghlabite princes, the conquerors of Sicily, who ruled in merely nominal dependence on the 'Abbásids (see vol. xvi. p. 579).

The Latin element in Africa and the Christian faith disappeared in a single generation; the Berbers of the mountains, who had never been Latinized and never really Christianized, accepted Islam without difficulty, but showed their stubborn nationality, not only in the character of their Mohammedanism, which has always been mixed up with the worship of living as well as dead saints (marabouts) and other peculiarities, but also in political movements. The empire of the Fátimites (see vol. xvi. p. 587) rested on Berber support, and from that time forth till the advent of the Turks the dynasties of north Africa were really native, even when they claimed descent from some illustrious Arab stock. When the seat of the Fátimite empire was removed to Egypt, the Zírites, a house of the Sanhaja Berbers, ruled as their lieutenants at Mahdíya, and about 1050 Mo'izz the Zírite, in connexion with a religious movement against the Shí'ites, transferred his very nominal allegiance to the Abbasid caliphs. The Fátimites in revenge let loose upon Africa a vast horde of Bedouins from Upper Egypt (B. Hilál and Solaim, the ancestors of the modern nomads of Barbary. All Africa was ravaged by the invaders, who, though unable to found an empire or overthrow the settled government in the towns, forced the agricultural Berbers into the mountains, and, retaining from generation to generation their lawless and predatory habits, have ever since made order and prosperity almost impossible in the open parts of the country. The Zírite dynasty was finally extinguished by Roger I. of Sicily, who took Mahdiya in 1148 and established his authority over all the Tunisian coast. Even Moslem historians speak favourably of the Norman rule in Africa; but it was brought to an early end by the Almohade caliph 'Abd al-Mu'min, who took Mahdíya in 1160. The Almohade empire soon began to decay, and in 1336 Abú Zakaríyá, prince of Tunis, was able to proclaim himself independent and found a dynasty, which subsisted till the advent of the Turks. The Hafsites (so called from Abú Hafs, the ancestor of Abú Zakaríyá, a Berber chieftain who had been one of the intimate disciples of the Almohade mahdi) assumed the title of Prince of the Faithful, a dignity which was acknowledged even at Mecca, when in the days of Mostansir, the second Hafsite, the fall of Baghdad left Islam without a titular head. In its best days the empire of the Hafsites extended from Tlemcen to Tripoli and they received homage from the Merinids of Fez; they held their own against repeated Frankish invasions, of which the most notable were that which cost St Louis of France his life (1270) and that of the duke of Bourbon (1390), when English troops took part in the unsuccessful siege of Mahdíya. They adorned Tunis with mosques, schools, and other institutions, favoured letters, and in general appear to have risen above the usual level of Moslem sovereigns. But their rule was troubled by continual wars and insurrections; the support of the Bedouin Arabs was imperfectly secured by pensions, which formed a heavy burden on the finances of the state;[1] and in later times the dynasty was weakened by family dissensions. Leo Africanus, writing early in the 16th century, gives a favourable picture of the "great city" of Tunis, which had a flourishing manufacture of fine cloth, a prosperous colony of Christian traders, and, including the suburbs, nine or ten thousand hearths; but he speaks also of the decay of once flourishing provincial towns, and especially of agriculture, the greater part of the open country lying waste for fear of the Arab marauders. Taxation was heavy, and the revenue very considerable: Don John of Austria in a report to Philip II. states that the land revenue alone under the last Hafsite was 375,935 ducats, but of this a great part went in pensions to the Arabs.

The conquest of Algiers by the Turks gave a dangerous neighbour to Tunis, and after the death of Mohammed the Hafsite in 1525 a disputed succession supplied Khair al-Dín Barbarossa with a pretext for occupying the city in the name of the sultan of Constantinople. Al-Hasan, the son of Mohammed, sought help from the emperor, and was restored in 1535 as a Spanish vassal, by a force which Charles V. commanded in person, while Andrea Doria was admiral of the fleet. But the conquest was far from complete, and was never consolidated. The Spaniards remained at Goletta and made it a strong fortress; but the interior was a prey to anarchy and civil war, until in 1570 'Alí Pasha of Algiers utterly defeated Hámid, the son and successor of Hasan, and occupied Tunis. In 1573 the Turks again retreated on the approach of Don John, who had dreams of making himself king of Tunis; but this success was not followed up, and in the next year Sultan Selim II. sent a strong expedition, which drove the Spaniards from Tunis and Goletta, and reduced the country to a Turkish province. The civil administration was now placed under a pasha; but in a few years a military revolution transferred the supreme power to a dey elected by the janissaries, who formed the army of occupation. The government of the deys lasted till 1705, but was soon narrowed or overshadowed by the authority of the beys, whose proper function was to manage the tribes and collect tribute. From 1631 to 1702 the office of bey was hereditary in the descendants of Murád, a Corsican renegade, and their rivalry with the deys and internal dissensions kept the country in constant disorder. Ibrahím, the last of the deys (1702-1705), destroyed the house of Murád and absorbed the beyship in his own office; but, when he fell in battle with the Algerians, Hosain b. 'Alí, the son of a Greek renegade, was proclaimed sovereign by the troops under the title of "bey," and, being a prince of energy and ability, was able to establish the hereditary sovereignty, which has lasted without change of dynasty to the present time.

Frequent wars with Algiers, which need not detain us, form the chief incidents in the internal history of Tunis under the beys. Under deys and beys alike Tunis was essentially a pirate state. Occasional acts of chastisement, of which the bombardment of Porto Farina by Blake in 1655 was the most notable, and repeated treaties, extorted by European powers, checked from time to time, but never put an end to, the habitual piracies, on which indeed the public revenue of Tunis was mainly dependent. The powers were generally less concerned for the captives than for the acquisition of trading privileges, and the beys took advantage of the commercial rivalry of England and France to play off the one power against the other. The release of all Christian slaves was not effected till after the bombardment of Algiers; and the definite abandonment of piracy may be dated from the presentation to the bey in 1819 of a collective note of the powers assembled at Aix-la-Chapelle. The Government had not elasticity enough to adapt itself to so profound a change in its ancient traditions; the finances became more and more hopelessly embarrassed, in spite of ruinous taxation; and attempts at European innovations in the court and army made matters only worse, so long as no attempt was made to improve the internal condition of the country. In the third quarter of the 19th century not more than a tenth part of the fertile land was under cultivation, and the yearly charge on the public debt exceeded the whole annual revenue. In these circumstances only the rivalry of the European powers that had interests in Tunis protracted from year to year the inevitable revolution. The French had long regarded the dominions of the bey as their natural inheritance, and in 1881, having got a grievance against the bey in a commercial transaction of the French African Society, with the execution of which he had interfered (the affair of the Enfida estate), a French force crossed the Algerian frontier under pretext of chastising the independent Kroumir or Khomair tribes in the north-east of the regency, and, quickly dropping the mask, advanced on the capital and compelled the bey to accept the French protectorate. The actual conquest of the country was not effected without a serious struggle with Moslem fanaticism; but all Tunis was brought completely under French jurisdiction and administration, supported by military posts at every important point. The power of the bey is null and his dignity merely nominal,—a fact acknowledged by Great Britain by the surrender in 1883 of Her Majesty's consular jurisdiction in the regency.

Literature.—Of Arabic sources accessible in translations the geographical works of Ya'kubí (*Descriptio al Magribi*, by De Goeje, Leyden, 1860), Al-Bakrí (*Descr. de l'Afrique septentr.*, by De Slane, Paris, 1859; Arabic text, *ibid.*, 1857), and Edrísí (*Descr. de l'Afrique*, &c., by Dozy and De Goeje, Leyden, 1866) belong to the 10th, 11th, and 12th centuries respectively; the history of Ibn Khaldún (*Hist. des Berbères*, by De Slane, 4 vols., Algiers, 1852-56) includes the earlier Hafsites, that of Al-Kairawání (*Hist. de l'Afrique*, by Pellissier and Rémusat, Paris, 1845, in *Expl. Scient. de l'Algérie*, vol. vii.; Arabic text, Tunis, 1286 A.H.) deals especially with Tunis, and goes down to 1681. The geography of Tunis is treated by E. Pellissier (*Explor. Scient. de l'Algérie*, vol. xvi., Paris, 1853), C. Tissot (*Géog. Comparée de la Province Romaine d'Afrique*, vol. i., Paris, 1884), and Piesse (*Itinéraire de l'Algérie*, &c., new ed., Paris, 1887), and in Murray's *Handbook*, by Sir R. Playfair (1887), who has also published *Travels in the Footsteps of Bruce in Alg. and Tunis* (London, 1877). A French survey is in progress, and some of the maps are published. For the modern history, see Rousseau, *Annales Tunisiennes* (Algiers, 1864), and Broadley, *Tunis Past and Present* (Edinburgh, 1882); for the archæology, Davis, *Carthage and her Remains* (London, 1860), Guérin, *Voyage Archéologique* (1862), and D'Herisson, *Mission Archéol. en Tunisie* (Paris, 1881). The excellent description of Africa by Leo Africanus is in Ramusio and Purchas. Shaw's *Travels* (1738) may still be consulted. Of other books of travels Maltzan's *Reise* (Leipsic, 1870) deserves mention

TUNIS, capital of the regency of the same name, in 36° 50′ N. lat. and 10° 12′ E. long., is situated on an isthmus between two salt lakes, a marshy sebkha to the south-west and the shallow Boheira to the north-east. The latter is twelve miles in circumference, and on the side opposite Tunis is connected with the Bay of Tunis at the port of Goletta (Ḥalk al-Wad) by a short canal. The old town, of which the walls have in great part disappeared, lies between two suburbs, the Ribáṭ al-Soweika on the north and the Ribáṭ Bab al-Jezíra on the south. These suburbs were surrounded by a wall in the beginning of the 19th century. Between the old town and the Marine Gate on the Boheira a European quarter, containing the palace of the resident, public offices, the provisional cathedral, and huge blocks of new houses in the French style, has sprung up. At the extreme west of the old town is the citadel, now used as barracks, whose lofty circuit includes the mosque built by Abú Zakaríyá the Hafsite in 1232. To the same century belongs the great mosque of the Olive Tree (Jámi' al-Zeitúna) in the centre of the town, with its many domes and spacious cloister, which possesses a library and serves as a college for some 450 students of Moslem learning. To the north near the walls of the old town rises the dome of the mosque named after Sídí Mahrez, a renowned saint of the 5th century of the Flight, whose tomb gives it a right of sanctuary for debtors. There are many other mosques and chapels, but all are closed against Christians. The palace of the bey, between the citadel and the mosque of the Olive Tree, is partly in bad French taste, but contains some rooms of the 18th century with admir able Moorish decoration in the delicate stucco arabesque work for which Tunis was formerly famous. The chief attraction of the old town lies in its bazaars, which retain their Oriental character unimpaired. Water is supplied to numerous fountains by an ancient aqueduct from Jebel Zaghwán, repaired at a cost of half a million sterling by the late Bey Mohammed al-Ṣádik. The principal educational establishments besides that of the great mosque are the Ṣádikíya college, founded in 1875 for gratuitous instruction in Arabic and European subjects, the college of St Charles, conducted by priests and open to Christians and Moslems alike, and the normal school, founded in 1884 by the bey to train teachers in the French language and European ideas. The population of Tunis is about 125,000, of whom one-fifth are Jews and one-fifth Europeans, chiefly Maltese and Italians.

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[1] In the 13th and 14th centuries the Hafsites also paid tribute to Sicily for the freedom of the sea and the right to import Sicilian corn,—a clear proof of the decline of Tunisian agriculture.

The environs of Tunis are admirable from the beautiful views they present; the finest prospects are from the hill on the south-east, which is crowned by a French fort, and from the Belveder on the north of the town (Jebel al-Túba), on which stands a very ancient fortress. Half-an-hour's drive west of the town is the decaying palace called the Bardo, a little town in itself, remarkable for the "lion court" and some apartments in the Moorish style. The port of Goletta, with 4000 inhabitants, is connected with Tunis by a railway 10 miles long. The older or southern part of the town next the canal has a fortress, now used as barracks, built by the Turks on the site of the Spanish fortress destroyed in 1574. The ruins of Carthage lie a few miles north of Goletta. The chief manufactures of Tunis are still textiles, as in the time of Leo Africanus. The manufacture of silk dates from the settlement of Moorish refugees from Spain about 1600. There are also tanneries, a tobacco factory, and some minor industries. The annual exports of grain, oil, stuffs, hides, and essences are valued at £720,000, and the imports, chiefly of cotton goods, at £560,000. There are two French steamers weekly between Marseilles and Goletta, and the coast towns are served and connected with Malta both by French and Italian packets.

History.—Tunis was a Carthaginian city and is repeatedly mentioned in the history of the Punic wars. Strabo speaks of its hot baths and quarries. Under the Arabs it rose to importance, became the usual port for those going from Kairwan to Spain, and was one of the residences of the Aghlabites. In the 10th century it suffered severely, and was repeatedly pillaged in the wars of the Fátimites with Abú Yazíd and the Zenáta Berbers. For its later fortunes see above in the history of the country, of which since the accession of the Hafsites it has been the capital.

TUNNELLING. The process of making a more or less horizontal underground passage, or tunnel, without removing the top soil is known as tunnelling. In former times any long tube-like passage, however constructed, was called a tunnel. At the present day the word is sometimes popularly applied to an underground passage constructed by trenching down from the surface to build the arching and then refilling with the top soil; but a passage so constructed, although indistinguishable from a tunnel when completed, is more correctly termed a "covered way," and the operations "cutting and covering," instead of tunnelling. Making a small tunnel, afterwards to be converted into a larger one, is called "driving a heading," and in mining operations small tunnels are termed "galleries," "driftways," and "adits." If the underground passage is vertical it is a shaft; if the shaft is commenced at the surface the operations are known as "sinking," and it is called a "rising" if worked upwards from a previously constructed heading or gallery.

Tunnelling has been effected by natural forces to a far greater extent than by man. In limestone districts innumerable swallow-holes, or shafts, have been sunk by the rain water following joints and dissolving the rock, and from the bottom of these shafts tunnels have been excavated to the sides of hills in a manner strictly analogous to the ordinary method of executing a tunnel by sinking shafts at intervals and driving headings therefrom. Many rivers find thus a course underground. In Asia Minor one of the rivers on the route of the Mersina Railway extension pierces a hill by means of a natural tunnel, whilst a little south at Seleucia another river flows through a tunnel, 20 feet wide and 23 feet high, cut 1600 years ago through rock so hard that the chisel marks are still discernible. The Mammoth cave of Kentucky and the Peak caves of Derbyshire are examples of natural tunnelling. Mineral springs bring up vast quantities of matter in solution. It has been estimated that the Old Well Spring at Bath has discharged since the commencement of the 19th century solids equivalent to the excavation of a 6 feet by 3 feet heading 7 miles long; and yet the water is perfectly clear and the daily flow is only the 150th part of that pumped out of the great railway tunnel under the Severn. Tunnelling is also carried on to an enormous extent by the action of the sea. Where the Atlantic rollers break on the west coast of Ireland, on the seaboard of the western Highlands of Scotland, and elsewhere, numberless caves and tunnels have been formed in the cliffs, beside which artificial tunnelling operations appear insignificant. The most gigantic subaqueous demolition hitherto carried out by man was the blowing up in 1885 of Flood Rock, a mass about 9 acres in extent, near Long Island Sound, New York. To effect this gigantic work by a single instantaneous blast a shaft was sunk 64 feet below sea level, from the bottom of which four miles of tunnels or galleries were driven so as to completely honeycomb the rock. The roof rock ranged from 10 feet to 24 feet in thickness, and was supported by 467 pillars 15 feet square; 13,286 holes, averaging 9 feet in length and 3 inches in diameter, were drilled in the pillars and roof. About 80,000 cubic yards of rock were excavated in the galleries and 275,000 remained to be blasted away. The holes were charged with 110 tons of "rackarock," a more powerful explosive than gunpowder, which was fired by electricity, when the sea was lifted 100 feet over the whole area of the rock. Where natural forces effect analogous results, the holes are bored and the headings driven by the chemical and mechanical action of the rain and sea, and the explosive force is obtained by the expansive action of air locked up in the fissures of the rock and compressed to many tons per square foot by impact from the waves. Artificial breakwaters have often been thus tunnelled into by the sea, the compressed air blowing out the blocks and the waves carrying away the débris.

With so many examples of natural caves and tunnels in existence it is not to be wondered at that tunnelling was one of the earliest works undertaken by man, first for dwellings and tombs, then for quarrying and mining, and finally for water supply, drainage, and other requirements of civilization. A Theban king on ascending the throne began at once to drive the tunnel which was to form his final resting place, and persevered with the work until death. The tomb of Menptah at Thebes was driven at a slope for a distance of 350 feet into the hill, when a shaft was sunk and the tunnel projected a further length of about 300 feet, and enlarged into a chamber for the sarcophagus. Tunnelling on a large scale was also carried on at the rock temples of Nubia and of India, and the architectural features of the entrances to some of these temples might be studied with advantage by the designers of modern tunnel fronts. Petrie has traced the method of underground quarrying followed by the Egyptians opposite the Pyramids. Parallel galleries about 20 feet square were driven into the rock and cross galleries cut, so that a hall 300 to 400 feet wide was formed, with a roof supported by rows of pillars 20 feet square and 20 feet apart. Blocks of stone were removed by the workmen cutting grooves all round them, and, where the stone was not required for use, but merely had to be removed to form a gallery, the grooves were wide enough for a man to stand up in.

Where granite, diorite, and other hard stone had to be cut, the work was done by tube drills and by saws supplied with corundum, or other hard gritty material, and water, —the drills leaving a core of rock exactly like that of the modern diamond drill. As instances of ancient tunnels through soft ground and requiring masonry arching, reference may be made to the vaulted drain under the south-east palace of Nimrud and to the brick arched tunnel, 12 feet high and 15 feet wide, under the Euphrates. In Algeria, Switzerland, and wherever the Romans went, remains of tunnels for roads, drains, and water-supply are found. Pliny refers to the tunnel constructed for the drainage of Lake Fucino as the greatest public work of the time. It was by far the longest tunnel in the world, being more than 3½ miles in length, and was driven under Monte Salviano, which necessitated shafts no less than 400 feet in depth. Forty shafts and a number of "cuniculi" or inclined galleries were sunk, and the excavated material was drawn up in copper pails, of about ten gallons capacity, by windlasses. The tunnel was designed to be 10 feet high by 6 feet wide, but its actual cross section varied. It is stated that 30,000 labourers were occupied eleven years in its construction. With modern appliances such a tunnel could be driven from the two ends without intermediate shafts in eleven months.

No practical advance was made on the tunnelling methods of the Romans until gunpowder came into use. Old engravings of mining operations early in the 17th century show that excavation was still accomplished by pickaxes or hammer and chisel, and that wood fires were lighted at the ends of the headings to split and soften the rock in advance (see fig. 1). Crude methods of ventilation by shaking cloths in the headings and by placing inclined boards at the top of the shafts are also on record. In 1766 a tunnel 9 feet wide, 12 feet high, and 2880 yards long was commenced on the Grand Trunk Canal, England, and completed eleven years later; and this was followed by many others. On the introduction of railways tunnelling became one of the ordinary incidents of a contractor's work; probably upwards of 4000 railway tunnels have been executed.

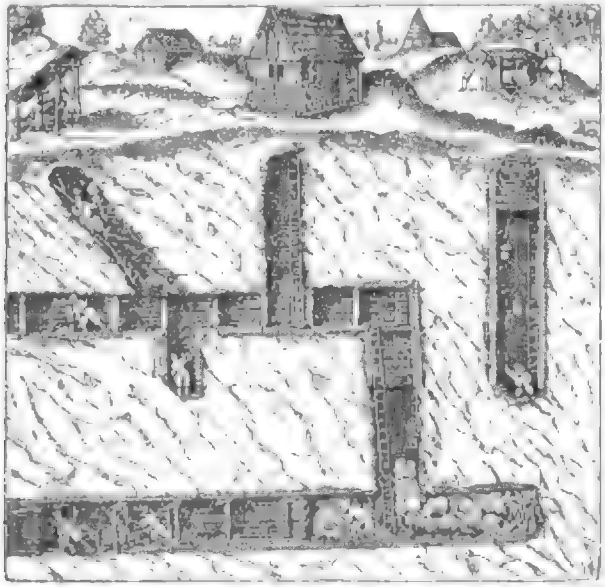


FIG. 1.—Method of mining, 1621. (From *De Re Metallica*, Basel, 1621.)

Subaqueous Tunnelling.—In 1825 Brunel commenced and in 1843 completed the Thames tunnel, which was driven at points through liquid mud by the aid of a "shield" at a cost of about £1300 per lineal yard. It is now used by the East London Railway. In 1872 Chesborough began tunnelling under the Detroit river, between Canada and Michigan, U.S., but the work was abandoned owing to continued irruptions of water after some 600 yards of headings had been driven.

The most important subaqueous work yet accomplished—the Severn tunnel, 4⅓ miles in length—was commenced in 1873 and finished in 1886, Messrs Hawkshaw, Son, Hayter, and Richardson being the engineers and Mr T. A. Walker the contractor. The bed of the Severn is formed principally of marls, sandstones, and conglomerates in nearly horizontal strata, overlying highly inclined coal measures, shales, and sandstones, which are also exposed in the bed of the river. The tunnel is made almost wholly in the Trias and Coal Measure formations, but for a short distance at its eastern end it passes through gravel. The lowest part of the line is below the "Shoots," where the depth is 60 feet at low water and 100 feet at high water, and the thickness of Pennant sandstone over the brickwork of the tunnel is 45 feet. Under the Salmon Pool, a depression in the bed of the river on the English side, there is a cover of only 30 feet of Trias marl. Much water was met with throughout. In 1879 the works were flooded for some months by a large land spring on the Welsh side of the river. The water which supplied the spring came from fissures in the carboniferous limestone, which was met with only at this place, and it is now conveyed by a side heading parallel to the tunnel to a shaft 29 feet in diameter, in which are fixed pumps of adequate power. On another occasion the works were flooded by water which burst through a hole in the river bed at the Salmon Pool. This hole, which was in the Trias marl and had an area of 16 feet by 10 feet, was subsequently filled with clay and the works were completed beneath it. The tunnel is for a double line of railway and is lined throughout with vitrified bricks set in Portland cement mortar. A heading was first driven entirely across the river to test the ground and subsequently another heading at a lower level. "Breakups" were made at intervals of two to five chains and the arching was carried on at each of these points. All parts of the excavation were timbered, and the greatest amount excavated in any one week was 6000 cubic yards. Owing to the inrush of water it was frequently necessary to completely roof the timbering with felt or corrugated iron before the bricklayers could commence the arching. The total amount of water raised at all the pumping stations is about 27,000,000 gallons in twenty-four hours; but the total pumping power provided is equal to 66,000,000 gallons in twenty-four hours. The ventilation is effected by a fan of the Guibal pattern, 40 feet in diameter and 12 feet wide, making forty-three revolutions and drawing 447,000 cubic feet of air per minute from the tunnel through an 18-feet shaft at Sudbrooke (Monmouth).

Another example of subaqueous tunnelling, second only in importance to the foregoing, is the Mersey tunnel, the length of which between the pumping shafts on each side of the river is 1 mile. From each shaft a drainage heading was driven through the red sandstone with a rising gradient towards the centre of the river. This heading was partly bored out by a Beaumont machine to a diameter of 7 feet 4 inches, and at a rate attaining occasionally 65 lineal yards per week. All of the tunnel excavation, amounting to 320,000 cubic yards, was got out by hand labour, since heavy blasting would have shaken the rock. The minimum cover between the top of the arch and the bed of the river is 30 feet. Pumping machinery is provided for 27,000,000 gallons per day, which is more than double the usual quantity of water; and ample ventilation is secured by two 30-feet diameter and two 40-feet diameter Guibal fans. Messrs Brunlees and Fox were the engineers, and Messrs Waddell the contractors for the works, which were opened in 1886, about 6 years after the commencement of operations.

Proposals for the construction of a tunnel about 30 miles in length to connect England and France have been brought forward periodically from the commencement of the 19th century, but nothing was done until 1881, when preliminary works of some importance were commenced by Sir Edward Watkin and the South-Eastern Railway Company. At the proposed point of crossing the deepest part of the channel is 210 feet, and, as the beds on the English side and those on the French side, so far as relates to the grey chalk and chalk marl, are each 225 feet thick, it is assumed that those strata are continuous and that the tunnel would be driven through a water-tight material. Shafts have been sunk near Folkestone, and experimental headings have been driven 2000 yards under the sea, on the line of the tunnel. The heading, 7 feet in diameter, was cut by a Beaumont boring machine, having two arms with steel teeth, and driven by compressed air; the usual rate of progress was 15 lineal yards per day.

A partially constructed subaqueous tunnel now lies drowned under the Hudson river at New York. An attempt was made to drive a double tunnel through the mud and silt forming the river bed. In 1880, when about a hundred yards had been completed, the water burst in, and twenty men were drowned. Work was subsequently resumed on the following plan (see fig. 2). A pilot tunnel, consisting of an iron tube of 6 feet 6 inches in diameter, was advanced from 30 to 40 feet ahead of the main tunnel, to form a firm support for the iron plates of the latter by means of radial screws. Compressed air, pumped into the tunnel at a pressure of about 20 lb per square inch, prevented the weight of silt and water from crushing the plating and flowing into the tunnel. The excavated silt was mixed with water and ejected by compressed air. Between the shafts the length of the proposed tunnel is 1 mile, and about one-eighth of the distance had been accomplished when the works were stopped for financial reasons.

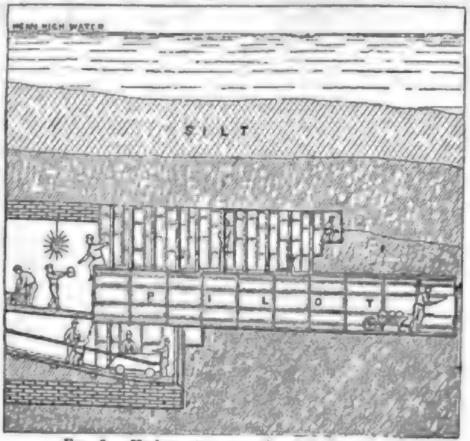


FIG. 2.—Hudson river tunnel—method of work.

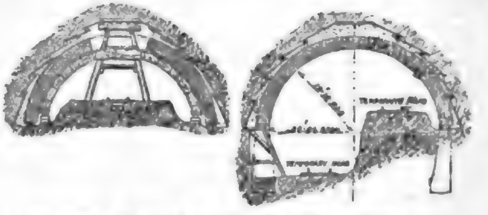
Small subaqueous tunnels have been driven through clay without difficulty under Lakes Michigan and Erie, and elsewhere in America. In England a heading was driven nearly across the Thames in 1807, and eighty years later two 10 feet 6 inch iron-lined tunnels were constructed under the river close to the foundation of London Bridge by Mr Greathead, with the aid of a simple annular shield advanced by six hydraulic presses. Where open gravel or water has to be tunnelled through a diaphragm must be fitted to the shield. Mallet proposed in 1858 to carry in this way a tubular tunnel across the English Channel. Various plans have been suggested for the removal of the soil in advance of the shield. Mr Greathead would effect it by the circulation of a closed current of water, carrying the stuff through the shield from front to back; and an American plan provides for forcing it bodily out of the way by a plough-shaped shield, aided by jets of water at a very high pressure.

Tunnelling through Mountains.—Where a great thickness of rock overlies a tunnel, it is necessary to do the work wholly from the two ends, without intermediate shafts. The problem resolves itself into devising the most expeditious way of excavating and removing the rock, and there are none of the uncertainties and difficulties which make subaqueous tunnelling of so high an interest. Experience has led to great advances in speed and economy, as will be seen from the following particulars of the three tunnels through the Alps, the longest yet constructed.

Tunnel.	Length.	Progress per Day.	Cost.
	Miles.	Lineal Yards.	Per Lineal Yard.
Mont Cenis	7¾	2·37	£226
St Gotthard	9¼	6·01	143
Arlberg	6⅓	9·07	108

In 1857 the first blast was fired in connexion with the Mont Cenis works; in 1861 machine drilling was introduced; and in 1871 the tunnel was opened for traffic. With the exception of about 300 yards the tunnel is lined throughout with brick or stone. Little interest now attaches to the method of tunnelling adopted at Mont Cenis, as it is in several respects obsolete. During the first four years of hand labour the average progress was not more than 9 inches per day on each side of the Alps; but with compressed-air rock-drills the rate towards the end was five times greater.

In 1872 the St Gotthard tunnel was commenced and in 1881 the first locomotive ran through it. Mechanical drills were used from the commencement. Tunnelling was carried on by driving in advance a top heading about 8 feet square, then enlarging this sideways, and finally sinking the excavation to invert level (see figs. 3 and 4). Air for working the rock-drills was compressed to seven atmospheres by turbines of about 2000 horse-power. Six to to eight Ferroux drills, making about 180 blows a minute, were mounted on a carriage and pushed up to the point of attack. From thirteen to eighteen holes were drilled by the machine and its sixteen attendants to depths of from 2′ 7″ to 4′ 3″ in three to five hours, and the work of charging with dynamite, firing, and clearing away was then done by twenty-two men in three to four hours. The charge per hole averaged 1⅜ lb, and after firing a strong current of compressed air was directed over the face of the excavation. Four sets of holes were under favourable circumstances drilled in twenty-four hours, which rendered a progress of 13 feet per day in such rock as gneiss attainable in each heading.

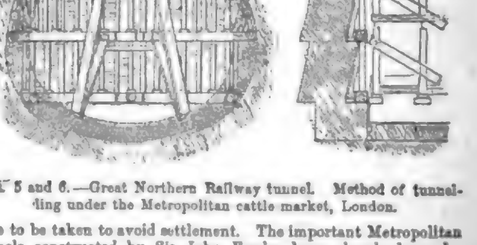


FIGS. 3 and 4.—Method of excavation in St Gotthard tunnel.

The driving of the Arlberg tunnel was commenced in 1880 and the work was completed in little more than three years. The main heading was driven along the bottom of the tunnel and shafts were opened up 25 to 70 yards apart, from which smaller headings were driven right and left. The tunnel was enlarged to its full section at different points simultaneously in lengths of 8 yards, the excavation of each occupying about twenty days, and the masonry 14 days. Ferroux percussion air drills and Brandt rotary hydraulic drills were used, and the performance of the latter was especially satisfactory. After each blast a fine spray of water was injected, which assisted the ventilation materially. In the St Gotthard tunnel the discharge of the air drills was relied on for ventilation. In the Arlberg tunnel over 8000 cubic feet of air per minute were thrown in by ventilators. In a long tunnel the quick transport of materials is of equal importance with rapid drilling and blasting. In the Arlberg, to keep pace with the miners, 900 tons of excavated material had to be removed, and 350 tons of masonry to be introduced, daily at each end of the tunnel, which necessitated the transit of 450 wagons. This traffic was carried on over a length of 3½ miles on a single track of 27-inch gauge with two sidings. When the locomotives ran into the tunnel the fires were damped down, and, as the pressure in the boiler was fifteen atmospheres, the stored-up heat in the water furnished the necessary power. The cost per lineal yard varied according to the thickness of masonry lining and the distance from the mouth of the tunnel. For the first 1000 yards from the entrance the prices per lineal yard were £11, 8s. for the lower heading; £7, 12s. for the upper one; £30, 10s. for the unlined tunnel; £45 for the tunnel with a thin lining of masonry; and £124, 5s. with a lining 3 feet thick at the arch, 4 feet at the sides, and 2 feet 8 inches at the invert.

Long Tunnels.—The new Croton aqueduct tunnel from Croton dam to the reservoir in New York is worthy of note both for its great length and the rapid progress made with it. The distance is 33½ miles and practically the whole is tunnelled through rock. Shafts were sunk about 1½ miles apart and headings driven each way. Ingersoll drills were chiefly used, and the rate of advance with the headings was in 1886 1¼ miles per month. The old Croton aqueduct was 7 feet 8 inches wide by 8 feet 5 inches high; the new one is 13 feet 7 inches in width and height.

Tunnelling in Towns.—Where tunnels have to be carried through soft soil and in proximity to valuable buildings special precautions have to be taken to avoid settlement. The important Metropolitan tunnels constructed by Sir John Fowler have already been described under RAILWAY (vol. xx. p. 239). Another successful ex-



FIGS. 5 and 6.—Great Northern Railway tunnel. Method of tunnelling under the Metropolitan cattle market, London.

ample of such work is the tunnel driven in 1886 by Mr Johnson, the Great Northern Company's engineer, under the Metropolitan cattle market. Where clear of buildings the tunnel was executed in 12-feet lengths measured from the finished brickwork, the excavation extending another 5 feet. The face of the excavation was carried out in four sections, the first between the head trees and the first sill was formed with a rake of 1 in 4½, the second and third with a rake of 1 in 6, and the fourth was vertical, the whole face being close boarded (see figs. 5 and 6). The arch and side walls were eight rings and the invert six rings thick. A 12-feet length was completed in 12 to 14 days, and the subsidence in the ground was about 3½ inches. Under buildings and roads the tunnel was executed in 6-feet lengths. The crown bars, 15 inches in diameter, alternating six and seven in number, were built in with solid brickwork in cement and hard wood wedging. The skeleton centres for the arching were supported by props notched into the ribs and provided with wedges for tightening up. A 6-feet length was built in six days, and the surface subsidence, consequent upon the impossibility of exactly fitting the poling boards to the clay, was only from 1 inch to 1⅜ inches. Several heavy buildings were tunnelled under without any structural damage arising.

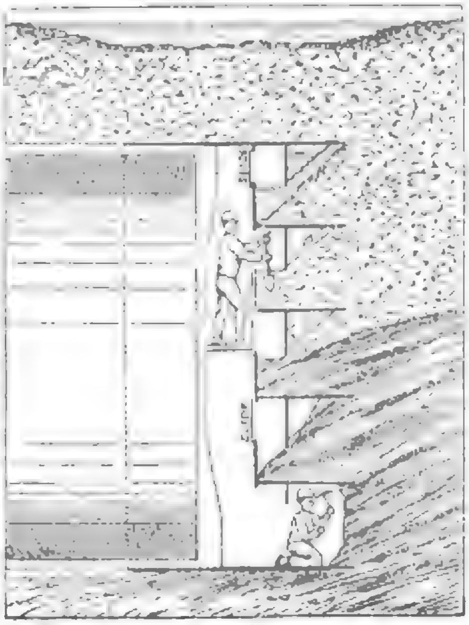
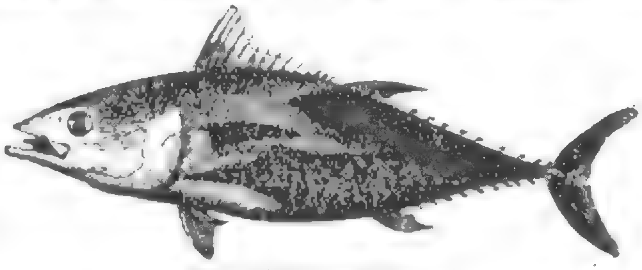


FIG. 7.—Mr B. Baker's pneumatic shield.

Where open ballast and running sand heavily charged with water are met with a tunnel cannot be driven on the ordinary system without seriously endangering adjoining buildings. To meet such cases, and also to provide a safe means of tunnelling under dock basins, canals, and rivers, the pneumatic shield (see fig. 7) was designed by Mr Benjamin Baker. The shield is supported against external pressure by vertical girders about 6 feet apart. Horizontal shelves of steel plates with cutting edges are spaced about 4 feet apart, and the face of the shield is closed by vertical plates and slides; the arrangement is such that any slide can be opened to admit of the ballast or sand being excavated, whilst the compressed air filling the tunnel prevents the influx of water during the process. Where hard watertight clay is encountered, sections of the shield plates are unbolted to admit miners. When sufficient material has been excavated the shield is advanced by hydraulic pressure and the brick arching built.

See AQUEDUCT and RAILWAY; also Drinker's *Tunnelling*, New York, 1878 (a most important work); and *Proc. Inst. Civ. Eng.*, art. "Tunnels." (B. B.)

TUNNY (*Thynnus thynnus*), one of the largest fishes of the family of Mackerels, belongs to the genus of which the Bonito (*Th. pelamys*) and the Albacores (*Th. albacora*, *Th. alalonga*, &c.) are equally well-known members. From the latter the tunny is distinguished by its much shorter pectoral fins, which reach backwards only to, or nearly to, the end of the first dorsal fin. It possesses nine short finlets behind the dorsal, and eight behind the anal fin. Its colour is dark bluish above, and greyish, tinged and spotted with silvery, below. The tunny is a pelagic fish, but periodically approaches the shore, wandering in large shoals, at least in the Mediterranean, within well-ascertained areas along the coast. The causes by which its wanderings are regulated in the Atlantic Ocean are much less understood; it not unfrequently appears in small companies or singly in the English Channel and in the German Ocean, probably in pursuit of the shoals of pilchards and herrings on which it feeds. The regularity of its appearance on certain parts of the coasts of the Mediterranean has led to the establishment of a systematic fishery, which has been carried on from the time of the Phœnicians to the present day. Immense numbers of tunnies were caught on the Spanish coast and in the Sea of Marmora, where, however, this industry has much declined. The Sardinian tunnies were considered to be of superior excellence. The greatest number is now caught on the north coast of Sicily, the fisheries of this island supplying most of the preserved tunny which is exported to other parts of the world. In ancient times the fish were preserved in salt, and that coming from Sardinia, which was specially esteemed by the Romans, was known as *Salsamentum sardicum*. At present preference is given to tunny preserved in oil. Many of the fishes, especially the smaller ones, are consumed fresh. The tunny occurs also in the South Pacific; but several other species seem to take its place in the Indo-Pacific Ocean. It is one of the largest fishes, attaining to a length of ten feet and to a weight of more than a thousand pounds.


Tunny (*Thynnus thynnus*).

On the tunny fisheries of ancient and modern times, see Cuvier and Valenciennes, *Hist. Nat. des Poissons* (vol. viii. pp. 71-92).

TUNSTALL, a market town of Staffordshire, England, is situated on a branch line of the London and North-Western Railway and on the Trent and Mersey Canal, 4 miles north-west of Stoke and 168 north-west of London. Among the public buildings are the market (1858), town hall (1884), old court-house (now used as a free library and reading room), and board schools (1880). The chief manufactures are those peculiar to the Potteries district; there are also large iron-works (coal and iron being obtained in the neighbourhood), and brick and tile works. The town is chiefly the growth of the 19th century, and in 1811 numbered only 1677 inhabitants. In 1885 it was included for parliamentary purposes in the borough of Newcastle-under-Lyme. It is governed by a local board of twenty-four members. The population of the urban sanitary district (area 690 acres) was 13,540 in 1871, and 14,244 in 1881.

TURANIAN. This word means etymologically no more than "not Iranian," and in this sense the word Turan was used by Sasanian monarchs to cover those parts of their realm that did not belong to Iran. The application of the word to denote the Ural-Altaic family of languages is extremely unfortunate and seems to be falling out of use. See PHILOLOGY, vol. xviii. p. 779.

TURBINE. See HYDROMECHANICS, vol. xii. p. 524.

TURBOT,[1] the largest and best known of a genus of flat fishes, *Rhombus*, which bears the appropriate systematic name of *Rh. maximus*. The turbot has great width of body, and is scaleless, but is covered with conical bony tubercles. The eyes are on the left side of the body, the lower being slightly in advance of the upper; the mouth is large and armed with teeth of uniformly minute size. The turbot is found all round the coasts of Europe (except in the extreme north), preferring a flat sandy bottom with from 10 to 50 fathoms of water. The broad banks off the Dutch coast are a favourite resort. It is a voracious fish, and feeds on other fish, crustaceans, and mollusks. It seems to constantly change its abode, wandering northward during the summer, and going into deeper water in the cold season. Some thirty years ago it was estimated that the Dutch supplied turbot to the London market to the value of £80,000 a year. At present (1887) the value of turbot annually sold in London cannot be ascertained; but it must be several times that amount, and is principally earned by English line-fishermen and trawlers. Although the turbot abounds off the west coast of Ireland, the fishing is not carried on with the same energy and success as in the English Channel and German Ocean. The turbot is also common, though not abundant, in the Mediterranean, and is replaced in the Black Sea by an allied species with much larger bony tubercles (*Rh. mæoticus*). Both species grow to a large size, being usually sold at from 5 to 10 ℔; but the common turbot is stated to attain to a weight of 30 ℔. Both from its size and the excellent flavour of its flesh it ranks next after the codfish among British sea-fishes.

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[1] The word "turbot" is of great antiquity, perhaps of Celtic origin; it is preserved in French in the same form as in English, and is composed of two words, of which the second is identical with the "but" in holibut and with the German "Butte," which signifies flat fish. The German name for the turbot is "Steinbutte."

TURENNE, Henri de la Tour d'Auvergne, Vicomte de (1611-1675), a famous French general of the 17th century, was the second son of Henri, Duc de Bouillon, by Elizabeth, daughter of William I., prince of Orange, and was born at Sedan on 11th September 1611. He was carefully educated in the strictest doctrines of the Reformed religion, and at the age of thirteen was sent to learn war from his uncles Maurice and Henry of Nassau in the campaigns of these princes against the Spaniards. In 1626 he received a commission as captain of infantry in the service of Holland, and by 1630 had shown such military capacity that Richelieu invited him back to France and appointed him colonel of a regiment. He was present at the relief of Casale, and on 21st June 1635 was made a maréchal de camp for his services at the siege of La Motte in Lorraine under De la Force. In that year he took command of a division in the army under Cardinal La Valette in the defence of Mainz, and, when the cardinal's army had to fall back on Metz from want of provisions, Turenne commanded the rear-guard, covering the retreat with admirable skill. In 1636 he was present under La Valette at the siege of Saverne, where he was wounded, and in the campaign in Franche Comté; in 1637 he served under the same commander in Flanders, took Landrecies, and drove back the cardinal infant from Maubeuge. In 1638 he served under Bernhard of Saxe-Weimar at the siege of Breisach, and in the following year was transferred to the army of D'Harcourt in Italy. It was at this epoch that he established his fame as a general. In November 1639 he covered the retreat of the army, and fought a famous engagement, known as the battle of the "route de Quiers"; in 1640 he saved Casale, and insisted upon not abandoning the siege of Turin, which town surrendered on 24th September; in 1641 he took Coni, Ceva, and Mondovi; and on 11th March 1642 he was promoted to the rank of lieutenant-general. After he had served for a short time in Roussillon, he was appointed by Richelieu in 1643 to the command of the army in Italy, under Thomas of Savoy, although his brother, the Duc de Bouillon, had just before been arrested as an accomplice in the conspiracy of Cinq Mars. Mazarin did not exhibit quite so much confidence in Turenne, and in December 1643 removed him from Italy, sending him to collect the remains of Bernhard of Saxe-Weimar's army and form them once more into an organized force; but he softened the transference by creating Turenne a marshal of France on 16th May 1644.

Turenne's four campaigns in Germany, which largely contributed to the peace of Westphalia, have always been regarded as models in the art of war. In June 1644 he crossed the Rhine at Breisach, and was marching against the Comte de Mercy, the Imperialist general, who was at Freiburg, when he was superseded by the Duc d'Enghien, better known by his later title of the Prince de Condé. D'Enghien, after fighting the three days' battle of Freiburg, left the army again to Turenne, who took Philippsburg and Mainz, and then went into winter quarters. In May 1645 Turenne was surprised by Mercy at Marienthal and defeated; but he skilfully concentrated the remains of his army and retreated into Hesse, where he was soon joined by D'Enghien. The two marshals, having reorganized their army, marched against Mercy and totally defeated him at Nördlingen on 3d August 1645, when Mercy was killed. D'Enghien again left the army to Turenne, who in conjunction with the Swedish army under Wrangel overran Franconia and Swabia, taking all the fortresses there in 1646. In 1647 he conducted a still more masterly campaign, and after beating the Bavarians and Imperialists in two engagements he and the Swedes occupied Bavaria, and drove the old duke out of his dominions.

When the troubles of the Fronde (see France, vol. ix. p. 572, and Mazarin) broke out, Turenne, who was in command of the veteran troops of Bernhard of Saxe-Weimar in Alsace, hesitated which side to take, till the Duchesse de Longueville (*q.v.*), with whom he fell violently in love, persuaded him to side with the parlement. But his troops refused to follow him, and he had to fly with her to Flanders. He there took a command in the Spanish army under Don Estevan Gomar, and, when trying to raise the siege of Réthel, was utterly defeated by Du Plessis-Praslin. But in 1652 he defeated Condé at Gien, and nearly annihilated his army in the battle of the Faubourg St. Antoine. When the troubles of the Fronde were over, Turenne marched upon the frontier, and in several campaigns defeated the Spaniards over and over again, by these victories paving the way for the peace of the Pyrenees (1659), the natural complement of the peace of Westphalia. In these campaigns he had once more to fight against Condé, general-in-chief of the armies of Spain, and in 1654 he showed his superiority by raising the siege of Arras and driving the Spaniards from their lines. In 1656 Condé, assisted by Don John of Austria, won an exactly similar victory and relieved Valenciennes, which Turenne was besieging. The prolonged contest between the two was decided in 1658 by Turenne's victory of the Dunes, in which Cromwell's contingent of 6000 soldiers took part.

Louis XIV. now began to rule in reality, and one of his first acts was to create Turenne in 1660 marshal-general of the armies of France. Seven years later Turenne occupied French Flanders and took all the fortresses in that province, though the king was nominally in command of the army,—an exploit equalled in the following year by Condé's rapid occupation of Franche Comté. It was in 1668 that Turenne made his notorious change of faith. Born of Calvinist parents and educated a Protestant, he had in compliance with the tenets of his religion refused to marry one of Richelieu's nieces in 1639, and had eventually married a daughter of the Protestant Marshal de la Force. But it can hardly be believed that he was converted at the age of fifty-seven from religious convictions. In 1672 the second great European war broke out, brought about by the ambition of Louis XIV. Turenne once more took command of the army, which the king accompanied, and speedily occupied the greater part of Holland, which, however, they were forced to evacuate owing to the Dutch cutting their dykes. In the following year Turenne marched into Westphalia to oppose the imperialist forces, and, though his army was small compared to that of Montecuculi, the imperialist general, he managed to make head against both him and the elector of Brandenburg. In 1673 he was compelled to act on the defensive; but in 1674 in spite of his inferiority of numbers he boldly resumed the aggressive. Crossing the Rhine at Philippsburg in June, and marching rapidly to Sinsheim, he defeated the imperialist general Caprara and the duke of Lorraine. He then retired for a time, but in December of the same year he made a sudden rush into the enemy's winter quarters and utterly routed the elector of Brandenburg, who was then general of the imperialists, at Colmar. Between the battle of Sinsheim and the dash at Colmar, Turenne, under orders from Louvois, committed the acts which are the greatest blot upon his fame by devastating the Palatinate. After the rout of Colmar, and the defeat of Türkheim which followed it, he laid waste the greater part of Alsace, as a defensive measure against another advance of the imperialists. He then advanced into the heart of Germany, and again met Montecuculi, who had succeeded the elector of Brandenburg as general-in-chief. The two generals manœuvred for four months in much the same way as Wellington and Marmont marched and counter-marched before the battle of Salamanca; at last, on 27th July 1675, their field of battle was chosen, and, as Turenne was directing the position of a battery, he was struck by a cannon ball and killed on the spot. The news of his death was received with universal sorrow; Fléchier, Mascaron, Saint-Évremond, and Lamoignon wrote *éloges* of him; and Madame de Sevigné describes the consternation caused by his sudden loss. His body was taken to St-Dénis, and buried with the kings of France. Even the extreme revolutionists of 1793 respected it, and, when the bones of the sovereigns were thrown to the winds, the remains of Turenne were preserved at the museum of natural history until 23rd September 1800, when they were removed by order of Bonaparte to the church of the Invalides at Paris, where they still rest.

Turenne's fame rests on his military achievements; as a man he was not more distinguished for his virtues than the duke of Marlborough, whom in many respects he resembled. He had indeed the calmness of all philosophic, cold-minded temperaments, but few other praiseworthy qualities. As a politician he holds no high place. (H. M. S.)

TURGAI, a Russian province in Central Asia, formerly a part of the Kirghiz steppe, and now embodied in the governor-generalship of the Steppes, is bounded by Uralsk and Orenburg on the W. and N., by Akmolinsk on the E., and by Syr-Daria and the Sea of Aral on the S. This extensive and irregularly-shaped territory, which has an area (176,800 square miles) as large as that of Caucasia and Transcaucasia taken together, belongs to the Aral-Caspian depression. It has, however, the Mugojar Hills on its western border and includes a part of the southern Urals; and from Akmolinsk it is separated by a range of hills which runs between the two chief rivers of the Kirghiz steppe—the Turgai and the Sary-su. In the north it includes the low belt of undulating land which stretches from the Mugojar Hills towards the north-east and separates the rivers belonging to the Aral basin from those which flow towards the Arctic Ocean, and beyond this range it embraces the upper Tobol. The remainder is steppe land, sloping gently towards the Sea of Aral. The Mugojar Hills consist of an undulating plateau nearly 1000 feet in height, built up of Permian and Cretaceous deposits, and deeply grooved by rivers. They are not the independent chain which our maps make them out to be[1]: they merely continue the Urals towards the south, and are connected with the Ust Urt plateau by a range of hills which was formerly an island of the Aral-Caspian Sea. Their northern extremity joins the undulating plateau (400 to 600 feet), built up of sandstones and marls, which separates the tributaries of the Tobol from those of the Ural, and falls by a range of steep crags—probably an old shore-line of the Aral basin—towards the steppes. The steppe land of Turgai is only some 300 feet above the sea-level, and is dotted with lakes, of which the Tcholgardenghiz, which receives the Turgai and its tributary the Irghiz, is the largest. The Turgai was, at a recent epoch, a large river flowing into the Sea of Aral and receiving an extensive system of tributaries, which are now lost in the sands before joining it. Remains of aquatic plants buried in the soil of the steppe, and shells of *Mytilus* and *Cardium*, both still found in the Sea of Aral, show that during the Glacial period this region was covered by the waters of the Aral-Caspian Sea.

The climate of Turgai is exceedingly dry and continental. Orsk, a town of Orenburg, on its north-western border, has a January as cold as that of the west coast of Nova Zembla (–4° Fahr.), while in July it is as hot as July in Morocco (73°); the corresponding figures for Irghiz, in the centre of the province, are 7° and 77°. At Irghiz and Orsk the annual rainfall is somewhat under 10 and 12 inches respectively (3 inches in summer). The west winds are desiccated before they reach the Turgai steppes, and the north-east winds, which in winter bring cold, dry snows from Siberia, raise in summer formidable clouds of sand. A climate so dry is of course incompatible with a vigorous forest growth. There is some timber on the southern Urals, the Mugojar Hills, and the water-parting of the Tobol; elsewhere trees are rare,—only shrubs, such as the wild cherry (*Cerasus Chamæcerasus*) and the dwarf almond (*Amygdalus nana*) growing on the hilly slopes, while the rich black-earth soil of the steppe is chiefly covered with feather grass (*Stipa pennata*), the well-known ornament of the south Russian steppes. In spring the grass vegetation is luxuriant, and geese and cranes are attracted in vast numbers by the fields of the Kirghiz from the depth of the steppe. The jerboa (*Dipus jaculus*) and the marmot (*Spermophilus rufescens*) are characteristic of the fauna of the region; another species of marmot (*Arctomys bobac*) and the *Canis corsac* are common; and the saiga antelope of Central Asia is occasionally met with. Further south the black earth disappears and with it the feather grass, its place being taken by its congener, *Stipa capillata*. Trees disappear, and among the bushes along the banks of the rivers willows and the pseudo-acacia or Siberian pea tree (*Caragana microphyla*) are most prevalent. In the middle parts of the province the clayey soil is completely clothed with wormwood (*Artemisia fragrans* and *A. monogyna*), with a few grassy plants on the banks of the rivers and lakes (*Lasiagrostis splendens*, *Alhagi camelorum* and *A. kirghizorum*, *Obione portulacoides*, *Halimodendrum argenteum*); while large areas consist of shifting sands, salt clays clothed with a rich carpet of various *Salsolaceæ*, and dried beds of old lakes. Such lakes as still exist, notwithstanding the rapid desiccation now going on, are surrounded by rush thickets,—the retreat of wild boars. Turgai is thus the borderland between the flora of Europe and that of Central Asia.

In 1882 the population of Turgai was estimated at 323,110, all nomad Kirghiz, with the exception of some 3600, who are settled in four villages officially described as towns. Agriculture is in its earliest stage of development; but some 100,000 quarters of corn are raised in the south-west by the Kirghiz, who sell some of it in Orenburg. Cattle-breeding is the chief occupation, and within the province there are some 800,000 horses, 335,000 cattle, about 200,000 camels, and more than two million sheep. But the want of fodder in spring occasions violent murrains, which sometimes result in actual famine among the Kirghiz. Endeavours have recently been made to induce the people to make communal stores of hay, but the 300,000 cwts. yearly collected in this way are insufficient. The Kirghiz of the southern parts go in winter to the better sheltered parts of Syr-Daria, while in the summer some 30,000 *kibitkas* (felt tents) of nomads come from the neighbouring provinces to graze their cattle on the grassy steppes of Turgai. Some 30,000 cwts. of salt are annually got from the lakes. The four settlements of the province are Turgai, chief town and seat of the provincial administration, with less than 400 inhabitants, and the "district towns" of Irghiz (920), Ak-tube (400), and Kara-butak (300), the last two being more or less fortified. Several merchants in these carry on trade with the Kirghiz, exchanging manufactured goods for wool and skins, which are sent to the frontier settlements of Orenburg. There is a brisk caravan traffic through Turgai.

TURGOT. ANNE ROBERT JACQUES TURGOT, MARQUIS DE L'AULNE (1727-1781), French statesman and economist, was born at Paris, 10th May 1727. He was the third son of Michel Étienne Turgot and of Madeleine Françoise Martineau. His family, which was ancient and noble, is said to have been originally Scottish, but had long been settled in Normandy. His ancestors early abandoned the sword for the robe. Both his father and grandfather had been in the civil service of the state: his father was "prévôt des marchands" at Paris, and won a high reputation as a magistrate and administrator. Turgot in his childhood was timid, and showed in company an absent and embarrassed air, from which he never afterwards entirely freed himself, and which in later life was sometimes unjustly attributed to hauteur. His mother, through excessive or injudicious efforts to correct these faults, appears to have aggravated them. He obtained his early education at the Collége Louis-le-Grand, and was afterwards a student of the Collége du Plessis. He then entered the seminary of St Sulpice, and thence passed to the Sorbonne with the view of taking his licence in theology. But he decided finally in 1751 not to follow the ecclesiastical profession. His opinions were inconsistent with that calling, and he said "he could not consent to wear a mask all his life." He showed at this time an enthusiastic love of literature and powers of memory which are described as "prodigious," as well as a penetrating intellect and a sound judgment. We have the testimony of the Abbé Morellet, who was then his intimate acquaintance and constant companion, to the singular purity, the simplicity, modesty, and frank gaiety which characterized him.

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[1] See P. S. Nazaroff, in "Recherches Zoologiques dans les Steppes des Kirghizes," in *Bull. Soc. des Natur. de Moscow*, 1886, No. 4.

As prior of the Sorbonne (an honorary office conferred annually on some distinguished student) he wrote and delivered publicly in 1750 two remarkable pieces,—one *On the Benefits which the Christian Religion has conferred on Mankind*, the other *On the Historical Progress of the Human Mind*. Having chosen the law as his profession, he was appointed in 1752 "conseiller substitut du procureur général," and afterwards "conseiller au parlement." The controversy arising from the refusal of the sacraments to the Jansenists by the archbishop of Paris being then agitated between the parlement and the clergy, Turgot wrote (1753) *Letters to a Vicar-General on Toleration* and a pamphlet entitled *Le Conciliateur*, in favour of religious liberty and against the interference of the temporal power in theological disputes. In 1753 he became "maître des requêtes." He discharged his professional duties with scrupulous purity and conscientious industry. He continued at the same time his studies in ancient and modern literature (including English and German), mathematics, astronomy, chemistry, and natural history, and frequented the salons of Madame de Graffigny (authoress of *Les Lettres Péruviennes*), Madame Geoffrin, and Madame du Deffand. Whilst he enjoyed the acquaintance and society of D'Alembert, Baron d'Holbach, Raynal, Marmontel, Morellet, Galiani, Helvétius, and other notabilities of the time, he maintained his intellectual independence and refused to connect himself with any party or political group. About this time he also entered into relations with Quesnay and Gournay—the principal members of the physiocrats. He was attracted to them by the similarity of their sentiments on social questions and their opinions on economic policy to those which he himself entertained. Turgot accompanied Gournay in 1755 and 1756 in his official tours of inspection as intendant of commerce, and on Gournay's death in 1759 he wrote his *Éloge*. He then made a short visit to eastern France and a part of Switzerland. When he arrived at Geneva he went to see Voltaire at Les Délices, and formed with him what proved to be a lasting friendship. He contributed about this period several articles to the *Encyclopédie*. In 1761 the controller-general Bertin appointed him intendant of the *généralité* of Limoges. In that district the mass of the people were sunk in poverty and barbarism; the corvées for the construction of roads and the transport of military equipages were oppressive; the country was depopulated by the requisitions for the militia; the taxation was excessive and unfairly distributed; the state of the roads was wretched; and the general condition of agriculture was deplorable. Turgot's administration of the district lasted for thirteen years, and was marked by a steady pursuit of the public good, and a firm resistance to inertia, prejudice, and corruption. In particular he strongly maintained the cause of the industrious poor, and insisted on a more equitable assessment of the public charges which pressed unduly upon them. With nobly disinterested spirit he refused to be transferred to other *généralités* in which the salary was higher and the administration easier. Rising above the common prejudices of the *philosophes*, he sought the cooperation of the clergy, both to inform him of everything relating to the circumstances of the people which it was desirable for him to know, and to explain to their flocks the nature and objects of the measures he proposed to put in operation; and he acknowledges that he found in them earnest and active auxiliaries. But he was not seconded as he ought to have been by the central Government, and had often to remonstrate with the Abbé Terray, minister of finance. During the scarcity of 1770 and 1771, which was particularly severe in Limousin, he devoted himself with untiring assiduity to the relief of the distressed, and, when he had exhausted such public funds as were available, incurred for the same object a personal debt of more than 20,000 livres. Shortly after the accession of Louis XVI. Turgot was appointed by Maurepas (19th July 1774) minister of marine, and in that capacity began at once to initiate important reforms and to conceive far-reaching projects. But he filled the post only for five weeks, being then (21st August) promoted to the ministry of finance. In his new office he addressed to the young king a declaration of the principles by which he intended to be guided: "No bankruptcy, no increase of taxation, and no borrowing." Economy and wise management were to be his only resources. Fearing the opposition he must encounter, he appealed to Louis to support him. By a decree of the 13th September 1774, he re-established free trade in grain within the kingdom, which had been suspended by Terray, and authorized the importation of supplies from abroad; the traffic in other alimentary substances was also relieved of many impediments, and various monopolies and exclusive privileges were abolished; the *octroi* taxation was reformed, public works promoted, and improvements in agriculture encouraged. Some of these measures were made the pretext for disturbances, known as *la guerre des farines*, which Turgot always suspected the Prince de Conti of having fomented. The riots had to be suppressed by armed force, and the energetic action of the minister against them was made a ground of attack by his enemies. The parlement had been weakly recalled by Louis from the exile to which in the preceding reign Maupeou had condemned it. It now constituted itself the organ of the resistance of menaced interests to the measures of Turgot, who would gladly have abolished it, providing in its place better political securities and courts of justice on a new plan. In January 1776 he presented to the king a memoir proposing, amongst other things, the abolition of the corvée, to be replaced by a territorial tax, from which the privileged classes were not to be exempt, and the suppression of the *jurandes* (exclusive trade corporations). The edicts for these purposes were submitted to Miromesnil, keeper of the seals, a secret enemy of Turgot, who, spurred on by Maurepas, wrote a memoir against them, and opposed them in the king's council. The courtiers, the nobility, the clergy, and the leading members of the industrial corporations now combined against the minister, and were joined by a large part of the common people, who did not understand his policy. The Count de Provence, afterwards Louis XVIII., wrote a pamphlet, entitled *The Dream of M. de*

Maurepas, against Turgot. The parlement refused to register the decrees; but the king held a *lit de justice*, which Voltaire proposed to call a *lit de bienfaisance*, and compelled the registration. This forced submission only aggravated the rancour of Turgot's enemies, and the king had not the firmness to sustain his minister against the coalition. A vile conspiracy having poisoned Louis's mind against him, he addressed to the king an eloquent letter in which he pointed out the grave perils impending over the throne and the state, and warned Louis that princes who are tempted to give themselves up to the direction of courtiers should remember the fate of Charles I. The minister received his dismissal on the 12th of May 1776. He had been in office only twenty months, of which he had lost six in repressing sedition, and for seven more had been confined to his bed by the gout; but he had done during his tenure an extraordinary amount of work. Voltaire, however, nobly avenged Turgot on his enemies in his *Épitre à un Homme*. The fallen minister devoted his remaining years to his favourite studies, especially to physical science and the ancient poets; he enjoyed the society of Lavoisier, D'Alembert, Condorcet, Bossut, Rochon, and Rouelle, and attended the meetings of the Academy of Inscriptions, of which he was elected vice-director in 1777. He also corresponded with Price and Franklin, and, if we may believe Condorcet, with Adam Smith, whose acquaintance he had made at Paris in 1766.[1] Turgot died at Paris on 18th March 1781.

Turgot's official career is for ever memorable in the history of social politics. Never did a public man give himself to the service of the community with more earnest and unselfish devotion. He made it his object to convince before commanding, in order that his aims might be better understood and his directions more surely obeyed; and, in issuing any instruction, making any decision, or advising any legislative act, he stated fully, by way of preamble, the grounds on which he proceeded. In the documents which he prepared on these occasions we have a body of valuable materials on administrative and economic questions; some of them contain the substance of chapters in the *Wealth of Nations*. When he became minister, the finances were in what seemed a desperate condition, and the general state of affairs justified the prediction of Louis XV.—"après moi le déluge." Turgot framed a vast plan of reform, at once administrative and economic, as the only hope for the salvation of the state. He speaks of his system of measures as intended for "the regulation of the kingdom," thus showing that he contemplated nothing less than a pacific revolution. But the first condition of success in such an effort was wanting, namely, the entire confidence and unfaltering support of the king, and the energetic exercise of the royal power in carrying out a policy of thorough reform against all adverse influences.[2] Turgot's struggle, though it failed from causes independent of himself, cannot be regarded without profound sympathy and admiration. Nor was it without a large measure of immediate success. Whilst he scrupulously observed all the pecuniary obligations of the state, he greatly diminished the crushing deficit which he found on his accession to office, and re-established the public credit in such a degree that the Dutch bankers offered him a loan of sixty millions of livres at less than 5 per cent. His financial and other plans, of course, fell with him, and his most important measures were annulled; but his policy and his writings exercised a lasting influence, and many of his projects were realized by the Revolution. Turgot is altogether one of the most massive and imposing figures of the 18th century. His whole character and public action are marked by an air of austere grandeur. Single-mindedness and veracity were of the very essence of his nature. Absolutely unbiased by selfish ends, he lived only for France, for truth, and for his duty. Believing intensely in a definite system of social and economic principles, which he had early formed by independent study and reflexion, he was prepared to carry them out with dauntless determination, and with a lofty contempt for the interested or prejudiced opposition they were sure to encounter. He has been accused of a doctrinaire rigidity, and it is possible that, as a practical man, he wanted flexibility; yet he was often willing, not indeed to disguise his convictions, but to postpone the realization of his plans. In his public acts he always showed a lively concern for the poor and the suffering; in private life he was humane and benevolent; in his relations with his friends, amiable and affectionate. Malesherbes, the only other minister of his time who was worthy to be his colleague, said of him that "he had the head of Bacon and the heart of L'Hôpital," and, on the moral side at least, this was no exaggerated estimate.

Possessed of a many-sided culture, Turgot wrote on a great variety of subjects—philosophic, scientific, and literary—though political economy is the branch of knowledge with which his name must always be most closely associated. Already in 1749, whilst a student at St Sulpice, he addressed to his friend, Abbé de Cicé, afterwards bishop of Auxerre, a *Letter on Paper Money*, in which he asserted, in opposition to the views of Law and his followers, doctrines similar to those now accepted by all competent authorities. In one of his discourses at the Sorbonne in 1750, moving into the higher regions of the philosophy of society, he makes a remarkable attempt to work out the pregnant conception, already enunciated by Pascal, of the continuity of the intellectual movement of our race, thus preparing the way for Condorcet's *Esquisse*, and ultimately for the sociology of Comte. In 1753 he translated under the title of *Questions Importantes sur le Commerce*, a tract of Dr Josiah Tucker on the expediency of naturalizing foreigners. He contributed to the *Encyclopédie* the articles *Étymologie*, *Existence*, *Expansibilité*, *Fondations*, and *Foires et Marchés*. The first of these contains much that is just as well as interesting, though in the time of Turgot the subject could not yet be treated on genuinely scientific bases. In the second he undertakes a refutation of the Berkeleian theory. The third contains some ingenious suggestions in practical physics. The article on foundations maintains the right of the Government to dispose of them for the public good, suppressing them if hurtful, and directing the funds to more useful objects; the policy advocated in it was afterwards carried into effect by the constituent assembly. In the paper on fairs and markets he argues that these are institutions adapted only for an immature state of commercial relations, and that more good would be done by liberating trade from the legislative fetters which everywhere impeded it than by bestowing special privileges or other encouragements on particular localities as centres of exchange. In the *Éloge* of Gournay he combines with his tribute to the memory of his friend a vindication of the principle of industrial freedom, which that friend had condensed in the oft-repeated maxim, "Laissez faire, laissez passer." To the period of Turgot's intendance belong his unfinished *Valeurs et Monnaies*, intended to form an article in the *Dictionnaire de Commerce* of Morellet; his *Letters* (to the Abbé Terray) *on the Freedom of the Corn-Trade*; his memoir *Sur les Prêts d'Argent*, in which he insists on the necessity of leaving free the interest on loans; and that on the principles which should direct legislation respecting mines and quarries, as well as the work on which his reputation as a systematic economist mainly rests, namely, his *Réflexions sur la Formation et la Distribution des Richesses*. This treatise was written for two Chinese youths who had been sent over by the Jesuit missionaries to study in France. The work was first published in 1766 in the *Éphémérides du Citoyen*, edited by Dupont de Nemours, and speedily passed through four editions. It gives in brief compass a luminous statement of some of the most important principles relating to the economic constitution of societies—the division of labour, the origin and use of money, the nature of capital and the different modes of its employment, the necessary rise of capitalist chiefs of industry, the legitimacy of interest on loans, and the impossibility of arbitrarily fixing the rate of that interest. It unfortunately contains, along with many truths, the erroneous doctrines of the physiocrats on the exclusive productiveness of agriculture and on the consequent propriety of imposing taxes only on the land of a country. This book was erroneously represented by Condorcet as "the germ of the *Wealth of Nations*," and has been spoken of by others as "anticipating some of the leading principles" of Smith. The truth is, most of what it contains had either been fully set forth by the earlier economists or was familiar to Quesnay and his group. It is, in fact, not a work of research but of exposition, and, regarded in this light, has real originality and may justly be pronounced a masterpiece.

Fuller information on the life, administrative labours, and writings of Turgot will be found in the following works:—Dupont de Nemours, *Notes et Mémoires sur la Vie, l'Administration, et les Ouvrages de Turgot*, 1782, and enlarged in his edition of Turgot's works mentioned below; Condorcet, *Vie de Turgot*, 1786; A. Batbie, *Turgot, Philosophe, Économiste, Administrateur*, 1861; J. Tissot, *Turgot, sa Vie, son Administration, ses Ouvrages* (a *mémoire couronné*), 1862; A. Neymarck, *Turgot et ses Doctrines*, 1885. The last-named contains the most complete treatment of the subject. See also an *Éloge* by Dupuy (1781) in the *Mémoires de l'Académie des Inscriptions et Belles-Lettres*, vol. xlv.; L. de Lavergne, *Les Économistes Français au Dix-Huitième Siècle*, 1870, and Mr John Morley's article in his *Critical Miscellanies*, 2d series, 1877. A collected edition of Turgot's writings was published for the first time by Dupont in 9 vols. (Paris 1808-11); the most complete and in every respect best edition is that contained in the *Collection des Principaux Économistes* of Coquelin and Guillaumin, 2 vols., 1844, with a biographical notice by Eugene Daire. An English translation of *The Formation and Distribution of Wealth* was published in London in 1793, and was reprinted in 1859 in Lord Overstone's *Select Collection of Scarce and Valuable Economical Tracts*, edited by J. R. M'Culloch. (J. K. I.)

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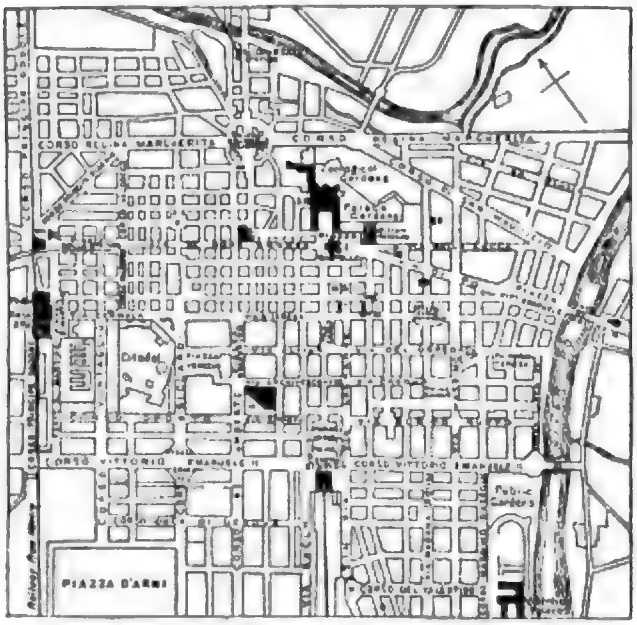
[1] Dugald Stewart, however, cannot find any evidence of a correspondence between Turgot and Smith. It has also been said that during this period Turgot corresponded with Hume. But little more than three months intervened between his dismissal and the death of Hume (25th August 1776) and there appears to be no trace of letters having passed between them in this interval. They had corresponded, but at a much earlier date; see Burton's *Life of Hume*, ii. 352, 381.

[2] Some have thought that the cardinal error in Turgot's policy lay in his not having convoked the states-general; that would, however, have been simply to open the flood-gates.

TURIN, a city of northern Italy, formerly the capital of Piedmont and the Sardinian states and now the chief town of a province in the compartimento of Piedmont, is situated in 45° 4′ 8″ N. lat. and 7° 48′ 22″ E. long. in the alluvial valley of the Po, just above the confluence of the Dora Riparia. By rail it is 54 miles from the Mount Cenis tunnel. The communal palace stands 788 feet above the sea. The Monte dei Cappuccini in the neighbourhood reaches 922 and La Superga 2405 feet. As viewed from the east the city stands out boldly against the Alps. Taken as a whole Turin may be described as a very modern city, with broad and regular streets, and large squares and public gardens. The cathedral of St John the Baptist is a cruciform Renaissance building dating from the close of the 15th century. The site was first occupied by a church erected, it is said, by the Lombard duke Agilulf (7th century). Behind the high altar of the cathedral (from which it is separated by a glass screen) is the chapel of the Sudario or Sidone, built (1657-1694) by Guarini as a royal burial-place. The "sudario" from which it takes its name is asserted to be the shroud in which Joseph of Arimathea wrapped the body of Jesus. La Beata Vergine della Consolata, another of Guarini's works, has a tower which originally belonged to the church of St Andrew, founded by the monk Bruning in 1014, and attracts attention by Vincenzo Vela's beautiful kneeling statues of Queen Maria Teresa and Queen Maria Adelaide, as well as by the image of the Madonna, which has the credit of having warded off the cholera in 1835. Other churches of some note are San Felippo Neri (1672-1772), the dome of which fell in just as it was approaching completion under the hands of Guarini, and La Gran Madre de Dio, erected to commemorate the return of the royal family in 1814. Of the secular buildings the more interesting are the Madama palace, first erected by William of Montferrat in the close of the 13th century, and the extensive royal palace begun in the 17th century. The university, founded in 1400 by Lodovico di Acaja, has faculties of jurisprudence, medicine and surgery, literature and philosophy, and the mathematical, physical, and natural sciences. The number of students enrolled was 2132 in 1886. About 1876 the old university buildings erected in 1713 by the Genoese architect Ricca began to prove too small for their purpose; and at the present time (1887) new buildings, fitted more especially for the medical and scientific departments, are being erected. The area of the botanical gardens has also been extended and the observatory enlarged. The medical school derives advantage from the number of important hospitals in the city. The royal lunatic asylum can accommodate 980 patients. Turin has a prison on the cell system (672 cells) and a female penitentiary for 300, besides two houses of correction. The academy of sciences was founded in 1757. It occupies a building erected in 1687 by Guarini as a Jesuit college. The museum of antiquities and the picture gallery, of which it has the custody, are both of high interest—the former for the local antiquities of Piedmont and Sardinia (notably from Industria) and for the Egyptian treasures collected by Donati and Drovetti, and the latter for its Van Dycks. There is a museum of zoology and mineralogy in the royal palace (another of Guarini's buildings), and the Castello palace contains the royal armoury (a collection made by Charles Albert in 1833) and the royal library with its rich manuscript collection and its 20,000 drawings, among which are sketches by Raphael, Michelangelo, and Da Vinci. The civic museum has a great variety of artistic and literary curiosities, among them a remarkable collection of autographs and the Lombard missal (1490). The Jewish synagogue, a striking and conspicuous building, erected in 1863 by Alessandro Antonelli, was purchased by the municipality in 1879 for a Renaissance museum. Other public institutions are the Albertine academy of the fine arts, the geographical society, and the Alpine club.



1. Madama palace.
2. Royal palace.
3. Cathedral.
4. University.
5. Carignano palace.
6. Di Citta palace.
7. Academy of science.
8. Academy of art.
9. Museum.
10. Arsenal.

The industries of Turin and its suburbs give employment to 17,936 persons (13,305 men, 4631 women). Spinning-mills, weaving-factories, "vesta" factories (De Medici), breweries, and ironworks are among the more extensive establishments. The commercial relations of the city are very extensive. It is the seat of the central offices of the North Italian Railway, and the central station is one of the most imposing buildings of its class in the country. The mean annual temperature at Turin (1866-84) is 53° Fahr. (Jan. 36°, July 74°), with a maximum of 96° and a minimum of 4°·1. Mists are frequent in the winter mornings, and to a less degree in autumn. Snow seldom falls in any great quantity, and on an average only on 7 days per annum. The rainfall, distributed over 100 days, reaches 32 inches—December being 1·6 and April 4·3. Water of good quality is brought to the city from a distance of 15 miles. The population of Turin was only about 4200 in 1377 and 9000 in 1530; but by 1702 it was returned as 43,866. In 1848 it had risen to 136,849, and in 1861 to 204,715. In spite of the changes caused by the removal of the capital, first to Florence and then to Rome, the census of 1881 showed 283,124 inhabitants (commune 252,832).

Turin, *Augusta Taurinorum*, took its name from the Taurini or Taurisci, an ancient Ligurian people. The town is first alluded to (but not distinctly by name) in the year 218 B.C., when it was captured by Hannibal after a three days' siege, being at that time a place of great strength. A colony of Roman veterans was introduced into the city, possibly after the battle of Philippi, or at any rate after the battle of Actium. It was assigned to the Stellatine tribe. Of Roman architecture scarcely any trace remains even in the oldest parts of Turin, but the arrangement of the streets of the old town recalls the alignments of the Roman military settlement. The Palazzo delle due Torri, often designated the Porta Palatina, is probably part of a building of the 8th century. Turin continued to be a place of importance and military strength under numerous vicissitudes, till at length it was made the chief town of Piedmont by Amadeus, first duke of Savoy. Under Emmanuel Philibert it became the usual residence of the ducal family, and in 1515 the bishopric was raised to metropolitan rank by Leo X. Between 1536 and 1562 Turin was occupied by the French, and in 1630 it lost 8000 of its citizens by the plague. The French were masters once more from 1640 to 1706, and again from 1798 till 1814, when the Sardinian states were restored to the house of Savoy. Between 1859 and 1865 Turin was the capital of united Italy. Among the many men of mark born in Turin it is enough to mention Lagrange, Gioberti, Cesare Balbo, Cavour, Marochetti the sculptor, D'Azeglio, and Sommellier.

TURKESTAN

THE terms "Turkestan" and "Central Asia" are often used indiscriminately to describe the whole of the immense territory to the east of the Caspian, comprised between Siberia on the north and Khorasan (Persia), Afghanistan, and Tibet on the south, or to designate separate, sometimes arbitrarily determined, parts of the same region. In the beginning of the 19th century the whole of the territory just named, with its great variety of altitudes, climate, inhabitants—these last differing as much in their history as in their present characteristics—was comprised under the vague denomination of High Tartary, or High or Interior Asia. After the appearance of Humboldt's first draft of *Asie Centrale* in 1831, the term "Central Asia" came into favour. But Humboldt's limits of Central Asia were too mathematical (from 39½° to 49½° N. lat.), and were further unsatisfactory because influenced by his erroneous conception of the mountains of Central Asia, which he supposed to run either along parallels or along meridians. Richthofen made an attempt to limit the sense of the term, proposing to apply it only to that region—embracing the Tarim drainage area and the Gobi—which has no outlet either towards the ocean or to the Sea of Aral and Lake Balkash (Balkhash), and which constitutes the Hang-hai of the Chinese and the supposed bed of the Tertiary Asiatic Mediterranean. But this terminology, besides the drawback of including within Central Asia the steppes of the Gobi as far east as Transbaikalia and the Great Khingan, notwithstanding the broad differences by which they are distinguished from the drainage area of the Tarim, was open to another objection, which has been pointed out in M. Mushketoff's *Turkestan*. It excluded from Central Asia Turkestan proper, which nevertheless has had the same recent geological history as the Tarim region, and therefore has so many features in common with it as regards soil, climate, flora, fauna, population, and even civil history. On the other hand, if Central or Interior Asia were to include West Turkestan, and its limits to be determined by those of the drainage-areas which have no outlet to the ocean, the basins of the Volga and Ural,—that is, territories purely European in character,—would have to be comprised under the same denomination. The fact is that in Asia, as so often elsewhere, hydrographical considerations alone furnish no sound basis for geographical delimitations, and that these last must result from a complicated variety of considerations, chiefly orographical, inasmuch as orographical are indicative of other physical characters, such as geology, climate, flora, fauna, and so on. Such were the views of Ritter and Humboldt, and we are now brought back to their conceptions, but corrected into accordance with improved knowledge of the Asiatic continent. The name Central Asia can still be used with great advantage to designate that immense portion of the continent to the east of the Caspian and the Ust-Urt plateau which is limited on the north by the important climatic and geo-botanic boundary of the Irtish and Aral water-parting and the Great or Ektagh Altai, on the east by the eastern Gobi, and on the south by the northern border of the Khor plateau (Altyn-Tagh and Kuen-Lun), the Hindu-Kush, and the Kopet-Dagh. Extensive as it is, this territory has its own climatic and geobotanic features; it forms a distinct part of the continent, when the orography of Asia is broadly viewed; and its inhabitants have a number of common characteristics resulting directly from the physical features of the territory. But this immense area must be subdivided; and its subdivisions become apparent as soon as the orographical features are grasped.

Two great plateaus constitute the two backbones, as it were, of the orographical structure of Asia,—that of eastern Asia, an immense triangle stretching north-eastwards, having the Himalayas for its base and the peninsula of the Tchuktchis for its apex; and that of western Asia, which extends at right angles to the above, from the lower Indus to the Black Sea. The Hindu-Kush connects these two massive swellings, both continents of the oldest formation in Asia. Both are fringed on their northern edges by lofty chains of mountains. The Tian-Shan, the Altai, the Sayan, and the Vitim Mountains rise in a long succession on the borders of the former, while a series of chains, which might be described under the general name of Kopet-Dagh, continued into the Transcaucasian chains, rise on the north-eastern edge of the western plateau.

West Turkestan.

An immense trapezoidal depression occupies the angle on the west where the great plateaus meet, and this depression is West Turkestan. Its south-eastern limits are the Hindu-Kush and the Tian-Shan; on its south-western edge it has the Iranian plateau; and its north-west and north-east boundaries correspond with the edge of the Ust-Urt and the Irtish and Aral water-parting, which separates it from Siberia. The trapezium is 1100 miles long from south-west to north-east, and 900 miles wide from south-east to north-west. It thus includes, not only the depression at the junction of the two plateaus, but also the girdle of alpine tracts which fringes them, and in whose deep and sheltered valleys the Turkish and partly Iranian population of Turkestan find a fertile soil and plenty of water for their fields, while their herds graze on the rich alpine meadows in the very heart of the Tian-Shan. Not orographically only but also in respect of its recent geological past, its climate, flora, fauna, and inhabitants, this region forms a geographical domain by itself, quite distinct from the steppes of south-eastern Russia, the prairies of Siberia, and the two great plateaus by which it is inclosed; and, although it is easily subdivided into two parts—the dry lowlands of the Transcaspian depression and the plains and highlands of Turkestan proper—it presents one geographical whole when contrasted with the surrounding regions. Some doubt may arise as to the propriety of including in it the plateau of Pamir; but its flora and fauna are so closely connected with those of the Tian-Shan that, although better treated as a separate sub-region, like the Transcaspian Turcoman steppes, it cannot be separated from the above. For the orographer, the "Roof of the World" is merely a succession of the wide *syrts* or alpine plateaus that are characteristic of the Tian-Shan. Most of this territory has within recent years been annexed to the Russian empire. Bokhara, with its vassal khanates in the gorges of the Pamir slopes, and Khiva, although they are still described as independent, are in reality rapidly becoming dependencies of Russia, and the railway from the Caspian, which is about to connect Merv with Samarkand, will complete the annexation of Bokhara. West Turkestan, therefore, is often called Russian Turkestan, as distinguished from Chinese or East Turkestan.

East Turkestan.

This second great region of Central Asia also has well-defined limits. A glance at any recent map shows that there is in the great eastern plateau a depression bordered by the deep slopes of the Pamir (Humboldt's Bolor) on the W., the border-ridges of Tibet (Kuen-Lun and Altyn-Tagh) on the S., the eastern Tian-Shan on the N., and the western Gobi on the E.[1] Although we call it a depression, because it is much lower than the surrounding plateaus, it is itself a plateau, ranging from 3000 to 4000 feet above sea-level. This depression—the Hang-hai of the Chinese, which, during the later Tertiary and earlier Quaternary period, was covered by a sea, of which a very small survival still exists in Lob-Nor—is now drained by the Tarim. Its deserts, in which human settlements are now very rare, though formerly the population was much denser, have been described under a variety of names (Little Bokhara, Alty-shar or Jity-shar, Kashgaria, and so on); but the name of East Turkestan has prevailed, and there is no reason for abandoning it, provided it is not confounded with DZUNGARIA (*q.v.*) in the north and the great Desert of Gobi in the east. Dzungaria is a deep trench leading from the lowlands to the central plateau, and has special physical features and a history of its own. The Mongolian Gobi, on the other hand, owing to its position on the lower terrace of the plateau of eastern Asia, must be regarded as a separate unity. In fact, it appears to be more closely connected with the plateau of the Selenga on the north and that of Ordos on the south than with East Turkestan; and it, too, has its own physical features, its own inhabitants, and its own history.

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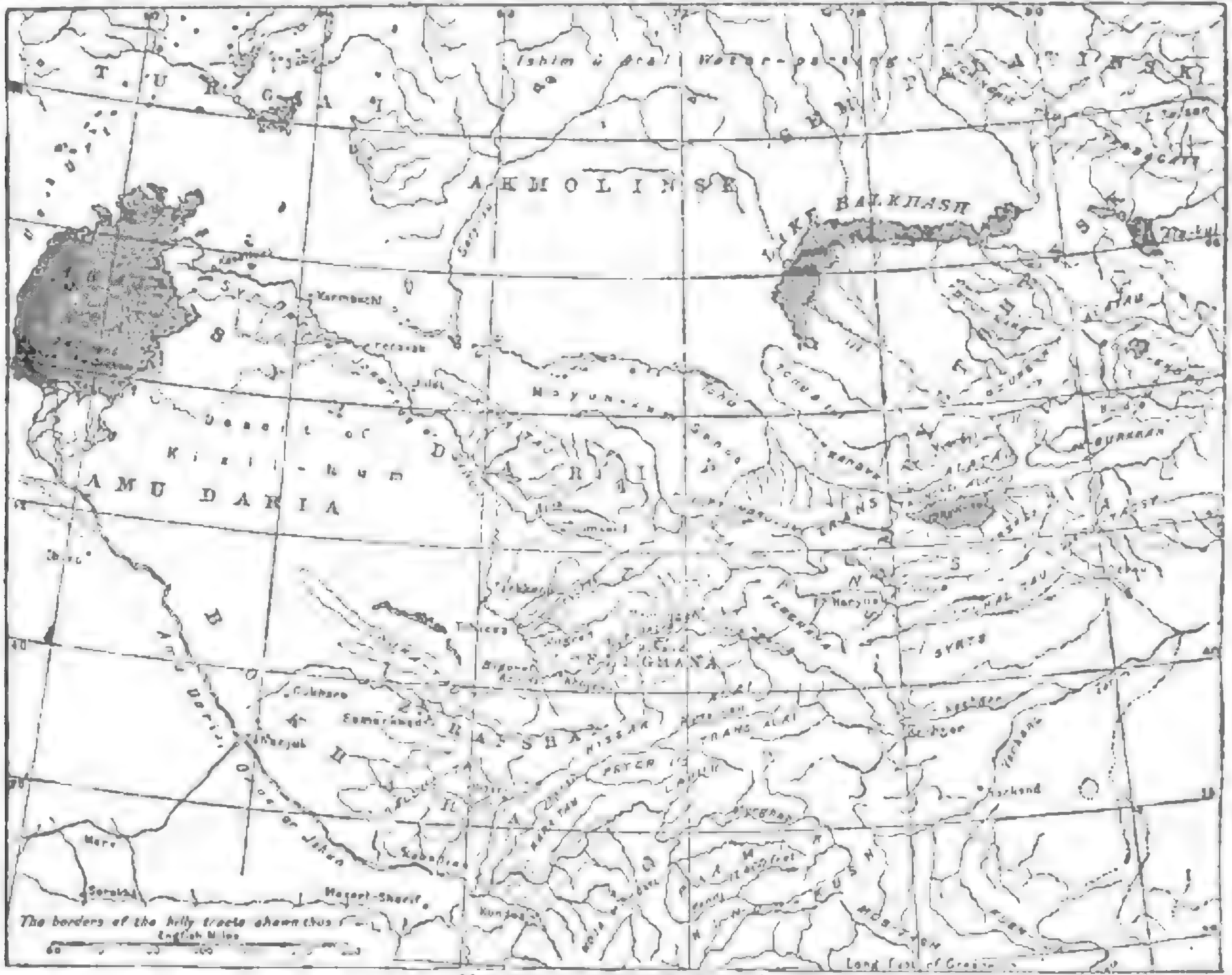
[1] In the map (issued October 1887) embodying the results of Prjevalsky's fourth journey, East Turkestan is plainly demarcated from the Gobi. This last falls by a steep slope towards the Tarim depression,

The expression Central Asia thus includes the following countries. (A) West Turkestan, comprising the Tian-Shan highlands, the Balkash plains, and the Aral-Caspian lowlands, politically divided into Russian Turkestan (the general-governorship of Turkestan and the Aral-Caspian slope of Turgai and Akmolinsk), the Chinese oasis of Kulja (Kuldja), the Transcaspian region, Khiva, Bokhara and its vassal khanates, and parts of Afghan Turkestan. (B) East Turkestan, comprising the Tarim region as far east as Lob-Nor. (C) Dzungaria, limited on the north-east by the Tarbagatai, Altai-Nauru, Irdyn-ula, and Artsa-bogdo Mountains.



Map of East and West Turkestan.[1]

WEST TURKESTAN.

General physical features. As comprised within the above limits, West Turkestan has an area of nearly 1,680,000 square miles, and a population of nearly 8,500,000.[2] It presents a very great variety of aspects, including the lonely plateau of Pamir, in height second only to that of Tibet; the immense complex of alpine tracts described under the general name of Tian-Shan (three times as long as the Alps of Europe), which lift their snow-clad peaks four and nearly five miles above the sea, and feed huge glaciers, while their deep valleys and gorges partake of almost every variety of climate and vegetation; rich prairies and still wider lowlands descending below the level of the ocean; and deserts where the winds, burning hot or icy, but always dry, have free scope to modify the surface, which is bare of vegetation.

Highland region. Nevertheless West Turkestan is sharply divided into two parts,—the highlands in the south-east and the plains and deserts in the north-west. The former cover an area nearly 1000 miles long by 270 broad, of which the northern parts are described under the general name of Tian-Shan (properly, T'han-Shañ). Their distinctive feature is that, like the highlands of Siberia, they constitute a high border-

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which narrows to the east of Lob-Nor and terminates about Añ-si, some 4800 feet above sea-level.

[1] See also the following maps:—HIMALAYA, vol. xi. Pl. XVI.; SIBERIA, vol. xxii. Pl. I.; and TIBET, Pl. IV. above.

[2] Separate portions of it are described under AFGHANISTAN, BOKHARA, KHIVA, OXUS, SYR-DARIA, SEMIPALATINSK, SEMIRYETCHENSK, TRANSCASPIAN REGION, ZERAFSHAN.

Pamir plateau.

ridge, running W.S.W. to E.N.E. on the edge of the great plateau of eastern Asia. This plateau is fringed on its outer side by a complex of shorter ranges, which mostly run parallel to the border-ridges and send off a series of isolated chains, due to a later system of upheaval, through the plains and steppes in a north-western direction. Down to the middle of the 19th century these highlands were almost absolutely unknown, and the orography of Central Asia as shown on our maps was quite hypothetical. Numerous surveys by Russian and British explorers have, however, recently disclosed the real structure of those regions; and it has now become possible to discriminate the leading features of the orographical conformation of the country. The Hindu-Kush, with its snow-clad summits of 18,000 and 20,000 feet, limits the highlands of Turkestan to the south-east. It appears now to be settled that this ridge runs from north-east to south-west, as far at least as the latitude of Cabul, and possibly still farther south; and the last Russian surveys of the Pamir show that it extends north-east as far as Tash-Kurgan (37° 45′ N. lat., 75° E. long.). At the foot of its north-western slope it has the plateau of Pamir—the "Roof of the World,"—with an area of about 37,000 square miles. A series of chains, gently sloping and dome-shaped, rising 4000 or 5000 feet above the level of the plateau, traverse it from south-west to north-east, with a remarkable parallelism, dividing it into a series of broad parallel flat-bottomed grooves or valleys, which do not sink below 10,000, and sometimes 14,000, feet above sea-level. Thus the features of the lower plateaus of north-eastern Asia reappear here on a greater scale, having the same characters and the same direction in the plaitings of the earth's crust.

Nearly 150 miles to the north-west of the Hindu-Kush lies the north-western border of the Pamir, fringed by the lofty Trans-Alai Mountains. Their crest, covered with snow, rises nearly 4 miles above the sea (Kaufmann Peak 23,000 feet); but the traveller approaching them from the south would hardly guess their height, because their southern slope towards the wildernesses of the plateau, themselves 13,000 feet high, is very gentle. The great elevation of the border-chain is only realized when it is seen from the Alai valley on the north, where its steep and deeply furrowed sides tower up like a dark wall, from 11,000 to 14,000 feet high, above the high and broad valley of the Kizil-su. The geological structure of the Alai valley must not be inferred from its orographical features, otherwise we should describe it as longitudinal. It is watered by the Kizil-su, which flows towards the west-south-west and joins the Amu-Daria under the name of Vaksh (or Wakhsh). On the north it has the lofty Alai-Tagh range, also partially snow-clad. On our best maps the Trans-Alai Mountains are figured as an isolated range, some 120 miles in length; and it cannot yet be affirmed with certainty which chains of the Tian-Shan, possessing the same border-ridge characters, ought to be considered as its continuations. Further research is needed to determine whether it is continued south-west by the Darvaz, or Lahor, Mountains, where the group of lofty Sel-tau peaks feed the extensive Fedtchenko glacier, or by the Hoja-Mahomet chain on the left bank of the Amu-Daria.[1] Thus the real north-western limits of the Pamir are still unsettled. As for the north-eastern continuations of the Trans-Alai, the present writer is inclined to trace them, not in the Kokshal-tau, but in the Terskei Ala-tau and the high mountains of Sary-yassy, where the Khan-Tengri lifts its snow-clad granitic cap 24,000 feet above the sea, and is surrounded by numerous vast glaciers (Semenoff's and Mushketoff's Muz-art). It would thus separate, broadly speaking, the drainage area of the Tarim from those of Lake Balkash and the Sea of Aral. Thus the border-ridge of the Central Asian plateau would have a length of more than 1000 miles from the Amu to Kulja, and the valleys of the upper Naryn and Tekkes would therefore be homologous with that of the Alai.

Alpine tracts.

A girdle of alpine tracts, from 150 to 180 miles in width, which fringes the outer edge of the Pamir plateau, consists of shorter chains running parallel to the border ridge and ranging from 11,000 to 17,000 and 20,000 feet in altitude. They are separated by deep valleys, mostly with three separate foldings of Azoic rocks. Some of these ranges are covered with perennial snow and feed great glaciers, among which Schurovsky and Fedtchenko glaciers around the lofty Kok-su group are especially worthy of mention. These subsidiary chains all belong to the oldest system of upheavals, which have had a north-east direction, and which at four different places are modified by more modern ones having a north-western direction. In lat. 47° N. the orographical structure becomes more complicated, the alpine region being pierced by the broad Dzungarian trench, which leads from the lowlands of the Irtish to the heights of the Central Asian plateau. A high ridge—the Tarbagatai—continued in the Tchinghiz (Jinghiz) and Karkaralinsk Mountains, branches off north-westwards, separating Turkestan from Siberia. Further east the Tian-Shan is continued on our maps in an eastern direction; but our knowledge of it still remains very imperfect.[2]

Lacustrine basins of Tian-Shan.

A series of deep depressions,—Balkh, Ferghana, Issyk-kul, and Kulja,—sinking to low levels amidst the Tian-Shan highlands follow one another in a north-east direction. That of Issyk-kul is occupied by the lake of the same name (5000 feet above the sea), while the second and fourth, now desiccated, are lacustrine basins. A great number of smaller lacustrine basins, mostly filled with Tertiary conglomerates, occur higher up in the mountains. For the orographer and the geologist they are homologous with those of the Altai and east Siberia (Bukhtarma, Us, Irkut, Barguzin, and others). The rivers that issued from the high alps had to pierce many parallel ridges in order to reach the plains, and they frequently expanded into wide lakes before cleaving through the chains of mountains the narrow and deep transverse gorges by which they descended to the lower terraces.

Lowland plains.

Like the highlands of Siberia, those of Turkestan are fringed by a girdle of plains, having an altitude of from 1000 to 1500 feet, and these again are skirted by an immense lowland area reaching only 400, 300, and 150 feet, or even sinking below the level of the ocean. These plains and lowlands cover nearly 650,000 square miles. Some geographers divide them into two portions,—the higher plains of the Balkash (the Ala-kul and Balkash drainage areas) and the Aral-Caspian depression, which occupies nearly two-thirds of the whole and has been ably described by M. Mushketoff under the appropriate name of Turanian basin,—the Kara-tau Mountains being considered as the dividing line between the two. The Balkash plains, more than 1000 feet above the sea, and covered with clay, with a girdle of loess at their foot, are well watered by the Ili and other feeders of Lake Balkash (see SEMIRYETCHENSK) and on their rich prairies are the homes of numerous Kirghiz. In the south-west the clayey soil becomes saline. There is the Famine steppe (Bek-pak-dala), while in the Ak-kum steppe, which surrounds Lake Kara-kul, large areas are covered with sands, partly shifting. A gulf of clayey plains penetrates up the Ili into the interior of the mountains, and its thick layers of loess form the Kulja oasis. Another gulf, penetrating much more deeply into the highlands up the trench occupied by Lakes Ebi-Nor and Ayar, and joining the trench of the upper Irtish, leads by an imperceptible gradient up to the plateau of Central Asia. It is known as the "Dzungarian Gate," and a gate it has been since the dawn of history for whole nations of nomads who have migrated from the rapidly desiccating plateau down to the grassy prairies of Siberia and Russia. The plains and lowlands of the Turanian basin are subdivided by a line drawn from north-east to south-west along a slight range of hills running from the sources of the Ishim towards the south-east corner of the Caspian (Bujnurd and Elburz edge of Khorasan). This low range, which most probably separated the lowlands of the Aral-Caspian region (submerged during the Post-Pliocene period) from the higher plains which had emerged by the end of the Tertiary period, now divides the Transcaspian steppes from the somewhat different higher plains (see TRANSCASPIAN REGION). In the Turanian basin the contrast between desert and oasis is much stronger than in the Balkash region. Fertile soil, or rather soil which can be rendered fertile by irrigation, is limited to a narrow terrace of loess along the foot of the mountains (see SYR-DARIA), and is surrounded by barren deserts. Even where the loess spreads over terraces at some distance from the mountains, as in the south-east Transcaspian region, it can be cultivated only when irrigated. The dryness of the climate is excessive: rain falls only where the hills cause the clouds to condense, the soil elsewhere being moistened only occasionally by a few showers. Two rivers only—the Syr and the Amu—succeed in crossing the desert and reaching the Sea of Aral. But their former tributaries no longer run their full course: the glacier-fed Zerafshan dries up amidst the gardens of Bokhara soon after emerging from the highlands; and the Tejen, the Murghab, and the Andkho lose themselves amidst the fields of the Turcomans. The only tributaries which the Amu retains are those which have the whole of their course in the highlands. In the north such formerly important tributaries of the Syr-Daria as the Tchu, with its subtributary the Sary-su, now dry up some hundreds of miles distant from the main stream. The arid desert absorbs every drop of running water which reaches its borders.

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[1] See G. Grum-Grzimailo, in *Izvestia* of Russ. Geog. Soc., vol. xxii., 1886.

[2] The present writer is inclined to consider the "Eastern Tian-Shan" of our maps, which runs east-south-east to Bagratch-kul, as a separate chain belonging to the more modern system of north-western upheavals, meeting at its eastern extremity a chain which trends towards the north-east.

Desiccation of West Turkestan.

The whole area is now undergoing geological changes on a vast scale. Rivers have changed their courses, and lakes their outlines. Far away from their present shores the geologist finds indubitable traces of the recent presence of the lakes in the shells they have left amidst the sands. Traces of former rivers and channels, which were the main arteries of prosperous regions within the period of written history, have now disappeared. Of the highly developed civilizations which grew up and flourished in Bactriana, Bokhara, and Samarkand the last traces are now undergoing rapid obliteration with the desiccation of the rivers and lakes. The great "Blue Sea" of Central Asia, the Sea of Aral, which at a recent epoch (Post-Glacial) extended south-west to Sary-kamysh, and the shells of which are found north and east of its present shores from 50 to 200 feet above its present level (162 feet above the ocean, and 245 above the Caspian), now occupies but a small portion of its former extent. It covers a shallow depression, some 23,000 square miles in area, which is drying up with astonishing rapidity, so that the process of desiccation can be shown on surveys separated only by intervals of ten years; large parts of it, like Gulf Aibughir, have dried up since the Russians took possession of its shores. Steamers regularly ply on its waters and ascend both its tributaries. The whole country is dotted with lakes, which are rapidly disappearing under the hot winds of the deserts; and the clayey *takyrs* of the steppes give evidence of thousands of lakes which have quite recently ceased to exist, leaving beds of clay kept wet by the condensed moisture of winter and the few rain-showers of early spring.

Geology.

Like the highlands of eastern Asia, those of Turkestan are mostly built up of Azoic gneisses and metamorphic slates, resting upon granites, syenites, old orthoclase porphyries, and the like. These upheavals date from the remotest geological ages; and since the Primary epoch a triangular continent having its apex turned towards the north-east, as Africa and America have theirs pointing southward, rose in the middle of what now constitutes Asia. It is only in the outer foldings of the highlands that Primary fossiliferous deposits are found,—Devonian, Carboniferous, and Permo-Carbonic. Within that period the principal valleys were excavated, and their lower parts have been filled up subsequently with Jurassic, Cretaceous, and Tertiary deposits. One of the most striking instances of this is the very thick Cretaceous and Tertiary deposits which cover the bottom of the valley of the Vaksh (right tributary of the Amu) and are continued for about 300 miles to the north-east, as far as the Alai valley,—probably along the edge of the Pamir plateau. The deposits of the Secondary period have not maintained their horizontal position. While upheavals having a north-eastern strike continued to take place after the Carboniferous epoch,[1] another series of upheavals, having a north-western strike, and occasioned by the expansion of diabases, dolerites, melaphyres, and andesites, occurred later, subsequently at least to the close of the Tertiary period, if not also before it, dislocating former chains and raising rocks to the highest levels by the addition of new upheavals to the older ones. Throughout the Triassic and Jurassic periods nearly all Turkestan remained a continent indented by gulfs and lagoons of the south European Triassic and Jurassic sea. Immense fresh-water lakes, in which were deposited layers of plants (now yielding coal), filled up the depressions of the country. Cretaceous and Tertiary deposits occur extensively along the edge of the highlands. Upper and Middle Cretaceous, containing phosphates, gypsum, naphtha, sulphur, and alum, attain thicknesses of 2000 and 5000 feet in Hissar. Representatives of all the Tertiary formations are met with in Turkestan; but, while in the highlands the strata are coast-deposits, they assume an open sea character in the lowlands, and their rich fossil fauna furnishes evidence of the gradual shallowing of that sea, until at last, after the Sarmathian period, it became a closed Mediterranean. During the Post-Pliocene period this sea broke up into several parts, united by narrow straits. The connexion of Lake Balkash with the Sea of Aral can hardly be doubted; but this portion of the great sea was the first to be divided. While the Sea of Aral remained in connexion with the Caspian, the desiccation of the Lake Balkash basin, and its break-up into smaller separate basins, were already going on. The Quaternary epoch is represented by vast morainic deposits in the valleys of the Tian-Shan. About Khan-Tengri glaciers descended to a level of 6800 feet above the sea,[2] and discharged into the wide open valleys or *syrts*. It is most probable that, when allowance has been made for the obliteration of glacial markings, and the region has been better explored, it will appear that the glaciation of Turkestan was on a scale at least as vast as that of the Himalayas. In the lowlands the Aral-Caspian deposits, which it is difficult to separate sharply from the later Tertiary, cover the whole of the area. They contain shells of molluscs now inhabiting the Sea of Aral, and in their petrographical features are exactly like those of the lower Volga. The limits of the Post-Pliocene Aral-Caspian sea have not yet been fully traced. It extended some 200 miles north and more than 90 miles east of the present Aral shores. A narrow strait connected it with Lake Balkash. The Ust-Urt plateau and the Mugojar Mountains (see TURGAI) prevented it from spreading north-westward, and a narrow channel connected it along the Uzboi (see p. 512 *supra*) with the Caspian, which sent a broad gulf to the east, spread up to Volga, and was connected by the Manytch with the Black Sea basin. Great interest, geological and historical, thus attaches to the recent changes undergone by this basin; but much still remains to be done before the numerous questions arising in connexion with it can be settled. Since the theory of geological cataclysms was abandoned, and that of slow modifications of the crust of the earth accepted, new data have been obtained in the Aral-Caspian region to show that the rate of modification after the close of the Glacial period, although still very slow, was faster than had been supposed from the evidence of similar changes now going on in Europe and America. The effects produced by desiccating agencies are beyond all comparison more powerful than those which result from the earthquakes that are so frequent in Turkestan. All along the base of the highlands, from Khojend to Vyernyi, earthquakes are frequent;[3] but, however destructive of life, their effects lie beyond the scope of our observational methods.

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[1] Mushketoff's *Turkestan* (pp. 35, 381) seems to justify this conclusion.

[2] See I. Ignatieff, in *Isvestia* of Russ. Geogr. Soc., vol. xxiii., 1887.

[3] For a list of them, see *Isvestia* of Russ. Geogr. Soc., vol. xxiii., 1887; [illegible] Orloff, in *Mem. of Kazan Naturalists*, 1873, iii.

Climate. The climate of West Turkestan is exceedingly dry and continental. Although the country is comprised within the latitudes of Sicily and Lyons, it has a south Norwegian January and a Persian summer. Temperatures of more than 100° Fahr. in the shade are common, and the heat is rendered still more unbearable by the reflexion from a soil destitute of vegetation. The winter is for the most part so cold that the average temperature of January is below the freezing point, and even reaches 0° Fahr. Snow falls for several months on the lower Syr-Daria, and, were it not blown away by the winds, sledge-communication would be possible. This river is frozen for an average of 123 days every year in its lower parts, and nearly 100 days at Perovsk. At Tashkend there is snow during two months and temperatures of −10° Fahr. have been measured. In 1876, on 24th October, almond-trees, vines, and cotton crops were buried under a heavy snowfall. To the south of Khojend the winter becomes more clement. Absence of rain is the distinctive feature of the climate. Although it rains and snows heavily on the mountains, only 11 inches of rain and snow fall throughout the year at Tashkend, at the base of the highlands; and the steppes of the lower Amu have less than 3 inches. A few showers are all that fall from the almost invariably cloudless sky above the Transcaspian steppes. The following table will illustrate the climate of Turkestan:—

	Latitude.	Height in feet.	Average temperature.			Rain in inches.
			Year.	January.	July.	
Akmolinsk	51° 12′	1020	28°·8	0°·0	69°·2	8·2
Semipalatinsk	50° 24′	590	27°·0	−0°·7	72°·5	7·7
Irghiz	48° 37′	360	41°·8	8°·4	76°·2	6·1
Kazalinsk	45° 45′	160	45°·5	10°·6	78°·0	7·9
Alexandrovsk	44° 33′	−80	51°·2	25°·0	78°·0	..
Kulja	43° 51′	2100	48°·7	14°·4	70°·5	..
Nukus	42° 27′	215	53°·0	19°·4	79°·6	2·9
Petro-Alexandrovsk	41° 28′	335	55°·0	..	..	2·4
Tashkend	41° 19′	1420	58°·3	29°·0	77°·5	11·2
Krasnovodsk	40° 00′	−70	59°·8	36°·3	83°·2	..
Yarkand (East Tur.)	38° 21′	4120	54°·2	21°·2	81°·7	..

Fauna. The fauna of Turkestan belongs to the great zoo-geographical domain of northern Asia, and is only differentiated by the presence of species which have disappeared from the peripheric parts of the Old World and now find a refuge in the remotest regions of the uninhabited plateau. From the great Palæoarctic region it is distinguished by the presence of Himalayan species. The distinctive animal of the Pamir plateau is the magnificent *Ovis poli* (conjectured to be the ancestor of our common sheep), mentioned by Marco Polo and rediscovered by Syevertsoff. It breeds by thousands on the Pamir, climbing the highest ridges, which it prefers to the valleys. The region to which it is confined has the shape of an ellipse, with its longer axis running south-west to north-east. The animal is rare on the upper Naryn, and never penetrates to the west of Sel-au. In the alpine tracts of the Tian-Shan, on the borders of the Pamir, their horns and skulls are frequently met with, but there the place of the species is now taken by *Ovis karelini*. The wild horse, which occurred in Poland a few centuries ago, has been discovered by Prejevalsky in the highlands of Dzungaria and described as *Equus prjevalskii* by Polyakoff. The wild camel inhabits the lonely plateaus south of the Ala-Shan; but no description of it has been published. The other mammals of Turkestan are mostly those which are met with elsewhere in north Asia. The large light-coloured Himalayan bear (*Ursus isabellinus*) has its home on the Pamir, and the smaller, strong, white-clawed *Leuconyx* up to the highest levels on the Tian-Shan. Antelopes, *Lepus lehmanni*, *Lagomys rutilus*, various species of *Arvicolæ*, and the Himalayan long-tailed marmot (*Arctomys caudatus*), the most characteristic inhabitant of the alpine meadows, are the only mammals of the Pamir proper. In the alpine region are found the badger (*Meles taxus*), the ermine (*Fœtorius ermineus*) and six other *Mustelidæ*, the wild dog (*Canis alpinus*), the common and the black-eared fox (*C. melanotis*), while the corsac fox (*C. corsac*) is met with only on the plains. Two species of lynx, the cheetah (*Felis jubata*), *Felis manul*, and *Felis irbis*, this last extending westwards as far as the Persian Gulf and eastwards as far as the river Amur, must be added to the above. The tiger is met with only on the lower Amu-Daria, except when it wanders to the alpine region in pursuit of the maral deer (*Cervus maral*). The jackal is characteristic of the steppes; it banishes the wolves and foxes. Hares are represented by several species, *Lepus lehmanni* being the most characteristic. Both the common and the long-tailed marmot (*A. baibacinus* and *A. caudatus*) are found at the foot of the mountains, as also four species of *Spermophilus*, three of voles, two of the mouse, and three of the hamster. The *Meriones* (four species) and the jerboa (five species) are only met with in the steppe region. Of ruminants, besides the sheep (*O. poli*, *O. karelini*, *O. nigrimontana*, *O. heinsii*), we find one mufflon (*Musimon vignei*), formerly known only in the Himalayas, the Chinese antelope (*Antilope subgutturosa*) and the saiga antelope in the steppes, the Siberian ibex and another goat, the yak, the zebu or Indian ox, the common ox, the camel, and the dromedary. The wild boar is common in the reed thickets along the rivers and lakes, where it stays during the winter, migrating to the highlands in summer. The hedgehog and porcupine are common in the plains.

It would be impossible to describe in a few words the avifauna. No fewer than 385 species are recorded, most of them being middle-European and Mediterranean. A large number were formerly known only in the Himalayas, or in Persia, while others have their origin in east Asia. The commonest are mostly European acquaintances. As for the very rich insect fauna, of which full descriptions are now accessible, it is worthy of note that among the *Lepidoptera* of the Pamir there is an interesting mixture of Tian-Shan with Himalayan species. M. Grum-Grzimailo found on the Pamir the *Colias nastes*, a species characteristic of Labrador and Lapland; like the alpine plants which bear witness to a Glacial period flora in the Himalayas, this butterfly is a survival of the Glacial period fauna of the Pamir.[1]

Flora. As a whole the flora of Turkestan belongs to that of Central Asia, which was formerly continued by geo-botanists as far west as the steppes of Russia, but which must now be considered as a separate region subdivided into two,—the Central Asian proper and that of the Gobi. It has its own habitus, notwithstanding the number of species it has in common with Siberia and south-east Russia on the one hand and with the Himalayas on the other, and this habitus is due to the dryness of the climate and the consequent changes undergone by the soil. Towards the end of the Glacial period the Tian-Shan Mountains had a flora very like that of northern Caucasus, combining the characters of the floras of the European Alps and the Altai, while the prairies had a flora very much like that of the south Russian steppes. During the Stone Age the human inhabitants lived in forests of maple, white beech, and apple trees. But the gradual desiccation of the country resulted in the immigration from the Central Asian plateau of such species as could adapt themselves to the dry climate and soil, in the disappearance of European and Altaic species from all drier parts of the region, in the survival of steppe species, and in the adaptation of many of the existing species to the needs of an arid and extreme climate and a saline soil.[2] At present the flora of Turkestan has a variety of characters, depending on the various physical aspects of the separate regions, the Pamir vegetation and that of the Aral-Caspian steppes constituting two types with numberless intermediate gradations.

There is no arboreal vegetation on the Pamir, except a few willows and tamarisks along the rivers. Mountain and valley alike are covered with soft carpets of grass, various species of *Festuca* predominating almost to the exclusion of all others. In the immediate vicinity of water the *ryang* (*Carex physoides*) grows, and a few patches are covered with *Allium*. To these may be added a few *Ranunculaceæ*, some *Myosotis*, low *Scabiosæ*, the common *Taraxacum*, one species of *Chamomilla*, and a few *Leguminosæ*. In the north and west the *Stipa* of the Russian steppes supersedes *Festuca* and affords splendid pasture for the herds of the Kara-Kirghiz. In the gorges and on the better-watered slopes of the mountains the herbaceous vegetation becomes decidedly rich. Besides the above-named there are many other *Gramineæ*, such as the beautiful *Lasiagrostis splendens*, and whole seas of *Scabiosæ*. *Eremurus*, of a variety of colours and 6 to 7 feet in height, forms thickets along with the tall *Scorodosma fœtida*. The northern slopes of the Alai chain are richer in trees. Up to 12,000 feet full-grown specimens occur of the *articha* (*Juniperus pseudo-Sabina*), characteristic of the whole northern slopes of the Turkestan highlands, the poplar, a very few birches (*B. Sogdiana*), and a rich underwood of shrubs familiar in European gardens, such as *Rhododendron chrysanthum*, *Sorbus aucuparia* (rowan), *Berberis heteropoda* (berberry), *Lonicera Tatarica* (honeysuckle), and *Cratægus* (hawthorn). Farther east and north comes the Turkestan pine (*Picea Schrenkiana*), while at lower levels there grow numerous willows, black and white poplars, tamarisk, large *Celtis*, as well as shrubs of *Elæagnus* (wild olive), *Hippophae rhamnoides* (sallow thorn), *Rubus fructicosus* (blackberry), *Prunus spinosa* (blackthorn), and *P. Armeniaca* (apricot). The characteristic poplar, *Populus diversifolia*, which does not seem to have found yet the shape of leaves best suited to the climate, and therefore produces them in most striking variety, and the dwarf *Acer Lobelii*—very different, however, from the European maple—also occur.

The above applies to most of the highlands of the Tian-Shan. The drier southern slopes are quite devoid of arboreal vegetation.

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[1] For ampler information, see Syevertsoff's "Vertical and Horizontal Distribution of Turkestan Animals," in *Isvestia* of the Moscow Soc. of Amateurs of Nat. Science, 1873; Fedtchenko's "Travels to Turkestan," extending over 18 parts of vols. xi., xix., xxi., xxiv., and xxvi. of the same *Isvestia*, and forming a series of monographs by specialists which deal with separate divisions of the animal and vegetable kingdom (the flora by Regel); Oshanin's *Zoo-Geographical Problems in Turkestan*, Tashkend, 1880; Grum-Grzimailo's "Flora and Fauna of Pamir," in *Isvestia* of Russ. Geogr. Soc., 1886; *Works of the Aral-Caspian Expedition*; Butleroff's "Ornith. of Nukus," in *Mem. St Petersb. Soc. Nat.*, vol. x., 1879; and the journeys of Borschoff, Semenoff, Syevertsoff, Osten-Sacken (*Sertum Tian-Shanicum*), Regel, Prjevalsky, and many others. *Cf.* also for the southern parts of the region *Reports* of the Afghan Boundary Commission.

[2] See M. Krasnoff's researches in *Isvestia* of Russ. Geogr. Soc., vol. xxiii., 1887.

On the northern slopes, at the higher levels, only the *Juniperus pseudo-Sabina* grows on the mountains, and rich meadow grasses cover the *syrts*. Lower down, at about 7500 to 8000 feet the conifer zone begins, characterized by the *Picea Schrenkiana*, which furnishes the inhabitants with timber and fuel. Of course the artcha and a few other deciduous trees also occur. The richest zone is that which comes next, extending downwards to 5000 and 4500 feet. There woods of birch, several species of poplar, the maple (*Acer Semenovii*), and a rich underwood spread over the mountain slopes. Orchards of apple and apricot surround the villages. The meadows are covered with a rich vegetation,—numberless bright *Pæoniæ*, variegated *Scabiosæ*, large *Convolvulaceæ*, all kinds of *Campanulæ*, dark-coloured *Eremurus*, splendid *Umbelliferæ*, yellow-flowered *Gallium*, a mass of *Rosaceæ*, *Altheæ*, *Glycyrrhizæ*, high-stemmed *Scorodosma fœtida*, and tall *Gramineæ*. But, as soon as the soil loses its fertile humus, it produces only a few of *Phlomis*, *Alhagi camelorum*, *Psammæ*, *Salsolaceæ*, *Artemisiæ*, *Peganum*, and some poppies and *Chamomillæ*, but only in the spring. The invading steppe plants appear everywhere in patches in the Turkestan meadows. Very often—almost invariably on the drier southern slopes of the mountains—the steppe vegetation climbs up to the level of the alpine. Nowhere, perhaps, is the effect of various soils—loess, clay, salt clay, and sand—upon vegetation better observable than in the recently-emerged and arid regions of Turkestan.

The "culture" or "apricot" zone is followed by the prairie belt, in which black-earth plants (*Stipa* and the like) struggle for existence against invading Central Asian forms. And then come the lowlands and deserts with their moving sandy *barkhans*, *shors*, and *takyrs* (see TRANSCASPIAN REGION). Two species of poplar (*P. pruinosa* and *P. diversifolia*), *Elæagnus angustifolia*, the ash, and a few willows grow along the rivers. Large areas are wholly destitute of vegetation, and after crossing 100 miles of such a desert the traveller will occasionally come upon a forest of *saksaul* (*Anabasis Ammodendron*). Contorted stems, sometimes of considerable thickness, very hard, and covered with a grey cracked bark, rise out of the sand, bearing green plumes of thin branches, with small greyish leaves and pink fruit. Sometimes the tree is a mere knot peeping above the sand with a crown of thin branches. But even these fantastic growths are rapidly being destroyed by the Kirghiz herdsmen, who use them for fuel.[1] In spring, however, the steppe assumes quite another aspect, being covered, except where the sands are shifting, with a rich vegetation. Persian species penetrate into Bokhara and the region of the upper Amu.

Vegetable products.

As already stated (p. 635), the climate of Turkestan varies considerably from north to south. In Akmolinsk and Semiryetchensk most of the kinds of corn which characterize Middle Russia are grown. South of the Tchu and the Syr-Daria gardening is a considerable industry; and, although rye and wheat continue to be the chief crops, the culture of the apple, and especially of the apricot (*urynk*), acquires importance. Attempts are also made to cultivate the vine. The inhabitants of the neighbourhood of Tashkend and Samarkand, as well as those of the much more northern but better sheltered Kulja oasis, add the cultivation of the almond, pomegranate, and fig. Vines are grown and cotton planted in those districts. Finally, about Khojend and in Ferghana, where the climate is milder still, the vine and the pistachio tree cover the hills, while agriculture and horticulture have reached a high degree of perfection. Successful attempts are now being made to grow the tea-plant in the Transcaspian region.

Agriculture.

The arable land, being limited to the irrigated terraces of loess already spoken of, occupies less than a fiftieth of the whole area of West Turkestan, even when the Transcaspian deserts are left out of account. The remainder is nearly equally divided between pasture land and desert (sandy steppe and barren mountain). Owing to a very equitable distribution of irrigation water in accordance with Moslem law, agriculture and gardening have reached a high stage of development in the oases. Two crops are usually taken every year.[2] Wheat, barley, millet, pease, lentils, rice, sorghum, lucerne, and cotton are the chief agricultural products. Carrots, melons, vegetable marrows, and onions are extensively grown. Rye and oats are cultivated in Kazalinsk and Kopal. Corn is exported. Owing to the irrigation, total failure of crops and consequent famines are unknown, unless among the Kirghiz shepherds. The kitchen gardens of the Mohammedans are, as a rule, admirably kept. Potatoes are grown only by the Russians. The cultivation of cotton is rapidly extending (32,000 acres in 1886), as also is sericulture, which is chiefly carried on in Ferghana, whence silk cocoons are an important item of export. Cattle-breeding is extensively pursued, and in Russian Turkestan alone recent estimates show 400,000 camels, 1,000,000 horses, 1,200,000 cattle, and 11,000,000 sheep. This last figure, however, is but a very rough estimate,—the flocks on the Kirghiz steppe being so large that the proprietors themselves do not know their exact numbers. Murrains are of frequent occurrence; a recent one resulted in a terrible famine among the Kirghiz. Live cattle, hides, wool, camel-hair, tallow, felt, and leather are exported to a considerable extent.

Minerals.

The mineral wealth of Turkestan is considerable. Traces of auriferous sands have been discovered at many places, but the percentage of gold is too poor to make the working remunerative. Silver, lead, and iron ores occur at several places; but the want of fuel is an obstacle to their exploitation. The vast coal-beds of Kulja and several inferior ones in Turkestan are not yet seriously worked, the total yearly output being only some 120,000 cwts. The naphtha wells of Ferghana and the layers of graphite about Sairam-Nor are also neglected. There are abundant deposits of gypsum, alum, kaolin, marble, and similar materials. Notwithstanding the salt springs of Ferghana and Syr-Daria, the salt lakes of the region, and the rock-salt strata of the Alexandrovsk Mountains, salt is imported.

Industry and trade.

Turkestan has no manufacturing industry carried on by means of machinery, except a few distilleries and two establishments for dressing raw cotton. But there is a great variety of artisan work, which, however, has been for some time declining and now stands at a rather low level.[3] Trade is very actively carried on. Its importance may be judged by the fact that in 1876 27,900 camels were used for the transport of wares to Tashkend. This town and Bokhara are the chief commercial centres, the principal articles of export to Russia, *via* Orenburg and Semipalatinsk, being raw cotton and silk, cattle and their products, while manufactured wares are imported in return. There is also an import and export trade to and from Urumtchi and China, *via* Kulja and Ak-su.

Ethnography.

Turkestan has been the theatre of so many migrations and conquests that its present population could not fail to be very mixed. Both Aryans and Mongols (especially the Ural-Altaic branch) have their representatives there, the former settled for the most part, the latter chiefly nomad. The Ural-Altaians, or Turanians, are numerically the predominant element, and consist of Turcomans, Kirghiz, Uzbegs, and Sarts. The Turcomans inhabit chiefly that part of Turkestan which is now known as the TRANSCASPIAN REGION (*q.v.*). They number less than one million. The Kara-Kalpaks ("Black Bonnets") may number about 50,000 in Turkestan, and some 300,000 in the Russian empire altogether. Very little is known of their history. They are supposed to be but recent immigrants to Syr-Daria, having come from the former Bulgarian empire on the middle Volga. Their language and habits are the same as those of the Kirghiz; but for the last century and a half they have had some acquaintance with agriculture. Their pacific temper exposed them to the raids of the Kirghiz, who compelled them first to settle in Dzungaria, then to change their dwellings several times, and ultimately (in 1742) to recognize the sovereignty of Russia. Even since that time they have been driven by the persecutions of their old enemies to cross the Aral-Caspian steppes and seek refuge near Astrakhan. The real masters of the steppes and highlands of Turkestan are the Kirghiz, of whom there are two branches,—the Kazak (Cossack) Kirghiz and the Kara (Black) Kirghiz or Burut (see KIRGHIZ). The Uzbegs, who played a predominant political part in Turkestan before the Russian conquest, are of Turco-Tartar origin and speak a pure Jagatai dialect; but they are mixed to a great extent with Persians, Kirghiz, and Mongols. They are subdivided into clans and lead a semi-nomadic life, preserving most of the attractive features of their Turkish congeners—especially their honesty and independence. When settled they are mostly designated as Sarts—a name which has reference more to manner of life than to anthropological classification, although a much stronger admixture of Iranian blood is evident in the Sarts, who also speak Persian at Khojend and Samarkand. Tarantchi or Taranji ("labourer" in Chinese) is the name given to those Sarts who were settled in the Kulja region by the Chinese Government after the rising of 1758. They constitute about two-fifths of the population of Kulja. After defeating the Dzungans in the year 1865, they took the political power in Kulja into their own hands, offering shelter to the Kirghiz who made inroads on the Russian dominions. This was made a pretext for the annexation of Kulja by Russia in 1871; but it has been since restored to China. The origin of the Dzungans is somewhat problematical. They number nearly 20,000, and inhabit the valley of the Ili in Kulja and partly are settled in Russian Turkestan. They are Mohammedans, but have adopted Chinese manners of life. The Mongolian branch is represented in Turkestan by Kalmucks and Torgoutes (Torgod) in the north-east and in Kulja, where they are mixed with Solons, Sibos, and Chinese. The Aryan Tajak (see TAJAK), the aborigines of the fertile parts of Turkestan, were subdued by the Turco-Mongolian invaders and partly compelled to emigrate to the mountains, where they are now known as Galtchas. They constitute the intellectual element of the country and are the principal owners of the irrigated land,—the Uzbegs being their labourers,—merchants, and mollahs or priests. They are Sunnite Mussulmans. The other representatives of Aryan ence in Turkestan are a few Persians, mostly liberated slaves; Indians, who carry on trade and usury in the cities; a few Gipsies; and the Russians. Among these last two distinct elements must be noticed,—the Cossacks, who are settled on the borders of the Kirghiz steppe and have assumed many Kirghiz features,[1] and the peasant-settlers who are beginning to colonize the valley of the Ili and to spread farther south. Exclusive of the military, the Russians number about 75,000, nearly two-thirds being in Semiryetchensk (Cossacks and peasants).

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[1] See Olga Fedtchenko and Prof. Sorokine's drawings of saksaul forests in *Album of Views of Russ. Turkestan*; also *Bull. Soc. Nat. Mosc.*, 1884, No. 1.

[2] See Middendorff's very valuable sketches of agriculture in Ferghana in *Mem. Acad. Sc. of St Petersburg*, 1881.

[3] See N. Mayeff's *Turkestan Exhibition of 1886*, Tashkend, 1886.

Cities.

Turkestan has no lack of populous cities, which, notwithstanding recent vicissitudes, continue to be important for their trade, while several others are widely famous for the part they have played in history. KHOKAND,[2] MARGHILAN, Namangan, and Andijan in Ferghana; TASHKEND and KHOJEND in Syr-Daria; SAMARKAND in Zerafshan; BOKHARA and KHIVA in the independent khanates have each from 30,000 to 100,000 inhabitants.

General condition of the country.

Populous cities adorned with fine monuments of Arabian architecture, numerous ruins of cities decayed, grand irrigation canals now lying dry, and written monuments of Arabian literature testify to a time when civilization in Turkestan stood at a much higher level than at present. This period was during the first centuries after its conversion to Islam. Now all is in decay. The beautiful mosques and madrasas are dilapidated; no astronomers watch the sky from the tops of their minarets; and the scholars of the madrasas waste their time on the most deplorably puerile scholasticism. The inspiration of early belief has disappeared; the ruling motive of the mollahs (priests) is the thirst for personal enrichment, and the people no longer follow the khojas (see p. 639 below). The agricultural labourer has preserved the uprightness, diligence, and sobriety which characterize the Turkish peasant in Asia as well as in Europe; but the richer inhabitants of the cities are grossly sensual. Centuries of wars, followed by massacres and cruel vengeance, an unceasing civil strife between parties disputing for supremacy in the name of religion, conspiracies, appeals to foreigners, and endless intrigues have hastened the decay of Mohammedan civilization in the khanates of Turkestan and paved the way for Russian conquest.

Effects of Russian influence.

It remains, however, an open question whether the Russians will be able to bring new vigour to the country and awaken intellectual life. They have failed to do so in eastern Russia, at Kazan, and elsewhere, where both civilizations—the European and the Asiatic—remain as thoroughly estranged from one another as they were three centuries ago. This estrangement is not merely religious, but social and economical. The followers of Islam, whose common law and religion know only of a temporary possession of the land, which belongs wholly to the Prophet, cannot accept the principles of unlimited property in land which European civilization has borrowed from Roman law; to do so would put an end to all public irrigation works, and to the system by which water is used according to each family's needs, and so would be fatal to agriculture. When taking possession of Turkestan, the Russians began to grant deeds establishing property rights over land in accordance with Roman law. But a study of the Mohammedan system soon put an end to so erroneous a policy, and Mussulman law is still respected. The Russians have abolished slavery in Turkestan; and their rule has put an end to the interminable intestine struggles, which had weakened and desolated the whole region. The barbarous tortures and executions which rendered Khiva notorious in the East are no longer heard of; and the continual appeals of the khojas for "holy" war against their rivals find no response. But the Russian rule has imposed many new taxes, in return for which Turkestan only gets troops of Russian merchants and officials, who, instead of becoming the exponents of what is best in European civilization, too often accept the worst features of the depraved Mussulman civilization of the higher classes of the country. New tribunals and new justices of the peace are about to be introduced (1887); schools are being diligently spread; but the wants of the natives are set behind those of the children of the Russian officials and merchants and the supposed necessities of Russification. A consulting hospital for Mohammedan women has recently been opened by women graduates in medicine at Tashkend.

EAST TURKESTAN.

Boundaries.

As already stated, by this name we designate that vast depression in the great plateau of eastern Asia which lies between the Tian-Shan Mountains in the north-west; the steep slopes of the Pamir and of the Tibet plateau, bordered by the Kuen-Lun, in the south-west and south; the Altyn-Tagh in the south-east as far as Lake Lob-Nor; and in the north-east the still imperfectly known mountains which run east-south-east from the Tian-Shan, having the Bagratch-kul on their northern slope.[3] Farther east the Kuruk-Tagh and the steep slope of the Gashun Gobi separate East Turkestan from the higher terrace of the plateau, so that about Lob-Nor the Tarim depression is narrowed to a width of about 100 miles; and on the 98th meridian, at Lake Tchin-shen-ho, the steep edge of the Gobi meets the spurs of the Nan-Shan Mountains.[4] This region has been and still is designated by a variety of names, such as the Tangut Plain, West Gobi (a most inappropriate name, as already pointed out by Ritter), Alty-shar or Jity-shar (the land of six or seven cities), Little Bokharia, Kashgaria, and so on. In its physical features it forms a connecting link between the Chinese territories and the Aral-Caspian depression. It covers about 465,000 square miles, but has hardly more than 1,000,000 inhabitants.

Physical features.

Although lying at a high altitude (Kashgar 4000 feet and Yarkand 4120 feet), it has the character of a depression in comparison, not only with the mountains, but also with the lofty plateaus which surround it,—Tibet, Pamir, and the Tian-Shan *syrts*. It has a general slope towards the east, and its lowest portions (formerly occupied by a great lacustrine basin) are only 2600 feet above the sea.[5] At its north-east edge, *i.e.*, at the foot of the remotest offshoots of the Tian-Shan, M. Prjevalsky measured an altitude of only 2600 feet. Its average altitude ranges from 3100 to 3700 feet, increasing to 4200 at its outer rim. No mountains or hills diversify its surface, which is that of a high plain. All the mountains which enclose it rise to considerable heights, far above the snow line. The steep slopes of the Pamir culminate in Tagharma Peak (25,360 feet). In the north the snowclad Kokshal-tau and Kirghiznyn Ala-tau form a series of uninterrupted chains, which reach a height of 24,000 feet in the Khan-Tengri and have at their southern base the broad and high alpine plateaus, or *syrts*, of which the Yulduz, dotted with lakes, has acquired historical fame as the meeting-place of the armies of Timur before his Dzungarian march. On the southern borders of East Turkestan, in the Kuen-Lun and Karakorum Mountains, is the Dapsang—one of the highest peaks of the globe; and farther east the Altyn-Tagh and the Nan-Shan (with Humboldt and Ritter ranges), which are among the highest mountains of Asia, separate it from the lofty Chaidam or Tsaidam plateau.[6] East Turkestan is thus secluded by high mountains and plateaus from the rest of the continent. Even the few passes which lead to it climb to altitudes of 14,000 feet. It is open only towards the east, where it is connected with the Gobi depression. Its position as the highway from China to West Turkestan and the Dzungarian empire has made it known, though only very imperfectly until lately, through Chinese documents, the narratives of the journeys of Buddhist missionaries, and the travels of Marco Polo, Rubruquis, and a few Jesuits. From a remote antiquity it was crossed by caravans going from China to Lake Balkash, Ferghana, and the Oxus. The route, after crossing the Gobi, proceeded either to the Dzungarian Gate, or, *via* Kashgar, to the high passes of Terek-Davan and Muz-art, which led to Ferghana and Issyk-kul. Both passes have a wide renown in Central Asia, the latter especially, on account of its difficulties, one of which is a

Passes.

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[1] See *Collection of Papers on Turkestan*, St Petersburg, 1876, by MM. Syevertsoff and Khoroshkin.

[2] Each of these towns in small capitals is described in a separate article.

[3] See the map of Asia, by A. Petermann, in Stieler's *Hand-Atlas*, No. 58, where the orography of Asia is represented, in the present writer's opinion, in a more trustworthy manner than on other maps of Asia.

[4] See map to Prjevalsky's fourth journey in *Izvestia* of Russ. Geogr. Soc., 1887.

[5] Barometrically observed, the possible error being about 300 feet.

[6] Prjevalsky, *Reisen in Tibet und am oberen Laufe des Gelben Flusses*, Jena, 1884.

huge glacier, which has to be ascended with the help of the ice axe.

River Tarim. One river only, the Tarim—now lost in the marshes of Lob-Nor—and its tributaries, water this region. It is formed by the confluence of several rivers flowing from the semicircle of mountains which fence in East Turkestan on the south, west, and north. The Kashgar-Daria rises under the name of Kizil-su on the Alai. The Yarkand-Daria has its origin in a high valley between the Kuen-Lun and Karakorum Mountains, at the base of Dapsang, from several streams, such as the auriferous Zerafshan, which is fed by the glaciers of the Karakorum pass; after piercing the Kuen-Lun, it enters the plain, where its waters are soon diverted to the fields and gardens of the Yarkand oasis. The Khotan-Daria rises farther east in the same valley, and also pierces the Kuen-Lun, its two branches—the Kara-kash and Urung-kash—being renowned for their "black" and "white" jade. This river only reaches the Tarim during the summer. The Tian-Shan Mountains contain the sources of several feeders of the Tarim; but some of them no longer reach the main stream. The Kizil-Kunghei disappears after having watered Utch-Turfan (Uj-Turfan); the Ak-su meets the Khotan-Daria at its junction with the Tarim; but the Baidu-gol and the Kutcha are lost in Lakes Baba-kul and Sary-kamysh. From the Yulduz plateau comes the Haidu-gol, which flows past Kara-Shar and enters the Bagratch-kul Lake, whence it issues under the name of Kontcha-Daria, and, crossing the east of East Turkestan from north to south, joins the marshes of Lob-Nor; thus the long-doubted connexion between these two lakes—the northern and the southern—really exists. The Tarim is navigable for steamers from the confluence of the Yarkand and Khotan rivers all the way to Lob-Nor.[1] **Deserts.** These rivers, however, do not bring life to the immense deserts, the aspect of which recalls partly the Aral-Caspian depression and partly the Mongolian Gobi. Their undulating surface is covered with a gravelly soil, out of which all the finer particles have been winnowed by the wind, and it resounds under the hoofs of the passing hordes; grass covers it only in the beginning of spring. Here and there occur clayey deposits with an efflorescence of salt, which is hard in summer but impassable after rains. Then come immense areas of loose sand, which is raised in clouds by storms of wind, and the hills of which, moving on like waves, invade the cultivated fields that have been conquered by laborious effort from the desert. The features with which the traveller in the Sahara, or on the plateau of eastern Iran about Lake Zareh (Hamun) is familiar, are here reproduced on the same large scale. The Takla-makan desert north of Khotan covers 93,000 square miles—an area nearly equal to that of Great Britain. As one approaches Lob-Nor, and thus touches upon territory that has emerged at a still more recent epoch, the desert becomes still drearier and still less passable on account of the shifting sands. Lob-Nor now consists of two basins; but the largest of them, although it has an area four times as large as that of the Lake of Geneva, can hardly be called a lake, since its greatest depth is less than 20 feet, while reeds rise 20 feet above the thin film of water and extend far beyond its shores. In fact the whole of the region, notwithstanding its considerable altitude above the ocean, has but recently emerged from under water. During the later portion of the Tertiary period it was covered with an immense Mediterranean sea, and even during the Post-Pliocene period was occupied by a lake. But, as we see on a smaller scale in Finland and Sweden, where the higher lacustrine depressions are more advanced in the process of desiccation than those situated at lower levels, so in Central Asia the more elevated Tarim region is more advanced in its desiccation than the Balkash basin, and this latter again is in a more advanced stage of the same process than the Aral-Caspian depression. The desiccation of East Turkestan must have gone on, however, within historical times at a much more rapid rate than geologists seem prepared to admit. East Turkestan has not always been the desert it now is. Many cities, in which Greek and Byzantine coins have been found, lie buried beneath the sands, and in one of these Buddhist statues have been discovered. Indeed it is very probable that the great migration of the first centuries of our era resulted from the necessity of abandoning East Turkestan.

Climate. The climate is severe: a cold winter follows a burning summer. A few showers slightly moisten the surface in spring; but the summer and autumn are rainless. The air is continually charged with dust, and often with sand.

Flora. The vegetation of the interior of East Turkestan is very poor, being the same as that of the steppes of West Turkestan. On the sandy hills are some tamarisks and *Elæagnus*, rapidly being used up as fuel; along the rivers are copses of poplars, which have difficulty in maintaining themselves, because no humus gathers in their shade, the dry leaves being blown away by the storms and scattered as dust over the desert; and, finally, along the old beds of rivers and lakes grow dense and rank beds of reeds, where the wild boar has his habitat. Immense areas are covered with *Salsolaceæ*, and the gravelly ground is clothed in spring with a rich carpet of grass. The oases possess all the plants which are cultivated in West Turkestan,—the mulberry, walnut, pear, apple, apricot, olive, and vine. Cotton, rice, maize, millet, and wheat are grown; and Middendorff's[2] remark, that on the edge of the desert we find the best cultivated fields and the richest gardens, is still more applicable to the oases of East than to those of West Turkestan. But outside the oases desolation reigns. Wind freely modifies the surface, carrying away the finest particles of the gravelly soil, breaking down the *barkhans* as soon as man has destroyed the vegetation which grew on them, and lifting the sand into the air and whirling it along in columns of the most fantastic shapes.

Fauna. As a rule, the mammals are not numerous, and the fauna closely resembles that of the Tian-Shan. It seems to be owing to the loneliness of its deserts that East Turkestan has preserved the wild ancestors of our domestic animals. Besides the wild ass (*Equus hemionus*), Prjevalsky discovered in the Dzungarian steppes the wild horse—the real ancestor of our domestic horse—and on the plateau of Tsaidam the wild camel and the wild yak.[3]

Industries and minerals. Raw cotton and silk are exported to a considerable amount; but of manufactured cottons only a rough *mata* is sent to Semiryetchensk for the Kirghiz. Some silk wares, carpets, and silk "grain" are exported from Khotan, leather-ware from Yarkand, polished and copper ware from Ak-su, and small iron ware from Kutcha. Stock-breeding is of paramount importance, and cattle, asses, camels, and sheep are reared in considerable numbers. Mineral resources are not wanting, but the mining industry is in a primitive condition. Gold is obtained from alluvial deposits at Kiria, coal at Kashgar, jade in Khotan, and sulphur and saltpetre at Utch-Turfan.

Oases. It is only along the base of the mountains, where there is a fringe of loess, and where streams bring the necessary moisture, that human settlements have sprung up, or rather maintained themselves until now. The series of oases skirts the base of the Tian-Shan and the Kuen-Lun. Kashgar stands at the apex of the angle made by those two ranges, while Yanghi-hissar, Yarkand, Khotan, and Kiria lie along the Kuen-Lun, and Utch-Turfan, Ak-su, Bai, Kutcha, Kurla, Karashar, and Turfan along the Tian-Shan. Many miles of desert separate these oases from each other; and their population could be, and has been, much greater than it is, for there is no lack of water in the streams which rise beneath the snow covering of the mountains. The various oases, which are named after their chief towns, have always been nearly independent of each other. Still, in the course of their much disturbed history, Khotan, Yarkand, Kashgar, and Ak-su, one after another acquired a kind of supremacy over the rest. At present Yarkand and Kashgar are the most important. The city of Yarkand has nearly 60,000 inhabitants; it is surrounded by walls, and has a separate fort, Yanghi-hissar; ruins of old settlements are scattered around. Its Chinese merchants carry on an active trade, and the Turkish population are breeders of cattle on an extensive scale. Wheat, barley, rice, beans, sorghum, mulberries, and a variety of fruit trees are grown in the gardens. KASHGAR (*q.v.*), surrounded by a series of populous villages, is the chief commercial centre, owing to its position on the highway to Lake Issyk-kul. It is surrounded by forts, one standing at the confluence of the Kashgar and Yarkand rivers. KHOTAN (*q.v.*) or Iltchi (also Yu-thian), a very populous city under the Han dynasty of China (206 B.C.-1 A.D.), has much declined of late. It is renowned for its gold mines, and especially for its jade and its musk. Copper kettles, carpets, some silk, and felt ware are manufactured. Sanju (7000 houses), Kilian, Pialma, Guma, Kargatyk, and Posgan, on the slopes of the Kuen-Lun between Yarkand and Khotan, are the richest parts of the region. Naya, Kiria, Tchira, all on small rivers flowing from the Kuen-Lun, continue the line of oases towards the east, terminating in Tchertchen, which now consists of but a few score of houses. The oases at the base of the Tian-Shan are Utch-Turfan (Ust-Turfan), Ak-su (formerly the capital of Sairam), Bai, Kutcha with Shah-yar, Bugur, Kurla, Karashar, and Turfan. Their inhabitants grow corn to a considerable amount, and keep numerous herds of cattle and flocks of sheep. The chief exports are wool, fowls, and the horns of the maral deer. On the lower Tarim, where a few settlements, supported chiefly by fishing, continue to struggle against the encroaching desert, the ruins of formerly populous towns testify that the region was not always the dreary waste it now is.

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[1] At the confluence the Tarim has at low water a depth of 3 to 5 feet and a width of 190 yards; towards Lob-Nor the depth increases to 14 feet (Prjevalsky, in *Izvestia* of Russ. Geog. Soc., 1887).

[2] *Op. cit.*

[3] Prjevalsky, *Reisen in Tibet*, &c.; and Wilkins (naturalist of M. Kuropatkin's expedition) in the Russian periodical *Priroda*, 1887, No. 3.

Population. The population is mixed, Aryans and Turanians being thoroughly intermingled. On the slopes of the Pamir, about Sary-kol, there is a purely Aryan population of Persian Galtchas. Kirghiz and Kara-Kirghiz inhabit the slopes of the Tian-Shan. Kalmucks occur in the north-east; and in the central parts the population consists of Turkish Sarts and Uzbegs and of Persian Tajak,—the Mongolian element increasing towards the north-east. The language is Turkish, like that spoken in West Turkestan, with several varieties of *patois* and a considerable addition of Chinese words. As a rule, the inhabitants of East Turkestan have an air of poverty. There are no rich mosques in their towns, such as those of Samarkand and Bokhara; the houses are of unbaked brick and poorly furnished. The dress is that customary in West Turkestan. But the habits of the people differ to some extent and the women enjoy greater liberty than in other Mohammedan countries: they go in the streets unveiled; free marriages, contracted for short terms, are not unfrequent. As a rule, the position of women is more independent—a feature noticed even by the earliest travellers in the country.

The aggregate population of East Turkestan, estimated between 575,000 and 1,500,000 in 1825, is now (1887) hardly more than 1,000,000. Kuropatkin estimates it at 1,200,000, Forsyth at 600,000. The population of the chief towns may be stated approximately as follows—Yarkand, 60,000; Kashgar, 50,000; Khotan, 40,000; Sanju, 35,000; Ak-su, 20,000; Kiria, 15,000; Yanghi-hissar, 10,000; Kargatyk, 10,000; Kurla, 6000.

History. It appears very probable that at the dawn of history East Turkestan was inhabited by an Aryan population, the ancestors of the present Slavonic and Teutonic races, and that a civilization not inferior to that of Bactriana had already developed at that time in the region of the Tarim.[1] Our knowledge, however, of the history of the region is very fragmentary until about the beginning of the Christian era. When the Huns (Hiong-nu) occupied west and east Mongolia in 177 B.C., they drove before them the Yue-chi (Yutes, Yetes, or Ghetes), who divided into two hordes, one of which invaded the valley of the Indus, while the other met the Sacæ in East Turkestan and drove them over the Tian-Shan into the valley of the Ili. Thus by the beginning of our era the Tarim region had a mixed population of Aryans and Ural-Altaians, some being settled agriculturists and others nomads. There were also several independent cities, of which Khotan was the most important. One portion of the Aryans emigrated and settled in what is now Wakhan (on the Pamir plateau), the present language of which seems very old, dating anterior to the separation of the Vedic and Zend languages. In the 1st century the Chinese extended their rule westwards over East Turkestan as far as Kashgar. But their dominion seems to have been merely nominal, for it was soon shaken off. By the end of the 5th century the western parts fell under the sway of the "White Huns" or Ephthalites, while the eastern parts were under Tangut (Thygun) dominion. The Chinese, however, still retained the region about Lob-Nor. Buddhism penetrated into the country at an early date; but in East Turkestan there were also followers of Zoroastrianism, of Nestorian Christianity, and even of Manichæism. An active trade was carried on by means of numerous caravans. The civilization and political organization of the country were dominated by the Chinese, but were also influenced to some extent by Græco-Bactrian civilization. Buddhism spread rapidly in the south-west, and the study of Pali became widely diffused. Our information as to the state of the country from the 2d century to the first half of the 7th is slight, and is chiefly derived from the *Journeys* of the Buddhist pilgrim Fa-hien in 399, Song-yun in 518, and Hwen-t'sang in 629. By this time Buddhism had reached its culminating point: in Khotan there were 100 monasteries and 5000 monks, and the Indian sacred literature was widely diffused; but already there were tokens of its decay. Even then the eastern parts of the Tarim basin seem to have been growing less and less populous. To the east of Khotan cities which were prosperous when visited by Song-yun had a century later fallen into ruins, while their inhabitants had migrated westwards. Legend has it that all the inhabitants of Go-lao-lo-tsia were buried in a sandstorm, and this seems to be but a poetical way of representing a phenomenon which was steadily going on in East Turkestan.

Little is known about these regions during the 7th, 8th, and 9th centuries. In the 7th century the Tibetan king, Srong-btsan, with the help of the western Turks, subjugated the western part of the Tarim basin. During the following century the Mohammedans under Kotaiba, after several excursions into West Turkestan, took Samarkand, Ferghana, Tashkend, and Khokand (712-713), and invaded East Turkestan, penetrating as far as Turfan and China. The Chinese supremacy was not shaken by these invasions. But, on the outbreak of internal disturbances in China, the Tibetans took possession of the western provinces of China, and intercepted the communications of the Chinese with Kashgaria, so that they had to send their troops through the lands of the Hui-khe (Hoei-ke, or Hoei-hu). In 790 the Tibetans were masters of East Turkestan; but their rule was never strong, and towards the 9th century we find the country under the Hoi-he. Who these people were is somewhat uncertain. According to Chinese documents, they came from the Selenga; but most Orientalists identify them with the Uigurs. In the opinion of M. Grigorieff, whom we follow in this sketch,[2] the Turks who succeeded the Chinese in the western parts of East Turkestan were the Karluk Turks, who extended farther south-west up to Kashmir, while the north-eastern parts of the Tarim region were subdued by the Uigurs. Soon Mongolian hordes, the Kara-Kitais, entered East Turkestan (11th century), and then penetrated into West Turkestan, Khiva falling under their dominion. During the following century Jenghiz Khan overran China, Turkestan, India, Persia, Russia, and Hungary; Kashgaria fell under his rule in 1220, though not without strenuous resistance followed by massacres. The Mongolian rule was, however, not very heavy, the Mongols merely exacting tribute. In fact, Kashgaria flourished under them, and the fanaticism of Islam was considerably abated. Women again acquired greater independence, and the religious toleration then established permitted Christianity and Buddhism to spread freely. This state of affairs lasted until the 14th century, when Tughlak Timur, who extended his dominions to the Kuen-Lun, accepted Islam. He transferred his capital from Ak-su to Kashgar, and had a summer residence on the banks of Issyk-kul. His son reigned at Samarkand, but was overthrown by Timur-lane (see TIMUR), and the reign of the great conqueror was a fertile source of suffering to the region. To put an end to the attacks of the wild Tian-Shan tribes, he undertook in 1389 his renowned march to Dzungaria, which was devastated; East Turkestan also suffered severely.

The re-introduction of Islam was of no benefit to the Tarim region. In the 14th and 15th centuries Bokhara and Samarkand became centres of Moslem scholarship, and sent great numbers of their learned doctors to Kashgaria. Rubruquis, who visited East Turkestan in 1254, Marco Polo between 1271 and 1275, and Hois in 1680, all bore witness to great religious tolerance; but this entirely disappeared with the invasion of the Bokharian mollahs. They created in East Turkestan the power of the *khojas*, who afterwards fomented the many intestine wars waged between the rival factions of the White and the Black Mountaineers. In the 17th century a powerful Kalmuck confederation arose in Dzungaria, and extended its sway over the Ili and Issyk-kul basins, having its capital on the Ili. To this power or to the Kirghiz the "Whites" and "Blacks" alternately appealed in their struggles, in which Yarkand supported the latter and Kashgar the former. These struggles paved the way for a Chinese invasion, which was supported by the White khojas of Kashgar. The Chinese entered Dzungaria in 1758, and there perpetrated a terrible massacre, the victims being estimated at one million. The Kalmucks fled and Dzungaria became a Chinese province, with a military colonization of Sibos, Solons, Dahurs, Chinese criminals, and Moslem Dzungars. The Chinese next re-conquered East Turkestan, marking their progress by massacres and transporting 12,500 partisans of independence to the Ili valley. Hereupon the dissentient khojas fled to Khokand and there gathered armies of malcontents and fanatic followers of

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[1] Such is the conclusion reached by Lassen (*Indische Alterthumskunde*), and supported by M. Grigorieff (Ritter's *Asien* in Russ. transl.; Addenda to "East Turkestan," in Russian). In connexion with the objection based upon the sub-boreal character of the regions which were the cradle of the Aryans, as proved by the so-called palæontology of the Aryan languages, it may be observed that by the end of the Glacial, and during the earlier Lacustrine (Post-Glacial) period, the vegetation of Turkestan and of Central Asia was quite different from what it is now. It was Siberian or north European. The researches by M. Krasnoff (see above, p. 635) as to the characters of the former flora of the Tian-Shan, and the changes it has undergone in consequence of the extremely rapid desiccation of Central Asia, must be carefully borne in mind in all speculations founded upon the testimony of language as to the original home of the Aryans.

[2] See Ritter's *Asien*, "East Turkestan" (Russ. trans.), ii. 292; also Kuropatkin's *Kashgaria*.

Islam. Several times they succeeded in overthrowing the Chinese rule—in 1825, in 1830, and in 1847—but their successes were never permanent. After the "rebellion of the seven khojas" in 1847 nearly 20,000 families from Kashgar, Yarkand, and Ak-su fled to West Turkestan through the Terek-Davan pass, many of them perishing on the way. In 1857 another insurrection broke out; but a few months later the Chinese again took Kashgar (for the details see KASHGAR). In the course of the Dzungarian outbreak of 1864 the Chinese were again expelled; and Yakub Beg became master of Kashgar in 1872. But five years later he had again to sustain war with China, in which he was defeated, and East Turkestan once more became a Chinese province.

Bibliography.—The literature on Turkestan has of late years become very voluminous, especially in the form of papers scattered through the periodicals published by the European Geographical Societies and other scientific bodies. The reader is referred to the following works as fitted to facilitate research. Vols. vi. and vii. of Elisée Reclus's *Géographie Universelle* contain maps showing the routes of the chief explorers. Prof. Mushketoff's *Turkestan* (in Russian, vol. i. 1886) contains an excellent critical analysis of all explorations of Turkestan and works thereupon, and the information they contain with regard to the physical geography and geology of West Turkestan. Prof. Grigorieff's addenda to Ritter's *Asien* embody the whole of the older and more modern researches into the geography and history of East Turkestan down to 1872. *Amu and Uzboi* (Saratoff, 1879), by the chief of the Amu-Daria expedition, and Bogdanoff's *Review of Expeditions and Explorations in the Aral-Caspian Region from 1720 to 1874* (St Petersburg, 1875) are most useful works. Prof. Lenz's paper "Ueber den früheren Lauf des Amu-Daria, in *Mem. Acad. Sc. St Petersburg*, discusses valuable information borrowed from ancient sources. Mezhoff's *Turkestanskiy Sbornik* is a catalogue of the Central-Asian library at Tashkend, and his annual "Index" contains full classified lists of Russian geographical literature. Of works of a general character, with descriptions of both regions (apart from travels), the following, arranged in chronological order, are worthy of mention:—Semenoff's "Tian-Shan," being vol. i. of Ritter's *Asien* (Russ. trans., 1856); Grigorieff's "East Turkestan," forming two vols. of Ritter's *Asien* (Russ. transl., 1869 and 1873); Syevertsoff's "Vertical and Horizontal Distribution of *Mammalia* in Turkestan," in *Izvestia Lub. Est.* of Moscow, 1873; Wenjukoff's *Die Russisch-Asiatischen Grenzlande* (trans. from Russian by Krahmer, Leipsic, 1874); Hellwald's *Centralasien*, 1875; Petzholdt's *Umschau im Russ. Turk.*, 1877; Kuropatkin's *Kashgaria*, 1879 (partially translated into French); Kostenko's *Turkestanskiy Krai*, 3 vols., 1880, very copious translations from which are embodied in Lansdell's *Central Asia*, but unhappily too intimately combined with less useful information; Schlagintweit's *Reisen in Indien und Hochasien*, vol. iii., East Turkestan; Prjevalsky's three journeys to Central Asia (the first two translated into English; all three in German); Olga Fedtchenko's *Album of Views of Russ. Turk.*, 1883; Nalivkin's *History of the Khanate of Kokand* (in Russ.), Kazan, 1885; Vambéry's *Das Turkenvolk*, 1885; Roskoschny's *Afghanistan u. angrenz. Länder* (for Afghan Turk.); and Mushketoff's *Turkestan*, vol. i. (in Russian), 1886. (P. A. K.)

TURKEY

PART I.—HISTORY.

Er-Togh- [illegible]

'Osmán.

SOMEWHERE about the second decade of the 13th century the little Turkish tribe which in due course was to found the Ottoman empire fled before the Mongols from its original home in Central Asia, and, passing through Persia, entered Armenia, under the leadership of Suleymán Sháh, its hereditary chief. His son, Er-Ṭoghrul, who succeeded him as head of the tribe, when wandering about the country with his warriors came one day upon two armies engaged in a furious battle. Er-Toghrul at once rode to the assistance of the weaker party, who were on the point of giving way, but who through the timely aid thus rendered not only regained what they had lost but totally defeated their enemies. The army thus saved from destruction proved to be that of 'Alá-ud-Dín, the Seljúk sultan of Asia Minor, and their adversaries to be a horde of marauding Mongols. By way of recompense for this service 'Alá-ud-Dín granted to Er-Toghrul a tract of land on the Byzantine frontier, including the towns of Sugut and Eski Shehr. 'Osmán, the son of Er-Ṭoghrul and the prince from whom the race derives its name of 'Osmánli (see TURKS, p. 661 below), corrupted by Europeans into Ottoman, was born in Sugut in 1258 (A.H. 656). While still young 'Osmán won from the Greeks Ḳaraja Ḥiṣár (Kara-hissar) and some other towns, on which account he received from his suzerain, the Seljúḳ sultan of Ḳonya (Konieh), the title of beg or prince, along with the drum and the horse-tail standard, the symbols of princely rank.

Early Turkish [illegible]

In 1300 (699) the Seljúḳ empire (see SELJUKS) fell to pieces under the onslaught of the Mongols, who were, however, powerless to replace it by any government of their own. Thereupon ten separate Turkish dynasties arose from its ruins: that of Ḳarasi sprang up in ancient Mysia, the houses of Ṣaru Khan and Aydin in Lydia, of Mentesha in Caria, of Tekka in Lycia and Pamphylia, of Ḥamíd in Pisidia and Isauria, of Ḳaraman in Lycaonia, of Kermiyan in Phrygia, of Ḳizil Aḥmedli in Paphlagonia, and of 'Osmán in Phrygia Epictetus. These principalities were all eventually merged in that of the 'Osmánlis, once the least among them, and the inhabitants assumed the name of Ottoman. Hence by far the greater portion of the people called Ottomans owe their name to a series of political events. On the collapse of the Seljúḳ power the Greeks retained hardly any possessions in Asia except Bithynia and Trebizond. Armenia was abandoned for a time to roving Tatar or Turkman tribes, till some sixty or seventy years later one or two petty local dynasties sprang up and founded short-lived states.

Founding of Ottoman power.

The year 1301 (700), in which 'Osmán, who shortly before had succeeded his father, first coined money and caused the khutba, or public prayer for the reigning monarch, to be read in his name—the two prerogatives of an independent sovereign in the East—may be regarded as the birth-year of the Ottoman empire; and it was about this time that his followers and subjects began to call themselves 'Osmánlis, or, as we might render it, 'Osmanites. Having thoroughly established his authority in his capital of Yeni Shehr, 'Osmán began to wrest from the Greeks many of the neighbouring towns and strongholds, among others Ayina Göl and Koyun Hisári, routing before the last named a large Byzantine army. He then turned his attention to the administration of his state, and such was the feeling of security he succeeded in establishing that large numbers of people from the surrounding districts flocked into his dominions and became his subjects. After six years of peace several of the Byzantine castellans of the neighbourhood, instigated by the governor of Brusa (Broussa), made a simultaneous attack upon the Ottomans, but 'Osmán totally defeated them and sent in pursuit Kara 'Alí Alp, who took possession of all their domains. Gházán, the khan of the Mongols, who had entered into an alliance with the emperor of Constantinople, sent to all the Turkish princes an arrogantly worded message forbidding them to do any hurt to the Byzantine territories. To show how light he held this menace, 'Osmán assembled an army forthwith, marched to Nicæa and thence to the Bosphorus, laying waste the country as he went and taking possession of a number of towns and villages. Michael, called by the Turkish historians Kösa Míkhál or Michael Scantbeard, the governor of one of these, embraced Islám and became one of the most trusted officers of 'Osmán and of his son and successor Orkhan. The descendants of this Michael were the hereditary commanders of the akinjis, a corps of light cavalry who played a great part in the early Ottoman wars. The first service on which Michael was employed was to destroy, along with Orkhan, a Mongol horde that had taken and pillaged the Ottoman town of Karaja Hisár. Meanwhile 'Abd-ur-Rahmán and Akcha Koja, two of 'Osmán's generals, were adding to the Ottoman dominions in the north, capturing several towns and laying siege to the city of Nicæa. The Ottoman chiefs next resolved to acquire Brusa, the natural capital of these parts. So they built round it a series of towers, in which they placed garrisons, with the view of intercepting communications and eventually starving the city into submission. At length, in 1326 (726), after a desultory siege of eight years, the keys were, through the intervention of Míkhál, handed over to Orkhan, who was in command of the Ottomans, and the townspeople were allowed to ransom themselves for 30,000 sequins. Very soon after this 'Osmán died, aged seventy, at Sugut, whence his remains were carried for burial to Brusa. 'Osmán was distinguished for piety and generosity as well as for equity and courage. He cared nothing for amassing wealth, and on his death his personal effects were found to consist of two or three suits of clothes, a few weapons, some horses, and a flock of sheep. And so high was his reputation for justice that, we are told, many of the Asiatic subjects of the Cæsars fled to him for that protection which their own rulers would not or could not give them.

Orkhan.

Orkhan, who succeeded his father 'Osmán, continued the war against the Greeks, taking from them Nicomedia, Nicæa, and many of the towns which they still retained in Asia. Hitherto the Ottomans had not interfered with the other Turkish states; but now Orkhan, granting a short respite to the Byzantines, took advantage of a dispute regarding the succession to the throne of Ķarasi, entered that principality, and annexed it to his own dominions. To his son Suleymán the Ottomans owe their first establishment in Europe: one night that prince, accompanied by a few companions, crossed the Hellespont on a raft and surprised the town of Galipoli (Gallipoli). The next day he brought over a number of Turkish troops, with whose assistance he possessed himself of many of the neighbouring towns and villages; but his career was cut short by a fatal fall from his horse when out hunting. Orkhan did not long survive his son, grief at whose untimely end is said to have hastened his own death, in 1359 (761). This monarch is celebrated for the number of mosques, colleges, and other public institutions that he founded. During his reign the Ottoman army was thoroughly organized, and a body of regular paid soldiers was raised, which formed the nucleus of the military power of the state, though the old irregular militia was still called out whenever a campaign was to be undertaken. The famous corps of the janissaries (Turkish *yeni cheri*, *i.e.*, "new troop") was instituted at this time. It consisted of the children of Christian subjects, who were educated as Mussulmans and brought up to a military life.

Murád I.

Having taken the city of Angora from certain territorial lords who, incited by the prince of Ķaraman, had attacked the Ottoman dominions, Murád I., the son and successor of Orkhan, found himself free to extend his possessions across the Hellespont. He forthwith passed over into Europe, where he and his generals soon reduced almost all Roumelia, capturing Adrianople, Philippopolis, and many other places of importance. These successes alarmed the Christian princes, who determined to make a vigorous effort to drive the Turks back into Asia. The kings of Bosnia, Hungary, and Servia accordingly marched with a large army upon Adrianople, but were surprised during the night and completely defeated by an inferior Turkish force. Some time after this victory Murád returned to Asia, where he celebrated the wedding of his son Báyezíd with the daughter of the prince of Kermiyán, a large portion of whose territory was made over to the 'Osmánli monarch as the dower of the bride. Next year, when Murád set out to inspect his new possessions, he met the prince of Ḥamíd, whom he constrained to sell all his dominions. The Ķaraman prince, ever the jealous rival of the Ottoman, now stirred up some of the Turkman tribes to ravage his enemy's land; but Murád was beforehand with him, and, entering his country, defeated him and annexed the district of Aķ-Shehr to his own kingdom. The Bosnian and Bulgarian princes having allied themselves against the sultan, the Turkish commander in Europe invaded Bulgaria, which was speedily subdued and added to the Ottoman possessions. Murád next entered Servia and advanced to the plain of Kosovo, where he found awaiting him the levies of Servia, Bosnia, Hungary, Albania, and Walachia. The Turks, though far inferior in number to their adversaries, gained a complete victory, 1389 (791), but it was purchased with their sovereign's life. After the battle Murád was riding over the field with some of his people, when a wounded Servian, who was lying among the slain, sprang up and stabbed him so that he died almost immediately afterwards. In consequence of this battle Servia became subject to the Turk.

Battle of Kosovo.

Báyezíd I.

Báyezíd I., surnamed Yildirim, "Thunderbolt," on account of the fury of his attack and the rapidity of his movements, received the oath of fealty on the battlefield of Kosovo. He did much to secure the position of the Ottomans in Europe, taking many of the towns which still remained to the Christians in Roumelia. In Asia he annexed the remaining Turkish principalities, and pushed his conquests as far as Cæsarea and Sívás. The Christians made another great effort to free themselves from their Eastern foes: whilst Báyezíd was absent in Asia, the king of Hungary led a powerful army, in the ranks of which were many knights of France and Germany, into the Ottoman dominions and laid siege to Nicopolis. Báyezíd sped to the rescue, and inflicted an overwhelming defeat on the Christians. He next turned his attention to Constantinople, the reduction and annexation of which he had long meditated, when he was summoned to meet Tímúr, the Tatar conqueror, who had invaded his Asiatic dominions and taken Sívás. The Ottoman and Tatar hosts encountered each other outside Angora, and there the former sustained their first disastrous overthrow, Báyezíd being taken prisoner and his army practically annihilated. Next year, 1403 (805), he died in captivity; the story of his having been imprisoned in an iron cage is not confirmed by the Turkish historians, and is most probably fictitious. After this victory Tímúr overran the Ottoman territories in Asia, taking and sacking Brusa, Nicæa, and many other cities. With a view to the complete annihilation of the 'Osmánli power, he restored the independence of the Turkish principalities which Báyezíd had annexed, and placed them under the rule of their former emírs.

Muhammed I.

On the withdrawal of Tímúr from Asia Minor the four surviving sons of Báyezíd fought for what was left of their father's kingdom; after ten years of civil war success finally rested with Muḥammed, who alone of the four is reckoned among the Ottoman sovereigns. The attention of the new sultan, whom his people called Chelebi Muḥammed or Muḥammed the Debonair, was turned rather to the restoration of his father's empire than to the conquest of neighbouring countries. In Europe he lived on amicable terms with the Byzantine emperor, and the Christian kings further north did not venture to make any serious attack upon him. But in Asia he had to contend with many enemies, the most formidable of whom was the emír of Ķaraman, who, having been defeated and made prisoner, was generously pardoned and restored to liberty. Another difficulty with which Muḥammed had to deal was a strange religious outbreak: a vast number of fanatic dervishes, headed by an apostate Jew and a Turkish adventurer of low birth, rose in revolt, and were only dispersed after several bloody battles. This sultan, who was much beloved by his subjects and is spoken of with praise by the Byzantine historians, was stricken with apoplexy while riding in Adrianople, and died almost immediately in the thirty-third year of his age, 1421 (824).

Murád II.

The first care of his son and successor Murád II. was to rid himself of a pretender to the throne who, aided by the Greek emperor, had made a descent upon the Asiatic shore of the Dardanelles. This adventurer was soon defeated and pursued to Adrianople, where he was taken and hanged. In revenge for the assistance rendered to his enemy, the sultan invested Constantinople, but he was compelled to relinquish the siege in order to subdue a revolt headed by his brother, which had broken out in Asia. Murád again annexed all the Turkish principalities which had been restored by Tímúr, except those of Kizil Ahmedli and Karaman, which did not finally become incorporated with the empire till the time of Muhammed II. The Turks were now called upon to face the most formidable Christian enemy they had yet encountered, namely Hunyady, the illegitimate son of Sigismund, king of Hungary. This famous general, after having inflicted several severe though not very important defeats upon his adversaries, invaded European Turkey with a large army of Hungarians, Poles, Servians, Bosnians, Walachians, and Frankish crusaders, the last-named being under the command of Cardinal Julian. The Ottoman army was utterly routed, Sophia taken, and the chain of the Balkans forced; and Murád was compelled to sign a treaty for ten years, by which he resigned all claims to Servia and gave over Walachia to Hungary. Weary of the cares of state, and thinking that peace was, for a time at least, secured, Murád abdicated in favour of his young son Muhammed and sought a quiet retreat in the town of Magnesia. But he was not allowed to enjoy repose for long: the Christian princes, incited by Cardinal Julian and in direct violation of the treaty, assembled their forces, and, under Hunyady as commander-in-chief, without declaring war, entered the Turkish dominions and took many of the Ottoman strongholds in Bulgaria. When the news reached Murád he resumed the imperial power, put himself at the head of his troops, and advanced to meet the invaders, who had just captured Varna. Outside that town a great battle was fought, in which a copy of the violated treaty, raised high upon a lance, formed one of the standards of the Ottomans. The conflict, which was long and bloody, resulted in the total overthrow of the Christians, the Polish king, Ladislaus, and Cardinal Julian being among the slain, 1444 (848). Murád again abdicated and sought the retirement of Magnesia; but once again he had to take up the reins of government. This time the janissaries and sipáhís, accustomed to the firm rule of the victor of Varna, had refused obedience to the young Muhammed. The sultan remained at the head of the state until his death, which occurred in 1451 (855).

Muhammed II.

Fall of Constantinople.

Muhammed II., who now ascended the throne for the third time, determined to accomplish the long-cherished design of his house, and make Constantinople the capital of the 'Osmánli empire. He easily found a pretext for declaring war against Constantine Palæologus and in the spring of 1453 (857) led an immense army to beleaguer the city. His troops covered the ground before the landward walls between the Sea of Marmora and the Golden Horn; but he found that even his monster cannon could do but little against the massive fortifications. At length he resolved to assail the city from its weakest side, that facing the Golden Horn. But the Greeks, having foreseen the likelihood of an attack from this quarter, had thrown a great chain across the entrance to the harbour, thereby blocking the passage against the hostile ships. The Ottomans, however, constructed a road of planks, five miles long, across the piece of ground between the Bosphorus, where their own fleet lay, and the upper part of the Golden Horn. Along this road they hauled a number of their galleys, with sails set to receive the aid of the favouring wind, and launched them safely in the harbour, whence they cannonaded with more effect the weaker defences of the city. This compelled the Greek emperor to withdraw a portion of his little garrison from the point where the more serious attack was being made, to repair the destruction wrought in this new quarter. At dawn on May 29th the Ottomans advanced to storm the city. The Christians offered a desperate resistance, but in vain. The emperor died fighting in the forefront of the battle, and at noon Muhammed rode in triumph into his new capital and went straight to the cathedral of St Sophia; there, before the high altar, where the preceding night Constantine had received the Holy Sacrament, he prostrated himself in the Moslem act of worship. The capture of Constantinople is not the only exploit to which Muhammed owes his surname of Fátih, or the Conqueror: he also reduced Servia and Bosnia, overthrew and annexed the Greek empire of Trebizond and the Turkish principality of Karaman, acquired the suzerainty of the Crimea, and won many of the islands of the Greek Archipelago from the Venetians and Genoese. But before Belgrade, which he had besieged as the first step to an attack upon the northern kingdoms, he suffered a serious defeat, being driven wounded from the field by Hunyady and John Capistran, with the loss of 300 cannon and 25,000 men. Rhodes, whither an Ottoman force was despatched, was the scene of another failure: here the Knights of St John gallantly and successfully withstood their Muhammedan foes, and compelled them to retire from the island. In Albania a long and, for a time, successful resistance was offered to the Turkish arms by the famous George Castriot, the Iskender Beg of the Turks. This chieftain had been in his youth in the service of Murád II., and was by him appointed governor of his native Albania, whereupon he revolted and tried to restore the independence of his country. Among the favourite designs of Muhammed were the subjugation of Italy and the establishment of the Mussulman dominion in the capital of Western Christendom. A Turkish army crossed the Adriatic and stormed the city of Otranto; but its further progress was stopped, and for ever, by the death of the Conqueror, which occurred a few months later, in 1481 (886). The Muhammedan soldiers besieged in Otranto, being unsupported from Turkey, were, after a long and brave defence, forced to surrender.

Báyezíd II.

Báyezíd II. was hardly seated on the throne before he was called upon to face a formidable revolt raised by his younger brother Jem. This youthful pretender, who was both talented and high-spirited, was, after a number of adventures, finally compelled to fly the country. He sought the protection of the Knights of St John at Rhodes, who, however, retained him a prisoner, and made an arrangement with Báyezíd whereby they received from that monarch a yearly sum of 45,000 ducats as the price of the compulsory detention of his brother. After thirteen years of captivity the unfortunate prince was murdered by Pope Alexander VI. (Borgia), who, it is said, received 300,000 ducats from the sultan as the reward of his crime. Though frequently compelled to engage in defensive wars, Báyezíd was of a peace-loving and unambitious disposition, and a few towns in the Morea were all the additions made to the empire while he was on the throne. It was during his reign, however, that the Ottoman fleet began to be formidable to Christendom, the desperate battle off Sapienza, won by Kemál Re'ís against the Venetians, being the first of the Turkish naval victories over the Mediterranean powers. Báyezíd, whose pacific habits had alienated the sympathies of the janissaries, was in 1512 (918) forced by these dreaded guards to abdicate in favour of Selím, the youngest of his three sons. This prince had already been in open revolt against his father; but his determined and warlike character had won for him the esteem of the Turkish prætorians. Báyezíd's health, which had long been failing, gave way under this blow; and the old sultan died three days after his deposition, at a little village on the way to Demitoka, whither he was going to end his life in retirement.

Selím I. was personally the greatest of the Ottoman monarchs: his unflinching courage and tireless vigour were not more remarkable than his political sagacity and his literary and poetic talents; but so merciless was he that he has always been known in Turkish history as Yawuz Selím or Selím the Grim. Happily for Europe he turned his attention to the neighbouring Muhammedan states and left the Christian powers in peace. Having caused both his brothers to be put to death, he marched against Persia, the king of which country had given refuge to the family of one of the hapless Turkish princes. The quarrel between them was further embittered by religious hatred: the sháh of Persia was the pillar of the Shí'ites, as the Ottoman sultan was of the Sunnites. Selím in his fanatical zeal had ordered a massacre of his Shí'ite subjects, in which forty-five thousand persons suffered death. The sháh was eager to avenge the slaughter of his co-religionists. The janissaries showed signs of insubordination upon the march, but Selím resolutely maintained order and reduced them to submission. At length they came upon the Persian host drawn out on the plain of Chaldiran, where a great battle was fought, which ended in the rout of the Persians and left the way to Tabríz, the residence of the Persian king, open to the sultan. Thither Selím proceeded; but eight days later he set out on his homeward march. The battle of Chaldiran brought no addition of importance to the empire; but the districts of Diyár-Bekr (Diarbekr) and Kurdistán, through which the army had passed on the way to Persia, were completely subdued and annexed to the Ottoman dominions. Selím's next important campaign was against the Memlúks of Egypt. This body of Eastern chivalry offered a most gallant resistance to the 'Osmánlis; but, possessing no artillery, which they disdained as unbecoming men of valour, they were defeated in a series of engagements, and Selím and his army entered Cairo as conquerors in 1517 (923). The results of this war were momentous and far-reaching: the Ottoman empire was greatly increased by the addition of Egypt, Syria, and the Hejáz, of all of which the Memlúks had been lords; the caliphate of Islám was won for the house of 'Osmán, Selím constraining the representative of the old 'Abbásid family, who resided, a purely spiritual prince, at Cairo, to make over to him and his heirs the rights and privileges of the successors of the Prophet. The sultan at the same time acquired from him the sacred banner and other relics of the founder of Islám, which had been handed down to the Arabian prince from his fathers, and which are now preserved in the seraglio at Constantinople. On his return Selím set himself to strengthen and improve his fleet, doubtless with a view to the conquest of Rhodes. He died, however, in 1520 (926), before his extensive preparations were completed. This sultan reigned only eight years, but in that short time he almost doubled the extent of the Ottoman empire.

Suleymán I., who succeeded his father Selím as sultan, had not been long on the throne before he found himself involved in a war with the king of Hungary. He marched northwards with a powerful army and wrested from the enemy several places of importance, including the strongly fortified city of Belgrade. Having left a large garrison in this city, which was regarded as the key to the Christian lands north of the Danube, the sultan returned to Constantinople, where he continued his father's work of creating a strong and efficient Ottoman fleet. When all was ready Suleymán set out for Rhodes, determined to wipe away the disgrace of his ancestor's second failure, as he had done that of his first. The conquest of Egypt had, moreover, rendered the possession of Rhodes necessary to the Turks, as the passage between Constantinople and their new acquisition could never be safe so long as that island remained in hostile hands. The Knights of St John met the attack in a manner worthy of their illustrious order; but the overwhelming force of the Ottomans and the hopelessness of any relief compelled them to accept the sultan's terms. These were highly honourable to the defenders, who were permitted to retire unmolested, while Suleymán pledged himself to respect the Christian religion in the island, which now, 1522 (929), became his. Four years after the conquest of Rhodes the sultan again invaded Hungary, where in the renowned battle of Mohacz he annihilated the army of the Magyars and slew their king. Thence he marched along the Danube to Buda-Pesth, which opened its gates to him, and there he rested a little while before starting on his homeward way. The disturbed state of Asia Minor hastened Suleymán's departure; but in three years (1529) he was back at Buda, ostensibly as the ally of Zapolya, an Hungarian who claimed the throne left vacant by Louis, who fell at Mohacz. Ferdinand of Austria had opposed the claim of Zapolya, who thereon had applied to the sultan for aid, which that monarch was most willing to accord. The troops of Ferdinand being driven from Buda, Suleymán, accompanied by his protégé, advanced upon Vienna. On 27th September 1529 the vast Turkish host, under the personal command of one of the greatest of the family of 'Osmán, laid siege to the capital of the German empire, and on the 14th of the following month, after a most desperate assault carried on for four days, the invaders were compelled to retire, leaving the city in the possession of its heroic defenders. The torrent of Turkish military might had now reached its northern limit: once again it vainly swept round the walls of Vienna, but further it never went. Suleymán next directed his arms against Persia, from which country he won a large portion of Armenia and 'Irák as well as Baghdád, the old capital of the 'Abbásid caliphs. In 1542 he was again in Hungary, having been appealed to by the widow of Zapolya on behalf of her infant son against the pretensions of Ferdinand. Suleymán promised to place the child upon the throne when he should be of a proper age; in the meantime he treated Hungary as an Ottoman province, dividing it into sanjaks or military districts, and garrisoning Buda and other important cities with Turkish troops. Six years later a truce for five years was concluded between the sultan and Ferdinand, whereby almost all Hungary and Transylvania were made over to the former, who was also to receive a yearly present, or more correctly tribute, of thirty thousand ducats. The Turks, now at the zenith of their power, were the terror of all around them. The achievements of the Ottoman navy during the reign of Suleymán were hardly, if at all, less remarkable than those of the army. Khayr-ud-Dín, the Barbarossa of the Europeans, won Algiers for Turkey, and held the Mediterranean against the fleets of Spain and Italy; Torghud added Tripoli to the empire; and Piyála routed the galleys of Genoa, Florence, Naples, and Malta off the isle of Jerba. But fortune did not always smile upon the crescent. In 1565 (973) Suleymán sustained the second great check he was destined to encounter. The Turks once more measured swords with the Knights of St John and drove them from Malta, which had been given to the order by Charles V. on its expulsion from Rhodes. A powerful Turkish army and fleet, commanded by officers of renown, were accordingly despatched to win Malta for the Ottoman crown; but so valiantly was it defended that the Turks were forced to withdraw with a loss of twenty-five thousand men. Suleymán died in harness. In 1566 (974), when seventy-six years of age, he entered Hungary for the last time, summoned thither to aid his vassal, young Sigismund Zapolya. Sziget, a place which had foiled the Turks on previous occasions, was the first object of attack. Count Zrinyi, the governor, determined to resist to the last.

Annexation of Algiers and Tripoli.

so the Ottomans found themselves compelled to undertake the siege of this comparatively unimportant town. There on the night of 4th September the great sultan died, and a few hours later Count Zrinyi and his brave companions perished amid the smoking ruins of the fortress they had most nobly held. Under Suleymán I., whom European historians call the Magnificent, but whom his own people style Ḳánúní or the Lawgiver, the Turkish empire attained the summit of its power and glory. The two great disasters, at Vienna and Malta, were eclipsed by the number and brilliancy of the sultan's victories, by which large and important additions were made to the empire in Europe, Asia, and Africa.

Selím II. Selím II., the unworthy son and successor of the Magnificent Suleymán, was the first Ottoman monarch who shrank from leading his army in person. He was a man of mean and ignoble character, whose sole pleasure seems to have consisted in the indulgence of his degraded tastes and vicious appetites. The first conflict between the Turks and the Russians occurred in his reign. In view of a threatened war with Persia, the grand vizier Ṣokolli conceived the idea of uniting the rivers Don and Volga by a canal, by means of which an Ottoman fleet could be sent into the Caspian. But in order to carry out this scheme it was necessary that the town of Astrakhan should be in the hands of the Turks. A considerable force was accordingly despatched from Constantinople to take possession of that city; but the Russian army which Ivan the Terrible sent to its relief drove back the Turks and their Tatar allies from before the walls, 1569 (977). Cyprus was the next object of attack. This island, which belonged to Venice, was assailed and taken, though not without heavy loss, at a time of peace between the republic and the Porte, 1570–71 (978). The Christian powers of the Mediterranean were roused and alarmed by this act of treachery, and a maritime league was formed through the efforts of Pope Pius V., with Spain, Venice, and Malta for its most important members. On 7th October 1571 the Christian fleet, under the command of Don John of Austria, encountered the Ottoman ships, led by the galley of the ḳapudan pasha, Mu'ezzin-záda 'Alí, just outside the Gulf of Lepanto. A furious conflict ensued, which resulted in the utter defeat of the Turks, their admiral being killed and their fleet almost annihilated. This famous fight, although it brought little immediate material advantage to the victors, was of the highest moral value to them; for it broke the spell of Barbarossa, and showed that the Ottoman was no longer invincible on the seas. The only other event of importance during this reign was the final conquest of Tunis for Turkey by Ḳilij 'Alí, who won it from the Spaniards in 1574 (982). Selím II. died miserably the same year.

Murád III. Murád III., who now succeeded to the Ottoman throne, was no improvement upon his father; he ruled in name only, all real power being in the hands of worthless favourites. As a natural consequence the empire began rapidly to decay; corruption infected all ranks of official society, the sultan himself selling his favours for bribes; while the other great curse of old Turkey, military insubordination, showed itself in a more threatening aspect than ever. The janissaries mutinied on several occasions, and each time compelled the weak Murád to accede to their demand. Notwithstanding this wretched state of affairs, some extensive and important, though not permanent, additions were made to the empire. These, consisting of Azerbijan and Georgia—the latter had been in alliance with Persia—were the result of a campaign against the last-named country, the internal condition of which was then even worse than that of Turkey. Transylvania, Moldavia, and Walachia rose in revolt, encouraged by the war which broke out in 1593 between Turkey and Austria. In 1594 hostilities with Persia were resumed; and early in the following year Murád died, leaving the empire to his eldest son Muḥammed III.

Muḥammed III. Things had been going very badly in the war with Austria, when in June 1596 the grand vizier and the mufti, joining their voices with that of Sa'd-ud-Dín the historian, prevailed upon the new sultan, whose character resembled only too closely that of his father, to place himself at the head of the Ottoman army which was about to march into Hungary. Four months later Muḥammed met the imperialists under the archduke Maximilian, and the Transylvanians led by Prince Sigismund, on the marshy plain of Keresztes, where a battle lasting three days took place. Although at one time things looked so hopeless for the Turks that the sultan would have fled but for the entreaties and remonstrances of Sa'd-ud-Dín, the 'Osmánlis gained a complete and decisive victory. But nothing came of it; for Muḥammed, instead of following up his success, hastened back to Constantinople to receive the congratulations of his courtiers and to resume his indolent and voluptuous life. Nothing else worthy of note occurred during his inglorious reign. He died in 1603 (1012).

Muḥammed III. was the last heir to the Ottoman throne who was entrusted with the government of a province during his father's lifetime; henceforth all the sons of the sultan were kept secluded in a pavilion called the Ḳafes or cage in the seraglio gardens. This new system, which was necessarily very prejudicial to the character of the future rulers, had its origin in the same dread of rivals that caused a sultan in those times to put all his brothers to death immediately on his accession.

Aḥmed I. The reign of Aḥmed I. is not marked by any event of importance. The peace of Sitavorok (Zsitvatorok) between Turkey and Austria, 1606 (1015), made no change of any moment in the territorial possessions of either power, but is interesting as being the first treaty in which an Ottoman sultan condescended to meet a Christian prince on a footing of equality. Hitherto the Turkish monarchs had affected to grant merely short truces to their European enemies. But this peace was to be permanent; the annual payment or tribute of thirty thousand ducats by Austria was to be discontinued; and the ambassadors sent from the Porte were now to be officials of rank, and not, as formerly, menials of the palace or camp.

Muṣtafa I. Aḥmed died in 1617 (1026) and was succeeded by his brother Muṣtafa I. Up till this time the succession had been regularly from father to son; but, as Muṣtafa's life had been spared by his brother on his accession, that prince now ascended the throne in preference to 'Osmán, the eldest son of Aḥmed I. This arose from the peculiar nature of the Turkish law of succession, which gives the throne to the eldest male relative of the deceased sovereign. Muṣtafa was, however, imbecile; so after a reign of three months he was deposed, and his nephew 'Osmán, though only fourteen years of age, seated on the throne in his stead.

'Osmán II. An unsuccessful war with Persia, which had been going on for some time, was now brought to an end by a treaty which restored to the sháh all the territories conquered since the days of Selím II. In 1621 the sultan led his troops against Poland, partially with the view of weakening the janissaries, whom he justly regarded as the most deadly enemies of his empire. This expedition was not attended by any important results, neither Turks nor Poles gaining a decisive advantage. On his return 'Osmán formed another plan for freeing himself from his tyrannical soldiery: he gave out that he was going to make the pilgrimage to Mecca, but his real intention was to proceed only as far as Damascus, there place himself at the head of an Asiatic army, and march against the janissaries and sipáhís in Constantinople. But the janissaries heard of this design and rose in revolt. Incited by a vizier whom 'Osmán had deposed, they seized their sovereign and dragged him to the state prison of the Seven Towers, where shortly afterwards he was foully murdered by the traitor minister, 1622 (1031).

The wretched Mustafa was again raised to the throne, only to be deposed fifteen months afterwards in favour of Murád, the eldest surviving brother of 'Osmán.

In Murád IV., who succeeded to the supreme power in 1623 (1032), when a child of eleven years, Turkey had once more a sultan of the old 'Osmánli type. Since the death of Suleymán the empire had been cursed with a succession of *rois fainéants*, under whom it had rapidly fallen to decay. The vigour and courage of the new sultan stayed it for a while upon its downward course, and restored to it something of its bygone glory. While still quite young, Murád had been compelled by the mutinous janissaries to deliver into their cruel hands his favourite vizier, Ḥáfiz Pasha. This embittered him against that corps, and, when soon afterwards the soldiers began openly to discuss his deposition, Murád swiftly and suddenly cut off the ringleaders and all others whom he suspected of disloyalty; this struck fear into the hearts of the disaffected soldiers, who, finding themselves without any to organize or direct them, returned to their allegiance. Murád next turned his attention to checking the intolerable corruption and abuses which pervaded every department of the state. He had but one simple though terribly drastic method of reform,—the execution of every official whom he even suspected of any malpractice. Having restored some sort of order in his capital, Murád marched against Persia and recaptured the city and district of Erivan. In 1638 (1048) he undertook a second and more important campaign against the same power. His object was the recovery of Baghdád, which had been taken by the sháh's troops some sixteen years before. The Persians resisted long and gallantly, but at length the Turks carried the city by storm, when Murád disgraced himself by the slaughter of a vast number of the inhabitants. By the peace which followed Turkey restored Erivan to Persia, but retained Baghdád, which has been in its hands ever since. Murád on his return entered Constantinople in triumph. This sultan died in 1640 (1049); his death is said to have been hastened by habits of intemperance, which he had contracted towards the close of his life.

Ibráhím, the brother of the late sultan, now mounted the Ottoman throne. He was another of those wretched princes who gave themselves up to the indulgence of their own follies and vices without bestowing a thought upon the welfare of their people or the prosperity of their country. All the evils that had been curbed for a time by the stern hand of Murád broke out afresh and in worse form than before. The sultan himself was the most venal of the venal. Shut up in the seraglio, he thought of nothing but the gratification of his own and his favourites' caprices; gem-encrusted coaches and pleasure-boats, and carpets and hangings of richest sable for his rooms, were among the objects for which he plundered his people and sold every office to the highest bidder. This went on for eight years, till at length his subjects, weary of his exactions and tyranny, deposed him, and made his son Muhammed, then only seven years of age, sultan in his room. The only events of note that occurred during Ibráhím's tenure of power are the capture of Azoff from the Cossacks and the occupation of Crete. This island, which was then in the hands of Venice, was soon overrun, but it was not till well on in the next reign, after a siege of twenty years, that the Ottomans succeeded in taking Candia the capital.

Muhammed IV.

The minority of Muhammed IV., who became sultan in 1648 (1058), was marked by all the troubles and evils that might have been anticipated, until the grand vizierate was conferred on Köprili Muhammed in 1656 (1067). This statesman, who was seventy years old when he entered upon the duties of prime minister of Turkey, was the founder of an illustrious family of viziers, whose integrity and strength of character did much to counteract the pernicious influence of degenerate sultans and to prop up for a season the declining empire. Old Köprili accepted the office of grand vizier only upon condition of receiving absolute power; this he employed much in the same way as Murád IV. had done when he set about the work of reform: he executed every one who fell under his suspicion. He died in 1661 (1072), leaving the vizierate to his son Fázil Ahmed. Ahmed was, like his father, a man of great ability, and happily for Turkey he enjoyed the complete confidence of the young sultan, who cared for nothing but the chase, whence he is called in the Ottoman histories Avji Muhammed or Muhammed the Huntsman. Before long Ahmed was called on to lead the Turkish army against Austria. He took Neuhäusel and several places of little importance; but near the convent of St Gotthard (on the Raab) he was completely defeated in 1664 (1075) by a smaller Christian force under Montecuculi. A truce for twenty years on the basis of the treaty of Sitavorok was the result of this battle; the Ottomans, however, retained Neuhäusel. Ahmed next appeared in arms in Crete, for the purpose of bringing to a close the siege of Candia, which had been going on ever since 1648; but it was not till other three years had passed that the brave garrison opened the gates to the grand vizier, in 1669 (1079). The sultan himself was induced to head the next campaign, which was undertaken on behalf of the Cossacks of the Ukraine, who had craved the protection of the Porte against Poland. The Turks took the cities of Kamenetz and Lemberg, whereupon King Michael sued for peace, 1672 (1083), and promised to make over Podolia and the Ukraine to Turkey and to pay an annual tribute of 220,000 ducats. The sultan accepted these terms and returned home in triumph; but the Poles refused to be bound by them, and under the command of Sobieski they attacked and defeated the troops of Aḥmed Pasha. The war lasted till 1676, when it was brought to an end by the treaty of Zurawno, which left the sultan in possession of Podolia and almost all the Ukraine. Three days after this peace was signed Aḥmed Pasha died. Few men have done more to ruin their country than Ḳara Musṭafa, who succeeded Ahmed in the grand vizierate. His pet scheme was the conquest of Germany and the establishment of a great Turkish province between the Danube and the Rhine, with himself as nominal viceroy but virtual sovereign. He accordingly marched with an enormous army, probably not far off half a million strong, against Vienna. In the summer of 1683 (1094) this mighty host appeared before the walls of the Austrian capital. For an account of the siege, see vol. xix. p. 296. A few weeks after his discomfiture Ḳara Musṭafa was executed at Belgrade by the sultan's orders. Venice and Russia now declared war against Turkey; misfortune followed misfortune; city after city was rent away from the empire; the Austrians were in possession of almost the whole of Hungary, the Italians of almost all the Morea. At length a severe defeat at Mohacz, where Suleymán had triumphed years before, exhausted the patience of the soldiery, and Muhammed IV. was deposed in 1687 (1099).

Siege of Vienna.

Suleymán II.

The first year of the reign of Suleymán II., who succeeded his brother, was marked by a serious mutiny of the janissaries of the capital, who, aided by the dregs of the population, created a reign of terror in Constantinople, during which they pillaged the palaces of the principal officers of the government and murdered the grand vizier, along with many of the members of his household. The Austrians, under Charles of Lorraine, Louis of Baden, and Prince Eugene, were carrying all before them in the north: Erlau, Belgrade, and Stuhlweissenburg fell into their hands; and by the end of 1689 the Ottomans had lost almost all their former possessions beyond the Danube. Meanwhile the Venetian leader, Morosini, was equally successful in the Morea, completing the conquest of that province, which he added to the dominions of St Mark. When matters had come to this pass, the sultan summoned an extraordinary meeting of the divan to consult on the measures to be taken to meet the danger threatening on every hand. By the unanimous advice of his ministers, Suleymán appointed to the grand vizierate Köprili-záda Musṭafa, another son of old Köprili Muḥammed. This statesman, who had been trained in the duties of office under his father and brother, worthily upheld the high name of his house. He gave up the whole of his gold and silver plate to be coined into money wherewith to pay the troops; he sought out the best men to fill positions of trust and responsibility in the army and navy; and he exercised and encouraged a wise and just policy of toleration towards the Christian subjects of the sultan. Such was the confidence which his high character and illustrious connexion inspired that large numbers of volunteers hastened to join the Turkish hosts; and in a very few weeks from the time when he took command of the army Musṭafa had driven the Austrians out of Servia, and Belgrade once more received a garrison of Ottoman troops. Musṭafa returned in triumph to Constantinople, where, early in the summer of 1691 (1102), Suleymán II. died, and was succeeded on the throne by his brother Aḥmed II.

Aḥmed II. The most important event which occurred during the brief and disastrous reign of this monarch was the defeat and death at Slankamen (Szlankament) of Köprili-záda Musṭafa, who in August 1691 advanced from Belgrade to attack the Austrians under Louis of Baden. The unfortunate result of the battle was in great measure owing to the rashness of the vizier, who, in opposition to the advice of the oldest and most experienced of his officers, refused to await behind the lines the attack of the enemy. The Ottomans fought with desperate courage; but the day was decided against them by the death of Musṭafa, who was shot while cutting his way through the Christian ranks. Aḥmed II. reigned for four years, during which the hapless empire, besides continuing to suffer defeat at the hands of foreign foes, was visited with the curses of pestilence and domestic insurrection.

Musṭafa II. On the death of Aḥmed II. in the year 1695 (1106) Musṭafa II., son of Muḥammed IV., was girt with the sword of ‘Osmán. The new sultan, aware of the pitiful condition to which the empire had sunk, in part, at least, through the negligence and indifference of his predecessors, resolved to restore the old Ottoman usages, and placed himself at the head of his armies. His first campaign was altogether successful: he recaptured several important fortresses and totally defeated a great Austrian army. During the following winter he worked hard to repair the finances and bring the forces of the empire into a higher state of efficiency; and, when he set out in the spring against the Austrians, fortune continued to smile upon his banners. He defeated the duke of Saxe, raised the siege of Temesvar, and strengthened the garrisons of those fortresses which Turkey still held in Hungary. But in the next year, 1697, all was changed: Prince Eugene was at the head of the Austrians, and on the banks of the Theiss, near Zenta, the Turks sustained an overwhelming defeat, which compelled the sultan to retreat to Temesvar. Thence he returned to Constantinople, and never again led an army against the enemy. Recourse was once more had to the house of Köprili, and Amuja-záda Ḥuseyn, a nephew of old Köprili Muḥammed, was promoted to the grand vizierate. Ḥuseyn raised fresh troops; but he saw that what was really needful was peace, and this he succeeded in bringing about. **Peace of Carlowitz.** At Carlowitz on 26th January 1699 a peace was arranged, through the intervention of England and Holland, between Turkey on the one hand and Austria, Venice, Russia, and Poland on the other. The basis of the treaty, agreed to with certain modifications, was that each power should retain the territories in its possession at the time of opening negotiations. This arrangement left Austria in possession of Transylvania and almost all Hungary and Slavonia; Venice remained mistress of its conquests in Dalmatia and the Morea; Poland received Podolia; and Russia, which under Peter the Great was only now becoming conscious of its strength, retained Azoff, which it had wrested from Turkey three years before. Ḥuseyn Pasha took advantage of the restoration of peace to check the disorders which had sprung up in various parts of the empire, and to endeavour to effect much-needed reforms in many departments of the state. But unfortunately his efforts were thwarted by others less disinterested than himself; and, broken-hearted by the calamities of his country, he retired from office three years after the peace of Carlowitz, and very shortly afterwards died. Musṭafa II. very soon followed the example of his minister, and abdicated in 1703 (1115) in favour of his brother Aḥmed III.

Aḥmed III. Although the peace of the empire was often broken during his reign, Aḥmed III. was not of a warlike disposition, and all the representations and entreaties of Charles XII. of Sweden, who after the disaster of Pultowa had taken refuge in Turkey, failed to induce him to re-open hostilities with the czar. In 1710 Nu‘mán Pasha, son of Amuja-záda Ḥuseyn, and the last of the Köprili family, was appointed grand vizier. Though able and tolerant, he was so much addicted to interfering in the business of his subordinates that he became the object of general dislike, and was dismissed from his office after holding it for fourteen months. The menacing preparations of Russia in the south had more influence with the Porte than the prayers of the Swedish king, and in 1711 the new grand vizier, Baltaji Muḥammed, marched into Moldavia to meet the forces of Peter the Great, who had formed an entrenched camp near the village of Hush, on the right bank of the Pruth. Here the vizier blockaded him, and after two days' severe fighting compelled him to surrender with all his army. By the treaty which followed the czar pledged himself, among other things, to restore the fortress of Azoff and all its dependencies to the sultan, and to grant the king of Sweden a free and safe passage to his own country through the Muscovite dominions. The lenity of Baltaji Muḥammed in not destroying the czar and his army when they were within his grasp caused such discontent at Constantinople that he was dismissed from the vizierate, which was conferred on ‘Alí Pasha, known as Dámád ‘Alí or ‘Alí the Son-in-Law, from the circumstance of his having married a daughter of the sultan. This vizier distinguished himself by winning back from Venice the whole of the Morea in a single campaign (1715). His next venture, a war against Austria, undertaken in the following year, had a very different issue, he himself being slain and his army routed in a great battle at Peterwardein. Next year Prince Eugene, the conqueror of Dámád ‘Alí, laid siege to Belgrade, which he forced to capitulate after driving off a large army sent by the Turks to its relief. **Treaty of Passarowitz.** These events led to the peace of Passarowitz in 1718, by which Austria acquired that portion of Hungary which had remained in the possession of Turkey, as well as extensive territories in Servia and Walachia. The grand vizier Ibráhím, another son-in-law of the sultan, who was at the head of affairs from 1718 to 1730, contrived to secure for the empire an unusually long respite from internal disorders; but the sultan's love of costly pomp and splendour and the luxurious magnificence of his court rendered him so unpopular that, in consequence of a riot in the autumn of 1730 (1143), he voluntarily abdicated the throne, and his nephew Maḥmúd I. became pádisháh in his stead. (E. J. W. G.)

History from 1718.

Mahmúd I.

Wars with Russia.

With the treaty of Passarowitz the Venetian republic disappears from the scene of Turkish warfare. Russia gradually becomes a more formidable enemy than Austria; and the subject Christian races imperceptibly enter on the first stages of national consolidation and revival. After the long and resultless war with Persia hostilities again broke out with Russia in 1736. Marshal Münnich stormed the lines of Perekop and devastated the Crimea; but he was unable to maintain his army there and retreated with greatly diminished forces. Azoff was taken by General Lascy; and in the following year Otchakoff fell into the hands of Münnich, while the Crimea was again invaded and ravaged. Austria now joined Russia, and the Porte had to sustain a war in Servia and Bosnia as well as on the coasts of the Black Sea. The double combat was carried on with very different results. While the Russians won victory after victory, and finally penetrated into the heart of Moldavia, the Austrians were defeated and driven across the Danube. On their advancing from Belgrade in the summer of 1739 they were defeated with great loss at Krotzka, and compelled to sue for peace. The treaty of Belgrade, which was signed on 1st September 1739, restored to the Porte Belgrade and Orsova, with the portions of Servia, Bosnia, and Walachia which it had ceded to Austria at the peace of Passarowitz. Russia, unable to continue the war with a victorious Turkish army ready to fall upon its flank, had to conclude peace on very moderate terms. It received Azoff, but under a stipulation that the fortifications should be razed, and that no Russian vessels of war should be kept either on the Black Sea or on the Sea of Azoff. The peace was the last advantageous one made by the Porte without allies; and the succeeding thirty years were on the whole a period of respite from misfortune.

Mustafa III.

After this followed the wars with the empress Catherine, before whose genius and resources it seemed as if Turkey must inevitably sink into nothingness. The first contest was provoked by the armed intervention of the empress in Polish affairs and her well-known intrigues with rebellious subjects of the Porte. War was rashly declared by Mustafa III. in October 1768. In 1769 the Russians entered Moldavia and captured the fortress of Choczin (Chotim); in the following year their armies made good the conquest of Moldavia and Walachia, while a fleet from the Baltic entered the Greek Archipelago and landed troops in the Morea. The Greeks of the Morea rose in insurrection; they were, however, overpowered, and the small Russian force withdrew, leaving the Greeks to the vengeance of their conquerors. At sea the Turks suffered a severe defeat near Chios, and their fleet was subsequently blockaded and set on fire in the Bay of Tchesme, the principal officers in the Russian navy being Englishmen. Assistance was, moreover, given by the Russians to Ali Bey, a Mameluke chieftain who was in rebellion against the Porte in Egypt, and to Tahir, a sheikh who had made himself independent at Acre. In 1771 the Russians invaded and conquered the Crimea. Austria now took alarm, and signed a convention with the Porte preparatory to armed intervention. But the partition of Poland reunited the three neighbouring Christian powers and prevented a general war. An armistice was agreed upon between Russia and the Porte, and negotiations followed. These were broken off in 1773. The Russians crossed the Danube, and, though unsuccessful in their attempts upon Silistria and Varna, so completely defeated the Turkish forces in the field that on 21st July 1774 the Porte concluded peace at Kutchuk-Kainardji under conditions more unfavourable than those which it had rejected in the previous year. The Tartar territory of the Crimea, with Kuban and the adjoining districts, was made into an independent state, Russia retaining Azoff, Kertch, and Kinburn. Moldavia and Walachia were restored, but on the condition that, as occasion might require, the Russian minister at Constantinople might remonstrate in their favour. Russia, in fact, was given a species of protectorate over these provinces. Permission was given to Russia to erect a church in Constantinople, and the following engagement was made: "The Porte promises to protect the Christian religion and its churches; and it also allows the court of Russia to make upon all occasions representations as well in favour of the new church at Constantinople as on behalf of its ministers, promising to take such representations into consideration." Out of this clause arose the claim of Russia to the right of protection over all the Christian subjects of the Porte, though the specific right of intervention was clearly attached only to a single church and its ministers. By other clauses in the treaty the obligations restraining Russia from making fortifications and placing ships of war on the Black Sea were annulled. It received the right of free navigation for its merchant ships on all Turkish waters, and the right of placing consuls at all Turkish ports. These last two conditions were of great historical importance through their effect upon Greece. The consuls appointed were usually Greek traders, and permission to carry the Russian flag was indiscriminately given to Greek vessels. Hence there followed that great development of Greek commerce, and of the Greek merchant navy, which in half a century made the insurgent Greeks more than a match for the Turks at sea

Conquest of Crimea by Russia.

War with Russia and Austria.

The stipulation that the Crimea and adjoining districts should be made into an independent state was of course not intended by Russia to be anything more than a veil for annexation; and in 1783 Catherine united this territory to her dominions. She had now definitely formed the plan of extinguishing Turkish sovereignty in Europe and placing her younger grandson on the throne of a restored Greek kingdom. The boy was named Constantine, his whole education was Greek and such as to fit him for the throne of Constantinople. Joseph II. of Austria threw himself eagerly into the plan for a partition of the Ottoman empire, and in 1788 followed Russia into war. While the Russians besieged Otchakoff, Joseph invaded Bosnia; but he was unsuccessful and retired ingloriously into Hungary. Otchakoff was stormed by Suwaroff on 16th December 1788. In the following year the Turkish armies were overthrown by Suwaroff in Moldavia and by the Austrian Laudon on the south of the Danube. The fate of the Ottoman empire seemed to tremble in the balance; it was, however, saved by the convulsions into which Joseph's reckless autocracy had thrown his own dominions, and by the triple alliance of England, Prussia, and Holland, now formed by Pitt for the preservation of the balance of power in Europe. Joseph died in 1790; his successor Leopold II. entered into negotiations, and concluded peace at Sistova in August 1791, relinquishing all his conquests except a small district in Croatia. Catherine continued the war alone. Ismail was captured by Suwaroff with fearful slaughter, and the Russian armies pushed on south of the Danube. Pitt, with the triple alliance, attempted to impose his mediation on the empress Catherine, and to induce her to restore all her conquests. She refused, and both Prussia and England armed for war; but public opinion declared so strongly against the minister in England that it was impossible for him to pursue his plan. Catherine nevertheless found it in her interest to terminate the war with the Porte. Poland claimed her immediate attention; and, adjourning to a more convenient season her designs upon Constantinople, she concluded the treaty of Jassy in January 1792, by which she added to her empire Otchakoff, with the seaboard as far as the Dniester. The protectorate of Russia over Tiflis and Kartalinia was recognized.

Affairs in Egypt and Syria.

Catherine's successor Paul (1796-1801) made it his business to reverse his mother's policy by abandoning the attack on Turkey. Bonaparte's invasion of Egypt and the destruction of the French fleet by Nelson at the battle of the Nile led the Porte to join the second coalition against France. Bonaparte, invading Syria, was checked and turned back at Acre, where Jezzar Pasha was assisted in his strenuous defence by an English squadron under Sir Sidney Smith. A Turkish army was meanwhile transported from Rhodes to the Egyptian coast. This army was destroyed by Bonaparte on his return to Egypt at the battle of Aboukir on 25th July 1799, after which Bonaparte set sail for France, leaving the Egyptian command to Kléber. Kléber, cut off from all communication with France and threatened by superior Turkish forces, entered into a convention at El Arish for the evacuation of Egypt. This convention, however, was annulled by Lord Keith, the English admiral, and Kléber replied by giving battle to the Turks and defeating them at Heliopolis on 20th March 1800. Egypt was finally wrested from the French by the English expedition under Abercromby, and restored to the sultan. The Ionian Islands, which France had taken from Venice at the time of the treaty of Campo Formio, were conquered by a combined Russian and Turkish force, and were established as a republic, at first under the joint protectorate of Russia and the Porte, afterwards under the sole protectorate of Russia. The former Venetian ports on the mainland of Epirus and Albania were given up to Turkey. Somewhat later, under pressure from St Petersburg, the sultan undertook not to remove the hospodars, or governors, of Walachia and Moldavia without consulting Russia, and to allow no Turks except merchants and traders to enter those territories.

Internal condition of empire.

On the restoration of peace France reassumed its ancient position as the friend and ally of the Porte. The sultan now on the throne was Selím III. (1789-1807). Though the results of the war of the second coalition had been favourable to Turkey, the Ottoman empire was in a most perilous condition. Everywhere the provincial governors were making themselves independent of the sultan's authority; a new fanatical sect, the Wahhabees, had arisen in Arabia and seized upon the holy places; the janissaries were rebellious and more formidable to their sovereign than to a foreign enemy; and the Christian races were beginning to aspire to independence. It had seemed for a while as if the first to rise against the Porte would be the Greeks, among whom the revolutionary influences of 1789 and the songs of the poet Rhegas, put to death by the Turks in 1798, stirred deep feelings of hatred against their oppressors. Circumstances, however, postponed the Greek revolt and accelerated that of the Servians. In the country immediately south of the Danube the sultan's authority was defied by the janissaries settled about Belgrade and by Passwan Oglu, ruler of Widdin in Bulgaria. The pasha of Servia, hard pressed by these rebels, called upon the rayas to take up arms in defence of the sultan. They did so, and in 1804 the janissaries answered by a series of massacres in the Servian villages. The Servians now rose as a nation against the janissaries. Kara George became their chief, and in combination with the pasha of Bosnia, acting under the sultan's orders, exterminated the janissaries or drove them out of the country. Victorious over one oppressor, the Servians refused to submit to another. They carried on the war against the sultan himself, and at the suggestion of Russia sent envoys to Constantinople demanding that for the future the fortresses of Servia should be garrisoned only by Servian troops.

Servian revolt.

Difficulties of Selim III.'s reign.

When the third European coalition against France was in course of formation Russian and French influences were in rivalry at Constantinople. The victories of Napoleon in 1805 gave him the ascendency, and his envoy prevailed upon the sultan to dismiss, without consulting Russia, the hospodars of Walachia and Moldavia, who were considered to be agents of the court of St Petersburg. This was a breach of the engagement made by the sultan in 1802, and it was followed by the entry of Russian troops into the principalities. England, as the ally of Russia, sent a fleet under Admiral Duckworth through the Dardanelles to threaten Constantinople. While the admiral wasted time in negotiations, the French ambassador, General Sebastiani, taught the Turks how to fortify their capital. The English admiral found that he could do nothing, and repassed the Dardanelles, suffering some loss on the passage. The war on the Danube was not carried on with much vigour on either side. Alexander was occupied with the struggle against Napoleon on the Vistula; Selím III. was face to face with mutiny in Constantinople, having brought upon himself the bitter hatred of the janissaries by attempting to form them into a body of troops drilled and disciplined after the methods of modern armies. While the military art in Europe had been progressing for centuries, Turkey had made no other changes in its military system than those which belonged to general decay. Its troops were a mere horde, capable indeed of a vigorous assault and of a stubborn defence, but utterly untrained in exercises and manœuvres, and almost ignorant of the meaning of discipline. Selím was a reformer in government and administration as well as in military affairs. He broke from the traditions of his palace, and began a new epoch in Turkish history; but the influences opposed to him were too strong, and a mutiny of the janissaries in Constantinople deprived him of his crown. He was allowed to live, but as a prisoner, while the puppet of the janissaries, Mustafa IV., was placed on the throne (May 1807).

Bairaktar.

Mahmúd II.

A few weeks after this event the treaty of Tilsit ended the war between France and Russia, and provided for the nominal mediation of Napoleon between Russia and the Porte. A truce followed between the armies on the Danube. Among the Turkish generals who had understood the necessity of Selím's reforms, and who were prepared to support him against the janissaries, was Bairaktar, commander at Rustchuk. As soon as the truce gave him freedom of action, Bairaktar marched upon Constantinople. Leading his troops against the palace, he demanded the restoration of Selím. As the palace gates were closed, Bairaktar ordered an assault; but at the moment when his troops were entering Selím was put to death. Besides Mustafa there was only one member of the house of Osman remaining, his brother Mahmúd, who concealed himself in the furnace of a bath until the palace was in the hands of Bairaktar's soldiers. He was then placed on the throne (July 1808). For a while Bairaktar governed as grand vizier. He was rash enough, however, to dismiss part of his own soldiers from Constantinople. The janissaries attacked him in his palace. A tower in which he defended himself was blown up, and after a battle in the streets of

Constantinople between the janissaries and the remainder of Bairaktar's troops, during which the dethroned sultan Mustafa was put to death, the janissaries remained conquerors, and Maḥmúd was forced to submit to their demands. The innovations of the late reign were abolished, and for a while Mahmúd seemed content to reign as servant of the reaction.

Peace of Bucharest.

It is well known that plans for the partition of the Ottoman empire occupied Napoleon and Alexander at Tilsit. Austria, though unwilling to see Russia aggrandized, was prepared in the last resort to combine with the dismembering powers, if all attempts to prevent the execution of the plan by diplomatic means should fail. But after a few years the alliance declined and a war between France and Russia was seen to be inevitable. Meanwhile the conflict on the Danube had been resumed, and the Servians were still in arms. The Russians had advanced into Bulgaria and captured Silistria. England, which had made peace with Turkey in 1809, sought to reconcile the belligerents, in order that the czar might be free to employ his whole force against Napoleon. In May 1812 a treaty was signed at Bucharest, by which Bessarabia was ceded to Russia, the river Pruth becoming the boundary of the two empires. The Porte in this treaty promised to grant an amnesty to the Servians, to leave to them the management of their internal affairs, and to impose upon them only moderate taxes. These promises, however, were neither accepted by the Servians as a sufficient concession, nor were they observed by the Porte. The Servians continued to fight, and ultimately secured their autonomy about 1817 without help from Russia.

Mahmúd's rule.

Maḥmúd II. (1808-1839) was the only sultan of modern times who possessed the qualities of a great ruler. Brought up in the seclusion of the seraglio till the age of twenty-three, when he was suddenly placed on the throne, it is surprising that he should have shown the power, the resolution, and the intelligence which marked his government. The difficulties of his reign were enormous. He belonged to an epoch when the Ottoman empire might fairly be considered as in actual dissolution. This he to some extent arrested, and the reforms which he effected, partial and imperfect as they were, have prolonged the existence of the Turkish state to our own day. The first and most obvious internal danger to be met was the insubordination of the provincial pashas. Against these rebellious servants Mahmúd waged a persistent and unwearying war, now employing them against one another, now crushing them by his own armed force. One of the most formidable was Ali Pasha of Janina, who had made himself master of Albania and part of Greece. When Mahmúd in 1820 threw his armies upon this chieftain, the outbreak of hostilities in Epirus was the signal for the insurrection of Greece. While Hypsilanti, grandson of a hospodar of Moldavia who had been put to death by the Porte, raised the standard of revolt in Moldavia, asserting that Russia had promised the Christians its support, the Greeks of the Morea rose and exterminated the Turkish population among them. Hypsilanti was soon crushed; and the rising in the Morea was answered by massacres of the Greeks in the principal cities of the empire, and by the execution of Gregory, patriarch of Constantinople, the head of the Greek Church. These deeds of violence excited the utmost indignation in Russia. A despatch was sent to Constantinople, calling upon the Porte to restore the churches which had been destroyed, to guarantee the inviolability of Christian worship in the future, and to discriminate in its punishments between the innocent and the guilty. These demands were presented as an ultimatum by the Russian ambassador, who, not receiving an answer within the time allowed, quitted Constantinople (27th July 1821). The influence of Austria and England, however, restrained the emperor Alexander from declaring war, and the Greeks were left to sustain their combat by themselves. As long as Ali Pasha was unsubdued, the only forces which the sultan could employ against the Greeks were irregular bands of volunteers. It was by one of these hordes that the fearful massacres of Chios, in the spring of 1822, were perpetrated. In that same spring, however, the overthrow and death of Ali set free the regular troops. Two armies of considerable strength now moved southwards from Thessaly, with the object of reducing the country north of the Gulf of Corinth and then uniting to conquer the Morea. The western army, commanded by Omer Brionis, was checked by the Suliotes, and subsequently beaten back by the defenders of Missolonghi. The eastern army, after advancing under the command of Dramali into the Morea, was compelled to retreat. But the passes in its rear had been seized by the Greeks; on all sides the enemy closed in upon it; and it was only through the disorders of the Greeks themselves that Dramali's force escaped annihilation. Of those who survived the encounter most perished by sickness and famine in the neighbourhood of Corinth. Nor was the fortune of the Ottomans better at sea. The destruction of their admiral's vessel with all its crew by the fire-ship of the Greek captain, Kanaris, caused such terror that all further attempts to reduce the islands were abandoned, and the fleet returned to the Dardanelles.

Ali Pasha of Janina.

Greek revolt.

Mehemet Ali's assistance to Turkey.

After an interval of ineffective land warfare, the sultan determined to call upon Mehemet Ali, pasha of Egypt, for assistance. Mehemet had risen to power in the disturbed period that followed the expulsion of the French from Egypt. He had a more powerful fleet than that of his sovereign, and an army disciplined after the European system. In calling upon his powerful vassal for help the sultan must have been aware of the dangers which his aggrandizement would involve. Mehemet eagerly responded to Maḥmúd's call; and his son Ibráhím, in command of a powerful armament, set sail in the spring of 1824 from Alexandria against Crete. This island was rapidly conquered, and Ibráhím, after failing in some combined operations against Samos, crossed over to the Morea. Here he marched across the peninsula, carrying all before him. Nauplia alone maintained its defence, while the Egyptian sent out his harrying columns, slaughtering and devastating in every direction. From the Morea Ibráhím was summoned to assist the Turks, who had been for nine months unsuccessfully engaged in a second siege of Missolonghi. Ibráhím began his siege operations in the beginning of 1826; but it was not for three months more that Missolonghi fell. The tide of Ottoman conquest moved on eastwards, and the acropolis of Athens capitulated in the following year. But the defence of Missolonghi had lasted long enough to bring the powers of Europe into the field. On the death of the emperor Alexander at the end of 1825, Canning sent the duke of Wellington to St Petersburg to negotiate conditions of joint diplomatic action on the part of England and Russia. A protocol signed at St Petersburg on 4th April 1826 fixed the conditions on which the mediation of Great Britain was to be tendered to the Porte. Greece was to remain tributary to the sultan, but to be governed by its own elected authorities and to be independent in its commercial relations. The surviving Turkish population was to be removed from Greece; all property belonging to Turks, whether on the continent or the islands, was to be purchased by the Greeks. This protocol was developed into the treaty of London between England, Russia, and France, signed in July 1827, by which the three powers bound themselves to put an end to the conflict in the East. In pursuance of this treaty the mediation of the powers was offered to the Porte, and an armistice demanded. It was contemptuously refused. The united fleets of the powers consequently appeared before Navarino, where Ibráhím was assembling his forces for an expedition against Hydra. After a vain attempt at negotiation, they entered the harbour and fought the battle of Navarino, on 20th October 1827, in which the Turco-Egyptian fleet was totally destroyed. Canning had just died; his successors could only speak of Navarino as an "untoward event" and withdraw from further interference, leaving Russia and the Porte face to face. After a proclamation by the sultan calling the Mohammedans to arms, war was declared by Russia in April 1828. The moment was singularly favourable for Russia, for Maḥmúd had, little more than a year before, exterminated the janissaries. After bringing over soldiers from Asia to make him secure of victory in the event of a conflict, he had called upon the janissaries to contribute a certain number of men to the regiments about to be formed on the European pattern. The janissaries refused and raised the standard of rebellion. Mahmúd opened fire on them with cannon, and the slaughter did not cease until the last of them had perished. The great difficulty in the way of a military reorganization was thus removed, and the newly-modelled regiments were raised to about 40,000 men. Small as the army was with which he had to meet the Russian invasion in 1828, the campaign of that year was honourable to the Turkish arms. Though Varna fell into the hands of the Russians, Silistria and Shumla were successfully defended, and the Russians, after suffering great losses, were compelled to withdraw to winter quarters on the Danube. In the following year they advanced through Bulgaria, defeated the Turks at Kulevtcha, and, after the surrender of Silistria, crossed the Balkans under the command of Diebitsch. They reached Adrianople, which immediately capitulated. Diebitsch, concealing the real weakness of his force, sent out detachments towards the Euxine and the Ægean, while the centre of his army marched on Constantinople. Had the sultan known the insignificant number of his enemy, he might safely have defied him. But the wildest exaggerations were current in the capital; Kars and Erzeroum had fallen into the hands of Paskiewitch, commander of the czar's forces in Asia; and in Constantinople the friends of the slaughtered janissaries threatened revolt. Mahmúd listened to the advocates of peace, and on 14th September hostilities were brought to a close by the treaty of Adrianople. This treaty gave Russia the ports of Anapa and Poti on the eastern coast of the Black Sea; but its most important clauses were those which confirmed and extended the protectorate of the czar over the Danubian principalities. The office of hospodar, hitherto tenable for seven years, was now made an appointment for life, and the sultan undertook to permit no interference on the part of neighbouring pashas with these provinces. No fortified point was to be retained by the Turks on the left bank of the Danube; no Mussulman was to reside or hold property within the principalities. The Bosphorus and the Dardanelles were declared free and open to the merchant ships of all nations. The Porte further gave its adherence to the treaty of London relating to Greece, and accepted the act entered into by the allied powers for regulating the Greek frontier. An indemnity in money was declared to be owing to Russia; and by leaving the amount to be fixed by subsequent agreement Russia retained in its own hands the most powerful means of enforcing its influence at Constantinople. The suzerainty over Greece, which the powers had at first agreed to leave to the sultan, was by common consent abandoned, and Greece became an independent kingdom.

Battle of Navarino.

Suppression of janissaries.

War with Russia.

Treaty of Adrianople.

Conflict with Mehemet Ali.

At the close of eight years of warfare Mahmúd's southernmost provinces were even more completely severed from the empire than Servia and the Danubian principalities. It was in vain that he had borne the humiliation of calling upon his vassal, Mehemet Ali, for help, and Mehemet's reward had now to be paid. Crete was offered to him; this, however, was far from satisfying his ambition, and in November 1831 he threw an army under Ibráhím into Palestine and began the conquest of Syria. The sultan now declared Mehemet and his son to be rebels, and despatched an army against them. The first encounter took place in the valley of the Orontes. The Turks were put to the rout, and retired into Cilicia. Ibráhím following gained a second victory at the pass of Beylan, and, after crossing Mount Taurus, destroyed the last army of the sultan at Konieh, on 21st December 1832. In this extremity Maḥmúd looked for help to the European powers, and Russia at once tendered its aid. At the request of the sultan a Russian fleet appeared before Constantinople. The French ambassador thereupon threatened to quit the capital; and finally, under French mediation, terms of peace were signed with Ibráhím at Kutaya (April 1833), the sultan making over to his vassal, not only the whole of Syria, but also the province of Adana between Mount Taurus and the Mediterranean.

Alliance with Russia.

Scarcely had this treaty been concluded when Russian influence again won the ascendency at Constantinople, and a treaty of alliance between Turkey and Russia was signed at the palace of Ünkiar Skelessi, which in fact reduced Turkey to the condition of a vassal state. The form of the treaty was skilfully framed to disguise the relation of dependence which it created and the right of intervention in the internal affairs of the Ottoman empire which it gave to Russia. Each power pledged itself to render assistance to the other not only against the attack of an external enemy but wherever its peace and security might be endangered. Another article declared that, in order to diminish the burdens of the Porte, the czar would not demand the material help to which the treaty entitled him, but that in lieu thereof the Porte undertook, whenever Russia should be at war, to close the Dardanelles to the war-ships of all nations. The control of the Dardanelles was thus transferred from Turkey to Russia, and the entrance to the Black Sea converted into a Russian fortified outpost. In this treaty, brilliant as it appeared, Russia had gone too far. The Western powers declared that they would not recognize it, and the most strenuous and systematic efforts were henceforth made both by France and England to diminish Russian influence in the East. France, anxious to gain in Egypt a counterpoise to England's naval power in the Mediterranean, made itself the patron and ally of Mehemet Ali. England adhered to the cause of the sultan, and on many occasions showed its hostility to Mehemet. Thus the two Western powers, though both in antagonism to Russia, were directly in conflict with one another in their Eastern policy. Mahmúd in the meantime was steadily preparing to renew the war with his rival. He obtained the services of Moltke and other Prussian officers in organizing his army, and, after a successful campaign against the rebellious tribes of Kurdistan, assembled his troops in the spring of 1839 on the upper Euphrates, and marched against Ibráhím. In the operations which followed the advice of the European officers was persistently disregarded by the pasha in command; and on 24th June the Turkish army was annihilated by Ibráhím at Nisib. To complete the ruin of the empire, the Turkish admiral, Achmet Fewzi, sailed into the port of Alexandria and handed over his fleet to Mehemet Ali. The sultan did not live to hear of the overthrow of his hopes. He died in the same week in which the battle of Nisib was fought, leaving the throne to his son 'Abd-ul-Mejíd (1839-1861).

Renewal of war with Mehemet.

The very suddenness of these disasters contributed ultimately to the preservation of the Ottoman empire, inasmuch as it compelled the powers of Europe to take action. The French and English fleets appeared in the Dardanelles. The czar saw that it was impossible to maintain the treaty of Unkiar Skelessi, and this treaty was tacitly abandoned. Russia now addressed itself to the task of widening the existing differences between France and England. France insisted on far more favourable conditions for Mehemet Ali than England would allow, demanding that Egypt and all Syria should be given to him in hereditary dominion, with no further obligation towards the sultan than the payment of an annual tribute. Russia and the other powers took part with England, and ultimately, without asking the sanction of France, the four powers signed a treaty pledging themselves to enforce upon Mehemet the terms proposed by England, which practically reduced him to the position of an ordinary pasha in Palestine, while leaving him the hereditary government of Egypt. On the publication of this treaty Thiers, the French minister, prepared for war. He was, however, dismissed by Louis Philippe, and his successor, Guizot, accepted the situation. As Mehemet Ali refused to give up his conquests, an Anglo-Austrian naval squadron was sent to co-operate with a Turkish force in attacking the coast-towns of Syria. Acre was captured, and Ibráhím, assailed by the mountain tribes of the interior, was forced to retire to Egypt. A convention made between Mehemet and Sir Charles Napier, who had appeared at Alexandria with part of the fleet, formed the basis of the ultimate settlement, by which Mehemet, after formal submission to the sultan, was recognized as hereditary governor of Egypt. Russia now united with the other powers in a declaration that the ancient rule of the Ottoman empire, forbidding the passage of the Dardanelles to the war-ships of all nations, except when the Porte should itself be at war, was accepted by Europe at large.

The young sultan entered on his reign nominally as an independent sovereign, but really under the protection of the European powers. His minister, Reshid Pasha, who had gained in an unusual degree the confidence of Western statesmen, understood the necessity of bringing the Turkish system of government more into harmony with the ideas of the civilized world. An edict, known as the *Hatti-sherif of Gulhane*, announced the speedy establishment of institutions "which should insure to all subjects of the sultan perfect security for their lives, their honour, and their property, a regular method of collecting the taxes, and an equally regular method of recruiting the army and fixing duration of service." Scarcely had this edict been published when Reshid was driven from power by a palace intrigue. His reforming efforts, like those of Mahmúd, were not wholly ineffective; yet little was realized in comparison with what was promised and what was needed. The Turkish Government was soon discredited, and the intervention of Europe required, by conflicts between the Christian and Mohammedan tribes in the Lebanon, resulting in massacres of the former. After the convulsions of 1848 the sultan incurred the enmity of the autocratic courts by refusing to give up Kossuth and other exiles who had taken refuge within his dominions. The suppression of the national Hungarian Government by Russia in 1849 had heightened in the emperor Nicholas the sense of his own power. He now looked forward to the speedy extinction of Turkey, and in 1853 proposed to the British ambassador, Sir H. Seymour, a plan for the division of "the sick man's" inheritance as soon as he should expire. Disputes between France and Russia relating to the rights of the Latin and Greek Churches in certain sacred places were made the occasion for the assertion of a formal claim on the part of the czar to a protectorate over all Christians in Turkey belonging to the Greek Church. This claim not being acknowledged by the Porte, a Russian army entered the Danubian principalities. After ineffective negotiations war was declared by the sultan on 4th October 1853. Hostilities commenced in Walachia, and the Turkish fleet was attacked and destroyed at Sinope. England and France allied themselves with the Porte, and landed an army at Varna in the spring of the following year. Silistria was successfully defended by the Turks; and, on the occupation of the Danubian principalities by Austria, the allies took up the offensive and transferred their forces to the Crimea. The siege of Sebastopol followed, ending in its capture in September 1855. Meanwhile Russian and Turkish forces were opposed in Asia. Kars maintained a gallant defence, but succumbed to famine two months after the fall of Sebastopol. The peace of Paris followed, in which Russia ceded to Turkey the portion of Bessarabia adjacent to the mouth of the Danube. The Black Sea was neutralized, Russia and the Porte alike engaging to keep no war-ships and to maintain no arsenals there. The exclusive protectorate of Russia over the Danubian principalities was abolished, and the autonomy of these provinces, as well as of Servia, placed under the guarantee of all the powers. The Porte published a firman, the *Hatti-Humaiun*, professing to abolish "every distinction making any class of the subjects of the empire inferior to any other class on account of their religion, language, and race," and establishing complete equality between Christians and Mahommedans; the powers in return declared the Porte admitted to the advantages of the public law and concert of Europe. The absurd stipulation was added that no right should thereby accrue to the powers to interfere either collectively or separately in the relations of the sultan with his subjects.

Crimean War.

Internal disorders.

The Crimean War gave to part of the Balkan population twenty years more of national development under the slackened grasp of the Porte; and by extinguishing the friendship of Austria and Russia it rendered the liberation of Italy possible. But each direct proviso of the treaty of Paris seemed made only to be mocked by events. Scarcely a year passed without some disturbance among the Christian subjects of the sultan, in which the interference of the powers invariably followed in one form or another. A new series of massacres in the Lebanon in 1860 caused France to land a force in Syria. Walachia and Moldavia formed themselves into a single state under the name of Roumania, to which the house of Hohenzollern soon afterwards gave a sovereign. Bosnia and Montenegro took up arms. Servia got rid of its Turkish garrisons. Crete fought long for its independence, and seemed for a moment likely to be united to Greece under the auspices of the powers; but it was ultimately abandoned to its Turkish masters. The overthrow of France in the war of 1870 and the consequent isolation of England led Russia to declare the provision of the treaty of Paris which excluded its ships of war and its arsenals from the Black Sea to be no longer in force. To save appearances, the British Government demanded that the matter should be referred to a European conference, where Russia's will was duly ratified.

A few years later the horizon of eastern Europe visibly darkened with the coming storm. Russian influences were no doubt at work; but the development of national feeling which had so powerfully affected every other part of Europe during the 19th century could not remain without effect among the Christian races of the Balkan peninsula. In 1875 Bosnia and Herzegovina revolted. In the meantime the government of 'Abd-ul-'Aziz (1861-1876) had become worse and worse. The state was bankrupt. Ignatieff, the Russian ambassador, gained complete ascendency in the palace, and frustrated every attempt on the part of the better Turkish statesmen to check the torrent of misrule. His creature, Mahmúd Pasha, maintained his place in spite of universal contempt, until a conspiracy was formed at Constantinople which cost the sultan his throne (30th May 1876) and a few days later his life. His imbecile successor, Murád V., gave place after a reign of three months to 'Abd-ul-Hamíd II. The Bosnian insurrection had already extended to Bulgaria, and the slaughter of the Turkish inhabitants in certain villages had been avenged by massacres of the most fearful character. Servia and Montenegro took up arms. The resources of European diplomacy were exhausted in fruitless attempts to gain from the Porte some real securities for better government, and in April 1877 Russia declared war.

War with Russia.

The neutrality of Austria had been secured by a secret agreement permitting that country to occupy Bosnia and Herzegovina, if Russia should extend its influence beyond the Balkans. The Bulgarian massacres had excited such horror and indignation in England that Lord Beaconsfield was forced to remain neutral. The ministry contented itself with stating that England would not permit Egypt to be the scene of hostilities, nor acquiesce in any prolonged occupation of Constantinople by Russian troops. Turkey was thus left without an ally. The Russians entered Bulgaria in June; and, while Rustchuk was besieged, their advanced guard under Gourko hurried across the Balkans. Meanwhile Osman Pasha, coming from Widdin, occupied and fortified Plevna on the Russian line of march. Against his redoubts the Russians, ill commanded, threw themselves in vain, and Gourko was compelled to fall back on the Shipka Pass. But in December the capture of Plevna, in which Roumanian troops cooperated, set free the invading army, and the march on Constantinople was resumed. The Balkans were passed in mid-winter; Adrianople was occupied; and the Turkish armies were captured or annihilated. The Russians now pressed forward to the very suburbs of Constantinople, and on 3d March 1878 peace was concluded at San Stefano. In Asia the Russians had captured Kars and were besieging Erzeroum.

Treaties of San Stefano and Berlin

The treaty of San Stefano ceded to Russia the portion of Bessarabia taken from it in 1856, together with the Dobrudja, and also Kars, Batoum, and the adjoining territory in Asia. It recognized the independence of Servia, Montenegro, and Roumania, and largely extended the territory of the first two. Bulgaria was constituted an autonomous state, though tributary to the Porte, and was defined so as to extend to the Ægean Sea and to include the greater part of the country between the Balkans and the coast. Crete, Thessaly, and Epirus were to receive the necessary reforms at the hands of a European commission. To this treaty Great Britain refused to give its assent, and vigorous preparations were made for war. The fleet was at the Dardanelles, and Indian troops were brought to Malta. Russia could no longer count on the neutrality of Austria. Under these circumstances the court of St Petersburg consented to submit the treaty to a European congress, which, after a secret agreement had been made between Russia and England on the principal points of difference, assembled at Berlin. The treaty of San Stefano received various modifications, the principal being a reduction of the territory included in Bulgaria and the division of that state into two parts. Bulgaria north of the Balkans was constituted an autonomous principality; Bulgaria south of the Balkans was made into a province, with the title of Eastern Roumelia, subject to the authority of the sultan, but with a Christian governor and an autonomous administration. Austria received Bosnia and Herzegovina. The territory ceded to Servia and Montenegro by the treaty of San Stefano, as well as that ceded to Russia in Asia, was somewhat diminished. The Porte was advised to make some cession of territory to Greece, and the line of frontier subsequently recommended gave to Greece Janina as well as Thessaly. The usual promises of organic reform were made by Turkey. By a separate convention England undertook the defence of Asiatic Turkey and received Cyprus. The organization of Eastern Roumelia was duly taken in hand by a European commission and brought to a favourable conclusion; but it was not until a naval demonstration had been made by England that the final cession of Dulcigno to the Montenegrins was effected, and that Thessaly, without Epirus, was given up to Greece.

Bulgarian question

Alexander of Battenberg became prince of Bulgaria. By a popular movement in 1885 Bulgaria and Eastern Roumelia were united into a single state. This revolution occasioned the utmost displeasure at St Petersburg; and under Russian influence Prince Alexander was kidnapped and forced to abdicate. The Porte offered no armed resistance to the union. (C. A. F.)

Literature.—The best work on Ottoman history is Von Hammer's *Geschichte des Osmanischen Reiches* (Buda-Pesth, 1834-35), which covers the period between 1300 and 1774. The author availed himself of the writings of the Turkish annalists as well as of those of his European predecessors; and all later Western historians of the empire have borrowed directly or indirectly from his volumes. This valuable work has been translated into French by Hellert, *Histoire de l'Empire Ottoman* (Paris, 1835-43). The best English work is Creasy's *History of the Ottoman Turks* (London, 1854-56); it is compiled for the most part from Von Hammer. Prince Cantemir of Moldavia's *History of the Growth and Decay of the Othman Empire* (London, 1734) contains many interesting particulars, but is not always trustworthy. The best Turkish authorities for the period 1300-1730 are—Sa'd-ud-Dín, *Táj-ut-Tewáríkh* (1300-1520); Pechevi, *Táríkh*, i.e., "History" (1520-1631); Na'íma, *Táríkh* (1591-1659); Ráshid, *Táríkh* (1661-1722); and Chelebi-zada, *Táríkh* (1722-28). For the later period see Zinkeisen, *Geschichte des Osmanischen Reiches*, 7 vols. (Hamburg and Gotha, 1840-63); Finlay, *Greece under Othoman Domination* (Edinburgh, 1856); Kanitz, *Donau-Bulgarien* (Leipsic, 1875-79); Prokesch-Osten, *Geschichte des Abfalls der Griechen* (Stuttgart, 1867); Finlay, *Greek Revolution* (Edinburgh, 1861); Bourchier's Codrington; H. von Moltke, *Russisch-Türkische Feldzug* (1828-29) (2d ed., Berlin, 1877); H. von Moltke, *Briefe über Zustände in der Turkei* (1835-39) (3d ed., Berlin, 1877); Prokesch-Osten, *Mehmed Ali* (Vienna, 1877); Rosen, *Geschichte der Turkei* (1826-56) (2 vols., Leipsic, 1866-67); Kinglake, *Invasion of the Crimea* (6 vols., new ed., Edinburgh, 1875-80); Eichmann, *Reformen des Osmanischen Reiches* (Berlin, 1858); V. Baker, *War in Bulgaria* (2 vols., London, 1879); W. Muller, *Russisch-Turkischer Krieg* (Stuttgart, 1878). For the diplomatic history, see *Aus Metternich's Papieren* (Vienna, 1880-84); Wellington, *Despatches* (new ser., London, 1867-71); Gentz, *Dépêches inédites* (3 vols., Paris, 1876-77); Sir H. Bulwer, *Palmerston* (2 vols., London, 1871); Guizot, *Mémoires* (Paris, 1858-67); Sir E. Hertslet, *British and Foreign State Papers* (London, 1819, and still in progress), and *Map of Europe by Treaty* (1875); *Parliamentary Blue-books*; and *Papers Presented to Parliament.*

SULTANS OF THE HOUSE OF 'OSMÁN.

The dates are those of the sultan's accession, according to the Moslem and Christian eras.

			A. H.	A. D.
1.	'Osmán I.	son of Er-Toghrul	700	1301
2.	Orkhan	son of 'Osmán I.	726	1326
3	Murád I.	son of Orkhan	761	1359
4.	Báyezíd I.	son of Murád I.	791	1389
	Interregnum		804	1402
5.	Muhammed I.	son of Báyezíd I.	816	1413
6.	Murád II.	son of Muhammed I.	824	1421
7.	Muhammed II.	son of Murád II.	855	1451
8.	Báyezíd II.	son of Muhammed II.	886	1481
9.	Selím I.	son of Báyezíd II.	918	1512
10.	Suleymán I.	son of Selím I.	926	1520
11.	Selím II.	son of Suleymán I.	974	1566
12.	Murád III.	son of Selím II.	982	1574
13.	Muhammed III.	son of Murád III.	1003	1595
14.	Ahmed I.	son of Muhammed III.	1012	1603
15.	Mustafa I.	son of Muhammed III.	1026	1617
16.	'Osmán II.	son of Ahmed I.	1027	1618
	Mustafa I.	(restored)	1031	1622
17	Murád IV.	son of Ahmed I.	1032	1623
18.	Ibráhím	son of Ahmed I.	1049	1640
19.	Muhammed IV.	son of Ibráhím	1058	1648
20.	Suleymán II.	son of Ibráhím	1099	1687
21.	Ahmed II.	son of Ibráhím	1102	1691
22.	Mustafa II.	son of Muhammed IV.	1106	1695
23.	Ahmed III.	son of Muhammed IV.	1115	1703
24.	Mahmúd I.	son of Mustafa II.	1143	1730
25.	'Osmán III.	son of Mustafa II.	1168	1754
26.	Mustafa III.	son of Ahmed III.	1171	1757
27.	'Abd-ul-Hamíd I.	son of Ahmed III.	1187	1773
28.	Selím III.	son of Mustafa III.	1203	1789
29.	Mustafa IV.	son of 'Abd-ul-Hamíd I.	1222	1807
30.	Mahmúd II.	son of 'Abd-ul-Hamíd I.	1223	1808
31.	'Abd-ul-Mejíd	son of Mahmúd II.	1255	1839
32.	'Abd-ul 'Azíz	son of Mahmúd II.	1277	1861
33.	Murád V.	son of 'Abd-ul-Mejíd	1293	1876
34.	'Abd-ul-Hamíd II.	son of 'Abd-ul-Mejíd	1293	1876

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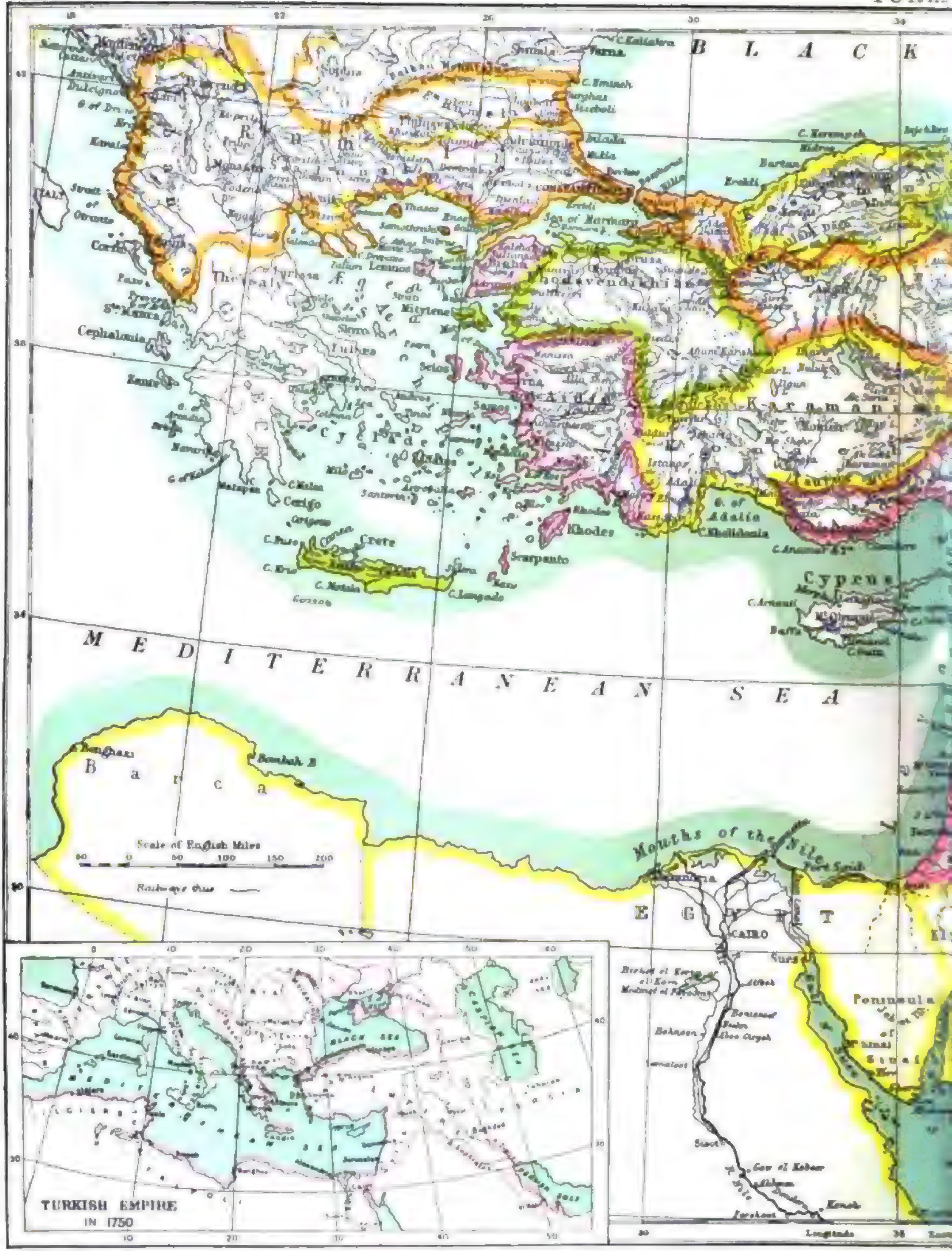
B L A C K
M E D I T E R R A N E A N   S E A
Barca
Benghazi
Bombah B.
Mouths of the Nile
E G Y P T
CAIRO
Alexandria
Port Said
Suez
Peninsula of Sinai
Cyprus
Crete
Rhodes
Scarpanto
Cyclades
Ægean Sea
Mitylene
Lemnos
Thasos
Samothraki
Thessaly
Cephalonia
Zante
Corfu
Strait of Otranto
Salonica
Monastir
Rumelia
Adrianople
CONSTANTINOPLE
Sea of Marmara
Varna
Shumla
C. Emineh
Burghas
Sizeboli
Khodavendikiar
Aidin
Karamania
Angora
Samos
Adalia
G. of Adalia
C. Khelidonia
C. Anamur
Cerigo
Matapan
C. Matala
C. Longado
Scale of English Miles
50
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50
100
150
200
Railways thus
Siout
Keneh
TURKISH EMPIRE IN 1750
BLACK SEA
CASPIAN SEA
18
22
26
30
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42
38
34
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60
Longitude
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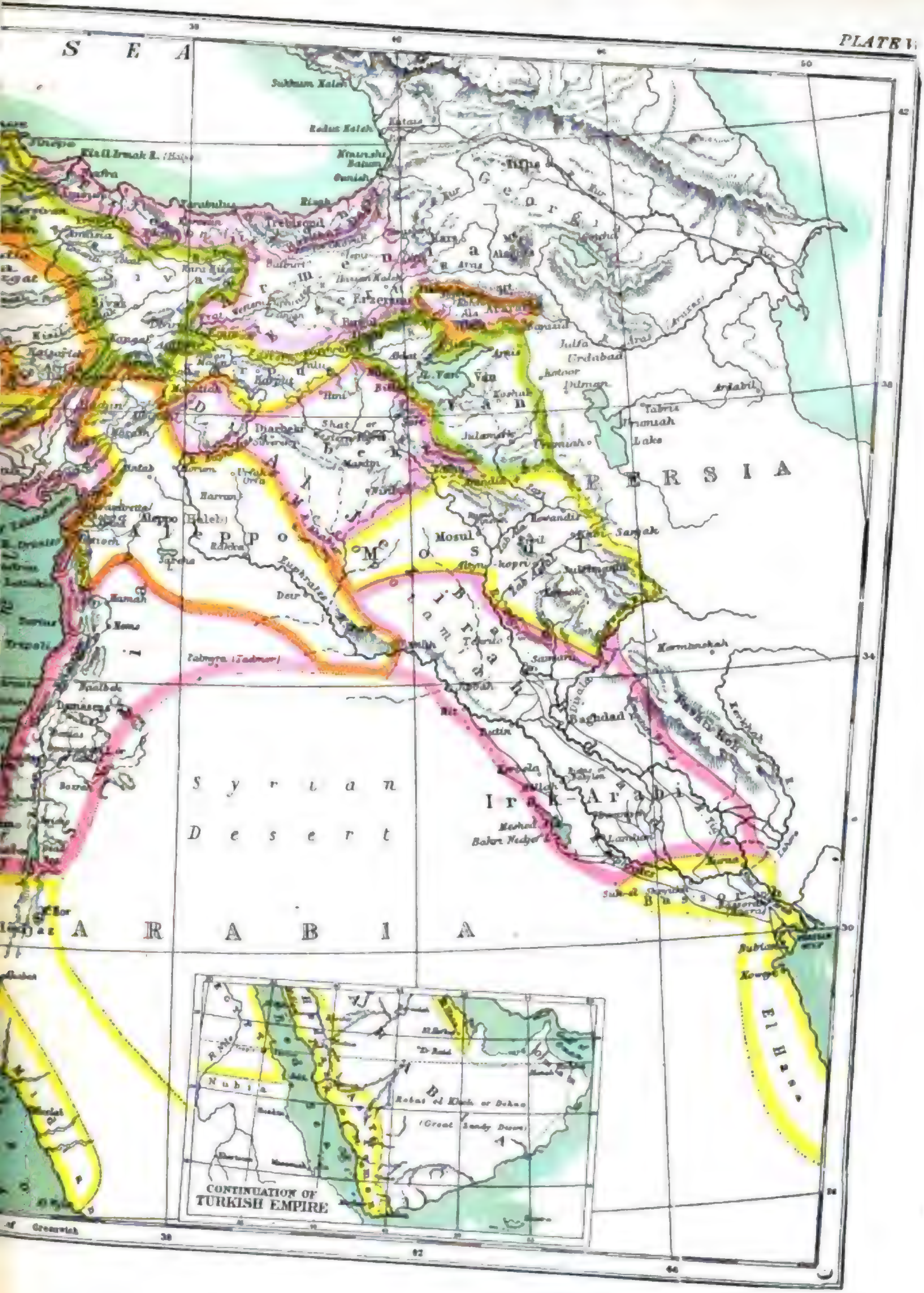
PLATE V



S E A
Sukhum Kaleh
Redut Kaleh
Batum
Ounieh
Rizeh
Trebizond
Tarabulus
Sinope
Kizil Irmak R. (Halys)
Bafra
Amasia
Tokat
Sivas
Yuzgat
Kaisarieh
Kangal
Kara Hissar
Baiburt
Erzerum
Kars
Tiflis
G e o r g i a
Alexandropol
Aras
Arakes
Ala Dagh
Erivan
Bayazid
Julfa
Urdabad
Ardabil
Tabriz
Urumiah
Lake
Van
R. Van
Bitlis
Mush
Kharput
Malatia
Diarbekr
Shat or Tigris
Mardin
Urfah
Orfa
Harran
Antab
Aleppo (Haleb)
A l e p p o
Antioch
Skanderun
Latakia
Tartus
Tripoli
Hamah
Homs
Baalbek
Damascus
Bosrah
Palmyra (Tadmor)
Deir
Euphrates
Mosul
M o s u l
Erbil
Rowandiz
Altun Kopri
Kerkuk
Suleimanieh
Sinnah
Samarra
Tekrit
Kermanshah
Baghdad
Hit
Anah
Kerbela
Hillah
Irak-Arabi
Meshed Ali
Bahr Nedjef
Suk-el-Sheioukh
Korna
Busrah
B u s o r a
Bubian
Koweyt
Persian Gulf
El Has
Syrian Desert
A R A B I A
P E R S I A
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Nubia
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(Great Sandy Desert)
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PART II.—GEOGRAPHY AND STATISTICS.

Turkey, or the Ottoman empire (*Osmanli Vilaieti*), embraces extensive territories in south-eastern Europe, western Asia, and northern Africa, grouped mainly round the eastern waters of the Mediterranean, and along both sides of the Red Sea, the west coast of the Persian Gulf, and the southern and western shores of the Black Sea. These territories form an aggregate of provinces and states, some under the direct control of the sultan, some enjoying a large share of political autonomy, some practically independent, either administered by foreign powers or ruled by hereditary vassals or tributary princes. The present (1887) extent of the Ottoman empire is about 1,692,150 square miles, and its population 42,346,000.

EUROPEAN TURKEY.

Since the Russo-Turkish War of 1878 (see above), the extremely irregular frontiers of European Turkey are conterminous with Greece in the south, and in the north with Montenegro, Austria, Servia, and Roumania, being separated from the last country partly by the Danube, partly by a conventional line drawn from Silistria on that river to Mangalia on the Black Sea. By the Berlin congress Roumania and Servia, hitherto vassal states, were made absolutely independent kingdoms, Roumania at the same time receiving the district of Dobrudja between the lower Danube and the Black Sea, and Servia those of Nish and Leskovatz about the upper Morava river. Montenegro was also recognized as an independent principality, with an increase of territory, which gave it a sea frontier limited southwards by the river Boyana, and including the Albanian ports of Dulcigno and Antivari on the Adriatic. The Greco-Turkish frontier was also shifted north, Greece obtaining most of Thessaly and a strip of Epirus (south Albania), so that since 1881 the border line runs from near Mount Olympus on the Gulf of Saloniki (40° N. lat.) west to the Pindus range, then southwest to the Gulf of Arta on the Ionian Sea. A still more serious step was taken towards disintegration by the withdrawal of Bulgaria and Eastern Roumelia from the immediate jurisdiction of the Sublime Porte. The former was constituted a tributary principality, with representative institutions, and Eastern Roumelia was erected into an autonomous province, both under the guarantee of the European powers. But in 1885 the latter province declared for union with Bulgaria, and since then these two territories have practically formed one state administered from Sophia, Europe assenting and Turkey consenting (imperial firman of 6th April 1886) on the retrocession to Turkey of the Moslem districts of Kirjali and the Rhodope. In the year 1878 Austria occupied and assumed the civil administration of the north-western provinces of Bosnia and Herzegovina, besides taking military possession of the contiguous strategical district of Novi-Bazar. The direct possessions of the sultan have thus been reduced in Europe to a strip of territory stretching continuously across the Balkan Peninsula from the Bosphorus to the Adriatic (29° 10′ to 19° 20′ E. long.), and lying in the east mainly between 40° and 42° and in the west between 39° and 43° N. lat. It corresponds roughly to ancient Thrace, Macedonia with Chalcidice, Epirus, and a large part of Illyria, constituting the present administrative divisions of Stambul (Constantinople, including a small strip of the opposite Asiatic coast), Edirneh (Adrianople), Saloniki with Kosovo (Macedonia), Janina (parts of Epirus and Thessaly), Shkodra (Scutari or upper Albania). To these must be added the Turkish islands in the Ægean usually reckoned to Europe, that is, Thasos, Samothrace, Imbros, and, in the extreme south, Crete or Candia, with estimated (1887) areas and populations as under :—

Provinces.	Area in Square Miles.	Population.
Constantinople	1,100	1,200,000
Adrianople	12,800	560,000
Saloniki and Kosovo	32,000	1,900,000
Janina	14,000	1,440,000
Scutari	13,000	390,000
Candia and other islands	3,600	230,000
Immediate possessions	76,700	5,720,000
Bulgaria, tributary principality	24,300	2,008,000
East Roumelia, autonomous province	14,000	975,000
Bosnia, Herzegovina, and Novi-Bazar, occupied by Austria	23,570	1,504,000
Total European Turkey since 1878	138,570	10,207,000
Dobrudja, ceded to Roumania	4,200	150,000
Nish and Leskovatz, ceded to Servia	4,250	367,000
Dulcigno, &c., ceded to Montenegro	2,000	116,000
Parts of Thessaly and Epirus, ceded to Greece	2,000	100,000 (?)
Total European Turkey before 1878	151,020	10,940,000

For detailed accounts of the physical features, climate, fauna, and flora of these regions, the reader is referred to the articles ALBANIA, BOSNIA, BULGARIA, CONSTANTINOPLE, EPIRUS, HERZEGOVINA, MACEDONIA, and THRACE. Here it will suffice to remark in a general way that the territory still directly administered from Stambul comprises one of the most favoured regions of the temperate zone. The extensive igneous and metamorphic system of the Great Balkans and Rhodope (Despoto-Dagh), culminating in the Rilo Dagh (9000 feet), interspersed in the Pindus range farther west by Permian formations of unknown age, and succeeded in the extreme east (both sides of the Bosphorus) by Lower Devonian sandstones and some more recent volcanic rocks, is pierced by the four rich alluvial valleys of the Maritza, Kara-su or "Blackwater," Struma (Strymon), and Vardar. These rivers, flowing in nearly parallel south-easterly courses to the Ægean, collect most of the drainage of Roumelia, as Thrace and Macedonia are commonly called by the Turks. The whole region thus enjoys a somewhat southerly aspect, sheltered from the north by the lofty crests of the Rilo Dagh and northern Pindus, and in every way admirably suited for the cultivation of most cereals, as well as of cotton, tobacco, madder, the mulberry, the vine, and fruits. Here maize yields such a bountiful harvest that, although originally introduced from America, it has long been regarded as indigenous, and for the Italians is simply the Turkish corn ("gran turco") in a pre-eminent sense. The inhabitants also, Greeks intermingled with Turks in the east, with Bulgarians in the west, are intelligent and industrious, noted for their skill in the manufacture of carpets and other woven goods, of saddlery, arms, and jewellery.

ASIATIC TURKEY.

Boundaries. The mainstay of the Ottoman dynasty is the Asiatic portion of the empire, where the Mohammedan religion is absolutely predominant, and where the naturally vigorous and robust Turki race forms in Asia Minor a compact mass of many millions, far outnumbering any other single ethnical element and probably equalling all taken collectively. Here also, with the unimportant exception of the islands of Samos and Cyprus and the somewhat privileged district of Lebanon, all the Turkish possessions constitute vilayets directly controlled by the Porte. They comprise the geographically distinct regions of the Anatolian plateau (Asia Minor), the Armenian and Kurdish highlands, the Mesopotamian lowlands, the hilly and partly mountainous territory of Syria and Palestine, and the coastlands of west and north-east Arabia. The changes caused by the Russo-Turkish War of 1878 were the cession to Persia of the little district of Kotur on the eastern frontier and to Russia of the districts of Kars and Batoum on the north-east frontier, while to England were conceded the military occupation and administration of Cyprus. Asiatic Turkey is conterminous on the east with Russia and Persia; in the south-west it encloses on the west, north, and north-east the independent part of Arabia. Towards Egypt the frontier is a conventional line drawn from Akabah at the head of the Gulf of Akabah north-westwards to the little port of El Arish on the Mediterranean. Elsewhere Asiatic Turkey enjoys the advantage of a sea frontage, being washed in the north-west and west by the Euxine, Ægean, and Mediterranean, in the south-west by the Red Sea, and in the south-east by the Persian Gulf.

Area and population. The above enumerated five natural divisions of Asiatic Turkey are divided for administrative purposes into about twenty vilayets, which, however, have been and still are subject to considerable fluctuations. The subjoined grouping, with areas and populations, is based mainly on data lately communicated confidentially to the British Government by Mr Redhouse. His estimates of population have been strikingly confirmed by the official returns that have for the first time just been made for certain provinces in Asia Minor and the Armenian highlands. Thus the census of the Trebizond vilayet, completed in 1886, gave a total of 1,010,000, which differs only by 7000 from Mr Redhouse's estimate for 1878 (1,017,000). So also the just completed (1887) census for the Erzeroum vilayet gives 583,000, or 998,000 including the territory ceded to Russia in 1878, which is 45,000 higher than Mr Redhouse's estimate.

Natural Divisions.	Provinces.	Area in Square Miles.	Population.
Asia Minor	Broussa with Biga and Ismid	32,000	1,900,000
	Aidin (Smyrna)	23,000	1,610,000
	Kastamuni	21,000	1,200,000
	Angora	27,000	860,000
	Konieh	[illegible]	1,280,000
	Adana	16,000	470,000
	Sivas with Janik	20,000	1,770,000
	Trebizond	12,000	1,010,000
Armenia and Kurdistan	Erzeroum and Van	40,000	583,000 1,000,000
	Diarbekr with Aziz	38,000	560,000
Mesopotamia	Baghdad	100,000	4,750,000
	Basra with El-Hasa	31,000	1,085,000
Syria and Palestine	Aleppo	46,000	1,450,000
	Damascus Lebanon Jerusalem	35,000	1,560,000 450,000 390,000
Arabia	Hejaz Yemen	200,000 (?)	720,000 830,000
	Archipelago	1,700	325,000
	Samos	210	41,000
	Cyprus	3,670	235,000
	Total Asiatic Turkey	691,580	24,330,000

Physical features. Detailed descriptions of Asiatic Turkey will be found under the separate articles ARABIA, ARMENIA, ASIA MINOR, KURDISTAN, MESOPOTAMIA, PALESTINE, and SYRIA. Of these natural divisions Asia Minor or Anatolia is by far the most important for extent, population, and natural resources. It constitutes an elevated and fertile plateau enclosed by irregular mountain ranges, which in the Taurus and Antitaurus on the south and east rise to from 7000 to 10,000 feet, culminating in the volcanic Erjish-Dagh, or Argæus, nearly 12,000 feet high. The plateau, which has a mean altitude of some 3000 feet, is depressed in the centre, where the Tuz-gol (Tatta Palus) and several other lacustrine basins have at present no outflow, but which appear to have formerly drained through the Sakaria (Sangarius) northwards to the Euxine. In the same direction, and in curiously parallel curves, flow the more easterly Kizil-Irmak (Halys) and Yeshil-Irmak (Iris), which carry off most of the surface waters of the plateau. The western rivers—Granicus, Xanthus (Scamander), Hermus, Simois, Meander—although renowned in song and history, are comparatively insignificant coast-streams, rushing from the escarpment of the plateau down to their fjord-like estuaries in the Ægean. None of the rivers are navigable to any distance from their mouths, and in the absence of good means of communication the very rich resources of the plateau in minerals and agricultural produce have hitherto been little developed. Owing to the different elevations and varied aspects of the land towards the Euxine, Ægean, and Mediterranean, the climate is extremely diversified, presenting all the transitions from intense summer heat along most of the seaboard to severe winters on the lofty tablelands of the interior, which are exposed to biting winds from the Russian steppes. Anatolia has an endless variety of natural products, from the hardy boxwood of Lazistan (Trebizond vilayet) to the sub-tropical figs and grapes of the western coastlands. On the plateau thrives the famous breed of Angora goats, whose soft, silky fleece (mohair) forms a staple export.

Of far less economic importance are the Armenian uplands, forming a rugged plateau of limited extent, above which rise many lofty peaks, culminating in the tower-crested Ararat (16,916 feet), the converging point of three empires. The long and terribly severe winters, intolerably hot short summers, and generally poor soil of Armenia present a marked contrast to the far more temperate climate, rich upland valleys, and densely wooded slopes of the more southern Kurdistan highlands. But these advantages are counterbalanced by the generally inaccessible nature of the country, the want of good highways, and especially the lawless character of its inhabitants, who have undergone little social change since the days of their wild Karduchi forefathers. In the heart of this savage region lies the magnificent basin of Lake Van, which, like Tuz-gol and the more easterly Urmiya, has no present outflow, but formerly, no doubt, discharged to the Tigris valley.

In the Van district lie the sources of most of the head streams of the TIGRIS (*q.v.*) and EUPHRATES (*q.v.*), which have created the vast and fertile alluvial plains of Mesopotamia. This latter region, the seat of the ancient Accadian and Assyrian and the more recent Moslem cultures, forms a continuous plain from the escarpments of the Kurdistan highlands to the Persian Gulf, broken only in the north by the Sinjar Hills, and capable of yielding magnificent crops wherever water is available. But under Osmanli rule the splendid system of irrigation works, dating from the dawn of history, has fallen into decay: the lower Euphrates now overflows its banks and converts much of the region above and below Kurnah, at the confluence of the two great arteries, into malarious marshlands. Hence the populous cities and innumerable villages formerly dotted over the Babylonian plains have been succeeded by the scattered hamlets of the Montefik and other amphibious Arab tribes.

This lowland region is separated by the more elevated Syrian desert or steppe from the much smaller and less productive provinces of Syria and Palestine. Here the main physical features are at once simple and yet striking. The narrow, hilly region disposed north and south between the Mediterranean and the desert, and stretching for over 400 miles between Anatolia and the Sinai Peninsula, culminates towards the centre in the parallel Libanus and Antilibanus (10,000 to 11,000 feet), enclosing between them the fertile depression of the Bekà' (Cœle-Syria). The stupendous ruins of Baalbek, standing at the highest point of this depression in 30° N. lat., mark the parting line between the northern and southern watersheds of the region. Northwards flows the El-'Asi (Orontes), southwards the Litáni (Leontes), both through the Beka in moderately sloping beds to the Mediterranean. For further particulars, see the articles LEBANON, JORDAN, PALESTINE. In the Lebanon the Christian Maronite communities enjoy a measure of self-government under the guarantee of France, while their pagan neighbours and hereditary foes, the Druses, are gradually withdrawing to the hilly Hauran district beyond Jordan.

Turkey's Arabian possessions comprise, besides El-Hasa on the Persian Gulf, the low-lying, hot, and insalubrious Tehama and the south-western highlands (vilayets of Hejaz and Yemen) stretching continuously along the east side of the Red Sea, and including the two holy cities of Mecca and Medina. These are held by military occupation, probably at a loss to the imperial exchequer, and certainly against the wishes of the inhabitants. But these drawbacks are supposed to be more than compensated by the political prestige derived from the possession of the Holy Land of Islam.

African Territories.

Area and population. Since the abandonment of eastern or Egyptian Soudan in 1884, consequent on the revolt of the Mahdi, and the occupation of Tunis by the French in 1881, Turkey in Africa has been reduced to the two territories of Egypt and Tripolitana with Barca and Fezzan, jointly occupying the north-east corner of the continent. Of these Tripolitana alone is directly administered, constituting the pashalik or vilayet of Tripoli. Egypt, whose southern frontier was temporarily fixed in January 1887 at the station of Akashe above Wady Halfa, near the second cataract in Lower Nubia (22° N. lat.), has formed a practically independent principality under the dynasty of Mehemet Ali since 1841, subject only to an annual tribute of £695,000 to the Porte. The areas and populations of Turkey in Africa were estimated as follows in 1887:—

	Area in Sq. Miles.	Population.
Tripoli, with Barca and Fezzan, a vilayet	485,000	1,000,000
Egypt, tributary principality	374,000	6,600,000
Total Turkey in Africa	[illegible]	7,600,000

The Empire.

Administration. Turkey is essentially a theocratic absolute monarchy, being subject in principle to the direct personal control of the sultan, who is himself at once a temporal autocrat and the recognized caliph, that is, "successor" of the Prophet, and consequently the spiritual head of the Moslem world (see MOHAMMEDANISM). But, although the attempt made in 1876 to introduce representative institutions proved abortive, this theoretical absolutism is nevertheless tempered not only by traditional usage, local privilege, the juridical and spiritual precepts of the Koran and its *'ulemá* interpreters, and the privy council, but also by the growing force of public opinion and the direct or indirect pressure of the European powers. The 'ulemá[1] form a powerful corporation, whose head, the *sheikhu 'l-Islám*, ranks as a state functionary scarcely second to the grand vizier, or prime minister. Owing to their intensely conservative and fanatical spirit, the 'ulemá have always been determined opponents of progress, and are at present one of the greatest obstacles to reform in a political system where the spiritual and temporal functions are inextricably interwoven. Besides these expounders of Koranic doctrine, the sovereign is to some extent bound also by the *Multeka*, a legal code based on the traditional sayings of Mohammed and the recorded decisions of his successors, having the force of precedents.

The grand vizier (*sadr-azam*), who is nominated by the sultan, presides ex-officio over the privy council (*mejliss-i-khass*), which, besides the sheikhu 'l-Islám, comprises the ministers of home and foreign affairs, war, finance, marine, trade, public works, justice, public instruction, and worship, with the president of the council of state and the grand master of artillery. For administrative purposes the immediate possessions of the sultan are divided into vilayets (provinces), which are again subdivided into sanjaks or mutessarifs (arrondissements), these into kazas (cantons), and the kazas into nahiés (parishes or communes). A vali or governor-general, nominated by the sultan, stands at the head of the vilayet, and on him are directly dependent the pashas, effendis, beys, and other administrators of the minor divisions. All these officials unite in their own persons the judicial and executive functions, and all alike are as a rule thoroughly corrupt, venal in the dispensation of justice, oppressors of the subject, embezzlers of the public revenues, altogether absorbed in amassing wealth during their mostly brief and precarious tenure of office.[2] Foreigners settled in the country are specially protected from exactions by the so-called "capitulations," in virtue of which they are exempt from the jurisdiction of the local courts and amenable for trial to tribunals presided over by their respective consuls. Cases between foreigners of different nationalities are heard in the court of the defendant, and between foreigners and Turkish subjects in the local courts, at which a consular dragoman attends to see that the trial is conducted according to law.

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[1] See SUNNITES, vol. xxii. p. 660.

[2] Major-General F. T. Haig, who travelled through the heart of Yemen in the winter of 1886-87, thus speaks of the administration in that almost exclusively Moslem province: "The fiscal system of the Turks, if it were really carried into effect, would be by no means bad; but like every other department of the government it is ruined by the utter corruption that prevails in every branch of the administration from top to bottom. No more eloquent expounders of the evils and hopelessness of their whole system are to be found than the Turks themselves, as I found from conversation with two or three of their own officials" (*Proc. R. Geog. Soc.*, August 1887, p. 467). Mr G. P. Devey also, consul at Erzeroum, reports that in a part of that province the sheep-tax for 1886 was collected three times over: "On the first occasion the real number had been underestimated, and the collector therefore came again, and, finding that such was the case, made the villagers pay the whole sum of 14,000 piastres (9000 had been levied on the previous occasion), instead of the difference, on the ground that they had cheated the Government in not declaring their whole stock. A third time a collector visited the caza, and, when the villagers could produce no receipt that the tax had been paid (for none had been given), a third time the full sum was taken" (*Cons. Rep.*, July 1887, p. 3).

The trade returns for the last few years show that the country is slowly recovering from the disastrous consequences of the Russo-Turkish War. For the four years 1882-86 the exports from and imports to Turkey were valued as under :—

	Exports.[1]	Imports.		Exports.[1]	Imports.
1882-3	£10,900,000	£17,000,000	1884-5	£11,326,000	£18,263,000
1883-4	9,550,000	17,350,000	1885-6	10,690,000	17,702,000

The share of the chief foreign states in these exchanges is shown in the subjoined table[2] for the years 1884-85 and 1885-86 :—

	Imports from		Exports to	
	1884-5.	1885-6.	1884-5.	1885-6.
Great Britain	£8,304,000	£7,755,000	£3,923,000	£4,081,000
France	2,225,000	2,050,000	4,063,000	3,296,000
Austria	3,800,000	3,468,000	1,113,000	1,001,000
Russia	1,204,000	1,556,000	306,000	341,000
Italy	563,000	536,000	339,000	327,000
Greece	395,000	318,000	500,000	437,000
United States	275,000	166,000	63,000	107,000
Persia	553,000	482,000	7,030	7,450
Roumania	228,000	565,000	88,000	96,000
Belgium	254,000	261,000	2,525	9,456

The chief staples of the export trade are raisins (£1,370,000 in 1884-85), wheat (£900,000), cotton (£700,000), opium (£500,000), olive oil (£450,000), valonia (£450,000), barley (£332,000), figs (£200,000), sesame (£196,000), maize (£194,000), pulse (£185,000), nuts (£184,000), mohair (£145,000), wool (£140,000), dates (£125,000); and of the import trade cotton and cotton stuffs (£4,350,000, in 1883-84), cereals and flour (£1,350,000), sugar (£1,150,000), draperies, hosiery, &c. (£735,000), woollen stuffs (£650,000), coffee (£535,000), metals (£516,000), ironmongery (£475,000), dyes (£450,000), silk and silk stuffs (£400,000), petroleum (£375,000), hides and skins (£255,000), live stock (£236,000), chemicals (£167,000), coal (£135,000).

In the next table are given the principal seaports of the empire with their imports, exports, and shipping for 1886 :—

	Exports.	Imports.	Vessels entered.	Tonnage.
Alexandria	£11,710,000	£9,417,000	1249	1,020,000
Constantinople	....	....	9072	5,193,000
Smyrna	4,331,000	2,706,000	1615	1,303,000
Saloniki	1,362,000	1,660,000	5440	574,000
Iskanderoon and Tripoli	1,022,000	1,670,000	626	351,000
Samsun, with Ordu and Unieh	806,000	787,000	478	455,000
Trebizond and Kirasun	715,000	1,904,000	6062	478,000
Beyrut, with Akka and Haifa	602,000	995,000	4009	618,000
Kavala	457,000	201,000	778	145,000
Crete (six ports)	385,030	633,000	8760	491,000
Dédéagatch	298,000	160,000	....	....
Tripoli (Africa)	231,000	310,000	501	272,000
Burgas	222,000	281,000	1371	115,000
Gallipoli and Rodosto	212,000	185,000	....	....
Suez	172,000	709,000	712	1,100,000
Benghazi	121,000	171,000	261	54,000
Jaffa	120,000	240,000	1000	459,000
Jeddah	119,000	?	1040	317,000

Exclusive of coasting craft, the mercantile fleet of Turkey in 1885 consisted of 14 steamers of 11,000 tons and 400 sailing vessels of 65,000 tons.

All branches of the foreign trade, together with most of the local traffic and the banking business, are almost exclusively in the hands of Greeks, Armenians, Jews, and foreigners. The Turks and other Mohammedans are engaged nearly altogether in agricultural and pastoral pursuits. But the land, especially in Anatolia, is gradually passing from its Moslem owners into the possession of Christian mortgagees. Scarcely any accurate agricultural returns are available, except for one or two districts. In the Erzeroum vilayet in 1886[3] the live-stock stood as under,—sheep 1,485,000, goats 645,000, oxen 470,000, buffaloes 48,000, horses 61,000, asses 42,000, mules 5000; beehives numbered 80,000. The chief agricultural produce for the same year was—wheat 16,690,000 bushels, barley 13,297,000 bushels, beans 46,250 cwts., melons 17,000 cwts., mulberries 10,000 cwts., other fruits 40,000 cwts. In the same year of the 12,000 square miles constituting the Trebizond vilayet 2160 were under cultivation, 1860 uncultivated, 2520 woodland, and 5520 highland pasturage, the annual yield being about 2,300,000 cwts. of cereals, 1,000,000 cwts. of nuts, fruits, vegetables, &c., and 500,000 cwts. of fodder; whilst of live-stock there were 300,000 sheep and goats, 150,000 horses, 25,000 mules and asses, 60,000 oxen.[4]

Finance.

Previous to 1880 Turkey was commonly regarded as practically bankrupt. But since then a considerable improvement has been effected. Trustworthy data are still wanting; but a careful estimate gave the gross revenue and expenditure of 1884 at £T16,313,000 and £T16,223,000 respectively, the expenditure including over £T4,000,000 available for state creditors. The public debt stood at £106,437,000 in 1882. The sultan is reported to draw a sum of from £1,000,000 to £2,000,000 annually from the public revenues for the support of the seraglio or imperial household of over five thousand persons.

Army.

Until 1886 the military service, compulsory on all Moslems over 18 years of age, was kept up by 45,000 annual recruits drawn by ballot; but in November of that year universal conscription of the whole able-bodied male population was decreed. By this measure the army, hitherto reckoned at about 160,000 men, with a war strength of from 450,000 to 500,000, will be probably raised to a permanent footing of 1,000,000 effectives under the flag and in the reserves. These will continue to be grouped in the three categories of the nizam or regulars in active service, the redif or first reserve, and the mustahfiz or second reserve. There is to be a considerable increase of cavalry, all conscripts being allowed to join that branch of the service who have the means of providing themselves with mounts and equipment. For military purposes the empire is divided into seven divisions, with headquarters at Constantinople, Adrianople, Monastir, Erzingian, Baghdad, Damascus, and Sanaa, all except Sanaa (for Yemen) hitherto furnishing an army corps for the nizam and two for the redif.

Navy.

The navy at the beginning of 1887 comprised 15 large and several smaller ironclads (monitors, gunboats, &c.), a number of mostly old-fashioned steamers, and 14 torpedo boats, and was manned by 30,000 sailors and 10,000 marines (nominal strength), raised by conscription or voluntary enlistment and serving for 12 years in the active and reserve classes.

Education.

Public instruction is much more widely diffused throughout the empire than is commonly supposed. This is due partly to the Christian communities, notably the Maronites and others in Syria, the Anatolian and Roumelian Greeks, and the Armenians of the eastern provinces and of Constantinople. Education is practically limited amongst the Mohammedans to reading and writing and the study of the Koran. But amongst the Christians, especially the Armenians, the Greeks of Smyrna, and the Syrians of Beyrut, it embraces a considerable range of subjects, such as classical Hellenic, Armenian, and Syriac, as well as modern French, Italian, and English, modern history, geography, and medicine. Large sums are freely contributed for the establishment and support of good schools, and the cause of national education is seldom forgotten in the legacies of patriotic Anatolian Greeks. Even the Turks are bestirring themselves in this respect, and great progress has been made during the last twenty years in the Erzeroum vilayet.[5] In 1886 that province contained 1216 schools and 163 madrasas (colleges), with a total attendance of 25,680, including 1504 girls. Elsewhere few official statistics are available.

Communication.

Besides administrative and financial reforms, one of the most pressing needs is improved means of communication. In Trebizond the route from the coast at Unieh through Niksar to Sivas has recently been completed to the limits of the vilayet. But the works on the more important road from Kirasun to Kara-hissar for the silver and lead mines at Lijessy are still suspended, owing to disputes between the contiguous provincial administrations. Many of the great historic highways are also much out of repair. At the end of 1885 only 1250 miles of railway were completed in the empire, of which 903 were in Europe and 347 in Asia. The chief lines are those connecting the capital with Adrianople (210 miles), Adrianople with Saremby (152), Saloniki with Uskub (150), Zenica with Brod (118), Uskub with Mitrovitza (75), and Kulleli with Dédéagatch (70) in Europe, and, in Asia, Scutari with Ismid (40), Smyrna with Ala-Shehr (130), and Smyrna with Denizli (170). By imperial decree (August 1887) a contract was granted to an English syndicate for the extension of the Ismid line and the construction of a system of Asiatic railways to extend to Baghdad within the space of ten years.

The telegraph system is much more developed, comprising (1885) 14,620 miles, with 26,100 miles of wire and 470 stations. The yearly average of letters and packages of all sorts sent through the 710 post-offices scarcely exceeds 2,600,000. Most of the foreign postal service is conducted through the British, Austrian, German, French, and Russian privileged post-offices.

For the ethnography of the Turks, see TURKS. (A. H. K.)

PART III.—LITERATURE.

In all literary matters the Ottoman Turks have shown themselves a singularly uninventive people, the two great schools, the old and the new, into which we may divide their literature, being closely modelled, the one after the classics of Persia, the other after those of modern Europe, and more especially of France. The old or Persian school flourished from the foundation of the empire down to about 1830, and still continues to drag on a feeble existence, though it is now out of fashion and cultivated by none of the leading men of letters. These belong to the new or European school, which sprang up some fifty or sixty years ago, and which, in spite of the bitter opposition of the partisans of the old Oriental system, has succeeded, partly through its own inherent superiority and partly through the talents and courage of its supporters, in expelling its rival from the position of undisputed authority which it had occupied for upwards of five hundred years. **Old school.** For the present purpose it will be convenient to divide the old school into three periods, which may be termed respectively the pre-classical, the classical, and the post-classical. Of these the first extends from the early days of the empire to the accession of Suleymán I., 1301-1520 (700-926); the second from that event to the accession of Mahmúd I., 1520-1730 (926-1143); and the third from that date to the accession of 'Abd-ul-'Azíz, 1730-1861 (1143-1277).

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[1] Exclusive of tobacco, which for fiscal reasons is not included in the general trade returns, but the export of which amounted to £11,500,000 in value for 1884-5, and nearly £11,000,000 for 1885-6.

[2] Consul-General Fawcett's *Report* for July 1887, p. 31.

[3] *Cons. Rep.* for July 1887.

[4] *Cons. Rep.*, May 1887.

[5] *Cons. Rep.*, July 1887, p. 4.

General character of Ottoman literature. The works of the old school in all its periods are entirely Persian in tone, sentiment, and form. We find in them the same beauties and the same defects that we observe in the productions of the Iranian authors. The formal elegance and conventional grace, alike of thought and of expression, so characteristic of Persian classical literature, pervade the works of the best Ottoman writers, and they are likewise imbued, though in a less degree, with that spirit of mysticism which runs through so much of the poetry of Irán. But the Ottomans did not stop here: in their romantic poems they chose as subjects the favourite themes of their Persian masters, such as Leyli and Mejnún, Khusrev and Shírín, Yúsuf and Zuleykhá, and so on; they constantly allude to Persian heroes whose stories occur in the *Sháh-Náma* and other storehouses of Iranian legendary lore; and they wrote their poems in Persian metres and in Persian forms. The mesneví, the kasída, and the ghazel,—all of them, so far at least as the Ottomans are concerned, Persian,—were the favourite verse-forms of the old poets. A mesneví is a poem written in rhyming couplets, and is usually narrative in subject. The kasída and the ghazel are both monorhythmic; the first as a rule celebrates the praises of some great man, while the second discourses of the joys and woes of love. Why Persian rather than Arabian or any other literature became the model of Ottoman writers is explained by the early history of the race (see TURKS). Some two centuries before the arrival of the Turks in Asia Minor the Seljúks, then a mere horde of savages, had overrun Persia, where they settled and adopted the civilization of the people they had subdued. Thus Persian became the language of their court and Government, and when by and by they pushed their conquests into Asia Minor, and founded there the Seljúk empire of Rúm, they carried with them their Persian culture, and diffused it among the peoples newly brought under their sway. It was the descendants of those Persianized Seljúks whom the early Ottomans found ruling in Asia Minor on their arrival there. What had happened to the Seljúks two centuries before happened to the Ottomans now: the less civilized race adopted the culture of the more civilized; and, as the Seljúk empire fell to pieces and the Ottoman came gradually to occupy its place, the sons of men who had called themselves Seljúks began thenceforth to look upon themselves as Ottomans. Hence the vast majority of the people whom we are accustomed to think of as Ottomans are so only by adoption, being really the descendants of Seljúks or Seljúkian subjects, who had derived from Persia whatever they possessed of civilization or of literary taste. An extraordinary love of precedent, the result apparently of conscious want of original power, was sufficient to keep their writers loyal to their early guide for centuries, till at length the allegiance, though not the fashion of it, has been changed in our own days, and Paris has replaced Shíráz as the shrine towards which the Ottoman scholar turns. While conspicuously lacking in creative genius, the Ottomans have always shown themselves possessed of receptive and assimilative powers to a remarkable degree, the result being that the number of their writers both in prose and verse is enormous. Of course only a few of the most prominent, either through the intrinsic merit of their work or through the influence they have had in guiding or shaping that of their contemporaries, can be mentioned in a brief review like the present. It ought to be premised that the poetry of the old school is greatly superior to the prose.

Pre-classical period. Ottoman literature may be said to open with a few mystic lines, the work of Sultán Veled, son of Mauláná Jelál-ud-Dín, the author of the great Persian poem the *Mathnawí*. Sultán Veled flourished during the reign of 'Osmán I., though he did not reside in the territory under the rule of that prince. Another mystic poet of this early time was 'Áshik Pasha, who left a long poem in rhyming couplets, which is called, inappropriately enough, his *Díván*. The nocturnal expedition across the Hellespont by which Suleymán, the son of Orkhan, won Gallipoli and therewith a foothold in Europe for his race, was shared in and celebrated in verse by a Turkish noble or chieftain named Gházi Fázil. Sheykhí of Kermiyán, a contemporary of Muhammed I. and Murád II., wrote a lengthy and still esteemed mesneví on the ancient Persian romance of Khusrev and Shírín; and about the same time Yaziji-oghlu gave to the world a long versified history of the Prophet, the *Muhammediya*. The writers mentioned above are the most important previous to the capture of Constantinople; but there is little literature of real merit prior to that event. The most notable prose work of this period is an old collection of stories, the *History of the Forty Vezírs*, said to have been compiled by a certain Sheykh-záda and dedicated to Murád II. A few years after Constantinople passed into the hands of the Ottomans, some ghazels, the work of the contemporary Tatar prince, Mír 'Alí Shír, who under the *nom de plume* of Nevá'í wrote much that shows true talent and poetic feeling, found their way to the Ottoman capital, where they were seen and copied by Ahmed Pasha, one of the viziers of Muhammed II. The poems of this statesman, though possessing little merit of their own, being for the most part mere translations from Nevá'í, form one of the landmarks in the history of Ottoman literature. They set the fashion of ghazel-writing; and their appearance was the signal for a more regular cultivation of poetry and a greater attention to literary style and to refinement of language. In Sinán Pasha, another minister of Muhammed the Conqueror, Ottoman prose found its first exponent of ability; he left a religious treatise entitled *Tazarru'át* (Supplications), which, notwithstanding a too lavish employment of the resources of Persian rhetoric, is as remarkable for its clear and lucid style as for the beauty of many of the thoughts it contains. The most noteworthy writers of the Conqueror's reign are, after Ahmed and Sinán, the two lyric poets Nejátí and Zátí, whose verses show a considerable improvement upon those of Ahmed Pasha, the romantic poets Jemálí and Hamdí, and the poetesses Zeyneb and Mihrí. Like most of his house, Muhammed II. was fond of poetry and patronized men of letters. He himself tried versification, and some of his lines which have come down to us appear quite equal to the average work of his contemporaries. Twenty-one out of the thirty-four sovereigns who have occupied the throne of 'Osmán have left verses, and among these Selím I. stands out, not merely as the greatest ruler, warrior, and statesman, but also as the most gifted and most original poet. His work is unhappily for the greater part in the Persian language; the excellence of what he has done in Turkish makes us regret that he did so little. The most prominent man of letters under Selím I. was the legist Kemál Pasha-záda, frequently called Ibn-Kemál, who distinguished himself in both prose and verse. He left a romantic poem on the loves of Yúsuf and Zuleykhá, and a work entitled *Nigáristán*, which is modelled both in style and matter on the *Gulistán* of Sa'dí. His contemporary, Mesíhí, whose beautiful verses on spring are perhaps better known in Europe than any other Turkish poem, deserves a passing mention.

Classical period. With the accession of Selím's son, Suleymán I., the classical period begins. Hitherto all Ottoman writing, even the most highly finished, had been somewhat rude and uncouth; but now a marked improvement becomes visible alike in the manner and the matter, and authors of greater ability begin to make their appearance. Fuzúlí, one of the four great poets of the old school, seems to have been a native of Baghdád or its neighbourhood, and probably became an Ottoman subject when Suleymán took possession of the old capital of the caliphs. His language, which is very peculiar, seems to be a sort of mixture of the Ottoman and Ázerbiján dialects of Turkish, and was most probably that of the Persian Turks of those days. Fuzúlí showed far more originality than any of his predecessors; for, although his work is naturally Persian in form and in general character, it is far from being a mere echo from Shíráz or Ispahán. He struck out a new line for himself, and was indebted for his inspiration to no previous writer, whether Turk or Persian. An intense and passionate ardour breathes in his verses, and forms one of the most remarkable as well as one of the most attractive characteristics of his style; for, while few even among Turkish poets are more artificial than he, few seem to write with greater earnestness and sincerity. His influence upon his successors has scarcely been as far-reaching as might have been expected,—a circumstance which is perhaps in some measure owing to the unfamiliar dialect in which he wrote. Besides his *Díván*, he left a beautiful mesneví on the story of Leylí and Mejnún, as well as some prose works little inferior to his poetry. Bákí of Constantinople, though far from rivalling his contemporary Fuzúlí, wrote much good poetry, including one piece of great excellence, an elegy on Suleymán I. The Ottomans have as a rule been particularly successful with elegies; this one by Bákí has never been surpassed. Rúhí, Lámi'í, Nev'í, the janissary Yahya Beg, the mufti Ebú-Su'úd, and Selím II. all won deserved distinction as poets. During the reign of Ahmed I. arose the second of the great poets of the old Ottoman school, Nef'í of Erzerúm, who owes his pre-eminence to the brilliance of his kasídas. But Nef'í could revile as well as praise, and such was the bitterness of some of his satires that certain influential personages who came under his lash induced Murád IV. to permit his execution. Nef'í, who, like Fuzúlí, formed a style of his own, had many to imitate him, of whom Sabrí Shákir, a contemporary, was the most successful. Ná'ilí, Jevrí, and Fehím need not detain us; but Nábí, who flourished under Ibráhím and Muhammed IV., calls for a little more attention. This prolific author copied, and so imported into Ottoman literature, a didactic style of ghazel-writing which was then being introduced in Persia by the poet Ṣá'ib; but so closely did the pupil follow in the footsteps of his master that it is not always easy to know that his lines are intended to be Turkish. A number of poets, of whom Seyyid Vehbí, Rághib Pasha, Rahmí of the Crimea, Kelím, and Sámí are the most notable, took Nábí for their model. Of these, Sámí is remarkable for the art with which he constructed his ghazels. Among the writers of this time who did not copy Nábí are Sábit, Rásikh, and Ṭálib, each of whom endeavoured, with no great success, to open up a new path for himself. We now reach the reign of Ahmed III., during which flourished Nedím, the greatest of all the poets of the old school. Little appears to be known about his life further than that he resided at Constantinople and was alive in the year 1727 (A.H. 1140). Nedím stands quite alone: he copied no one, and no one has attempted to copy him. There is in his poetry a joyousness and sprightliness which at once distinguish it from the work of any other Turkish author. His ghazels, which are written with great elegance and finish, contain many graceful and original ideas, and the words he makes use of are always chosen with a view to harmony and cadence. His kasidas are almost equal to his ghazels; for, while they rival those of Nef'í in brilliancy, they surpass them in beauty of diction, and are not so artificial and dependent on fantastic and far-fetched conceits. The classical period cames to an end with Nedím; its brightest time is that which falls between the rise of Nef'í and the death of Nedím, or, more roughly, that extending from the accession of Ahmed I., 1603 (1012), to the deposition of Ahmed III., 1730 (1143).

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We will now glance at the prose writers of this period. Under the name of *Humáyún Náma* (Imperial Book) 'Alí Chelebi made a highly esteemed translation of the well-known Persian classic *Anvár-i Suheylí*, dedicating it to Suleymán I. Sa'd-ud-Dín, the preceptor of Murád III., wrote a valuable history of the empire from the earliest times to the death of Selím I. This work, the *Táj-ut-Teváríkh* (Crown of Chronicles), is reckoned, on account of its ornate yet clear style, one of the masterpieces of the old school, and forms the first of an unbroken series of annals which are written, especially the later among them, with great minuteness and detail. Of Sa'd-ud-Dín's successors in the office of imperial historiographer the most remarkable for literary power is Na'ímá. His work, which extends from 1591 (1000) to 1659 (1070), contrasts strongly with that of the earlier historian, being written with great directness and lucidity, combined with much vigour and picturesqueness. Evliyá, who died during the reign of Muhammed IV., is noted for the record which he has left of his travels in different countries. About this time Ṭash-köpri-záda began and 'Atá-ulláh continued a celebrated biography of the legists and sheykhs who had flourished under the Ottoman monarchs. Ḥájí Khalífa (see vol. xi. p. 377), frequently termed Kátib Chelebi, was one of the most famous men of letters whom Turkey has produced. He died in 1658 (1068), having written a great number of learned works on history, biography, chronology, geography, and other subjects. The Persianizing tendency of this school reached its highest point in the productions of Veysí, who left a *Life* of the Prophet, and of Nergisí, a miscellaneous writer of prose and verse. Such is the intentional obscurity in many of the compositions of these two authors that every sentence becomes a puzzle, over which even a scholarly Ottoman must pause before he can be sure he has found its true meaning. The first printing press in Turkey was established by an Hungarian who had assumed the name of Ibráhím, and in 1728 (1141) appeared the first book printed in that country; it was Vanḳulí's Turkish translation of Jevherí's Arabic dictionary.

Post-classical period.

Coming now to the post-classical period, we find among poets worthy of mention Beligh, Nevres, Hishmet, and Sunbulí-záda Vehbí, each of whom wrote in a style peculiar to himself. Three poets of note—Pertev, Neshet, and Sheykh Ghálib—flourished under Selím III. The last-named is the fourth great poet of the old school. *Husn u 'Ashk* (Beauty and Love), as his great poem is called, is an allegorical romance full of tenderness and imaginative power. Ghálib's style is as original as that of Fuzúlí, Nef'í, or Nedím. The most distinguished of the prose writers of this period are perhaps Ráshid, the imperial historiographer, 'Ásim, who translated into Turkish two great lexicons, the Arabic *Ḳámús* and the Persian *Burhán-i Káti'*, and Ḳání, the only humorous writer of merit belonging to the old school.

Transition period.

When we reach the reign of Mahmúd II., the great transition period of Ottoman history, during which the civilization of the West began to struggle in earnest with that of the East, we find the change which was coming over all things Turkish affecting literature along with the rest, and preparing the way for the appearance of the new school. The chief poets of the transition are Fázil Bey, Wásif, notable for his not altogether unhappy attempt to write verses in the spoken language of the capital, 'Izzet Molla, Pertev Pasha, 'Ákif Pasha, and the poetesses Fitnet and Leylá. In the works of all of these, although we occasionally discern a hint of the new style, the old Persian manner is still supreme.

Modern school

More intimate relations with western Europe and a pretty general study of the French language and literature, together with the steady progress of the reforming tendency fairly started under Mahmúd II., have resulted in the birth of the new or modern school, whose objects are truth and simplicity. In the political writings of Reshíd and 'Ákif Pashas we have the first clear note of change; but the man to whom more than to any other the new departure owes its success is Shinásí Efendi, who employed it for poetry as well as for prose. The European style, on its introduction, encountered the most violent opposition, but now it alone is used by living authors of repute. If any of these does write a pamphlet in the old manner, it is merely as a *tour de force*, or to prove to some faithful but clamorous partisan of the Persian style that it is not, as he supposes, lack of ability which causes the modern author to adopt the simpler and more natural fashion of the West. The whole tone, sentiment and form of Ottoman literature have been revolutionized by the new school: varieties of poetry hitherto unknown have been adopted from Europe; an altogether new branch of literature, the drama, has arisen; while the sciences are now treated and seriously studied after the system of the West. Among writers of this school who have won distinction are Ziyá Pasha, Jevdet Pasha, the statesman and historian, Ekrem Bey, the author of a beautiful series of miscellaneous poems, *Zemzeme*, Ḥámid Bey, who holds the first place among Ottoman dramatists, and Kemál Bey, the leader of the modern school and one of the most illustrious men of letters whom his country has produced. He has written with conspicuous success in almost every branch of literature,—history, romance, ethics, poetry, and the drama.

For the Turkish language, see p. 661 below.

There is no work in existence which gives a satisfactory account of Ottoman literature. Von Hammer-Purgstall's *Geschichte der Osmanischen Dichtkunst* (Pesth, 1836) is not always trustworthy and leaves much to be desired in many ways. Other works on the poetry are *La Muse Ottomane*, by Servan de Sugny (Paris, 1853); *On the History, System, and Varieties of Turkish Poetry*, by Redhouse (London, 1878); *Ottoman Poems*, by Gibb (London, 1882). Of translations we have Bákí's *Díván*, by Hammer (Vienna, 1825); the *Travels of Evliyá*, by Hammer (London, 1834); *Rose und Nachtigall* (a poem of Fazlí, a mediocre writer of the time of Suleymán I.), Turkish and German, by Hammer (Pesth); *Les Conseils de Nabi Efendi*, by Pavet de Courteille (Paris, 1857); *The History of the Forty Vezirs*, by Gibb (London, 1886). An interesting and valuable sketch of Ottoman poetry is given by Kemál Bey in a series of articles in the Turkish literary journal *Mejmú'a-i Ebu-z-Ziyá*. (E. J. W. G.)

TURKEY, an abbreviation for TURKEY-COCK or TURKEY-HEN as the case may be, a well-known large domestic gallinaceous bird. How it came by this name has long been a matter of discussion, for it is certain that this valuable animal was introduced to Europe from the New World, and in its introduction had nothing to do with Turkey or with Turks, even in the old and extended sense in which that term was applied to all Mahometans. But it is almost as unquestionable that the name was originally applied to the bird which we know as the GUINEA FOWL (*q.v.*), and there is no doubt that some authors in the 16th and 17th centuries curiously confounded these two species. As both birds became more common and better known, the distinction was gradually perceived, and the name "Turkey" clave to that from the New World—possibly because of its repeated call-note—to be syllabled *turk, turk, turk*, whereby it may be almost said to have named itself (*cf. Notes and Queries*, ser. 6, iii. pp. 23, 369). But even Linnæus could not clear himself of the confusion, and unhappily misapplied the name *Meleagris*, undeniably belonging to the Guinea-Fowl, as the generic term for what we now know as the Turkey, adding thereto as its specific designation the word *gallopavo*, taken from the *Gallopava* of Gesner, who, though not wholly free from error, was less mistaken than some of his contemporaries and even successors.[1]

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[1] The French *Coq* and *Poule d'Inde* (whence *Dindon*) involve no contradiction, looking to the general idea of what India then was. One of the earliest German names for the bird, *Kalekuttisch Hün* (whence the Scandinavian *Kalkon*), must have arisen through some mistake at present inexplicable; but this does not refer, as is generally supposed, to Calcutta, but to Calicut on the Malabar coast (*cf. Notes and Queries*, ser. 6, x. p. 185).

The Turkey, so far as we know, was first described by Oviedo in his *Sumario de la Natural Historia de las Indias*[1] (cap. xxxvi.), said to have been published in 1527. He, not unnaturally, includes both Curassows and Turkeys in one category, calling both "Pavos" (Peafowls); but he carefully distinguishes between them, pointing out among other things that the latter make a wheel (*hacen la rueda*) of their tail, though this was not so grand or so beautiful as that of the Spanish "*Pavo*," and he gives a faithful though short description of the Turkey. The chief point of interest in his account is that he speaks of the species having been already taken from New Spain (Mexico) to the islands and to Castilla del Oro (Darien), where it bred in a domestic state among the Christians. Much labour has been given by various naturalists to ascertain the date of its introduction to Europe, to which we can at present only make an approximate attempt;[2] but after all that has been written it is plain that evidence concurs to show that the bird was established in Europe by 1530—a very short time to have elapsed since it became known to the Spaniards, which could hardly have been before 1518, when Mexico was discovered. The possibility that it had been brought to England by Cabot or some of his successors earlier in the century is not to be overlooked, and reasons will presently be assigned for supposing that one of the breeds of English Turkeys may have had a northern origin;[3] but the often quoted distich first given in Baker's *Chronicle* (p. 298), asserting that Turkeys came into England in the same year—and that year by reputation 1524—as carps, pickerels, and other commodities, is wholly untrustworthy, for we know that both these fishes lived in the country long before, if indeed they were not indigenous to it. The earliest documentary evidence of its existence in England is a "constitution" set forth by Cranmer in 1541, which Hearne first printed (Leland's *Collectanea*, ed. 2, vi. p. 38). This names "Turkey-cocke" as one of "the greater fowles" of which an ecclesiastic was to have "but one in a dishe," and its association with the Crane and Swan precludes the likelihood of any confusion with the Guinea-Fowl. Moreover the comparatively low price of the two Turkeys and four Turkey-chicks served at a feast of the serjeants-at-law in 1555 (Dugdale, *Origines*, p. 135) points to their having become by that time abundant, and indeed by 1573 Tusser bears witness to the part they had already begun to play in "Christmas husbandlie fare." In 1555 both sexes were characteristically figured by Belon (*Oyseaux*, p. 249), as was the cock by Gesner in the same year, and these are the earliest representations of the bird known to exist.

There is no need to describe here a bird so familiar and in these days so widely distributed. As a denizen of our poultry-yards (see POULTRY, vol. xix. p. 646) there are at least two distinct breeds, though crosses between them are much commoner than purely-bred examples of either. That known as the Norfolk breed is the taller of the two, and is said to be the more hardy. Its plumage is almost entirely black, with very little lustre, but the feathers of the tail and some of those of the back have a brownish tip. The chicks also are black, with occasionally white patches on the head. The other breed, called the Cambridgeshire, is much more variegated in colour, and some parts of the plumage have a bright metallic gloss, while the chicks are generally mottled with brownish grey. White, pied, and buff Turkeys are also often seen, and if care be taken they are commonly found to "breed true." Occasionally Turkeys, the cocks especially, occur with a top-knot of feathers, and one of them was figured by Albin in 1738. It has been suggested with some appearance of probability that the Norfolk breed may be descended from the northern form, *Meleagris gallopavo* or *americana*, while the Cambridgeshire breed may spring from the southern form, the *M. mexicana* of Gould (*Proc. Zool. Society*, 1856, p. 61), which indeed it very much resembles, especially in having its tail-coverts and quills tipped with white or light ochreous,—points that recent North-American ornithologists rely upon as distinctive of this form. If this supposition be true, there would be reason to believe in the double introduction of the bird into England at least, as already hinted, but positive information is almost wholly wanting.[4] The northern form of wild Turkey, whose habits have been described in much detail by all the chief writers on North-American birds, is now extinct in the settled parts of Canada and the eastern States of the Union, where it was once so numerous; and in Mexico the southern form, which would seem to have been never abundant since the conquest, has been for many years rare. Further to the south, on the borders of Guatemala and British Honduras, there exists a perfectly distinct species, *M. ocellata*, whose plumage almost vies with that of a Peacock in splendour, while the bare skin which covers the head is of a deep blue studded with orange caruncles (*Proc. Zool. Society*, 1861, pl. xl.).

The genus *Meleagris* is considered to enter into the Family *Phasianidæ*, in which it forms a Subfamily *Meleagrinæ*, peculiar to North and Central America. The fossil remains of three species have been described by Prof. Marsh—one from the Miocene of Colorado, and two, one much taller and the other smaller than the existing species, from the Post-Pliocene of New Jersey. Both the last had proportionally long and slender legs. (A. N.)

TURKS. The use of the name "Turks" has never been limited in a clear and definite way from the time of the Byzantine authors to the present day. To the former, as also to the Arabs, it has a collective sense like Scythians or Huns;[5] at the present day we are wont to restrict the name to the Osmanli Turks, though they themselves refuse to be called Turks, having, as they hold, ceased to be such in becoming imbued with Arabo-Persian culture. On the other hand, when we speak of Uigurs and Tatars, we mean tribes who style themselves Turks and really are such. It is only by the aid of historical and linguistical evidence that we can determine the true limits of the Turkish name.

Origin.

The national Turkish traditions, preserved by the Persian historians Rashid ed-Din and Jowaini from Uigurian books which are now lost, point to the region watered by the river Selenga and its affluents, the Orkhon and the Tugila, as the primitive seat of the Turkish people. Rashid ed-Din combines this tradition with that of the Mohammedan descendants of Oghuz, who, in accordance with Moslem traditions, derive the whole Turkish stock from Japhet, the son of Noah, or more accurately from Turk, the son of the former (Yafiz-oglan), and pretend that he pitched his tents in the vicinity of Lake Issyk-kul (in Semiryetchensk). But, though Turkish tribes did wander so far to the west, and even farther, in remote antiquity, it seems pretty certain that the Uigurian tradition has preserved the memory of the true origin of the race, that Turks and Mongols were originally different stems of a single people, and that these two members of the URAL-ALTAIC (*q.v.*) family were more closely related to each other than to any other member of the same family (Finno-Ugrians, Samoyedes, Tungus-Manchus). The evidence for this rests, not on the ethnological system of Rashid ed-Din, though it affords a secondary argument, but on the indubitable affinity of the Mongolian and Turkish languages and the similarity of the ethnological characters of the two races. Here, of course, we do not argue from the Osmanlis, who have lost all their original race-characters and have become "Caucasians" of the best type, but rather, for instance, from the Kirghiz, who are considered as the typical Turks of the present day, and are described by Ujfalvy as being midway between the Mongol and the Caucasian. We must now turn our attention to the wanderings of the Turks and their subsequent fate,—a rather difficult task,

Ethnological affinities.

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[1] Purchas (*Pilgrimes*, iii. p. 995) in 1625 quoted both from this and from the same author's *Hystoria General*, said to have been published a few years later. Oviedo's earlier work is only known to the present writer by the reprint of 1852.

[2] The bibliography of the Turkey is so large that there is here no room to name the various works that might be cited. Recent research has failed to add anything of importance to what has been said on this point by Buffon (*Oiseaux*, ii. pp. 132-162), Pennant (*Arctic Zoology*, pp. 291-300),—an admirable summary,—and Broderip (*Zoological Recreations*, pp. 120-137)—not that all their statements can be wholly accepted. Barrington's essay (*Miscellanies*, pp. 127-151), to prove that the bird was known before the discovery of America and was transported thither, is an ingenious piece of special pleading which his friend Pennant did him the real kindness of ignoring.

[3] In 1672 Josselin (*New England's Rarities*, p. 9) speaks of the settlers bringing up "great store of the wild kind" of Turkeys, "which remain about their houses as tame as ours in England." The bird was evidently plentiful down to the very seaboard of Massachusetts, and it is not likely to have been domesticated by the Indian tribes there, as, according to Hernandez, it seems to have been by the Mexicans. It was probably easy to take alive, and, as we know, capable of enduring the voyage to England.

[4] The results of a comparison of the skulls of wild and domesticated Turkeys are given by Dr Shufeldt in *Journ. of Comp. Medicine and Surgery*, July 1887.

[5] Constantine Porphyrogenitus calls the Magyars Turks, even in contradistinction to the truly Turkish Petchenegs.

owing to the want of accurate information. The only truly historical records are to be found in the Chinese chronicles and encyclopædias,[1] where, however, the Turkish proper names appear in such distorted forms as to be unrecognizable; yet, till the 6th century of our era, no other accounts are available.

It is generally admitted that the first Turkish people mentioned by the Chinese are the Hiong-nu, who, wandering to the west, occupied the country south of the Altai Mountains and expelled (about 177 B.C.) the former occupants of those regions, the Yue-chi,[2] Kan-goi, and Usun (U-ssun),—tribes of unknown nationality, but possibly also Turks.[3] The Hiong-nu were identified by Deguignes with the Huns, this denomination being used in a political or collective sense, and including, besides the Huns proper, the Ephthalites or White Huns, Avars, Bulgars, Magyars, Khazars, and Petchenegs, who are styled by several scholars Hunnic or Scythian peoples,—a term of no scientific value whatever, as the main body of these peoples consisted really of Mongol-Turks or Finno-Ugrians. As, however, separate articles have been devoted to most of these ethnical names, we abstain from further details, as also from discussion of the question of the Turkish origin of the Magyars and the Khazars, though that of the former seems to us as improbable as that of the latter is certain.[4] Be this as it may, the Hiong-nu are, so to speak, proto-Turks, and the history of the Turks proper begins with the Tu-kiu, the Chinese equivalent of the word Turk. Originally a division of the Hiong-nu, almost extirpated by wars, but miraculously saved from complete destruction, the Tu-kiu settled south of the Kin-Shan (Altai?) Mountains, and were miners and iron-smelters in the service of the Juen-Juen[5] ("les Tartares Geou-gen" of Deguignes). About 552 A.D., however, they conquered their former masters and founded a mighty empire under princes who took the title of Ili khan. In these Tu-kiu Deguignes recognized the Turks who entered into friendly relations with Byzantium, and to whom Justin II. sent two ambassadors, —Zemarchus (568) and Valentinus (575). The narratives of these ambassadors are preserved in the fragments of Menander Protector; and (comparing the variations of the corrupt text with the record of Tabarī) from him we learn that at the first date the reigning prince was Sinjibulus (Arabic Sinjibu).[6] From the Greek and the Arabo-Persian accounts it seems that Sinjibu put an end to the empire of the Ephthalites or Haitāls in those regions. He shared the conquered country with Khosrau I., the Oxus becoming the frontier between Irān and Turān. The memory of the empire of Sinjibu and of its political strength has been preserved by the Arabic authors Ibn Khordādbeh and Mas'ūdī, who inform us that the Turkish tribe of the Karluks, settled in the provinces of Ferghāna and Shāsh (Tashkend), were of old the mightiest of all the Turks, and that their sovereign, the khakān of khakāns, was obeyed by all the neighbouring princes. To them they reckon the mythical Afrāsiāb and the historical Shāwa.[7] It is uncertain at what epoch the empire of the Karluks came to an end; but the Chinese assert that about 650 they reduced the inhabitants of the Ili and Jaxartes territory, though they were unable to protect them afterwards against the inroads of the Arabs under Ḳotaiba b. Moslim (706-714). The latter defeated the armies sent to their aid under Kurbogha Noyon, a sister's son of the Chinese emperor.[8] It is also doubtful if the so-called Afrāsiāb kings or Ilek-khans, who reigned in the 10th century at Kāshgar and Balāsāghun and conquered (999) the dominions of the Samanids in Transoxiana, belonged to the Karluks, as is supposed by Grigorieff and Lerch. or to the Uigurs, as others think.

The Uigurs. The name Uigurs is very common during the Mongolian period, and Rashīd ed-Dīn and others use it (by an anachronism) in speaking of remote antiquity, though it is wholly unknown to the Arabic geographers, and, as Vambéry has shown, to the Uigurs themselves,—nay, even impossible in the old Turkish language, in which the form would be Utkur. The name Ugur, Ogur, or Ogor of Byzantine authors is really different; but Grigorieff has recognized the name in the corrupt Arabic form of Tagazgaz, which must be read Toguz-Ugur,[9] the "Nine Ugurs," to distinguish them from another division of the same tribe, the On-Ugur or "Ten Ugurs." In the time of Ibn Khordādbeh and Mas'ūdī these Turks had gained the supremacy amongst their brethren, and had their residence at Kushān, which has been identified with the Kiao-chang of the Chinese. According to their accounts, the Kiao-chang form the southern division of the Hui-khe (Hoei-ke of Deguignes), and were settled before the Christian era south and east of the Tian-Shan up to the Pamir plateau and the Kuen-Lun. The Arabic authors make them adherents of Manichæism; but, as the original Turkish Shamanism has developed into a dualistic system, this statement may rest on a partial misapprehension. It seems, however, certain that Buddhism reached these Turks on its way towards China, for we know that this religion spread in the 2d century B.C. throughout the adjacent kingdom of Bactria, and was still flourishing when Hwen-T'sang visited (7th century) those regions. Thus we can understand why the old Ural-Altaic religion bears a Sanskrit name. The northern division of the Hui-khe, which remained unknown to the Arabs, wandered from the Selenga region to the sources of the Yenisei, vanquished the Tu-kiu (745), and founded an empire from the Selenga to Lake Balkash, till they were overthrown (841) by the Ha-kas (identified with the Kirghiz). These northern Uigurs are called by the Chinese Kao-che, Chi-le, Di-li, and Te-le. The history of the southern branch is unknown, for the chronological data of Rashīd ed-Dīn and Abu-'l-Ghāzi are contradictory and useless, though their statements that the prince bore the title of Idi-kut and submitted to the Mongols have full historical weight. That the Uigurs rose during the

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[1] Translated in the well-known works of Deguignes, Visdelou, &c.; for a French translation by Stanisl. Julien of the accounts of the Pien-i-tien, referring to the Tu-kiu, see *Journ. Asiat.*, 1864, p. 325 *sq.*

[2] Comp. PERSIA, vol. xviii. pp. 592-4, 600, 603.

[3] Radloff, for instance, thinks that the name U-ssun, and perhaps remnants of the people denoted by it, survive in the present Uisuns, a division of the Great Horde of the Kirghiz. At the time of Alexander the Great's expeditions against the Scythians beyond the Jaxartes, we find in that region certain traces of the Turkish language in names of places and persons (cp. vol. xviii. p. 582, note 4). It is therefore certain that long before the age of the Hiong-nu Turkish tribes had spread to the borders of the Jaxartes, and even along the northern coast of the Caspian to the rivers Ural and Volga. But the ethnical denominations of antiquity—Scythians, Parthians, Massagetæ, Sacæ, &c.—do not convey to our mind clear ethnical distinctions, so that the true nationality of these peoples has been much debated. Neither are the pre-Semitic culture of Babylonia and the supposed "Turanian" origin of the Accads facts of such character that from them we can infer the presence of Turks in these regions in remote antiquity.

[4] On the Petchenegs see below.

[5] From their Chinese name it may be inferred that the Juen-Juen were a Mongolian people, in which case the Avars, who are supposed to have been a division of them, were also Mongols.

[6] See Nöldeke, *Geschichte der Perser und Araber*, p. 158. The first part of this name is without doubt the Turkish *sünjü*, *süngü*, which means "lance," a Turkish proper name of the same kind as Kilij= "sword," which in its Persian form, Nizek, was afterwards borne by a prince of Transoxiana, often mentioned in the accounts of the Arabic conquest.

[7] Cp. Mas'ūdī, ed. Paris, i. 288; Nöldeke, *ut sup.*, p. 269, n. 1.

[8] The title Noyon, if the present writer's conjecture on the text of Tabarī, ii. 1195, is right, proves that Kurbogha was a Mongolian prince.

[9] Before this Reinaud had conjectured that the Tagazgaz were the same as the Uigurs, but failed to correct the Arabic corruption.

Mongolian epoch to a certain supremacy by higher culture is attested by Rashid ed-Din and Jowaini, who often mention Uigurian books.

The Petchenegs.

The Petchenegs (Gr. Πατζινακαι, Πατζινακιται; Magyar *Besenyö*; Lat. *Bisseni*) were of old, as Constantine Porphyrogenitus tells us, settled about the lower Ural and Volga, but were driven thence (894-899) by the Ghuzz (Ouzoi). A part of them returned afterwards to their ancient abode, but the great majority wandered westward and settled on both sides of the Dnieper, driving the Hungarians before them to the Carpathians. Here they annoyed the neighbouring peoples by their raids, and engaged readily in the Russian expeditions against the Greek empire, till the policy of the Byzantine court incorporated large numbers of them with its own armies, sometimes with fatal result, as was experienced by Romanus Diogenes, when these auxiliaries passed to the camp of his antagonist Alp Arslān. At the period of the first crusade the Christian armies met with them on their march through Servia and Bulgaria; but the Petchenegs are not mentioned after the 13th century. The learning of Orientalists has discovered faint traces of the language once spoken by them in the Turkish dialect of the Bosnians.[1]

The Comans.

Comans or Cumani (Russ. *Polowtze*, Magyar *Palocz* and *Kun*) is a term chiefly used by Europeans for the Turkish tribes that occupied Moldavia and the adjacent regions of south Russia. The origin of the name is uncertain; but it seems to be Turkish, though it rarely occurs in Oriental records. The most probable conjecture regarding the people denoted by it is that they were a mixture of Ghuzz and Petchenegs. Oriental authors know much more of their neighbours to the east, the Kipchaks, a very common name of Turkish clans down to the present day. Sometimes both names are combined: Rubruquis speaks of the Coman Kipchaks. Anna Comnena informs us that the Comans spoke the same dialect as the Petchenegs, a dialect well known to European scholars from the so-called Codex Cumanicus.[2] On the arrival of the Mongols in these regions, the Kipchaks suffered great hardships, and large numbers of them were sold as slaves throughout the Mohammedan world. From them sprang the Bahrite Mameluke sultans of Egypt (1250-1380). The Comans sought refuge amongst the Hungarians and became Christians; but their arrival, causing internal dissensions in Hungary, greatly favoured the advance of the Mongolian arms. The remnants of the Comans, Kipchaks, and other Turkish tribes continued to dwell in southern Russia under Mongolian rule (see MONGOLS), whilst others became merged with the Hungarians.

The Ghuzz.

The Ghuzz dwelt originally in the far East amongst the Toguz-Ugur, but migrated in the reign of the caliph Al-Mahdī (775-785) to Transoxiana, where they adhered to the cause of the famous Al-Mokanna', not from religious predilection, but to satisfy their love of war and plunder. In the same manner they afterwards served every warlike prince in their neighbourhood, and entered like other Turks into the service of the caliphs. The main body of the life-guard of the 'Abbasids consisted of Turks, and some individuals rose very soon to high commands. Entrusted with the administration of distant provinces, they founded independent princely houses, such as those of the Tulunids and Ikhshids in EGYPT (vol. vii. p. 750) and the Ghaznavids (see GHAZNI). In the meantime fresh bands of the Ghuzz poured from the east and the north into Turkestan, the region becoming overstocked with a nomadic population. Some of them sought and found an outlet to the west by occupying the territory of the Petchenegs and joining the Turkish population of southern Russia; but the great majority, seeing the ruined state of the empire of the caliphs, crossed the Oxus and overran the northern and eastern provinces of Persia. How these loose desultory bands were guided to subsequent victories, and moulded with the peoples amongst whom they settled into regular political bodies, has been already narrated under SELJUKS (*q.v.*).

Turkmans.

Meanwhile they underwent a great change in their outward appearance, habits, &c., as Rashid ed-Din relates, owing to the influence of the air and the water, and, we may add, to frequent intermarriage with the inhabitants of the countries invaded by them. After some generations the change was great enough to strike their Iranian neighbours, who called them Turkmans (Turcomans),[3] a term implying resemblance to Turks. It is therefore quite natural that the modern Osmanlis should have become Caucasians; for, if Rashid ed-Din in the 13th century noticed the difference between a Turkman and a genuine Turk, the six centuries which have elapsed since amply suffice to have obliterated all original Ural-Altaic characteristics. The old name Ghuzz, originally, as it seems, the Turkish Oghuz (an eponymous hero of whom Turkish chronicles tell many fables) was wholly superseded by the new name Turkman and by other political names.

Empire of Khārizm.

During the Seljukian period there arose in Transoxiana the empire of the Khārizm shahs, founded by Mohammed b. Anushtegin, upon whom the government of Khārizm (Khiva),—which down to 995 had belonged to princes of Iranian descent—was conferred (1097) by the Seljuk prince Barkiyāroķ. His son Atsiz became independent (1138), but his empire seemed destined to early ruin by the arrival of the Kara-Chitai, who defeated the Seljuk prince Sinjar (1141) and became for a time supreme masters of Turkestan. Nevertheless the Kharizmian dynasty held its place as a tributary sovereignty, and developed great power under the princes Takash and Mohammed his son. The former defeated and killed (1194) the last Seljuk prince of 'Irāķ, and the latter extended his dominion from the Caspian to the Indus and from the Jaxartes to the coast of 'Omān. His cunning antagonist, the 'Abbāsid caliph An-Nāsir, invoked the aid of Jenghiz Khān, who scarcely required this invitation to attack Mohammed. The sack of Bokhāra was followed in the same year (1220) by that of the other principal cities of Transoxiana and by the persecution of the unhappy prince, who died in a forgotten island of the Caspian. His son Jelal-ed-Din was driven towards India, but by a change of fortune ascended once more the throne of his fathers, till the new Mongol khan, Ogdai, sent fresh armies against him and forced him to seek refuge in the Kurdish Mountains, where he was murdered (1231). The fate of the Turks of Transoxiana was shared by their brethren in Asia and Europe, and new Mongol-Turkish empires arose, of which an outline has been given under MONGOLS. As the Mongol rule grew weaker, there arose in Persia and on the frontiers of Asia Minor the Turkman dynasties of the Ak Koyun-lu, the Kara Koyun-lu, the Zu'l-kadria, and the Ramazān Oglu, whose history is closely connected either with that of the rise of the Ottoman power (see below) or with the history of PERSIA (see vol. xviii. p. 632 *sq.*).

Modern tribes.

At the present day the Turkish people occupy a very extensive area, the centre of which lies in Khiva, Bokhara, and Khokand, and which stretches from the lower Lena in Siberia to the Danube and from the Crimea to Kermān and India. Politically they belong to Russia, Turkey, Persia, China, and Afghanistan. In religion the great majority are Mohammedans; a few tribes in Russia are baptized Christians; and some others adhere to the original Shamanism, which has also influenced the religious conceptions of the Christian and Mohammedan Turks. The principal Turkish peoples are the following. (I.) By a popular distinction the Turks of Siberia and Russia, with some colonies in Turkey, are styled Tatars (see TARTARS), though the Yakuts of northern Siberia are not usually included in this term. The Yakuts, who are perhaps a mixture of Turkish and Tungus tribes, deviating from the ordinary course of Turkish wanderings, are settled about the lower Lena, and number probably 200,000 (Rittig, 80,000; Lansdell, 210,000).[1] They are nominally Christians. (II.) On the Kirghiz (Kara-Kirghiz and Kazāks) and Kara-Kalpaks see KIRGHIZ; but note that the Kipchaks, named there as a separate tribe, really form a subdivision of the Kazāk-Kirghiz, and are perhaps akin to the Kitai-Kipchaks, who are reckoned to the Uzbegs. (III.) Uzbeg is a political, not an ethnological denomination, originating from Uzbeg Khān of the Golden Horde (1312-1340). It was used to distinguish the followers of Shaibāni Khān (16th century) from his antagonists, and became finally the name of the ruling Turks in the khanates as opposed to the Sarts, Tajiks, and such Turks as entered those regions at a later date and are known to be Kirghiz, Kara-Kalpaks, or Taranjis. The Uzbegs are therefore a mixed race of different Turkish tribes. According to Kostenko,[2] they number 201,972 in the Russian provinces of Sir-Daria, Ferghāna, Zerafshan, and Amu-Daria, and Vambéry conjectures that there are 1,000,000 more in Bokhara, 700,000 in Khiva, and 200,000 under Afghan supremacy, giving a total number of about 2,000,000. They are agriculturists or inhabit the cities; a few are semi-nomads. (IV.) The eastern Turks on the southern slopes of the Tian-Shan Mountains at Kashgar, Ust-turfan, Ak-su, Sairam, Kutcha, Yarkand, Khotan, &c., are the remnants of the ancient Uigurs; and of the same origin are the Taranjis (=agriculturists), settled in the Ili valley and elsewhere. The number of the latter is given as about 50,000; that of the former may be estimated from the statements of Forsyth[3] and Kuropatkin[4] at about 1,000,000 for the whole district, the great majority being Turks and the rest Mohammedan Chinese (Sungans). (V.) The Turcomans (properly Turkmans) inhabit the steppe east of the Caspian and south of the Oxus from Astrabad to the Paropamisus. The term is sometimes taken to include their brethren in Persia and Asia Minor, who will be treated separately. The following are the principal tribes:—(1) the Tchaudors and Imrailis, in the north-western part of the Ust-Urt to the Gulf of Karaboghaz; (2) the Yomuts, extending from Khiva across the Ust-Urt to the Caspian, and along the sea-board to Persia; (3) the Göklen, on Persian territory, between the upper Görgen and Atrek; (4) the Tekkes, the most numerous tribe at the present day, divided into the Akhal Tekkes and the Merv Tekkes, so named after the centres where their greatest numbers are found; (5) the Sakars, on the left bank of the Oxus, to the east of Tcharjui, considered by Vambéry as a division of the Tekkes; (6) the Sariks, at Penjdeh and Yul-utan on the north-western slopes of the Paropamisus; (7) the Salors, one of the oldest Turkman tribes, who suffered greatly from the Tekkes, till they finally migrated (1857) to Zurabād in Persia, and left their former districts to the Tekkes and Sariks; (8) the Ersaris, on the Oxus about Khoja Salih; and (9) the Ali-elis, about Andkhui. Their total number, inclusive of some Turkmans who do not belong to any of these tribes, and are scattered throughout the provinces of Syr-Daria, Amu-Daria, Zerafshan, and Astrakhan (about 16,000), is estimated by Vambéry at about 1,000,000, and by Grodekoff at 1,170,000. The Turkmans are, with few exceptions, nomads, and were formerly the terror of their neighbours, who feared them as the "man-stealing Turks"; but since Merv has been annexed to Russia (1884) they have been compelled to abandon their predatory habits.[5] (VI.) The Turkish nomads scattered throughout Persia are partly the descendants of the Ghuzz tribes that invaded the country at the Seljukian period; others have migrated thither in the following centuries. They are known by the name of Ilāt or Iliyāt (meaning tribes or peoples) and consist of several tribes, having each its own chieftain, the Ilkhāni, appointed by the shah. An accurate list of the names of these tribes does not exist; but the most powerful and most numerous are the following. (1) The Kajars, who dwelt in Transcaucasia down to the time of Abbas the Great, by whom one division of them was compelled to settle at the south-east corner of the Caspian near Astrabād. To this division belongs the present dynasty of Persia. (2) The Afshars or Anshars, a very numerous tribe, in the province of Adarbaijān (Azerbijan). A division is also settled in the mountainous regions of the Anti-taurus; its members are nominally subjects of the Ottoman empire but really independent. (3) The Shekakis and Shah-sewen. The latter is not a tribal, but a political name, meaning those who love the shah, *i.e.*, partisans of the Safawī dynasty (1499-1736) and the Shī'ite faith. (4) The Kara Koyun-lu, near the town of Khoi, the remnants of the once powerful tribe named above. Besides these, many other names are recorded of tribes wandering in the Transcaucasian regions and in the provinces of Adarbaijān and Mazenderan, but many of them are very uncertain. All these Turks are comprehended under the general denomination of Adarbaijāni Turks; they are nomads or semi-nomads and speak a peculiar Turkish dialect, the Turk Azeri or Adarbaijāni Turkish. Some specimens of it have been published by Chodzko, Bergé, Melgunoff, and Barbier de Meynard. In the southern provinces of Persia are settled the (5) Kashkais, (6) Abul-werdis, (7) Kara-Gözlüs, (8) Bahar-lu, and (9) Inan-lu. To the first named are reckoned by some the Khalaches,[6] an old Turkish tribe which was already settled near Herat before the Seljukian period and has given rise to some Indian dynasties. Vambéry thinks that the total number of Iranian Turks may amount to about two millions, or, if we add the Caucasian Turks under Russian supremacy, three millions.[7]

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[1] Comp. Blau, *Bosnisch-Türkische Sprachdenkmäler* (Leipsic, 1868), p. 315.

[2] Edited by Geza Kuun, Buda-Pesth, 1880-83.

[3] The term "Turkman" occurs in Arabic chronicles of the Seljukian period, and even in Mokaddasī, p. 274. Rashid ed-Din therefore exaggerates in stating that it only came into use in his lifetime. But Vambéry's statement that it was applied of old to the descendants of Oghuz is contradicted by the genuine Persian text of Rashid ed-Din and the unanimous testimony of history. His objections against the popular etymology mentioned above are, however, not quite unfounded.

Turks of southern Persia.

(VII). The Osmanlis, under which term are comprehended all the Turkish subjects of the sultan of Turkey, consist chiefly of the following elements. (1) Turkmanian tribes and Turks of every description, who poured into Asia Minor after the defeat of Romanus Diogenes (1071); to these we may also reckon the Ottomans proper, though they did not enter the country till after the downfall of the Kharizmian empire. The Mongolian invasion drove the obscure ancestors of this the most illustrious Turkish dynasty to Asia Minor, whence they gradually spread to the province of Khodawendikyār (Bithynia). (2) Tatars scattered amongst the rest of the population, but forming a large colony in the Dobrudja. In part they occupied their present settlements before the conquest of Constantinople; but others have immigrated into Asia Minor during the last two centuries from the Crimea and Caucasus, since the Russian conquests of those regions. They have fared very badly under Turkish rule, as is attested by Captain Wilson. That tribes of Turkish origin were settled in Europe long before the rise of the Ottoman power is known from the Byzantine authors, who mention a colony of them (about 30,000) as early as the 10th century in the Vardar valley in Macedonia.[8] (3) The so-called Kizil-bashis or "Red Heads," a nickname of the Shī'itic Turkish immigrants from Persia, who are found chiefly in the plains from Kara-hissar along Tokat and Amasia to Angora. During the wars with Persia the Turkish sultans forced them to settle here. They are agriculturists and highly praised by several travellers for their honesty and laborious habits. (4) Turkmenian tribes—Yuruks and Götchebes (words meaning "nomads" and characteristic of their most distinctive quality),—who occupy the mountains in summer and descend into the plains in winter, though some are settled in the plains of Cilicia near Tarsus and Adana, the rest being semi-nomads. Reclus estimates the total number of Turks in Europe at 1,500,000 and 85,000 Tatars. For Asia Minor statistics are wanting; but P. de Tchihatchef, the chief authority for matters relating to this peninsula, thinks that 6,000,000 is a fair estimate for the total population, including Greeks, Armenians, Kurds, &c., but excluding the islands. It appears therefore necessary to reduce the already moderate number of Osmanlis given by Vambéry (10,000,000) to about 6,000,000.

Osmanlis.

LANGUAGE.

The Turkish, or, as some prefer to say, the Turco-Tatar language, is a member of the Ural-Altaic family (see URAL-ALTAIC) and comprehends many dialects, which differ considerably in their vocabulary and in a less degree also in their grammar. The study of these dialects has made great advances during the 19th century. Abel Rémusat in 1820 knew only of four, viz., the Uigurian, Jagatai, Tatar, and Osmanli. Béresine in 1848 distinguished nineteen, grouped round three types, viz., (1) Jagatai dialects (Uigur, Coman, Jagatai, Uzbegian, Turkmani, Kazani literary language); (2) Tatar dialects (Kirghizian, Bashkiri, Nogai, Kumi, Karatchai, Kara-Kalpaki, Meshtcheryaki, and Siberian); (3) Turki dialects (Derbendi, Adarbaijānī, Krimmi, Anadoli, and Rumili). Bohtlingk (1851) added the Yakuti, and Shaw (1877) the Eastern Turki. Radloff (1882) subdivided the one Siberian dialect of Béresine into more than a dozen different dialects. On phonetic principles the last-named proposes the following classification, which seems, however, not quite satisfactory: (1) Oriental dialects (Altai, Baraba, Lebed, Tuba, Abakan, Küärik, Soyon, Karagass dialects, and Uigur); (2) Occidental (Kirghizi, Irtish, Bashkir, and Volga dialects, with numerous subdivisions); (5) Central-Asiatic (Taranji, Jagatai, &c.); and (4) southern (Turkmani, Adarbaijāni, Caucasian, Anadoli, Krimmi, and Osmanli). It would be premature to criticise this system till the author publishes the second part of his grammar, which will treat of the real etymological phenomena of the north Turkish dialects.

Dialectical varieties.

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[1] Cp. E. Petri, "Neueres über die Jakuten," in *Peterm. Mitth.*, 1887, vol. xxxiii. p. 102 *sq.*

[2] *Turkestanskii Krai*, St Petersburg, 1880, p. 326.

[3] *Report of a Mission to Yarkand.*

[4] *Kashgaria*, translated by W. E. Gowan, Calcutta, 1882.

[5] Cp. N. Petrusevitch, *The Turcomans*, translated by R. Michell; O'Donovan, *The Merv Oasis*, London, 1882; and the journals of travellers in these regions, Vambéry, Schuyler, Lessar, &c.

[6] Cp. the *Tabakāt-i-Nāsiri*, by Major Raverty, p. 553 *sq.*, where the name is incorrectly written Khalj.

[7] Cp. Lady Sheil, *Glimpses of Life and Manners in Persia* (London, 1856), and various articles by Von Seidlitz in the *Russische Revue*, &c.

[8] Cp. Lejean, "Ethnographie der Europäischen Türkei," in *Peterm. Ergänz.-Heft* 4 (1861), p. 38.

On the phonetical characteristics of each of these dialects ample information is given in his *Phonetik der nördlichen Türk. Sprachen*.

These great dialectical varieties are easily accounted for by the want of a common Turkish literary language understood everywhere. The most developed and refined Turkish tongue, that of the Osmanlis, which is very rich in literary monuments, has admitted too many Arabic and Persian words, grammatical forms, and even whole sentences, and has been too much spoiled by the precepts of Persian rhetoric, to produce a popular literature. With the exception of some tales and novels, this literature has remained an exotic production, unintelligible even to the people who are supposed to speak the same language (see TURKEY, p. 656 above). The Jagatai and Uzbegian dialects would have answered the purpose better, and present the best type of a (hypothetical) general Turkish language, of which the most prominent features may be here given.

Alphabet. The Arabic alphabet is in general use, though some tribes in Russia make use of Russian and others in Asia Minor of Armenian and Greek characters. But the oldest Turkish alphabet, the Uigurian, is a direct transformation of the Syriac, and has fourteen characters. When and by whom it was invented is uncertain; the Arabic author of the *Fihrist* does not mention it, and the Uigurian MSS. which we possess date for the most part from the 15th century. It is commonly supposed to be the work of Nestorian missionaries, who may have preached the Gospel amongst the Turks as early as the 6th or 7th century.[1] In the age of Sinjibu the Turks seem to have used the Sogdian characters in their political intercourse with Byzantium; but as a rule they remained illiterate till their conversion to Islam. As the Semitic languages are characterized by the three-radical system and the constancy of the consonants, all Ural-Altaic languages are dominated by the law of vowel harmony and agglutination. We have therefore in Turkish a double range of vowels, commonly eight in number, of which *a*, *i*, *o*, *u* denote the hard or guttural and *ä*, *i*, *ö*, *ü* the soft or palatal vowels, the vowels in every separate word being of the same range. The *i* only is in most dialects indifferent. The law of agglutination is derived from the same principle, but has regard, not only to the vowels, but also to the consonants and the syllables; it is an abuse of the term if it is taken to mean that in Turkish no real etymology exists, but only an agglutination of themes and roots.

Etymology. As regards the etymology we observe the absence of gender, of a separate form for the dual, and of the nominative in the nouns. There are commonly five oblique cases—genitive, dative, accusative, commorative, and ablative—though Böhtlingk has shown that in the Yakut dialect, which distinguishes ten cases, the genitive is wanting. The adjective, unless used as substantive, is uninflected both as attribute and as predicate; the comparative is formed by the suffix *-rak* (*-rek*), and takes the compared noun in the ablative; the superlative has no specific form, though a peculiar intensive is formed by prefixing to the adjective (though in writing always as two words) a syllable beginning with the same consonant, and ending in a labial *p* or *m*: for instance, *kap kara*, "intensely black"; *kip kisil*, "intensely red." The decimal system has prevailed over an original septimal system. The article does not exist. The relative pronoun has been borrowed from the Persian in many dialects; it is absent in the original Turkish. The theme of the verb is seen in the imperative, from which are derived various participles and gerunds, used either separately or combined with pronominal suffixes. These combinations supply the forms of the simple tenses and moods, though different dialects use different forms of participle and gerund for this purpose. Compound tenses and moods are expressed by means of auxiliary verbs. The theme of the imperative may, by the addition of a simple consonant, vowel, or syllable, be modified into a negative, passive, reflexive, reciprocal, impossible, causative, or doubly causative form, which are conjugated in the same manner as the original form. The causative forms again admit of a passive negative, &c., so that in fact the number of possible verbal forms derived from a single theme has been calculated by Shaw at 29,000. There are no prepositions, only postpositions.

Syntax. In syntax the order of the words and clauses of a period is almost the inverse of what seems natural to us, the subject and its predicate being placed at the end, while all hypothetical, causal, prohibitive,—in short all subordinate—clauses come first. In the simple style of illiterate peasants, and in popular romances and tales, this method presents no inconvenience as regards easy understanding, but in the artificial, often excessively long periods of an Osmanli stylist, it presents serious difficulties to a European reader.

Bibliography.—(*a*) General works on the history and ethnography of the Turks: Deguignes, *Histoire des Huns*; Vambéry, *Das Turkenvolk* (Leipsic, 1885), *Ursprung der Magyaren* (Leipsic, 1882), and several other publications; Radloff, *Aus Sibirien* (Leipsic, 1884); W. Grigorieff, *Zemlevedjenie K. Rittera Wostotchni ili Kitaiski Turkestan*; Neumann, *Die Völker des südlichen Russland* (Leipsic, 1847). We may add the historians of the Mongols—D'Ohsson, Howorth, and others—the numerous journals of travellers amongst Turkish peoples, and several articles in the *Russische Revue*, *Journal of the Royal Asiatic Soc.*, &c. A full bibliography of works relating to Central Asia may be found in V. J. Mejoff, *Recueil du Turkestan* (St Petersburg, 1878-84), and a useful excerpt at the end of vol. ii. of Lansdell's *Russian Central Asia*. Other works have already been cited in the course of this article.

(*b*) For the study of Turkish dialects the subjoined books may be used. (1) *Osmanli*: the grammars and dictionaries of Redhouse, Mallouf, Zenker, Barbier de Meynard, &c. (2) *Uigur*: the works of Klaproth; Abel Rémusat *Recherches sur les Langues Tartares* (Paris, 1820); and Vambéry, *Uigurische Sprachmonumente und das Kudatku Bilik* (Innsbruck, 1870). (3) *Jagatai*: the dictionary of Pavet de Courteille, and Vambéry, *Jagataische Sprachstudien* (Leipsic, 1867). (4) *Eastern Turki*: Shaw's grammar and vocabulary (*Jour. Roy. As. Soc. of Bengal*, 1877). (5) *Tatar dialects*: the grammars of Kasimbeg-Zenker (Leipsic, 1848), Ilminski (Kasan, 1860), and Radloff (Leipsic, 1882); *Dictionary of Trojanski* (Kasan, 1833); the chrestomathies of Béresine (Kasan, 1857), Terentieff, and specially Radloff, *Proben der Volkslitteratur der türkischen Stämme Süd-Sibiriens* (St Petersburg, 1872). And (6) *Yakuti*: Böhtlingk, *Die Sprache der Jakuten* (St Petersburg, 1851). (M. T. H.)

TURMERIC, the tuberous root of *Curcuma longa*, L., an herbaceous perennial plant belonging to the natural order *Zingiberaceæ*. It is a native of southern Asia, being cultivated on a large scale both on the mainland and in the islands of the Indian Ocean. Turmeric has been used from a remote period both as a condiment and as a dye stuff, and to a more limited extent as a medicine. In Europe it is employed chiefly as a dye, also as an ingredient in curry powder and as a chemical test for alkalies. The root is prepared by cleaning it and drying it in an oven. There are several varieties (Madras, Bengal, Gopalpur, Java, China, and Cochin turmeric), differing chiefly in size and colour and to a slight degree in flavour. Some of these consist exclusively of the ovate central tubers, technically known as "bulbs," and others of the somewhat cylindrical lateral tubers, which are distinguished in trade as "fingers." Both are hard and tough, but break with a short resinous or waxy fracture, which varies in tint from an orange brown to a deep reddish brown.

Turmeric has a characteristic odour and an aromatic taste. The aroma it owes to a complex essential oil, which consists principally of an alcohol called *turmerol* (formula $C_{19}H_{28}O$), which differs from carvol in being unable to combine with hydrogen sulphide; the other constituents of the oil have not been determined. The colour is due to *curcumin*, $C_{14}H_{14}O_4$, of which the drug contains about 0·3 per cent. It possesses the properties of an acid, forming red-brown salts with alkalies and being precipitated from alkaline solutions by acids. When pure it forms yellow crystals having a vanilla odour and exhibiting a fine blue colour in reflected light. It is soluble in alcohol, in chloroform, and in alkaline solutions, but only sparingly in water. Paper tinged with a tincture of turmeric exhibits on the addition of an alkali a reddish brown tint, which becomes violet on drying. This peculiarity was pointed out by Vogel in 1815, and since that date turmeric has been utilized as a chemical test for detecting alkalinity. In India the drug is considered to possess cordial and stomachic properties: a decoction made with milk and sweetened is used as a remedy for colds. Externally it is employed in skin diseases and in the form of a cooling lotion for relieving the pain of conjunctivitis; the fumes of the burning tubers directed into the nostrils relieve congestion in cases of coryza. The cultivation of turmeric is carried on most successfully in light rich soil in well-watered districts. The plant is easily propagated by offsets. An acre yields about 2000 lb. Turmeric is said to grow in large quantities on the slopes of hills bordering the plains of the Beni in Bolivia and also in Panama. Several species of *Curcuma* and of allied genera yield yellowish aromatic roots. In Sierra Leone a kind of turmeric is obtained from a species of *Canna*.

TURNER, CHARLES (1773-1857), an English engraver, was born at Woodstock in 1773. He entered the schools of the Royal Academy in 1795; and, engraving in stipple in the manner of Bartolozzi, he was employed by Alderman Boydell. His finest plates, however, are in mezzotint, a method in which he engraved J. M. W. Turner's Wreck and twenty-four subjects of his *Liber Studiorum*, Reynolds's Marlborough Family, and many of Raeburn's best portraits, including those of Sir Walter Scott, Lord Newton, Dr Hamilton, Profs. Dugald Stewart and John Robison, and Dr Adam. He also worked after Lawrence, Shee, and Owen. He was an admirable engraver, large, broad, and masterly in touch; and he reproduced with great fidelity the characteristics of the various painters whose works he translated into black and white. In 1828 he was elected an associate engraver of the Royal Academy. He died in London on 1st August 1857.

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[1] For details about the spread of Christianity amongst the Turks, see Yule, *Cathay and the Way thither*, i. 90-100.

TURNER, Joseph Mallord William (1775-1851), one of the greatest painters of the English school, was born in London on 23d April 1775. His father, William Turner, a native of Devonshire, kept a barber's shop at 26 Maiden Lane, in the parish of St Paul's, Covent Garden; he was "a cheerful, talkative little man, with small blue eyes, a parrot nose, projecting chin, and a fresh complexion indicative of health." Of the painter's mother, Mary Marshall or Turner, little is known; she is said to have been a person of ungovernable temper and towards the end of her life became insane. Apparently the home in which Turner spent his childhood was not a happy one, and this may account for much that was unsociable and eccentric in his character. The earliest known drawing by Turner, a view of Margate Church, dates from his ninth year. It was also about this time that he was sent to his first school at New Brentford. Of education, as the term is generally understood, he received but little. His father taught him to read, and this and a few months at New Brentford and afterwards at Margate were all the schooling he ever had; he never mastered his native tongue, nor was he able in after life to learn any foreign language. Notwithstanding this lack of scholarship, one of his strongest characteristics was a taste for associating his works with personages and places of legendary and historical interest, and certain stories of antiquity seem to have taken root in his mind very strongly. By the time Turner had completed his thirteenth year his school days were over and his choice of an artist's career settled. In 1788-89 he was receiving lessons from Palice, "a floral drawing master," from T. Malton, a perspective draughtsman, and from Hardwick, an architect. He also attended Paul Sandby's drawing school in St Martin's Lane. Part of his time was employed in making drawings at home, which he exhibited for sale in his father's shop window, two or three shillings being the usual price. He coloured prints for engravers, washed in backgrounds for architects, went out sketching with Girtin, and made drawings in the evenings for Dr Munro "for half a crown and his supper." When pitied in after life for the miscellaneous character of his early work, his reply was "Well! and what could be better practice!" In 1789 Turner became a student of the Royal Academy. He also worked for a short time in the house of Sir Joshua Reynolds, with the idea, apparently, of becoming a portrait painter; but, the death of Reynolds occurring shortly afterwards, this intention was abandoned. In 1790 Turner's name appears for the first time in the catalogue of the Royal Academy, the title of his solitary contribution being "View of the Archbishop's Palace, Lambeth." About 1792 he received a commission from Walker, the engraver, to make drawings for his *Copper-Plate Magazine*, and this topographical work took him to many interesting places. The natural vigour of his constitution enabled him to cover much of the ground on foot. He could walk from 20 to 25 miles a day with ease, his baggage at the end of a stick, making notes and memoranda as he went. He rose early, worked hard all day, wasted no time over his simple meals, and his homely way of living made him easily contented with such rude accommodation as he chanced to find on the road. A year or two after he accepted a similar commission to make drawings for the *Pocket Magazine*, and before his twentieth year he had travelled over many parts of England and Wales. None of these magazine drawings are remarkable for originality of treatment or for artistic feeling.

Up to this time Turner had worked in the back room above his father's shop. His love of secretiveness and solitude had already begun to show itself. An architect who often employed him to put in backgrounds to his drawings says, "he would never suffer me to see him draw, but concealed all that he did in his bed-room." On another occasion, a visitor entering unannounced, Turner instantly covered up his drawings, and, in reply to the intimation, "I've come to see the drawings for———," the answer was, "You shan't see 'em, and mind that next time you come through the shop, and not up the back way." Probably the increase in the number of his engagements induced Turner about this time to set up a studio for himself in Hand Court, not far from his father's shop, and there he continued to work till he was elected an associate of the Royal Academy (1799).

Until 1792 Turner's practice had been almost exclusively confined to water colours, and his early works show how much he was indebted to some of his contemporaries. There are few of any note whose style he did not copy or adopt. His first exhibited oil picture appeared in the Academy in 1793. In 1794-95 Canterbury Cathedral, Malvern Abbey, Tintern Abbey, Lincoln and Peterborough Cathedrals, Shrewsbury, and King's College Chapel, Cambridge, were among the subjects exhibited, and during the next four years he contributed no less than thirty-nine works to the Academy. In the catalogue of 1798 he first began to add poetic quotations to the titles of his pictures; one of the very first of these—a passage from Milton's *Paradise Lost*—is in some respects curiously prophetic of one of the future characteristics of his art.

> "Ye mists and exhalations that now rise
> From hill or steaming lake, dusky or grey
> Till the sun paints your fleecy skirts with gold,
> In honour of the world's great author rise."

This and several other quotations in the following years show that Turner's mind was now occupied with something more than the merely topographical element of landscape, Milton's *Paradise Lost* and Thomson's *Seasons* being laid under frequent contribution for descriptions of sunrise, sunset, twilight, or thunderstorm. Turner's first visit to Yorkshire took place in 1797. It seems to have braced his powers and possibly helped to change the student into the painter. Until then his work had shown very little of the artist in the higher sense of the term: he was little more than a painstaking and tolerably accurate topographer, but even under these conditions he had begun to attract the notice of his brother artists and of the critics. England was, at the time, at a low point both in literature and art. Among the artists De Loutherbourg and Morland were almost the only men of note left. Hogarth, Wilson, Gainsborough, and Reynolds had passed away. Beechey, Bourgeois, Garvey, Farington—names well-nigh forgotten now—were the Academicians who painted landscape. The only formidable rivals Turner had to contend with were De Loutherbourg and Girtin, and after the death of the latter in 1802 he was left undisputed master of the field.

It is not therefore surprising that the exhibition of his works in 1798 was followed by his election to the associateship of the Royal Academy. That he should have attained to this position before completing his twenty-fourth year says much for the wisdom and discernment of that body, which further showed its recognition of his talent by electing him an Academician four years later. Turner owed much to the Academy. Mr Ruskin says, "It taught him nothing." Possibly it had little to teach that he had not already been able to learn for himself; at all events it was quick to see his genius and to confer its honours, and Turner, naturally generous and grateful, never forgot this. He enjoyed the dignity of Academician for nearly half a century, and during nearly the whole of that period he took an active share in the direction of the Academy's affairs. His speeches are described as "confused, tedious, obscure, and extremely difficult to follow"; but at council meetings he was ever anxious to allay anger and bitter controversy. His opinions on art were always listened to with respect; but on matters of business it was often difficult to know what he meant. His friend Chantrey used to say, "He has great thoughts, if only he could express them." When appointed professor of perspective to the Royal Academy in 1808, this painful lack of expression stood greatly in the way of his usefulness: he was often at a loss for words to express his ideas, and when he had recourse to his notes he found difficulty in reading them. Mr Ruskin says, "The zealous care with which Turner endeavoured to do his duty is proved by a series of large drawings, exquisitely tinted, and often completely coloured, all by his own hand, of the most difficult perspective subjects, illustrating not only directions of line, but effects of light, with a care and completion which would put the work of any ordinary teacher to utter shame." In teaching he would neither waste time nor spare it. "If a student would take a hint, Turner was delighted and would go on with him giving hint after hint; if he could not follow, he left him. Explanations are wasted time; a man who can see understands a touch; a man who cannot misunderstands an oration." With his election to the associateship of the Academy in 1799, Turner's early struggles may be considered to have ended. He had emancipated himself from hack work, had given up making topographical drawings of castles and abbeys for the engravers—drawings in which mere local fidelity was the principal object—and had taken to *composing* as he drew. Local facts had become of secondary importance compared with effects of light and colour. He had reached manhood, and with it he abandoned topographical fidelity and began to paint his dreams, the visionary faculty—the true foundation of his art—asserting itself, nature being used to supply suggestions and materials.

His pictures of 1797-99 had shown that he was a painter of no ordinary power, one having much of the poet in him, and able to give expression to the mystery, beauty, and inexhaustible fulness of nature. His work at this period is described by Mr Ruskin as "stern in manner, reserved, quiet, grave in colour, forceful in hand."

Turner's visit to Yorkshire in 1797 was followed a year or two later by a second, and it was on this occasion that he made the acquaintance, which afterwards ripened into a long and staunch friendship, of Fawkes of Farnley Hall. From 1803 till 1820 Turner was a frequent visitor at Farnley. The large number of his drawings still preserved there—English, Swiss, German, and Italian, the studies of rooms, outhouses, porches, gateways, of birds shot while he was there, and of old places in the neighbourhood—prove the frequency of his visits and his affection for the place and for its hospitable master. A caricature, made by Fawkes, and "thought by old friends to be very like," shows Turner as "a little Jewish-nosed man, in an ill-cut brown tail-coat, striped waistcoat, and enormous frilled shirt, with feet and hands notably small, sketching on a small piece of paper, held down almost level with his waist." It is evident from all the accounts given that Turner's personal appearance was not of a kind to command much attention or respect. This may have pained his sensitive nature, and led him to seek refuge in the solitude of his painting room. Had he been inclined he had abundant opportunity for social and friendly intercourse with his fellow-men, but he gradually came to live more and more in a state of mental isolation, keeping himself to himself, entirely absorbed in his art. "This man must be loved for his works, for his person is not striking nor his conversation brilliant," is the testimony of Dayes, the water-colour painter (and Girtin's master), in 1804. Turner could never make up his mind to visit Farnley again after his old friend's death, and his voice would falter when he spoke of the shores of the Wharfe.

Turner visited Scotland in 1800, and in 1801 or 1802 he made his first tour on the Continent. In the following year, of the seven pictures he exhibited six were of foreign subjects, among them Bonneville, the Festival upon the Opening of the Vintage of Mâcon, and the well-known Calais Pier in the National Gallery. The last-named picture, although heavily painted and somewhat opaque in colour, is magnificently composed and full of energy. A better idea of its masterly composition can be formed from Mr Seymour Haden's vigorous etching than from the picture itself, which is now greatly darkened by time.

In 1802, the year in which Turner became a Royal Academician, he took his old father, who still carried on the barber business in Maiden Lane, to live with him. The powder tax, imposed in 1795, drove out wigs and spoiled the old man's trade. "It is precisely," says Mr Hamerton, "when the painter wins the full honours of the Academy—honours which give a recognized and envied position in London society—that he takes his father home; a meaner nature would have tried to keep the old man at a safe distance." Turner's relations with his father were of the most dutiful and filial kind to the last.[1]

In 1804 Turner made a second tour on the Continent, and in the following year painted the Shipwreck and Fishing Boats in a Squall (in the Ellesmere collection), seemingly in direct rivalry of Vandervelde, in 1806 the Goddess of Discord in the Garden of the Hesperides (in rivalry of Poussin), and in 1807 the Sun rising through Vapour (in rivalry of Claude).[2] The last two are notable works, especially the Sun. In after years it was one of the works he left to the nation, on the special condition of its being hung beside the Claudes in the National Gallery. In this same year (1807) Turner commenced his most serious rivalry. Possibly it arose out of a desire to break down Claude worship, the then prevailing fashion, and to show the public that there was a living artist not unworthy of taking rank beside him. That the *Liber Studiorum* was suggested by the *Liber Veritatis* of Claude, and was intended as a direct challenge to that master, is beyond doubt. There is, however, a certain degree of unfairness to Claude in the way in which the challenge was given. Claude made drawings in brown of his pictures as they left the easel, not for publication, but merely to serve as private memoranda. Turner's *Liber* drawings had no such purpose, but were intended as a direct appeal to the public to judge between the two artists. The first of the *Liber* drawings were made in the autumn of 1806, the others at intervals till about 1815. They are of the same size as the plates and carefully finished in sepia. About fifty of them are now to be seen in the Turner rooms of the National Gallery. The issue of the *Liber* began in 1807 and continued at irregular intervals till 1819, when it stopped at the fourteenth number. Turner had resolved to manage the publishing business himself, but in this he was not very successful. He soon quarrelled with his engraver, F. C. Lewis, on the ground that he had raised his charges from five guineas a plate to eight. He then employed Charles Turner, who agreed to do fifty plates at the latter sum, but, after finishing twenty, he too wished to raise his price, and, as a matter of course, this led to another quarrel. Reynolds, Dunkarton, Lupton, Say, Dawe, and other engravers were afterwards employed—Turner himself etching and mezzotinting some of the plates. Each part of the *Liber* contained five plates, the subjects, divided into "historical," "pastoral," "marine," &c., embracing the whole range of landscape art. Seventy-one plates in all were published (including one as a gift of the artist to his subscribers); ten other plates—more or less completed—intended for the fifteenth and sixteenth numbers were never published, the work being stopped for want of encouragement. Absence of method and business habits may account for this. Turner is said to have got up the numbers in his own house with the help of a female servant. The plates, which cost the subscribers only five shillings apiece, were so little esteemed that in the early quarter of the 19th century they were sometimes used for lighting fires. So much has fashion, or public taste, changed since then that a fine proof of a single plate has sold for £210. The merit of the plates is unequal; some—for example, Solway Moss, Inverary Pier, Hind Head Hill, Ben Arthur, Rizpah, Junction of the Severn and Wye, and Peat Bog—are of great beauty, while a few are comparatively tame and uninteresting. Among the unpublished plates Stonehenge at Daybreak and Sheep Washing, Windsor Castle take a high place. The *Liber* shows strong traces of the influence of Cozens and Girtin, and, as a matter of course, of Claude. In most of the designs the predominant feeling is serious; in not a few, gloomy, or even tragic. A good deal has been written about Turner's intention, and the "lessons" of the *Liber Studiorum*. Probably his only intention in the beginning was to show what he could do, to display his art, to rival Claude, perhaps to educate public taste, and at the same time make money. If lessons were intended they might have been better conveyed by words. "Silent always with a bitter silence, disdaining to tell his meaning,"—such is Mr Ruskin's explanation; but surely Turner had little reason for either silence or contempt because the public failed to see in landscape art the means of teaching it great moral lessons. The seventy plates of the *Liber* contain an almost complete epitome of Turner's art. Already in this work are seen strong indications of one of his most remarkable characteristics—a knowledge of the principles of structure in natural objects: mountains and rocks are drawn, not with topographical accuracy, but with what appears like an intuitive feeling for geological formation; and trees have also the same expression of life and growth in the drawing of stems and branches. This instinctive feeling in Turner for the principles of organic structure is treated of at considerable length in the fourth volume of *Modern Painters*, and Turner is there contrasted with Claude, Poussin, and some of the Dutch masters, greatly to their disadvantage.

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[1] Turner's father died in 1830, and the loss of "poor old Dad," as he used to call him, left a terrible void. He had lived in his son's house for nearly thirty years, looking after the frugal affairs of his household, and making himself useful in various ways. It is said that he used to prepare and strain his son's canvases and varnish them when finished, which may explain a saying of Turner's that "his father used to begin and finish his pictures for him." He also attended to the gallery in Queen Anne Street, showed in visitors, and took care of the dinner, if he did not himself cook it. Turner was never the same man after his father's death, living a life of almost complete isolation.

[2] This spirit of rivalry showed itself early in his career. He began by pitting himself against his contemporaries, and afterwards, when his powers were more fully developed, against some of the old masters, notably Vandervelde and Claude. During these years, while he kept up a constant rivalry with artists living and dead, he was continuing his unresting and untiring study of nature, and, while seemingly a mere follower of the ancients, was accumulating that immense store of knowledge which in after years, when his true genius asserted itself, he was to use to such purpose.

After 1797 Turner was little concerned with mere topographical facts: his pictures might be like the places represented or not; much depended on the mental impression produced by the scene. He preferred to deal with the spirit, rather than with the local details of places. A curious example of the *reasonableness* accompanying his exercise of the imaginative faculty is to be found in his creations of creatures he had never seen, as, for example, the dragon[1] in the Garden of the Hesperides and the python in the Apollo, exhibited in 1811. Both these monsters are imagined with such vividness and reality, and the sense of power and movement is so completely expressed, that the spectator never once thinks of them as otherwise than representations of actual facts in natural history. It needs but a little comparison to discover how far Turner surpassed all his contemporaries, as well as all who preceded him, in these respects. The imaginative faculty he possessed was of the highest order, and it was further aided by a memory of the most retentive and unerring kind. A good illustration of this may be seen at Farnley Hall in a drawing of a Man-of-War taking in Stores. Some one, who had never seen a first-rate, expressed a wish to know what it looked like. Turner took a blank sheet of paper one morning after breakfast, outlined the ship, and finished the drawing in three hours, Fawkes sitting beside him from the first stroke to the last. The size of this drawing is about 16 in. by 11 in. Mr Ruskin thus describes it:

> "The hull of a first-rate occupies nearly one half of the picture to the right, her bows toward the spectator, seen in sharp perspective from stem to stern, with all her port-holes, guns, anchors, and lower rigging elaborately detailed, two other ships of the line in the middle distance drawn with equal precision, a noble breezy sea, full of delicate drawing in its waves, a store ship beneath the hull of the larger vessel and several other boats, and a complicated cloudy sky, all drawn from memory, down to the smallest rope, in a drawing-room of a mansion in the middle of Yorkshire."

About the year 1811 Turner paid his first visit to Devonshire, the county to which his family belonged, and a curious glimpse of his simple manner of life is given by Redding, who accompanied him on some of his excursions. On one occasion they spent a night together in a small road-side inn, Turner having a great desire to see the country around at sunrise.

> "Turner was content with bread and cheese and beer, tolerably good, for dinner and supper in one. In the little sanded room we conversed by the light of an attenuated candle and some aid from the moon until nearly midnight, when Turner laid his head upon the table and was soon fast asleep. Three or four hours rest was thus obtained, and we went out as soon as the sun was up to explore the surrounding neighbourhood. It was in that early morning Turner made a sketch of the picture Crossing the Brook." In another excursion to Borough Island, "the morning was squally and the sea rolled boisterously into the Sound. Off Stakes Point it became stormy; our Dutch boat rode bravely over the furrows. Two of the party were ill. Turner was all the while quiet, watching the troubled scene. Bolt Head, to seaward, against which the waves broke with fury, seemed to absorb his entire notice, and he scarcely spoke a syllable. While the fish were getting ready Turner mounted nearly to the highest point of the island rock, and *seemed writing rather than drawing*. The wind was almost too violent for either purpose."

This and similar incidents show how careless of comfort Turner was, and how devoted to his art. The tumult and discomfort by which he was surrounded could not distract his powers of observation; and some thirty years later there is still evidence of the same kind. In the catalogue of the exhibition of 1842 one of his pictures bears the following title, "Snow-Storm: steam-boat off a harbour's mouth making signals in shallow water, and going by the lead. The author was in that storm the night the 'Ariel' left Harwich."

From 1813 till 1826, in addition to his Harley Street residence, Turner had a country house at Twickenham. He kept a boat on the river, also a pony and gig, in which he used to drive about the neighbouring country on sketching expeditions. The pony, for which Turner had a great love, appears in his well-known Frosty Morning in the National Gallery. He appears to have had a great affection for animals, and one instance of his tenderness of heart is given by one who often joined him in the amusement of fishing, of which Turner was very fond. "I was often with him when fishing at Petworth, and also on the banks of the Thames. His success as an angler was great, although with the worst tackle in the world. Every fish he caught he showed to me, and appealed to me to decide whether the size justified him to keep it for the table or to return it to the river; his hesitation was often almost touching, and he always gave the prisoner at the bar the benefit of the doubt."

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[1] "The strange unity of vertebrated action and of a true bony contour, infinitely varied in every vertebra, with this glacial outline, together with the adoption of the head of the Ganges crocodile, the fish-eater, to show his sea descent (and this in the year 1806, when hardly a single fossil saurian skeleton existed within Turner's reach), renders the whole conception one of the most curious exertions of the imaginative intellect with which I am acquainted in the arts" (Ruskin, *Mod. Painters*, vol. v. p. 313).

In 1813 Turner commenced the series of drawings, forty in number, for Cooke's *Southern Coast*. This work was not completed till 1826. The price he at first received for these drawings was £7, 10s. each, afterwards raised to £13, 2s. 6d.

Crossing the Brook appeared in the Academy of 1815. It may be regarded as a typical example of Turner's art at this period, and marks the transition from his earlier style to that of his maturity. It represents a piece of Devonshire scenery, a view on the river Tamar. On the left is a group of tall pine-trees, beautifully designed and drawn with great skill and knowledge of structure, in the foreground a couple of children, with a dog carrying a bundle in its mouth across the brook, and beyond, a vast expanse of richly-wooded country, with glimpses of a winding river, an old bridge, a mill, and other buildings, and, in the far distance, the sea. Both in design and execution this work is founded upon Claude. Some critics consider it one of Turner's greatest works; but this is open to question.[1] It can hardly be called a work in full colour: it is limited to greys and quiet greens for the earth and pale blues for the sky. It is a sober but very admirable picture, full of diffused daylight, and in the painting of its distance better than any master who had preceded him. The fascination of the remote, afterwards so distinctive an element in Turner's pictures, shows itself here. Perhaps nothing tests the powers or tries the skill of the landscape-painter more severely than the representation of distant effects. They come and go so rapidly, are often in a high key of light and colour, and so full of mystery and delicacy, that anything approaching to real imitation is impossible. Only the most retentive memory and the most sensitive and tender feeling will avail. These qualities Turner possessed to a remarkable degree, and as his powers matured there was an ever-increasing tendency in his art to desert the foreground, where things were definite and clear, in order to dream in the infinite suggestiveness and space of distances. Dido Building Carthage also belongs to this period. It hangs beside the Claudes in the National Gallery. It pertains to the old erroneous school of historical painting. Towering masses of Claudesque architecture piled up on either side, porticoes, vestibules, and stone pines, with the sun in a yellow sky, represent the Carthage of Turner's imagination. With all its faults it is still the finest work of the class he ever painted. Carthage and its fate had a strange fascination for him. It is said that he regarded it as a moral example to England in its agricultural decline, its increase of luxury, and its blindness to the insatiable ambition of a powerful rival. He returned again to this theme in 1817, when he exhibited his Decline of the Carthaginian Empire: Hostages Leaving Carthage for Rome,—a picture which Mr Ruskin describes as "little more than an accumulation of academy student's outlines coloured brown."

In 1818 Turner was in Scotland making drawings for the *Provincial Antiquities* for which Sir Walter Scott supplied the letterpress, and in 1819 he visited Italy for the first time. One of the results of this visit was a great change in his style, and from this time his works became remarkable for their colour. Hitherto he had painted in browns, greys, and blues, using red and yellow sparingly. He had gradually been advancing from the sober grey colouring of Vandervelde and Ruysdael to the mellow and richer tones of Claude. His works now begin to show a heightened scale of colour, gradually increasing in richness and splendour and reaching its culminating point in such works as the Ulysses, Childe Harold's Pilgrimage, the Golden Bough, and the Fighting Téméraire. All these works belong to the middle period of Turner's art (1829-39), when his powers were entirely developed and entirely unabated. Much of his most beautiful work at this period is to be found in his water-colour drawings: those executed for Whitaker's *History of Richmondshire* (1819-21), for Cooke's *Southern Coast* (1814-26), for *The Rivers of England* (1824), for *England and Wales* (1829-38), *Provincial Antiquities* (1826), Rogers's *Italy* (1830), Scott's *Works* (1834), and *The Rivers of France* (1833-35) are in many instances of the greatest beauty. Of the Richmondshire drawings Mr Ruskin says, "The foliage is rich and marvellous in composition, the rock and hill drawing insuperable, the skies exquisite in complex form."

But perhaps one of the greatest services Turner rendered to the art of England was the education of a whole school of engravers. His best qualities as a teacher came from the union of strength and delicacy in his work; subtle and delicate tonality was almost a new element for the engraver to deal with, but with Turner's teaching and careful supervision his engravers by degrees mastered it more or less successfully, and something like a new development of the art of engraving was the result. No better proof can be found of the immense advance made than by comparing the work of the landscape engravers of the pre-Turnerian period with the work of Miller, Goodall, Willmore, Cooke, Wallis, Lupton, C. Turner, Brandard, Cousen, and others who worked under his guidance. The art of steel engraving reached its highest development in England at this time. Rogers's *Italy* (1830) and his *Poems* (1834) contain perhaps the most beautiful and delicate of the many engravings executed after Turner's drawings. They are vignettes,[2] a form of art which Turner understood better than any artist ever did before,—perhaps, we might add, since. The Alps at Daybreak, Columbus Discovering Land, and *Datur Hora Quieti* may be given as examples of the finest.

In 1828 Turner paid a second visit to Italy, this time of considerable duration, on the way visiting Nîmes, Avignon, Marseilles, Genoa, Spezzia, and Siena, and in the following year he exhibited the Ulysses Deriding Polyphemus, now in the National Gallery. It marks the beginning of the central and best period of Turner's power. This work is so well known that description is hardly needed. The galley of Ulysses occupies the centre of the picture; the oars are being thrust out and the sailors flocking up the masts to unfurl sail, while Ulysses waves the blazing olive tree in defiance of the giant, whose huge form is seen high on the cliffs above; and the shadowy horses of Phœbus are traced in the slanting rays of the rising sun. The impression this picture leaves is one of great power and splendour. The painting throughout is magnificent, especially in the sky. Leslie speaks of it as "a poem of matchless splendour and beauty." From this period onward till about 1840 Turner's life was one of unceasing activity. Nothing is more astonishing than his prodigious fertility; he rose early, worked from morning till night, entirely absorbed in his art, and gradually became more and more solitary and isolated. Between 1829 and 1839 he sent fifty-five pictures to the Royal Academy, painted many others on private commission, made over four hundred drawings for engravers, besides thousands of studies and sketches from nature. His industry accounts for the immense quantity of work he left behind him. There is not the slightest evidence to show that it arose from a desire to make money, which he never cared for in comparison with his art. He has been accused, perhaps not without some cause, of avarice and meanness in his business dealings, and many stories are told to his discredit. But in private he often did generous things, although owing to his reserved disposition his virtues were known only to a few. His faults on the other hand—thanks to the malice, or jealousy, of one or two individuals—were freely talked about and, as a matter of course, greatly exaggerated. "Keep it, and send your children to school and to church," were the words with which he declined repayment of a considerable loan to a poor drawing-master's widow. On another occasion, when interrupted in his work, he roughly chid and dismissed the applicant, a poor woman; but she had hardly left his door before he followed her and slipped a £5 note into her hand. His tenants in Harley Street were in arrears for years, but he would never allow his lawyer to distrain; and if further proof of his generosity were needed his great scheme for bettering the condition of the unfortunate in his own profession should suffice. On one occasion he is known to have taken down a picture of his own from the walls of the Academy to make room for that of an unknown artist.

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[1] Crossing the Brook was a great favourite with Turner. It was painted for a patron, who, dissatisfied with it, left it on the painter's hands. The price asked (£500) seems to have been part of the objection. Turner subsequently refused an offer of £1600 for it.

[2] "Of all the artists who ever lived I think it is Turner who treated the vignette most exquisitely, and, if it were necessary to find some particular reason for this, I should say that it may have been because there was nothing harsh or rigid in his genius, that forms and colours melted into each other tenderly in his dream world, and that his sense of gradation was the most delicate ever possessed by man" (Hamerton).

The first of Turner's Venetian pictures (Bridge of Sighs, Ducal Palace and Custom House, Venice, Canaletti Painting) appeared in the Academy in 1833. Compared with the sober, prosaic work of Canaletti, Turner's pictures of Venice appear like poetic dreams. Splendour of colour and carelessness of form generally characterize them. Venice appeared to him "a city of rose and white, rising out of an emerald sea against a sky of sapphire blue." Many of these Venetian pictures belong to his later manner, and some of them, the Sun of Venice Going to Sea (1843), Approach to Venice (1844), and Venice, Evening, Going to the Ball (1845), to his latest. As Turner grew older his love of brilliant colour and light became more and more a characteristic. In trying to obtain these qualities he gradually fell into an unsound method of work, treating oil as if it had been water-colour, using both indiscriminately on the same canvas, utterly regardless of the result. Many of his finest pictures are already in a ruined state, mere wrecks of what they once were.

The Fighting Téméraire Tugged to her Last Berth to be Broken up (see vol. xxi. p. 441, fig. 43) was exhibited in the Academy of 1839. By many it is considered one of his finest works. Turner had all his life been half a sailor at heart: he loved the sea, and shipping, and sailors and their ways; many of his best pictures are sea pieces; and the old ships of Collingwood and Nelson were dear to him. Hence the pathetic feeling he throws around the fighting Téméraire. The old three-decker, looking ghostly and wan in the evening light, is slowly towed along by a black, fiery little steam tug,—a contrast suggesting the passing away of the old order of things and the advent of the new; and behind the sun sets red in a thick bank of smoke or mist. The Slave Ship, another important sea picture, was exhibited in the following year, and in 1842 Peace: Burial at Sea, commemorative of Wilkie.

Turner had now reached his sixty-seventh year, but no very marked traces of declining power are to be seen in his work. Many of the water-colour drawings belonging to this period are of great beauty, and, although a year or two later his other powers began to fail, his faculty for colour remained unimpaired almost to the end. He paid his last visit to the Continent in 1843, wandering about from one place to another, and avoiding his own countrymen, an old and solitary man. At his house in Queen Anne Street they were often ignorant of his whereabouts for months, as he seldom took the trouble to write to any one. Two years later (1845) his health gave way and with it both mind and sight began to fail. The works of his declining period exercised the wit of the critics. Turner felt these attacks keenly. He was naturally kind-hearted and acutely sensitive to censure. "A man may be weak in his age," he once remarked, "but you should not tell him so."

After 1845 all the pictures shown by Turner belong to the period of decay,—mere ghosts and shadows of what once had been. In 1850 he exhibited for the last time. He had given up attending the meetings of the Academicians; none of his friends had seen him for months; and even his old housekeeper had no idea of his whereabouts. Turner's mind had evidently given way for some time, and with that love of secrecy which in later years had grown into a passion he had gone away to hide himself in a corner of London. He had settled as a lodger in a small house in Chelsea, overlooking the river, kept by his old Margate landlady, Mrs Booth. To the children in the neighbourhood he was known as "Admiral Booth." His short, sailor-like figure may account for the idea that he was an impoverished old naval officer. He had been ill for some weeks, and when his Queen Anne Street housekeeper at last discovered his hiding-place she found him sinking, and on the following day, the 19th December 1851, he died. He was buried in St Paul's cathedral, in deference to a wish he had himself expressed.

He left the large fortune he had amassed (about £140,000) to found a charity for the "maintenance and support of male decayed artists, being born in England, and of English parents only, and of lawful issue." His pictures he bequeathed to the nation, on condition that they were to be exhibited in rooms of their own, and that these rooms were to be called "Turner's Gallery." The will and its codicils were so confused that after years of litigation, during which a large part of the money was wasted in legal expenses, it was found impossible to decide what Turner really wanted. A compromise was effected in which the wishes of everybody, save those of the testator, were consulted, his next-of-kin, whom he did not mean to get a single farthing, inheriting the bulk of his property. The nation got all the pictures and drawings, and the Royal Academy £20,000.

It is unnecessary here to do more than allude to the charges which have been brought against Turner's moral character. Like most men of note he had his enemies and detractors, and it is to be regretted that so many of the stories they set in circulation should have been repeated by one of his biographers, who candidly admits having "spared none of his faults," and excuses himself for so doing by "what he hopes" is his "undeviating love of truth." The immense quantity of work accomplished by Turner during his lifetime, work full of the utmost delicacy and refinement, proves the singularly fine condition of his nervous system, and is perhaps the best answer that can be given to the charge of being excessively addicted to sensual gratification. In his declining years he possibly had recourse to stimulants to help his failing powers, but it by no means follows that he went habitually to excess in their use. He never lost an opportunity of doing a kindness, and under a rough and cold exterior there was more good and worth hidden than the world imagined. "During the ten years I knew him," says Mr Ruskin, "years in which he was suffering most from the evil-speaking of the world, I never heard him say one depreciating word of any living man or man's work; I never saw him look an unkind or blameful look; I never knew him let pass, without sorrowful remonstrance, or endeavour at mitigation, a blameful word spoken by another. Of no man but Turner, whom I have ever known, could I say this." Twice during his earlier days there are circumstances leading to the belief that he had thoughts of marriage, but on both occasions it ended in disappointment, and his home after his father died was cheerless and solitary, without solace or comfort of any kind.

If Turner had died early his reputation as an artist would have been very different from what it ultimately became. He would not have been recognized as a colourist. It was only after the year 1820 that colour began to assert itself strongly in his work. He painted for many a year in greys and greens and browns, went steadily through "the subdued golden chord," and painted yellow mists and suns rising through vapour; but as time went on that was no longer enough, and he tried to paint the sun in his strength and the full glories of sunshine. The means at the painter's disposal are, however, limited, and Turner, in his efforts after brilliancy, began to indulge in reckless experiments in colour. He could not endure even the slightest restraints which technical limitations impose, but went on trying to paint the unpaintable. As a water-colour painter Turner stands pre-eminent; he is unquestionably the greatest master in that branch of art that ever lived. If his work is compared with that of Barrett, or Varley, or Cozens, or Sandby, or any of the earlier masters, so great is Turner's superiority that the art in his hands seems to be lifted altogether into a higher region.

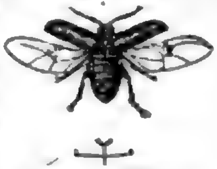
In 1843 a champion, in the person of Mr Ruskin, arose to defend Turner against the unjust and ignorant attacks of the press, and what at first was intended as a "short pamphlet, reprobating the manner and style of these critics," grew into the five volumes known as *Modern Painters*. The writer employs all his eloquence and his great critical faculty to prove how immeasurably superior Turner was to all who had ever gone before, hardly restricting his supremacy to landscape art, and placing him among the "seven supreme colourists of the world." Two lives of Turner have been written, one by Mr Thornbury, the other by Mr Hamerton. The work of the latter deserves the highest commendation; it gives a clear and consistent history of the great artist, and is characterized by refined thought and critical insight. An excellent little book by Mr W. C. Monkhouse should also be noticed. (G. RE.)

TURNHOUT, a town of Belgium, in the province of Antwerp, 25 miles east-north-east from Antwerp and 6 from the Dutch frontier, stands in the middle of a wide plain. It is a prosperous manufacturing and commercial centre, the chief industries being the weaving of cottons and linens (especially ticking), lace-making, paper-making, brick-making, dyeing, bleaching; there is also an establishment for the rearing of leeches. The population of the commune in 1876 was 15,743.

TURNING. See LATHE.

TURNIP. See AGRICULTURE, vol. i. pp. 365-368, and HORTICULTURE, vol. xii. p. 288.

TURNIP-FLY, TURNIP-FLEA, or EARTH FLEA-BEETLE, the name applied to several species of *Haltica* which infest turnip fields and do considerable damage to crops. The genus belongs to the family *Chrysomelidæ*, and includes about 100 species. The turnip-fly most usually met with, *Haltica nemorum*, is scarcely 2mm. in length and of a shining black colour, with two ochreous yellow longitudinal bands running along each wing-case; the bands are slightly sinuous and bend inwards at the hinder end. Of the eleven-jointed antennæ the first three segments are yellow and the remainder black. The coxæ are black, the rest of the legs having a yellowish hue. The coxæ and tibiæ are stout and formed for leaping, especially in the posterior pair of legs. The remarkable power of jumping has given rise to the name turnip-flea. The females are slightly longer and decidedly stouter than the males.



Turnip fly (*Haltica nemorum*).

Another species, *H. concinna*, has a greenish yellow or brassy appearance, and the tibiæ of the two posterior legs are armed with a thorn-like hook. A third species, *H. consobrina*, is of a dark blue colour above, whilst another species, *H. obscurella*, often very abundant, is of a lighter blue colour, and larger than those mentioned above.

The life-history of *Haltica nemorum* may be taken as an example of that of the genus. The beetles begin pairing during April, and continue all through the summer. The female lays but few eggs, usually one a day. The eggs are deposited on the under surface of a leaf, close under one of the projecting veins; they possess a protective colouring. The development within the egg lasts ten days, at the end of which a small larva creeps out, and at once eats its way through the lower epidermis of the leaf into the mesophyll and there forms long winding burrows. The larva or maggot is of a yellowish colour and somewhat cylindrical in form. It has three pairs of legs anteriorly and a pair of pro-legs at its hinder end. The most anterior and the most posterior segment bear a black spot. The mouth is provided with a pair of mandibles, by means of which the larva eats its way through the soft tissue of the leaf. This larval condition lasts about six days; the maggot then leaves the leaf and buries itself some one or two inches beneath the surface of the earth; here it turns into a chrysalis. From this the full-grown beetle emerges after an interval of fourteen days, and it is in this stage of its life-history that it proves most destructive to the turnip crop. Several broods may be produced each season; the beetle lives through the winter sheltered under fallen leaves, pieces of wood, clods of earth, &c., until the warmth of spring awakens it, when it soon begins to lay eggs.

Since the chief damage to the crop is due to the perfect beetle devouring the young leaves of the turnip plant, one of the most important methods of dealing with the pest is to ensure a strong and healthy growth of the plant, by means of manuring, watering, &c. Another preventative is the removal of such weeds as the shepherd's purse and charlock, which harbour the insect in great numbers, and the removal of any stubble in which it might pass the winter. When a crop is badly attacked dressings of soot and gas-lime mixed with sulphur and lime, or of soot or lime alone, prove efficacious, but these must be applied whilst the dew is on the leaves or the "fly" will escape.

TURNSTONE, the name long given[1] to a shore-bird, from its habit of turning over with its bill such stones as it can to seek its food in the small crustaceans or other animals lurking beneath them. It is the *Tringa interpres*[2] of Linnæus and *Strepsilas interpres* of most later writers, and is remarkable as being perhaps the most cosmopolitan of birds; for, though properly belonging to the northern hemisphere, there is scarcely a sea-coast in the world on which it may not occur: it has been obtained from Spitzbergen to the Strait of Magellan and from Point Barrow to the Cape of Good Hope and New Zealand—examples from the southern hemisphere being, however, almost invariably in a state of plumage that shows, if not immaturity, yet an ineptitude for reproduction. It also, though much less commonly, resorts to the margins of inland rivers and lakes; but it is very rarely seen except in the neighbourhood of water, and salt water for preference.

The Turnstone is about as big as an ordinary Snipe; but, compared with most of its allies of the group *Limicolæ*, to which it belongs, its form is somewhat heavy, and its legs are short. Still it is brisk in its movements, and its variegated plumage makes it a pleasing bird. Seen in front, its white face, striped with black, and broad black gorget attract attention as it sits, often motionless, on the rocks; while in flight the white of the lower part of the back and white band across the wings are no less conspicuous even at a distance. A nearer view will reveal the rich chestnut of the mantle and upper wing-coverts, and the combination of colours thus exhibited suggests the term "tortoise-shell" often applied to it—the quill-feathers being mostly of a dark brown and its lower parts pure white. The deeper tints are, however, peculiar to the nuptial plumage, or are only to be faintly traced at other times, so that in winter the adults—and the young always—have a much plainer appearance, ashy-grey and white being almost the only hues observable. From the fact that Turnstones may be met with at almost any season in various parts of the world,[3] and especially on islands as the Canaries, Azores, and many of those in the British seas, it has been inferred that these birds may breed in such places. In some cases this may prove to be true, but in most evidence to that effect is wanting. In America the breeding-range of this species has not been defined. In Europe there is good reason to suppose that it includes Shetland; but it is on the north-western coast of the continent, from Jutland to the extreme north of Norway, that the greatest number are reared. The nest, contrary to the habits of most *Limicolæ*, is generally placed under a ledge of rock which shelters the bird from observation,[1] and therein are laid four eggs, of a light olive-green, closely blotched with brown, and hardly to be mistaken for those of any other bird. A second species of Turnstone is admitted by some authors and denied by others. This is the *S. melanocephalus* of the Pacific coast of North America, which is said to be on the average larger than *S. interpres*, and it never exhibits any of the chestnut colouring.

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[1] The name seems to appear first in Willughby's *Ornithologia* (p. 231) in 1676; but he gave as an *alias* that of Sea-Dottrel, under which name a drawing, figured by him (pl. 58), was sent to him by Sir Thomas Browne.

[2] Linnæus (*Œl. och Gothländska Resa*, p. 217), who first met with this bird on the island of Gottland, 1st July 1741, was under the mistaken belief that it was there called Tolk (= *interpres*). But that name properly belongs to the REDSHANK (*q.v.*), from the cry of warning to other animals that it utters on the approach of danger.

[3] The authors of *The Water Birds of North America* (i. p. 123) in reference to this fact raise the ingenious question, "Do birds, after they have become old, effete, or barren, prefer to stay in a warm climate!"

Though the genus *Strepsilas* seems to be rightly placed among the *Charadriidæ* (*cf.* PLOVER), it occupies a somewhat abnormal position among them, and in the form of its pointed beak and its variegated coloration has hardly any very near relative. (A. N.)

TURPENTINE consists of the oleo-resins which exude from certain trees, especially from some conifers and from the terebinth tree, *Pistacia Terebinthus*, L. It was to the product of the latter, now known as Chian turpentine, that the term was first applied. The terebinth tree (τέρμινθος of Theophrastus) and its resin (ῥητίνη τερμίνθινη) were well known and highly prized from the earliest times. The tree is a native of the islands and shores of the Mediterranean, passing eastward into Central Asia; but the resinous exudation found in commerce is collected in the island of Scio. Chian turpentine is a tenacious semi-fluid transparent body, yellow to dull brown in colour, with an agreeable resinous odour and little taste. On exposure to the air it becomes dry, hard, and brittle. In their general characters, turpentines are soft solids or semi-fluid bodies, consisting of a mixture of one or more resins with essential oils, which, although differing in physical properties, have a composition corresponding to the formula $C_{10}H_{16}$. They also contain minute quantities of oxygenated oils. Formerly they had considerable reputation in medicine, and they still continue to be employed in plasters and ointments; but their great use is in the arts, for which they are separated by distillation into rosin or colophony (see ROSIN, vol. xx. p. 852) and oil or spirit of turpentine.

Crude or *common turpentine* is the commercial name which embraces the oleo-resin yielded by several coniferous trees, both European and American. The principal European product, sometimes distinguished as Bordeaux turpentine, is obtained from the sea pine, *Pinus maritima*, in the Landes department of France. Crude turpentine is further yielded by the Scotch fir, *P. sylvestris*, throughout northern Europe, and by the Corsican pine, *P. Laricio*, in Austria and Corsica. In the United States the turpentine-yielding pines are the swamp pine, *P. palustris*, and the loblolly, *P. Tæda*, both inhabiting North and South Carolina, Georgia, and Alabama. *Venice turpentine* is yielded by the larch tree, *Larix europæa*, from which it is collected principally in Tyrol. *Strasburg turpentine* is obtained from the bark of the silver fir; but it is collected only in small quantities. Less known turpentines are obtained from the mountain pine, *P. Pumilio*, the stone pine, *P. Cembra*, the Aleppo pine, *P. halepensis*, &c. The so-called *Canada balsam*, from *Abies balsamea* (see BALSAM, vol. iii. p. 293), is also a true turpentine.

Oil of turpentine as a commercial product is obtained from all or any of these oleo-resins, but on a large scale only from crude or common turpentine. The essential oil is rectified by redistillation with water and alkaline carbonates, and the water which the oil carries over with it is removed by a further distillation over calcium chloride. Oil of turpentine is a colourless liquid of oily consistence, with a strong characteristic odour and a hot disagreeable taste. Its boiling point ranges from 152° to 172° C. at ordinary temperature; its sp. gr. is between 0·856 and 0·870; and in optical properties it rotates the plane of polarized light both to right and left in varying degrees according to its sources. It is soluble in alcohol, ether, benzol, other essential oils, and the fixed oils, and itself is a solvent of resins and caoutchouc. On exposure to the air it dries to a solid resin, and when oxidized in the presence of water gives off peroxide of hydrogen—a reaction utilized in the preparation of a disinfectant called "sanitas." Oil of turpentine is largely used in the preparation of varnishes, and as a medium by painters in their "flat" colours.

TURPIN, archbishop of Rheims and the supposititious author of *Historia Karoli Magni et Rotholandi*, is probably to be identified with Tilpin, who was archbishop of Rheims towards the end of the 8th century. This Tilpin is alluded to by Hincmar (845-882), his third successor in the see. According to Flodoard (*ob.* 969), Charles Martel drove Ragobert, bishop of Rheims, from his office, putting in his place a warrior-clerk, Milo. The same writer represents Milo as discharging a mission among the Vascones or Basques, the very people to whom authentic history has ascribed the great Carolingian disaster at Roncesvalles. It is possible that we owe the warlike legends that have accumulated round the name of Turpin to some confusion of his identity with that of his martial predecessor. Flodoard says that Tilpin was originally a monk of St Denis; and we know from Hincmar that, after his appointment to Rheims, he occupied himself in securing the restoration of the metropolitan rights and landed property of his church, whose revenue and prestige had been impaired under Milo's rule. He was, according to the latter authority, elected in the days of Pippin, the son of Charles Martel, *i.e.*, between 752 and 768. He died, if we may trust the evidence of a diploma alluded to by Mabillon, in 794. Hincmar, who composed his epitaph, makes him bishop for forty years and more, from which it is evident that he was elected somewhere about 754. Flodoard, however, states that he died in the forty-seventh year of his bishopric. Tilpin was present at the synod of Rome in 769; and Pope Hadrian, at the request of Charlemagne, sent him a pallium and confirmed the rights of his church (*Gallia Christiana*, ix. 28-30). According to Flodoard, he substituted monks for canons in the monastery of St Remigius; and 17th-century tradition ascribed to him an ancient *pontificale*, still extant in Marlot's days (17th century).

The above is a summary of all that authentic history and trustworthy tradition teach about the author to whom the common voice of the Middle Ages ascribed the *Historia Caroli Magni*. A short account of the work has been given elsewhere (ROLAND, LEGEND OF). But, popular as this production was during the Middle Ages, it was rather the crystallization of earlier Roland legends than the source of later ones. Potthast has enumerated about fifty codices without by any means, according to M. Gaston Paris, exhausting the list. The latter writer has made the *Historia Karoli* the subject of a special study (*De Pseudo-Turpino*, Paris, 1865), which may be recommended as a model of brilliant though cautious scholarship. The great popularity of the pseudo-Turpin seems to date from the latter half of the 12th century; and M. Paris enumerates at least five French translations belonging to the 13th, and one into Latin verse of about the same age. Mr Ward (*Cat. of Romances*, 549) has recently expressed a doubt as to whether the Turpin chronicle was completed at Vienne.

TURQUOISE, a blue or bluish green mineral, valued, when cut and polished, as an ornamental stone. The finest variety occurs in Persia, whence it originally reached western Europe by way of Turkey, and thus came to be called by the Venetians, who imported it, *turchesa*, and by the French *turquoise*. It is chemically a hydrated phosphate of aluminium, associated with a variable proportion of hydrated phosphate of copper, to which it owes much of its colour. The green tints of certain varieties appear to be due to admixture with salts of iron. A fine blue Persian turquoise, analysed by Prof. A. H. Church, yielded—alumina 40·19, phosphorus pentoxide 32·86, water 19·34, cupric oxide 5·27, ferrous oxide 2·21, and manganous oxide 0·36. The most valued tint of the turquoise is a delicate blue, inclining slightly to green; in many specimens the green becomes more pronounced with age. Although the turquoise is practically opaque, sections may be ground so thin as to admit of examination by transmitted light. Its microscopic structure was first studied by Prof. Fischer of Freiburg (Baden), afterwards by H. Bücking of Strasburg, and recently by Clarke and Diller.

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[1] There is little external difference between the sexes, and the brightly-contrasted colours of the hen-bird seem to require some kind of concealment.

Thin sections are almost colourless. Between crossed Nicols they show either a fibrous texture or a finely-granular aggregate of doubly-refracting particles without definite crystalline outlines. The mineral has never been found crystallized, but occurs as veins, nodules, stalactitic masses, and incrustations. Large pieces are exceedingly rare. The specific gravity of turquoise is about 2·75, and its hardness below 6; it takes a fair polish and exhibits a feeble lustre. It is usually cut *en cabochon* or with a low convex surface, and in the East is frequently engraved with Persian and Arabic inscriptions, generally passages from the Koran,—the incised characters being in many cases gilt. Such objects are worn as amulets. The turquoise has always been associated with curious superstitions, the most common being the notion that it changes colour with variations in the state of its owner's health, or even in sympathy with his affections.

Persia is the chief centre of the turquoise trade, where the same mines have been worked for at least eight centuries. The finest stones are found near Nishápúr in Khorásan (see PERSIA, vol. xviii. p. 622). Tavernier, writing in the 17th century, states that the best turquoise, reserved for the sole use of the shah, was obtained from the mine which he describes as the *Vieille Roche*, while inferior stones were got from the *Nouvelle Roche*. These terms still survive, all turquoise of fine colour being said in trade to be from the "old rock," and that which is pale, or changes tint on exposure, is from the "new rock." According to a recent report by Consul Benjamin at Teheran the best turquoise is found at Abú Riáh, and all the Khorásan mines are farmed by a few prominent officials, who pay to the shah an annual rent of about £6500. Dr Tietze has lately described specimens of the matrix of the mineral brought to Vienna from Persia by General Schindler. These show that the turquoise occurs, not in clay-slate, as is often stated, but in a porphyritic trachyte or trachytic breccia, and in loose fragments in the neighbouring alluvium. The mineral is also found in Kerman in southern Persia, but the stone is of pale colour, tending to fade, and the mines which yield it are now nearly abandoned. In 1849 Major C. Macdonald found turquoise in Wady Maghara and Wady Sidreh, near SINAI (*q.v.*), where, according to Mr H. Bauerman, it lines the open joints of a ferruginous sandstone, and is also embedded in small ochreous nodules in the rock itself. The redder the rock the finer the colour of the associated turquoise. As the colour is liable to fade, the Arabian turquoise has not a good name among jewellers, and the workings were abandoned by Macdonald in 1865. In Wady Maghara there are relics of extensive mining operations, presumably for turquoise, of so early a date that the rock was wrought by flint implements. The early inhabitants of Mexico made much use of this mineral for inlaying obsidian ornaments, and for mosaic work with iron-pyrites. It was probably one of the stones known as *chalchihuitl*. In 1858 Prof. W. P. Blake called attention to the occurrence of turquoise at Cerillos, about 22 miles south-west of Santa Fé, in New Mexico, where mining operations for this mineral were carried on two centuries ago. The turquoise varies in colour from sky-blue to apple-green, and is found as nodules and small veins in a felspathic rock of micrograniti̇c texture, probably of eruptive origin. The mines of Cerillos are no longer worked. A similar green mineral is found at Turquoise Mountain in Cochise county and at Mineral Park, Mohave county, Arizona. It also occurs to a small extent in southern Nevada, where it is found as blue grains disseminated through a sandstone. In Europe, the turquoise is found at Oelsnitz in Saxony and near Jordansmühl in Silesia, occurring at the latter locality in clay-slate. Under the names of *callais* and *callaina* Pliny described a green mineral which, if not our turquoise, seems to have been very closely related to it. A bright green mineral, wrought into beads, and found with stone hatchets in ancient graves at Men-er Hroeck (Rock of the Fairy) in Brittany, was described in 1864 by M. Damour, who, seeking to identify it with Pliny's *callais*, revived this name. Dana afterwards brought the word into harmony with our mineralogical nomenclature by writing it callainite. The mineral in question is a hydrated phosphate of aluminium, apparently identical with Breithaupt's variscite. By many mineralogists the true torquoise is called calaite (see vol. xvi. p. 405).

Turquoise is commonly imitated by enamels, but of late some ingenious counterfeits have been made with the same chemical composition as the natural stone. To increase the deception, pieces of ochreous matter are inserted at the back of the artificial turquoise, to imitate the natural matrix. In order to distinguish between the genuine stone and its imitations, Pohl recommends that a splinter should be strongly heated in a platinum capsule, when the true turquoise is reduced to a brownish black powder or a friable mass with a decrepitating sound; the false turquoise does not decrepitate, but either fuses to a glass or is reduced to a frit.

For recent information on the turquoise, see "Das Vorkommen der Türkise bei Nischapur in Persien," by Dr E. Tietze, in *Verhandl. d. k. k. geolog. Reichsanstalt*, No. 6, 1884, p. 93; "Mikroskopische Untersuchung des Türkis," by H. Bücking, in *Zeitsch. f. Krystallog.*, vol. ii., 1878, p. 163; "Eine einfache und sichere Unterscheidungsweise der echten Türkise von deren Nachahmungen," in *N. Jahrb. f. Mineralogie*, 1878, p. 364; "Turquois from New Mexico," by F. W. Clarke and J. S. Diller, in *Americ. Journ. Science*, Sept. 1886, p. 211; "Revision of Mineral Phosphates, No. iv., Calaite," by A. H. Church, in *Chem. News*, x. p. 290; and note in *Journ. Soc. Arts*, xxxii., 1884, p. 1084.

TURRETIN, or TURRETINI. Three theologians of this name figure in the history of Genevan theology.

1. BENOIT TURRETIN (1588-1631), the son of Francesco Turretini, a native of Lucca, who settled in Geneva in 1579, was born in that town on 9th November 1588. He was ordained a pastor in Geneva in 1612, and became professor of theology in 1618. In 1620 he represented the Genevan Church at the national synod of Alais, when the decrees of the synod of Dort were introduced into France; and in 1621 he was sent on a successful mission to the states general of Holland, and to the authorities of the Hanseatic towns, with reference to the defence of Geneva against the threatened attacks of the duke of Savoy. He published in 1618-20 a defence of the Genevan translation of the Bible. Benoit Turretin died at Geneva on 4th March 1631.

2. FRANÇOIS TURRETIN (1623-87), son of the preceding, was born at Geneva on 17th October 1623. After studying theology in Geneva, Holland, and France, he became a pastor in Geneva in 1647, after a brief pastorate at Leyden, he again returned to Geneva as professor of theology in 1653. He was one of the most influential supporters of the *Formula Consensus Helvetica*, drawn up chiefly by Heidegger, in 1675, and of the particular type of Calvinistic theology which that symbol embodied. His *Institutio Theologiæ Elencticæ* (3 vols. 4to, Geneva, 1680-83) has passed through frequent editions, the last reprint having been made in Edinburgh in 1847. F. Turretin died at Geneva on 28th September 1687. He was also the author of volumes entitled *De Satisfactione Christi Disputationes* (Geneva, 1666) and *De Necessaria Secessione Nostra ab Ecclesia Romana* (Geneva, 1687).

3. JEAN ALPHONSE TURRETIN (1671-1737), son of the preceding, was born at Geneva on 13th August 1671. He was educated at Geneva and in Holland, and after travelling in England and in France was received into the "Vénérable Compagnie des Pasteurs" of Geneva in 1693. In 1697 he became professor of church history. During the next forty years of his life he enjoyed great influence in Geneva as the advocate of a more liberal theology than had prevailed under the preceding generation, and it was largely through his instrumentality that the use of the *Formula Consensus Helvetica* as a symbol was discontinued in 1725. He also wrote and laboured for the promotion of union between the Reformed and Lutheran Churches, his most important work in this connexion being *Nubes Testium pro Moderato et Pacifico de Rebus Theologicis Judicio, et Instituenda inter Protestantes Concordia* (Geneva, 1719). Besides this he wrote *Cogitationes et Dissertationes Theologicæ*, on the principles of natural and revealed religion (Geneva, 1737); and commentaries on Thessalonians and Romans were published posthumously. He died at Geneva on 1st May 1737.

TURTLE. See TORTOISE.

TUSCANY (Ital. *Toscana*), one of the sixteen compartimenti of the kingdom of Italy, contains eight provinces—Arezzo, Florence, Grosseto, Leghorn, Lucca, Massa-Carrara, Pisa, and Siena—and has an area of 9287 square miles, with a population of 2,208,869 in 1881. In 1859, immediately before it united with the kingdom of Sardinia, the grand-duchy of Tuscany, exclusive of Massa-Carrara, which then belonged to Modena, but including the islands of Gorgona, Elba, Pianosa, Formica, Montecristo, Giglio, and Giannutri, as well as the duchy of Lucca (united to it in 1847), had an area of 8625 square miles and a population of 1,806,940. See Italy, vol. xiii. pp. 489-490.

Etruria (*q.v.*) was finally annexed to Rome in 351 B.C. (see Rome), and constituted the seventh of the eleven regions into which Italy was, for administrative purposes, divided by Augustus. Under Constantine it was united into one province with Umbria, an arrangement which subsisted until at least 400, as the *Notitia* speaks of a "consularis Tusciæ et Umbriæ." In Ammianus Marcellinus there is implied a distinction between "Tuscia suburbicaria" and "Tuscia annonaria," the latter being that portion which lies to the north of the Arno. After the fall of the Western empire Tuscia, with other provinces of Italy, came successively under the sway of Herulians, Ostrogoths, and Greek and Lombard dukes. Under the last-named, "Tuscia Langobardorum," comprising the districts of Viterbo, Corneto, and Bolsena, was distinguished from "Tuscia Regni," which lay more to the north. Under Charlemagne the name of Tuscia or Toscana became restricted to the latter only. One of the earliest of the Frankish marquises was Boniface, either first or second of that name, who about 828 fought with success against the Saracens in Africa. Adalbert I., who succeeded him, in 878 espoused the cause of Carloman as against his brother Louis III. of France, and suffered excommunication and imprisonment in consequence. Adalbert II. (the Rich), who married the ambitious Bertha, daughter of Lothair, king of Lorraine, took a prominent part in the politics of his day. A subsequent marquis, Hugo (the Great), became also duke of Spoleto in 989. The male line of marquises ended with Boniface II. (or III.), who was murdered in 1052. His widow, Beatrice, in 1055 married Godfrey, duke of Lorraine, and governed the country till her death in 1076, when she was succeeded by Matilda (*q.v.*), her only child by her first husband. Matilda died in 1114 without issue, bequeathing all her extensive possessions to the church. The consequent struggle between the popes, who claimed the inheritance, and the emperors, who maintained that the countess had no right to dispose of imperial fiefs, enabled the principal cities of Tuscany gradually to assert their independence and govern themselves under consuls and elders of their own selection. The most important of these Tuscan republics or self-governed communes were Florence, Pisa, Siena, Arezzo, Pistoia, and Lucca. Some account of the manner in which they were all gradually absorbed by Florence will be found under Florence and Medici. The title of grand-duke of Tuscany was conferred on Cosmo de' Medici by Pius V. in 1567, and the emperor (Maximilian II.), after withholding his consent for some years, ultimately confirmed it to Cosmo's successor in 1576. In 1735, in view of the childlessness of Giovan Gastone, the last of the Medici, the succession of Francis, duke of Lorraine, afterwards emperor Francis I., was arranged for by treaty. In 1765 he was succeeded as grand-duke by his second son Leopold (see Leopold II.), who, on becoming emperor in 1790, handed Tuscany over to his second son Ferdinand, third grand-duke of the name. The duchy was occupied by the French in 1799, ceded to Louis, prince of Parma, by the convention of Madrid in 1801, and annexed to the French empire in 1808. Ferdinand, however, was reinstated in 1814, and on his death in 1824 was succeeded by his son Leopold, second grand-duke of the name, who was deposed by the constituent assembly on 16th August 1860. See Italy.

TUSCULUM, an ancient Latin city, situated in a commanding position on one of the eastern ridges of the Alban Hills, near the site of the modern Frascati (*q.v.*). It has a very beautiful and extensive view of the Campagna, with Rome lying fifteen miles[1] distant to the north-west, on the west the sea near Ostia, and the long range of the Sabine Hills on the north-east. According to tradition, the city was founded by Telegonus, the son of Ulysses and Circe; hence Horace (*Epod.*, i. 30) speaks of it as "Circæa mœnia" and Ovid (*Fast.*, iii. 91) as "Telegoni mœnia" (see also Prop., iii. 30, 4, and Sil. Ital., xii. 535). The legendary descent of one of the chief Tusculan families, the gens Mamilia, from Ulysses through Telegonus is commemorated on some denarii struck by the Mamilian gens in the later years of the Roman republic; these have on the reverse a figure of Ulysses recognized by his dog Argo. When Tarquinius Superbus was expelled from Rome his cause was espoused by the chief of Tusculum, Octavius Mamilius, who took a leading part in the formation of the Latin League, composed of the thirty principal cities of Latium, banded together against Rome. Mamilius commanded the Latin army at the battle of Lake Regillus, a piece of water which then lay immediately below the Colles Tusculani, but is now dried up. At this battle (497 B.C.) Mamilius was killed, and the predominance of Rome among the Latin cities was practically established. From that time Tusculum became an ally of Rome, and on that account frequently incurred the hostility of the other Latin cities. In 378 B.C., after an expression of complete submission to Rome, the people of Tusculum received the Roman franchise, and thenceforth the city continued to hold the rank of a *municipium*. Several of the chief Roman families were of Tusculan origin, *e.g.*, the gentes Mamilia, Fulvia, Fonteia, Juventia, and Porcia; to the last-named the celebrated Catos belonged. During the imperial period little is recorded about Tusculum; but soon after the transference of the seat of empire to Constantinople it became a very important stronghold, and for some centuries its counts occupied a leading position in Rome and were specially influential in the selection of the popes. During the 12th century there were constant struggles between Rome and Tusculum, and towards the close of the century the Romans, supported by the German emperor, gained the upper hand, and the walls of Tusculum, together with the greater part of the city, were destroyed.

Extensive remains still exist of the massive walls, which surrounded the city, and of its arx—a separate citadel—which stood on an abrupt rock, approached only on one side, that towards the city, with which it was connected by long walls. The walls are built of large blocks of the native "lapis Albanus" or peperino, some of them as much as 5 feet long by 3 feet thick. They probably belong to the early republican period; restorations in concrete faced with "opus reticulatum" of the 1st century B.C. can be traced in many places.

During the latter years of the republic and under the empire Tusculum was a favourite site for the country villas of wealthy Romans. That of Lucullus was very large and magnificent; other handsome houses were built there by Julius Cæsar, L. Crassus, Q. Metellus, Marcus Brutus, and others. A palace was erected by Tiberius near Tusculum on the way to Rome, close to the Via Latina.

The most interesting associations of the city are those connected with Cicero, whose favourite residence and retreat for study and literary work was at Tusculum. It was here that he composed his celebrated *Tusculan Disputations* and other philosophical works. Much has been written on the position of his villa, but its true site still remains doubtful. Its grounds are known to have adjoined the more splendid villas of Lucullus and the consul Gabinius (see Cic., *De Fin.*, iii. 2, and *Pro Dom.*, 24). The most probable site is that now marked by the Villa Rufinella to the west of Tusculum, where the hill is divided into two ridges. The scholiast on Horace, *Epod.*, i. 30, states that Cicero's villa was "ad latera superiora," the plural probably being used in allusion to the double ridge. The other theory, which places the site at Grotta Ferrata, some distance farther to the west, has little evidence to support it. Although Cicero (*Pro Sestio*, 43) speaks of his own house as being insignificant in size compared to that of his neighbour Gabinius, yet we gather from other notices in various parts of his works that it was a building of no mean size and pretension. It comprised two gymnasia (*Div.*, i. 5), with covered *porticus* for exercise and philosophical discussion (*Tusc. Disp.*, ii. 3). One of these, which stood on higher ground, was called "the Lyceum," and contained a library (*Div.*, ii. 3); the other, on a lower site, shaded by rows of trees, was called "the Academy." The main building contained a covered *porticus* or cloister, with apsidal recesses (*exedræ*) containing seats (see *Ad Fam.*, vii. 23). It also had bath-rooms (*Ad Fam.*, xiv. 20), and contained a number of works of art, both pictures and statues in bronze and marble (*Ep. ad Att.*, i. 1, 8, 9, 10). The central atrium appears to have been small, as Cicero speaks of it as an *atriolum* (*Ad Quint. Fr.*, iii. 1). The cost of this and the other house which he built at Pompeii led to his being burdened with debt (*Ep. ad Att.*, ii. 1). Nothing now exists which can be asserted to be part of Cicero's villa with any degree of certainty. The so-called "scuola di Cicerone," near the line of the ancient wall of Tusculum, is the substructure of some building formed in the usual Roman way by a series of vaulted chambers, and is clearly later in date than the time of Cicero. Other remains of houses exist in and near the city, but nothing is known as to their history or ownership.

Ruins of two theatres still exist. One of them, which is not earlier than the beginning of the 1st century, between the city and the arx, is fairly perfect, and still possesses most of its ancient seats, divided into four *cunei* by three flights of steps. Only traces remain of the other theatre, which abutted against the long walls that defended the road from the city to the arx. Remains of an amphitheatre of no great size can be traced, dating probably from the 3d century. There is also a large *piscina*, near the first-mentioned theatre. In the vicinity of Tusculum a number of interesting tombs have been discovered at various times; some, as for example that of the Furii, contained valuable inscriptions of the 4th and 3d centuries B.C.

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[1] Dionysius (x. 20) states that Tusculum was only 100 stadia (about 12½ miles) from Rome; but the fifteenth milestone on the Via Latina was close to the walls of Tusculum.

The city was supplied with water by the Aqua Crabra, and near it were the springs which fed two of the Roman aqueducts—the Aqua Tepula and Aqua Virgo (Front., *De Aq.*, 8).

For further information the reader is referred to Compagni, *Memorie Storiche dell' Antico Tusculo*; Canina, *Descr. dell' Antico Tusculo*; Gell, *Topogr. of Rome and its Vicinity*; and Nibby, *Dintorni di Roma*, vol. iii.

TUSSER, THOMAS (*c.* 1527-1580), poet, was the son of William Tusser by Isabella, daughter of Thomas Smith of Rivenhall, Essex, where he was born about 1527. Notwithstanding strong reluctance on his part he was sent in his early years to a music school, and became chorister in the collegiate chapel of the castle of Wallingford. He was afterwards admitted into the choir of St Paul's, and went thence to Eton, where he was under the tuition of Nicholas Udall. In 1543 he was elected to King's College, Cambridge, and soon afterwards exchanged to Trinity Hall. On leaving the university he was for about ten years at court, probably in some musical capacity. He then settled as a farmer in Suffolk, near the river Stour, an employment which he seems to have regarded as combining the chief essentials of human felicity. Subsequently he lived successively at Ipswich, West Dereham, Norwich, and London. There he died in April 1580, and was buried in the church of St Mildred in the Poultry. His monument was destroyed in the fire, but the quaint epitaph is preserved in Stow's *Survey of London*. A marble tablet, on which the epitaph is inscribed, has been erected to him in the church of Manningtree, Essex.

Tusser's poems on husbandry have the charm of simplicity and directness, and their practical saws were apparently relished, for in his lifetime they went through a number of editions. They are *A Hundreth Good Pointes of Husbandrie*, 1557, 1561, 1562, 1564, and 1570; *A Dialogue Wyuynge and Thryuynge*, 1562; *A Hundrethe Good Pointes of Husbandrie lately married unto a Hundrethe Good Pointes of Huswifry*, 1570; *Five Hundreth Pointes of Good Husbandrie united to as many of Good Wiferie*, 1573, 1576, 1577, 1585, 1586, 1590, 1593, reprinted with memoir by William Mavor, 1812, by Auber, 1873, and by the English Dialect Society, 1879. His metrical autobiography, printed in the Appendix to *Five Hundreth Pointes*, 1573, was republished in 1846 along with his will, which would seem to refute the sarcasms which became current, that he had not been successful in practising his own maxims. One of these references is contained in a volume of epigrams by H. P., *The More the Merrier*, 1608. One of the epigrams entitled *Ad Tusserum*, begins thus:—

> "Tusser, they tell me, when thou wert alive,
> Thou, teaching thrift, thyselfe could'st never thrive."

Possibly Tusser obtained the reputation of being poor from his practice of thrift; but in any case, if his will represents his worldly condition at the time of his death, he was not in poverty in his later years.

TVER, a government of central Russia, on the upper Volga, bounded by Pskoff and Novgorod on the W. and N., Yaroslavl and Vladimir on the E., and Moscow and Smolensk on the S.; it has an area of 25,225 square miles. Lying on the southern slope of the Valdai plateau, and intersected by deep valleys, it has the aspect of a hilly region, but is in reality a plateau ranging from 800 to 1000 feet in height. Its highest parts are in the north-west, where the Volga, Western Dwina, and Msta rise in marshes and lakes. The plateau is chiefly built up of Carboniferous limestones, Lower and Upper, underlain by Devonian and Silurian deposits, which appear only in the denudations of the lower valleys. The whole is covered by a thick sheet of boulder-clay (the bottom-moraine of the Scandinavo-Russian ice-sheet) and subsequent lacustrine deposits. A number of åsar (see vol. x. p. 368) occur on the slopes of the plateau. Ochre, brick, and pottery clays, as also limestone for building, are obtained, and there are chalybeate springs. The soil, which is clayey for the most part, is not fertile as a rule.

Nearly the whole of Tver is watered by the upper Volga (350 miles) and its tributaries, several of which (Vazuza, Dubua, Sestra, Tvertsa, and the tributaries of the Mologa) are navigable. The Vyshnevolotsk system of canals connects the Volga (navigable some 60 miles from its source) with the Baltic, and the Tikhvin system connects the Mologa with Lake Ladoga. The Msta, which flows into Lake Ilmeñ, and its tributary the Tsna, water Tver in the north-west, and the Western Dwina rises in Ostashkoff. This network of rivers highly favours navigation: as many as 3000 boats yearly pass through the Vyshnevolotsk system, and corn, linseed, spirits, flax, hemp, timber, metals, and manufactured ware to the annual value of £1,500,000 are shipped from, or brought to, the river ports of the government. Lakes, ponds, and marshes are numerous in the west and north-west, Lake Seliger—the source of the Volga—and Lake Mstino being the most important. The forests—coniferous in the north and deciduous in the south—are rapidly disappearing, but still cover 890,000 acres. The climate is continental; the average yearly temperature at Tver (41°·5 Fahr.) is the same as that of Orel and Tamboff (January 11°, July 67°). The population (1,646,683 in 1883, as against 1,567,300 in 1872) is unequally distributed, and in the districts of Kalyazin and Kashin attains a density not much less than that of the more highly favoured black-earth provinces of south east Russia (16 and 17 per square mile). Apart from some 100,000 Karelians and a few Poles and foreigners, the people are all Great Russians. Some traces of Finnish Ves and of Lithuanians are found in the north-east and south. The official returns give the number of Raskolniks as 25,000. Only 157,110 are urban; but agriculture is not the chief occupation. While barley and oats are exported, rye is imported. The crops for 1883-1885 averaged 2,889,400 quarters of corn and 4,078,400 bushels of potatoes. Cattle-rearing does not prosper, and the increase shown by the returns for 1883 (351,630 horses, 583,670 cattle, and 373,780 sheep) as against those of 1872 is simply due to better registration. Cheese-making has recently been introduced on the co-operative principle (2168 cwts. of cheddar exported to Britain in 1881). The fisheries in the lakes and rivers are productive. The peasants are principally engaged in various manufactures. The total production of the larger manufactures in 1883 was valued at £2,237,250 (tanneries £244,460, cottons £803,270, distilleries £320,010, flour-mills £263,500), and that of the petty trades carried on in combination with agriculture (preparation of pitch, tar, and turpentine, boat-building, construction of cars, sledges, wheels, boxes, tubes, and wooden vessels, and cabinet-making) was estimated in 1884 at £3,000,000, giving occupation to 101,400 persons. Certain branches of the leather industry are important, Kimry and Ostashkoff sending to the market £650,000 worth of boots annually. The small workshops of Tver and the surrounding district work some 4500 cwts. of iron into nails every year, and the Ostashkoff smiths use some 7000 cwts. of iron annually in the manufacture of hatchets, scythes, sickles, and different agricultural implements. Weaving, lace-making, leather embroidery, stocking-making, felting, and the like are also important petty trades, several of these being organized on co-operative principles by the *zemstvos*. The railway from St Petersburg to Moscow crosses Tver, and sends off two branches to Rzheff and to Rybinsk, all three lines being among the busiest in Russia. The river traffic also is considerable. The chief centres of trade, besides the city of Tver, are Byezhetsk, Rzheff, Kashin, Ostashkoff, Torshok, Krasnyi Kholm, and Vesiegonsk during its fair. The provincial assembly of Tver is one of the most prominent in Russia for its efforts in the cause of education and sanitary improvement. In 1883 there were 997 primary schools with 47,680 scholars (8500 girls), 17 gymnasia and progymnasia (1697 boys and 1263 girls), and two normal schools for teachers. The government is divided into twelve districts, the chief towns of which, with their populations in 1884, are—TVER (see below), Byezhetsk (5890), Kalyazin (5200), Kashin (5730), Kortcheva (2275), Ostashkoff (9900), Rzheff (26,480), Staritsa (2700), Torshok (12,910), Vesiegonsk (3370), Vyshniy Volotchok (11,590), and Zubtsoff (3160).

TVER, capital of the above government, lies 102 miles by rail to the north-west of Moscow, on both banks of the Volga (here crossed by a floating bridge) at its junction with the Tvertsa. The low right bank is protected from inundations by a dam. As a whole the town is but poorly built. The oldest church dates from 1564, and the cathedral from 1689. An imperial palace, the courts, and the post-office rank among its best buildings. A public garden occupies the site of the former fortress. The population was 39,100 in 1884. The manufactures, chiefly of cotton, employ 5900 workmen (5710 at the cotton mills), and a number of nail-making workshops employ some 800 men, while more than 1000 women are engaged in the domestic manufactory of hosiery for export to Moscow and St Petersburg. The traffic of the town is considerable, Tver being an intermediate place for the trade of both capitals with the provinces of the upper Volga.

Tver dates its origin from 1180, when a fort was erected at the mouth of the Tvertsa to protect the Suzdal principality against Novgorod. In the 13th century it became the capital of an independent principality, and remained so until the end of the 15th century. Mikhail Yaroslavovitch, prince of Tver, was killed fighting against the Tatars, as also was Alexander Mikhailovitch, who boldly fought for the independence of Tver against Moscow. It long remained an open question whether Moscow or Tver would ultimately gain the supremacy in Great Russia, and it was only with the help of the Tatars that the princes of the former eventually succeeded in breaking down the independence of Tver. In 1486, when the city was almost entirely burned down by the Muscovites, the son of Ivan III. became prince of Tver; the final annexation to Moscow followed four years later. In 1570 Tver had to endure, for some reason now difficult to understand, the vengeance of Ivan the Terrible, who ordered the massacre of 90,000 inhabitants of the principality. In 1609-12 it was plundered both by the followers of the second false Demetrius and by the Poles.

TWEED, a river in the south of Scotland, has its rise in the south-west corner of Peeblesshire, not far from the Devil's Beef Tub in Dumfriesshire. The stream flowing from Tweed's Well, about 1500 feet above sea-level, is generally regarded as its source, although the honour is also claimed for other streams issuing from a higher elevation. For the first 36 miles of its course it intersects the county of Peebles—frequently on this account called Tweeddale—in a north-easterly direction, passing between verdant hills separated by valleys watered by its numerous affluents. Having passed several picturesque keeps and castles, it reaches the town of Peebles, shortly before which it receives the Lyne Water from the north and the Manor Water from the south. The valley now widens; the scenery becomes softer and richer; and the river, bending in a more easterly direction, passes Innerleithen, where it receives the Leithen from the north and the Quair from the south. It then crosses Selkirkshire in a south-easterly direction, and, having received the Ettrick from the south on the borders of Roxburghshire, flows northward past Abbotsford, forming for about 2 miles the boundary between the counties of Selkirk and Roxburgh. After receiving the Gala, the Tweed crosses the north-western corner of Roxburghshire past Melrose and its abbey, and, after being joined by the Leader from the north, winds past Dryburgh abbey round the south-western corner of Berwickshire. The remainder of its course is in a north-easterly direction through Roxburghshire past Kelso, where it receives the Teviot from the south, and then between the counties of Berwick and Northumberland, past Coldstream and Norham castle to the town of Berwick, where it reaches the North Sea. It receives the Eden Water from the north at Edenmouth, the Leet Water from the north at Coldstream, and the Till from Northumberland between Coldstream and Norham castle. The last 2 miles of its course before reaching Berwick are in England. Though the latter part of its course is through a comparatively level country, the scenery along the river is full of charm, owing to the picturesque variety of its finely wooded banks. The associations connected with the keeps and castles of the Tweed have supplied materials for several of Sir Walter Scott's poems and romances; and its varied beauties have been sung by Hogg, Leyden, Thomson, and many others. The bed of the river is pebbly and sandy, and, notwithstanding discolorations from manufactures, the stream, from its clear and sparkling appearance, is still well entitled to the name of the "silver Tweed." The total area drained by it is about 1870 square miles, and its total length is 97 miles. Next to the Tay it is the largest river in Scotland. The Tweed has, however, no estuary, and its traffic is chiefly confined to Berwick. But for a short distance up the river some navigation is carried on by barges. The river is one of the best in Scotland for trout and salmon fishing.

See Sir Thomas Dick Lauder's *Scottish Rivers* and Prof. Veitch's *River Tweed*, 1884.

TWEEDS. See Woollen and Worsted Manufactures.

TWELVE TABLES. See Roman Law, vol. xx. p. 679 *sq.*, and Rome, vol. xx. p. 737.

TWENTY-FOUR PARGANAS, the metropolitan district of the lieutenant-governorship of Bengal, India, takes its name from the territory originally ceded to the East India Company, which contained twenty-four parganas or sub-districts. The district lies between 21° 55′ 20″ and 22° 57′ 32″ N. lat. and 88° 6′ 45″ and 88° 20′ 51″ E. long. It has an area of 2124 square miles, and is bounded on the north by Nadiyá, on the north-east by Jessore, on the south and south-east by the Sundarbans, and on the west by the river Húglí (Hooghly). The country consists for the most part of a vast alluvial plain within the delta of the Ganges, and is everywhere watered by numerous rivers, all branches of the Húglí. In the northern portion the soil is very rich, but the southern or seaboard part consists of the network of swamps and inland channels known as the Sundarbans. The Húglí and six other streams are navigable by the largest boats throughout the year. The district is well supplied with canals, the most important being Tolly's Nala (10 miles long), which connects the Húglí with the Bidyádhári. The Twenty-Four Parganás was once famous for its sport, but owing to the extension of cultivation game is now scarce. Tigers are seldom met with; leopards are more numerous; there are several varieties of deer. The district has many roads, and is traversed by the Eastern Bengal Railway and the Calcutta and South-Eastern State Railway.

In 1881 the population of the district, exclusive of Calcutta, numbered 1,869,859 (males 975,430, females 894,429), embracing 1,153,040 Hindus, 701,306 Mohammedans, and 13,976 Christians. The ten following municipalities had each a population of upwards of 10,000—South Suburban, 51,658; Agarpara, 30,317; Barangar, 29,982; Naihati, 21,533; Nawabganj, 17,702; Basurhat, 14,843; South Dum Dum, 14,108; Baduria, 12,981; Rajpore, 10,576; and Barasat, 10,533. The administrative headquarters of the district are at Alipur, a southern suburb of Calcutta. Rice forms the staple crop of the district; other crops are pulses, oil seeds, sugar-cane, tobacco, &c. Its principal exports are rice, sugar, *pán* leaf, fish, pottery, &c.; the imports comprise pulses of all kinds, oil-seeds, spices, turmeric, chillies, cloth, cotton, &c. The objects of the rural manufactures are sugar, cotton curtains, brass and iron work, horn sticks, and cotton and *tasar* silk cloth. The gross revenue of the district in 1885-86 amounted to £338,895, of which the land-tax contributed £155,181. The district was ceded to the East India Company by treaty by the nawáb názim of Bengal in 1757. Since then several changes have been made in its boundaries, the latest in 1863.

TWICKENHAM, a town of Middlesex, England, is situated on the north bank of the Thames and on the London and South-Western Railway, 11¼ miles south-west of London by rail. It is a straggling and irregular town, but has many fine suburban villas, and the district is noted for its sylvan beauty. Opposite the town there is an eyot in the river about 8 acres in extent, called Eel Pie Island, much resorted to by boating parties. The parish church of St Mary was rebuilt in red brick in very plain style after the fall of the old one in 1713, but the picturesque western tower of the 14th century still remains. It contains many interesting monuments, including one to Pope, who was buried in the nave. The principal public buildings are the town-hall and assembly rooms (built in 1876, and containing the free library established in 1882), the economic museum, the royal naval female school for the daughters of naval and marine officers, the Montpellier lecture hall, the metropolitan and City of London police orphanage, the almshouses of the London Carpenters' Company, and a branch of the national refuge for the homeless and destitute. The population of the urban sanitary district (area 2415 acres) in 1871 was 10,533, and in 1881 it was 12,479.

Twickenham at Domesday was included in Isleworth. Anciently it was called Twittenham or Twicanham. The manor was given in 941 by King Edmund to the monks of Christ Church, Canterbury, from whom it had been previously taken, but it was again alienated, for it was restored to the same monks by Edred in 948. In the reign of Henry VIII. it came into the possession of the crown, and by Charles I. was assigned to Henrietta Maria as part of her jointure. It was sold during the Protectorate, but after the Restoration the queen mother resumed possession of it. In 1670 it was settled for life on Catherine of Braganza, queen of Charles II. It still remains in possession of the crown, but since the death of Catherine has been let on leases. In the neighbourhood are many residences of literary or historical interest. Pope's villa, where he lived from 1717 till his death in 1744, has been removed. Among old mansions of interest still remaining are Strawberry Hill, the residence of Horace Walpole, now much altered; Marble Hill, built by George III. for the countess of Suffolk, and subsequently resided in by the marquis of Wellesley; Orleans House, built in the reign of Queen Anne by Johnstone, occupied for some time by the duke of Orleans, and from 1879 to 1883 as a club house; York House, said to have been the residence of James II. when duke of York, bestowed by Charles II. on Lord Clarendon when he married the duke of York's daughter, and in modern times resided in by the Comte de Paris; and Twickenham House, formerly the residence of Sir John Hawkins, author of the *History of Music*, and the meeting place of the "Literary Club." Of the old manor house of Twickenham, to which Catherine of Aragon is said to have retired after her divorce from Henry VIII., and which was subsequently the residence of Catherine of Braganza, queen of Charles II., the only remains are a ruin called the Aragon tower. Twickenham Park House, for some time the residence of Lord Chancellor Bacon, has been demolished.

TWILIGHT. The light of what is called the "sky" depends upon the scattering or reflexion of direct sunlight in the earth's atmosphere, mainly if not entirely due to those fine dust particles which (as we have recently learned) form the necessary nuclei for condensation of aqueous vapour. Were it not for these particles the sky would appear by day as it does in a clear winter night, and the stars would be always visible. Alpine climbers and aeronauts, when they have left the grosser strata of the atmosphere below them, find this state of things approximated to; and even at the sea-level the blue of the sky is darker when the air contains but few motes. After the sun has set, its rays continue for a time to pass through parts of the atmosphere above the spectator's horizon, and the scattered light from these is called twilight. It is, of course, most brilliant in the quarter where the sun has set. Before sunrise we have essentially the same phenomenon, but it goes by the name of "dawn." The brilliancy of either depends upon several conditions, of which the chief is, of course, the degree by which the sun has sunk below the horizon. But the amount of dust in the air affects the phenomenon in two antagonistic ways: it diminishes the amount of sunlight which reaches the upper air after passing close to the earth and it increases the fraction of this light which is scattered to form twilight. Hence no general law can be laid down as to the duration of twilight; but it is usual to state (roughly) that it lasts until the sun is about 18° under the horizon. If we make this assumption, it is a simple matter of calculation to solve questions as to the duration of twilight at a given place at a given time of year, the maximum duration of twilight at a given place, &c. In the older works on astronomy such questions were common enough, but they have now little beyond antiquarian interest. The more complex phenomena of twilight, such as the "after-glow," &c., probably depend upon the precipitation of moisture on the dust particles as the air becomes gradually colder. This will of course alter the amount of scattering; but it may also lead (by reflexion from strata of such particles) to an increase in the amount of light to be scattered.

TYCHO BRAHE. See Brahe.

TYLDESLEY WITH SHAKERLEY, a town of Lancashire, England, is situated on a considerable eminence, 11 miles west-north-west of Manchester and 199 north-west of London (by the London and North-Western Railway). The church of St George, a handsome building in the Early Pointed style, erected in 1827, has lately undergone restoration. Public baths were built in 1876. A public cemetery was formed in 1878. The town is the growth of the 19th century and depends upon its cotton-mills and the large collieries in the neighbourhood. It is governed by a local board of health of sixteen members. The population of the urban sanitary district (area 2490 acres) in 1871 was 6408 and in 1881 it was 9954.

At Domesday Tyldesley formed part of the manor of Warrington. One of its proprietors, Sir Thomas Tyldesley, was a distinguished Royalist. His son Edward in 1672 sold the manor to Ralph Astley, and from the Astleys it passed in 1728 to Thomas Johnson of Bolton. In 1823 it became the property of George Ormerod, author of the *History of Cheshire*.

TYLER, John (1790-1862), tenth president of the United States, was accustomed with pride, but with the support of conjecture rather than evidence, to claim relationship with Wat Tyler of the reign of Richard II. The earliest of his American ancestors was Henry Tyler, a reputed native of Shropshire, England, who in 1652 settled at Middle Plantation, Va., on the outskirts of what is now the city of Williamsburg. John Tyler was the son of Judge John Tyler, some time governor of Virginia, and was born at Greenway in that State, 29th March 1790. In 1802 he entered the grammar school of William and Mary, where, though fond of fun and frolic and cultivating an inherited taste for the violin, he made good progress in his studies. After graduating in 1806 he entered on the study of law, and in 1809 was called to the bar, where his progress from the first was rapid. He became a member of the State legislature in December 1811. In 1813 he raised a company in defence of Richmond, in command of which he subsequently served with the fifty-second regiment at Williamsburg and Providence Forge. In December 1816 he was elected to the house of representatives at Washington, where he displayed much readiness and skill in debate as an uncompromising advocate of popular rights. In 1825 he was elected governor of Virginia by a large majority, and the following year was re-elected unanimously. In 1827 he was chosen a senator. He opposed Clay on the tariff question in 1832, delivering a speech against the protective duties which lasted three days; but he voted for Clay's Compromise Bill of 1833. He was the only senator who voted against the Force Bill on 20th February of this year, a singularity of conduct which somewhat damaged his reputation in Virginia. Although opposed to the establishment of the United States Bank, he supported the resolutions in 1835 censuring President Jackson for the removal of the deposits, on the ground that the procedure was unconstitutional. In consequence of a vote of the Virginia legislature instructing him to vote for the expurgation of these resolutions from the senate journal he resigned, 21st February 1836. His action led the Whigs to bring him forward as a candidate for the vice-presidency, but he only received forty-seven votes. For some time after this he ceased to take an active part in politics; removing in the end of the year from Gloucester to Williamsburg, where he had better opportunities for legal practice, he devoted his chief attention to his professional duties. At the Whig convention which met at Harrisburg, Pennsylvania, 4th December 1839, he was nominated again for the vice-presidency on the Harrison ticket, and elected in November 1840. On the death of Harrison, soon after his inauguration in 1841, Tyler succeeded him. His elovation to the presidency was thus accidental in a double sense, for he had been nominated for the vice-presidency to reconcile the extreme faction. His policy in office (see UNITED STATES) was opposed to the party who nominated him and was on Democratic lines. In 1845 he was succeeded by Polk, and he spent the remainder of his life in retirement from active duties. He was nominated in 1861 for the lower house of the permanent congress, but died at Richmond on the 18th of the following January.

See L. G. Tyler, *Life and Times of the Tylers*, 2 vols., 1884.

TYNDALE, WILLIAM (*c.* 1484-1536), translator of the New Testament and Pentateuch (see ENGLISH BIBLE, vol. viii. pp. 384, 385), was born in Gloucestershire, possibly in the parish of Slimbridge, about the year 1484. Of his early education nothing is known; about his twentieth year he went to Oxford, where tradition has it that he was entered of Magdalen Hall. He afterwards resided at Cambridge. Ordained to the priesthood, probably towards the close of 1521, he entered the household of Sir John Walsh, Little Sodbury, Gloucestershire, in the capacity of chaplain and domestic tutor. Here he spent two years, and in the course of his private studies began to contemplate seriously the work of translating the New Testament into English. His sympathy with the "new learning," which he had not concealed in conversation with the higher clergy of the neighbourhood at Sir John's table, led to his being summoned before the chancellor of Worcester as a suspected heretic; and "with the goodwill of his master" he left for London in the summer of 1523. There he preached a little at St Dunstan-in-the-West, and worked at his translation, living for some months in the house of Humphrey Monmouth, an alderman; but finding publication impossible in England he sailed for Hamburg in May 1524. After visiting Luther at Wittenberg, he settled in Cologne, where he made some progress with a quarto edition of his New Testament, when the interference of the authorities of the town compelled his flight to Worms. The octavo edition (see vol. viii. p. 384) was here completed in 1526. Where Tyndale resided in the interval between 1526 and 1530—the year of publication of his translation of the Pentateuch—is not known; his *Parable of the Wicked Mammon* (1527), *Obedience of a Christian Man* (1528), and *Practice of Prelates* (1530), all bear to have been printed at "Marlborowe in the land of Hesse" or "Marborch." From 1530 onwards he appears to have lived chiefly in Antwerp, but of his life there hardly anything is recorded, except that as a marked man he was continually the subject of plots and intrigues, and that at last he was arrested and thrown into prison in the castle of Vilvorde, some six miles from Brussels, in 1535. Having been found guilty of heresy, he was put to death by strangling, and his body afterwards burnt at the stake on October 6, 1536.

The *Works* of Tyndale were first published along with those of FRITH (*q.v.*) and Barnes, "three worthy Martyrs and principal Teachers of the Church of England," by John Daye, in 1573 (folio). His *Doctrinal Treatises and Introductions to Different Portions of the Holy Scripture* were published by the Parker Society in 1848. For biography, see Demaus, *William Tyndale* (London, 1871); also the Introduction to Mombert's critical reprint of Tyndale's Pentateuch (New York, 1884), where a full bibliography is given. There seems no reason to doubt that the translation of Joshua, Judges, Samuel, Kings, and Chronicles in Matthew's Bible is substantially the work of Tyndale.

TYNE, a river in the north-east of England, is formed of two branches, the North Tyne, rising in the Cheviots on the borders of Roxburgh, and the South Tyne, rising at Tynehead Fell, at the south-eastern extremity of Cumberland. The North Tyne flows south-eastwards by Bellingham, a short distance below which it receives the Rede from the north, and 2 miles above Hexham it is joined by the South Tyne, which before the junction flows northward to Haltwhistle, and then eastward, receiving the Allen from the right a short distance above Haydon Bridge. The united streams then have a course of about 30 miles eastwards to the sea at Tynemouth. For a considerable part of its course the Tyne flows through a pleasant and richly cultivated country, but in its lower reaches the presence of coal pits has almost completely robbed the scenery of its natural charms, and the former sylvan retreats of monks and abbots are now occupied by blast furnaces and shipbuilding yards, and similar scenes of busy industry, which line both banks of the river from Newcastle to the sea. The river is navigable to Blaydon for small craft, and to Newcastle, 8 miles from its mouth, for large vessels.

The coal trade of the Tyne is the most important in England, and for its general shipping trade the river ranks next in importance to the Thames and the Mersey. The principal ports are Newcastle and North and South Shields, but below Newcastle the river is everywhere studded with piers and jetties. About a seventh of the whole tonnage of vessels built in England is built on the Tyne, the most important works being those of Jarrow. For boat-racing the Tyne vies in celebrity with the Thames.

TYNEMOUTH, a municipal and parliamentary borough of England, in Northumberland, includes the townships of Chirton, Cullercoates, North Shields, Preston, and Tynemouth. This last, the principal watering-place on this part of the coast, is picturesquely situated on a promontory on the north side of the Tyne at its mouth. It is connected with Newcastle, 8 miles to the west-south-west, by a branch of the North-Eastern Railway; its distance from London is 273½ miles by rail. The town has rapidly increased within recent years, and contains many well-built streets, squares, and villas. On the point of the promontory there is a small battery called the Spanish battery, and near it a monument has been erected to Lord Collingwood. Within the grounds to which the gateway of the old castle gives entrance are the ruins of the ancient priory of St Mary and St Oswin—the principal remains being those of the church. A pier, half a mile long, serves as a breakwater to the harbour. Among the principal public buildings are the assembly rooms and the aquarium (1872). The municipal buildings of the borough of Tynemouth are situated in North Shields, where are also the custom house, a master mariners' home, a seamen's institute, and a sailors' home founded by the late duke of Northumberland. Shipbuilding is carried on, and there are rope and sail works. The fish trade is of considerable importance and employs several steam and sailing boats. The population of the municipal and parliamentary borough of Tynemouth (incorporated in 1849; area 4303 acres), divided into the three wards of North Shields, Percy, and Tynemouth, was 38,941 in 1871, and 44,118 in 1881.

Tynemouth was a fortress of the Saxons, and was anciently known as Penbal Crag, "the head of the rampart on the rock." From remains found in 1783 it is supposed to have been a Roman station. The first church was built of wood by Edwin, king of Northumbria, about 625, and was rebuilt in stone by his successor Oswald in 634. The body of Oswin, king of Deira, was brought hither for burial in 651, and on this account Tynemouth came to be in great repute as a place of burial both for royal and ecclesiastical persons. The monastery was repeatedly plundered and burnt by the Danes, especially during the 9th century. After its destruction by Healfdeane in 876 it was rebuilt by Tostig, earl of Northumberland, who endowed it with considerable revenue; but, having been granted in 1074 to the monks of Jarrow, it became a cell of Durham. Malcolm III., king of the Scots, and his son Edward, who were slain in battle at Alnwick on 13th November 1093, were both interred in the monastery. In 1095 Earl Mowbray, having entered into a conspiracy against William Rufus, converted the monastery into a castle, which he strongly fortified. By William Rufus the priory was conferred on St Albans abbey, Hertfordshire. It was surrendered to Henry VIII. on 12th January 1539, and the site and remains were granted by Edward VI. in 1550 to the earl of Warwick, afterwards duke of Northumberland. In 1644 the castle was taken by the Scots under the earl of Leven. The town enjoyed various immunities at a very early period, which were afterwards the subject of some dispute. Edward I. restored to it several free customs of which it had been deprived. Afterwards it received a confirmation of its various former charters by Edward II. and Richard II.

TYPE-FOUNDING. See TYPOGRAPHY.

TYPE-WRITING. See WRITING MACHINES.

TYPHON, or TYPHOEUS, son, according to Hesiod (*Theog.*, 820 *sq.*), of the Earth and Tartarus, is described as a grisly monster with a hundred dragons' heads who was conquered and cast into Tartarus by Zeus. According to *Iliad* ii. 282, he lies in the land of the Arimi (Cilicia). Other legends place his prison under Ætna or in other volcanic regions and make him the cause of eruptions. The myth, therefore, as we have it, rests on a personification of volcanic forces. He is the father of dangerous winds (typhoons), and by later writers is identified with the Egyptian Set (see vol. vii. p. 717).

TYPHUS, TYPHOID, AND RELAPSING FEVERS. These are conveniently considered together, as they constitute the important class of continued fevers, having certain characters in common, although each is clearly distinguishable from the others. The following is a general account of the more salient features of each.

TYPHUS FEVER.

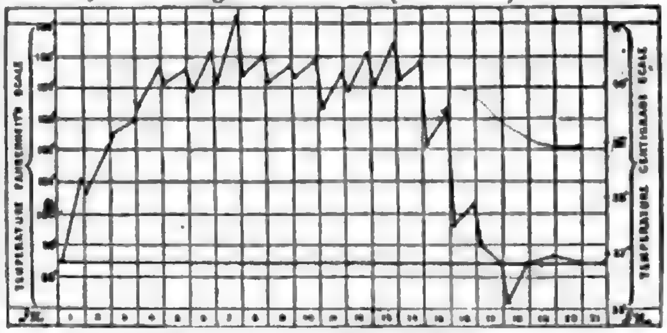
Typhus[1] is a continued fever of highly contagious nature, lasting for about fourteen days and characterized mainly by great prostration of strength, severe nervous symptoms, and a peculiar eruption on the skin. It has received numerous other names, such as spotted, pestilential, putrid, jail, hospital fever, &c. It appears to have been known for many centuries as a destructive malady, frequently appearing in epidemic form, in all countries in Europe, under the conditions to be afterwards referred to. The best accounts of the disease are those given by English writers, who narrate its ravages in towns and describe many "black assizes," in which it was communicated by prisoners brought into court to the judges, jurymen, court-officials, &c., with fatal effect, producing oftentimes a widespread consternation. Typhus fever would seem to have been observed in almost all parts of the world; but, although not unknown in warm countries, it has most frequently prevailed in temperate or cold climates.

Predisposing and exciting causes.

The causes concerned in its production include both the predisposing and the exciting. Of the former the most powerful of all are those influences which lower the health of a community, especially overcrowding and poverty. Hence this fever is most frequently found to affect the poor of large cities and towns, or to appear where large numbers of persons are living crowded together in unfavourable hygienic conditions, as has often been seen in prisons, workhouses, &c. Armies in the field are also liable to suffer from this disease; for instance, during the Crimean War it caused an enormous mortality among the French troops. Some high authorities, including Dr Murchison, have held that such conditions as those referred to are capable of generating typhus fever by themselves, and the apparent occasional *de novo* origin of this disease has doubtless the support of many striking facts which would appear to favour this view (see PATHOLOGY, vol. xviii. p. 803). In the light, however, of recent researches into the relation of specific disease germs to the production of fevers and other infectious maladies, there is increasing difficulty in maintaining this position; and the direction of opinion is decidedly towards the view that, however much insanitary conditions and overcrowding act as causes predisposing to the reception of the disease, the introduction into the system of a living organism or germ is necessary to the manifestation of the phenomena of the fever. Nevertheless no specific organism has yet been clearly identified in the case of typhus fever. This disease is now much less frequently encountered in medical practice than formerly,—a fact which must mainly be ascribed to the great attention which in recent times has been directed to improvement in the sanitation of towns, especially to the opening up of crowded localities so as to allow the free circulation through them of fresh air. In most large cities, however, limited epidemic outbursts of the disease occur from time to time, under the conditions of overcrowding and poverty, although the increased facilities possessed by local authorities for recognizing such outbreaks, and for the prompt isolation or removal of infected persons to hospitals, operate in general effectually to prevent any extensive spread of the fever. All ages are liable to typhus, but the young suffer less severely than the old. The disease appears to be communicated by the exhalations given off from the bodies of those suffering from the fever, and those most closely in contact with the sick are most apt to suffer. This is shown by the frequency with which nurses and physicians take typhus from cases under their care. As in all infectious maladies, there is often observed in typhus a marked proclivity to suffer in the case of individuals, and in such instances very slight exposure to the contagion may convey the disease. Typhus is highly contagious throughout its whole course and even in the early period of convalescence. The contagion, however, is rendered less active by the access of fresh air; hence this fever rarely spreads in well-aired rooms or houses where cases of the disease are under treatment. As a rule one attack of typhus confers immunity from risk of others, but numerous exceptions have been recorded.

Course of the fever.

The course of typhus fever is characterized by certain well-marked stages. (1) The stage of *incubation*, or the period elapsing between the reception of the fever poison into the system and the manifestation of the special evidence of the disease, is believed to vary from a week to ten days. During this time, beyond feelings of languor, no particular symptoms are exhibited. (2) The *invasion* of the fever is in general well marked and severe, in the form of a distinct rigor, or of feelings of chilliness lasting for hours, and a sense of illness and prostration, together with headache of a distressing character and sleeplessness. Feverish symptoms soon appear and the temperature of the body rises to a considerable height (103°-105° Fahr.), at which it continues with but little daily variation until about the period of the crisis. It is, however, of importance to observe certain points connected with the temperature during the progress of this fever. Thus about the seventh day the acme of the fever heat has been reached, and a slight subsidence (1° or less) of the temperature takes place in favourable cases, and no further subsequent rise beyond this lowered level occurs. When it is otherwise, the case often proves a severe one. Again, when the fever has advanced towards the end of the second week, slight falls of temperature are often observed, prior to the extensive descent which marks the attainment of the crisis. The pulse in typhus fever is rapid (100-120



Temperature chart of typhus fever.

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[1] From τῦφος, smoke or mist, in allusion to the stupor of the disease.

or more) and at first full, but later on feeble. Its condition as indicating the strength of the heart's action is watched with anxiety. The tongue, at first coated with a white fur, soon becomes brown and dry, while sordes (dried mucus, &c.) accumulate upon the teeth; the appetite is gone and intense thirst prevails. The bowels are as a rule constipated, and the urine is diminished in amount and high-coloured. The physician on examination may make out distinct enlargement of the spleen. (3) The third stage is characterized by the appearance of the *eruption* which generally shows itself about the fourth or fifth day or later, and consists of dark red (mulberry coloured) spots or blotches varying in size from mere points to three or four lines in diameter, very slightly elevated above the skin, at first disappearing on pressure, but tending to become both darker in hue and more permanent. They appear chiefly on the abdomen, sides, back, and limbs, and occasionally on the face. Besides this, the characteristic typhus rash, there is usually observed a general faint mottling all over the surface. The typhus rash is rarely absent and is a very important diagnostic of the disease. In the more severe and fatal forms of the fever, the rash has all through a very dark colour, and slight subcutaneous hæmorrhages (*petechiæ*) are to be seen in abundance. After the appearance of the eruption the patient's condition seems to be easier, so far as regards the headache and discomfort which marked the outset of the symptoms; but this is also to be ascribed to the tendency to pass into the typhous stupor which supervenes about this time, and becomes more marked throughout the course of the second week. The patient now lies on his back, with a dull dusky countenance, an apathetic or stupid expression, and contracted pupils. All the febrile symptoms already mentioned are fully developed, and delirium, usually of a low muttering kind, but sometimes wild and maniacal (*delirium ferox*) is present both by night and day. The peculiar condition to which the term "coma vigil" is applied, in which the patient, though quite unconscious, lies with eyes widely open, is regarded, especially if persisting for any length of time, as an unfavourable omen. Throughout the second week of the attack the symptoms continue unabated; but there is in addition great prostration of strength, the pulse becoming very feeble, the breathing shallow and rapid, and often accompanied with bronchial sounds. (4) A *crisis* or favourable change takes place about the end of the second or beginning of the third week (on an average the 14th day), and is marked by a more or less abrupt fall of the temperature (*vide* chart) and of the pulse, together with slight perspiration, a discharge of loaded urine, the return of moisture to the tongue, and by a change in the patient's look, which clears up and shows signs of returning intelligence. Although the sense of weakness is extreme, convalescence is in general steady and comparatively rapid.

Typhus fever may, however, prove fatal during any stage of its progress and in the early convalescence, either from sudden failure of the heart's action—a condition which is specially apt to arise—from the supervention of some nervous symptoms, such as meningitis or of deepening coma, or from some other complication, such as bronchitis. Further, a fatal result sometimes takes place before the crisis from sheer exhaustion, particularly in the case of those whose physical or nervous energies have been lowered by hard work, inadequate nourishment and sleep, or intemperance, in all which conditions typhus fever is apt to assume an unusually serious form.

Occasionally troublesome sequelæ remain behind for a greater or less length of time as the effects of the fever. Among these may be mentioned mental weakness or irritability, occasionally some form of paralysis, an inflamed condition of the lymphatic vessels of one leg (the swelled leg of fever), prolonged weakness and ill health, &c. Gradual improvement, however, may be confidently anticipated and even ultimate recovery.

The mortality from typhus fever is estimated by Murchison and others as averaging about 18 per cent. of the cases, but it varies much according to the severity of type (particularly in epidemics), the previous health and habits of the individual, and very specially the age,—the proportion of deaths being in striking relation to the advance of life. Thus, while in children under fifteen the death-rate is only 5 per cent., in persons over fifty it is about 46 per cent.

Treatment.

The treatment of typhus fever includes the prophylactic measures of attention to the sanitation of the more densely populated portions of towns. The opening up of cross streets intersecting those which are close-built and narrow, whereby fresh air is freely admitted, has done much to banish typhus fever from districts where previously it was endemic. Further, the enforcement of the law regulating the number of persons accommodated in common lodging-houses, and the application of the powers now vested in local authorities for dealing with cases of overcrowding everywhere, and for isolation and treatment of the infected, have had a like salutary effect. Where typhus has broken out in a crowded district the prompt removal of the patients to a fever hospital and the thorough disinfection and cleansing of the infected houses are to be recommended. Where, on the other hand, a single case of accidentally caught typhus occurs in a member of a family inhabiting a well-aired house, the chance of it being communicated to others in the dwelling is but small; nevertheless every precaution in the way of isolation and disinfection should be taken.

The treatment of a typhus patient is conducted upon the same general principles as have been illustrated in other fevers (see SCARLET FEVER, SMALLPOX). Complete isolation should be maintained throughout the illness, and the services of a day and a night nurse procured, who should keep a strict watch and preserve a record of the temperature and other observations, the times of feeding and the form of nourishment administered, as well as every other fact noticed, for the physician's information. Due attention should be given to the ventilation and cleansing of the sick chamber. The main element in the treatment of this fever is good nursing, and especially the regular administration of nutriment, of which the best form is milk, although light plain soup may also be given. The food should be administered at stated intervals, not, as a rule, oftener than once in one and a half or two hours, and it will frequently be necessary to rouse the patient from his stupor for this purpose. Sometimes it is impossible to administer food by the mouth, in which case recourse must be had to nutrient enemata. Alcoholic stimulants are not often required, except in the case of elderly and weakly persons who have become greatly exhausted by the attack and are threatening to collapse. The best indication for their use is that furnished by the condition of the circulation: when the pulse shows unsteadiness and undue rapidity, and the first sound of the heart is but indistinctly heard by the stethoscope, the prompt administration of stimulants (of which the best form is pure spirit) will often succeed in averting danger. Should their use appear to increase the restlessness or delirium they should be discontinued and the diffusible (ammoniacal or ethereal) forms tried instead.

Many other symptoms demand special treatment. The headache, which persists for days at the commencement and is with many a very distressing symptom, may be mitigated by removing the hair and applying cold to the head. The sleeplessness, with or without delirium, may be combated by quietness, by a moderately darkened room (although a distinction between day and night should be made as regards the amount of admitted light), and by soothing and gentle dealing on the part of the nurse. Opiate and sedative medicines in any form, although recommended by many high authorities, must be given with great caution, as their use is often attended with danger in this fever, where coma is apt to supervene. When resorted to, probably the safest form is a combination of the bromide of potassium or ammonium with a guarded amount of chloral. The writer has seen alarming effects follow the administration of opium. Occasionally the deep stupor calls for remedies to rouse the patient, and these may be employed in the form of mustard or cantharides to the surface (calves of legs, nape of neck, over region of heart, &c.), of the cold affusion, or of enemata containing turpentine. The height of the temperature may be a serious symptom, and antipyretic remedies appear to have but a slight influence over it as compared to that which they possess in typhoid fever, acute rheumatism, &c. The cold bath treatment, which has been recommended, cannot be carried out without serious risk to life in the necessary movement of the patient. It is a well-recognized rule that persons suffering from typhus fever ought not to be moved up in bed for any purpose after the first few days. Cold sponging of the hands and feet and exposed parts, or cold to the head, may often considerably lower the temperature. Throughout the whole progress of a case the condition of the bladder requires special attention, owing to the patient's drowsiness, and the regular use of the catheter becomes, as a rule, necessary with the advance of the symptoms.

The complications and results of this fever fall to be dealt with according to the methods of treatment applicable to their character and extent.

TYPHOID OR ENTERIC FEVER.

Typhoid or enteric fever (ἔντερον, the intestine) is a continued fever characterized mainly by its insidious onset, by a peculiar course of the temperature, by marked abdominal symptoms occurring in connexion with a specific lesion of the bowels, by an eruption upon the skin, by its uncertain duration, and by a liability to relapses.

Nature of typhoid.

This fever has received various names, such as gastric fever, abdominal typhus, infantile remittent fever, slow fever, nervous fever, &c. Dr Murchison, in reference to its supposed origin in putridity, uses the term "pythogenic fever," but this designation has not been generally adopted. Up till a comparatively recent period typhoid was not distinguished from typhus fever. For, although it had been noticed that the course of the disease and its morbid anatomy were different from those of ordinary cases of typhus, it was believed that they merely represented a variety of that malady. The distinction between the two diseases appears to have been first accurately made in 1836 by Messrs Gerhard and Pennock of Philadelphia, and still more fully demonstrated by Dr A. P. Stewart of Glasgow (afterwards of London). Subsequently all doubt upon the subject was removed by the careful clinical and pathological observations made by Sir William Jenner at the London fever hospital (1849-51). A clear distinction has been established between the two fevers, not only as regards their phenomena or morbid features, but equally as regards their origin. While typhus fever is a disease of overcrowding and poverty, typhoid may occur where such conditions are entirely excluded; and the connexion of this malady with specific emanations given off from decomposing organic or fæculent matters, or with contamination of food or water by the products of the disease, is now almost universally admitted. Alike in sporadic cases and in extensive epidemic outbreaks the existence of insanitary conditions in house drainage, water supply, &c., can in the majority of instances be made out. The question whether such conditions alone will suffice to beget this fever—or, in other words, its *de novo* origin—has, as in the case of typhus, been much discussed, and an affirmative opinion expressed by some high authorities. But the same remark must again be made as to the difficulties in the way of maintaining such a position in view of the evidence of the part played by microbes in infective processes.

Causes of its outbreak

That all insanitary conditions in respect of drainage of houses and localities furnish the most ready means for the introduction of the contagion of typhoid there is a general agreement, as there is equally that the most certain means of preventing its appearance or spread are those which provide a thoroughly trustworthy and secure drainage, a safe method of disposal of sewage, and a pure and abundant water supply. Typhoid fever is much less directly communicable from the sick to the healthy than typhus. The infective agent appears to reside in the discharges from the bowels, in which, particularly when exposed and undergoing decomposition, the contagium seems to multiply and to acquire increased potency. Thus in sewers, drains, &c., in association with putrefying matter, it may increase indefinitely, and by the emanations given off from such decomposing material accidentally escaping into houses, or by the contamination of drinking water in places where wells or cisterns are exposed to fæcal or sewage pollution, the contagion is conveyed. Of the precise nature of the contagious principle we have as yet no full information,[1] but there appears to be strong reason for believing that a specific microbe or organism plays a part in the propagation of the disease. Still it is obvious that for its successful implantation in and effect upon the system a peculiar condition of preparedness or receptivity to the morbific agent must be presupposed to exist in the individual, regarding which also our knowledge is of the vaguest. There is abundant evidence that one of the vehicles for the conveyance of the contagion is food, especially milk, which may readily become contaminated with the products of the disease where an outbreak of the fever has occurred in a dairy.

Typhoid fever is most common among the young, the majority of the cases occurring between the ages of fifteen and twenty-five (Murchison). But children of any age may suffer, as may also, though more rarely, persons at or beyond middle life. It is of as frequent occurrence among the well-to-do as among the poor. The greater number of cases appear to occur in autumn. In all countries this fever seems liable to prevail; and, while some of its features may be modified by climate and locality, its main characters and its results are essentially the same everywhere.

Pathological changes of typhoid.

The more important phenomena of typhoid fever will be better understood by a brief reference to the principal pathological changes which take place during the disease. These relate for the most part to the intestines, in which the morbid processes are highly characteristic, both as to their nature and their locality. The changes (to be presently specified) are evidently the result of the action of the contagium on the system, and they begin to show themselves from the very commencement of the fever, passing through various stages during its continuance. The portion of the bowels in which they occur most abundantly is the lower part of the small intestine (ileum), where the "solitary glands" and "Peyer's patches" on the mucous surface of the canal become affected by diseased action of a definite and progressive character, which stands in distinct relation to the symptoms exhibited by the patient in the course of the fever. (1) These glands, which in health are comparatively indistinct, become in the commencement of the fever enlarged and prominent by infiltration due to inflammatory action in their substance, and consequent cell proliferation. This change usually affects a large extent of the ileum, but is more marked in the lower portion near the ileo-cæcal valve (see ANATOMY). It is generally held that this is the condition of the parts during the first eight or ten days of the fever. (2) These enlarged glands next undergo a process of sloughing, the inflammatory products being cast off either in fragments or *en masse*. This usually takes place in the second week of the fever. (3) Ulcers are thus formed varying in size according to the gland masses which have sloughed away. They may be few or many in number, and they exhibit certain characteristic appearances. Thus they are frequently, but not always, oblong in shape, with their long axis in that of the bowel, and they have somewhat thin and ragged edges. They may extend through the thickness of the intestine to the peritoneal coat and in their progress erode blood-vessels or perforate the bowel. This stage of ulceration exists from the second week onwards during the remaining period of the fever, and even into the stage of convalescence. (4) In most instances these ulcers heal by cicatrization, leaving, however, no contraction of the calibre of the bowel. This stage of healing evidently occupies a considerable time, since the process does not advance at an equal rate in the case of all the ulcers, some of which have been later in forming than others. Even when convalescence has been apparently completed, some unhealed ulcers may yet remain and prove, particularly in connexion with errors in diet, a cause of relapse of some of the symptoms, and even of still more serious or fatal consequences. The mesenteric glands external to, but in functional relation with, the intestine, become enlarged during the progress of the fever, but usually subside after recovery.

Besides these changes, which are well recognized, others more or less important are often present. Among these may be mentioned one which the present writer has repeatedly observed in the severe and protracted forms of this fever, namely, marked atrophy, thinning, and softness of the coats of the intestines, even after the ulcers have healed,—a condition which may not improbably be the cause of that long-continued impairment of the function of the bowels so often complained of by persons who have passed through an attack of typhoid fever. Other changes common to most fevers are also to be observed, such as softening of the muscular tissues generally, and particularly of the heart, and evidences of complications affecting chest or other organs, which not unfrequently arise. The swelled leg of fever sometimes follows typhoid, as does also periosteal inflammation.

Progress of the disease.

The symptoms characterizing the onset of typhoid fever are very much less marked than those of most other fevers, and the disease in the majority of instances sets in somewhat insidiously. Indeed, it is no uncommon thing for patients with this fever to go about for a considerable time after its action has begun. The most marked of the early symptoms are headache, lassitude, and discomfort, together with sleeplessness and feverishness, particularly at night; this last symptom is that by which the disease is most readily detected in its early stages. The peculiar course of the temperature is also one of the most important diagnostic evidences of this fever. During the first week it has a morning range of moderate febrile rise, but in the evening there is a marked ascent, with a fall again towards morning, each morning and evening, however, showing respectively a higher point than that of the previous day, until about the eighth day, when in an average case the highest point is attained. This varies according to the severity of the attack; but it is no unusual thing to register 104° or 105° Fahr. in the evening and 103° or 104° in the morning. During the second week the daily range of temperature is comparatively small, a slight morning remission being all that is observed. In the third week the same condition continues more or less; but frequently a slight tendency to lowering may be discerned, particularly in the morning temperature, and the febrile action gradually dies down as a rule between the twenty-first and twenty-eighth days, although it is liable to recur in the form of a relapse. Although the patient may, during the earlier days of the fever, be able to move about, he feels languid and uneasy; and usually before the first week is over he has to take to bed, and soon the effects of the attack become more apparent. He is restless, hot, and uncomfortable, particularly as the day advances, and his cheeks show a red flush, especially in the evening or after taking food. The aspect, however, is different from the oppressed stupid look which is present in typhus, and more resembles the appearance of hectic. The pulse in an ordinary case, although more rapid than normal, is not accelerated to an extent corresponding to the height of the temperature, and is, at least in the earlier stages of the fever, rarely above 100°. In severe and protracted cases, where there is evidence of extensive intestinal ulceration, the pulse becomes rapid and weak, with a dicrotic character indicative of cardiac feebleness. The tongue has at first a thin whitish fur and is red at the tip and edges. It tends, however, to become dry, brown or glazed looking, and fissured transversely, while sordes may be present about the lips and teeth. There is much thirst and in some cases vomiting. Splenic and hepatic enlargement may be made out. From an early period in the disease abdominal symptoms show themselves with greater or less distinctness and are frequently of highly diagnostic significance. The abdomen is somewhat distended or tumid, and pain accompanying some gurgling sounds may be elicited on light pressure about the lower part of the right side close to the groin,—the region corresponding to that portion of the intestine in which the morbid changes already referred to are progressing. Diarrhœa is a frequent but by no means constant symptom. When present it may be slight in amount, or, on the other hand, extremely profuse, and it corresponds as a rule to the severity of the intestinal ulceration. The discharges are highly characteristic, being of light yellow colour resembling pea soup in appearance. Should intestinal hæmorrhage occur, as is not unfrequently the case during some stage of the fever, they may be dark brown, or composed entirely of blood. The urine is scanty and high-coloured. About the beginning, or during the course of the second week of the fever, an eruption frequently makes its appearance on the skin. It consists of isolated spots, oval or round in shape, of a pale pink or rose colour, and of about one to one and a half lines in diameter. They are seen chiefly upon the abdomen, chest, and back, and they come out in crops, which continue for four or five days and then fade away. At first they are slightly elevated, and disappear on pressure. In some cases they are very few in number, and their presence is made out with difficulty; but in others they are numerous and sometimes show themselves upon the limbs as well as upon the body. They do not appear to have any relation to the severity of the attack, and in a very considerable proportion of cases (particularly in children) they are entirely absent. Besides this eruption there are not unfrequently numerous very faint bluish patches or blotches about half an inch in diameter, chiefly upon the body and thighs. When present the rose-coloured spots continue to come out in crops till nearly the end of the fever, and they may reappear should a relapse subsequently occur. These various symptoms persist throughout the third week, usually, however, increasing in intensity. The patient becomes prostrate and emaciated; the tongue is dry and brown, the pulse quickened and feeble, and the abdominal symptoms more marked; while nervous disturbance is exhibited in delirium, in tremors and jerkings of the muscles (*subsultus tendinum*), in drowsiness, and occasionally in "coma vigil." In severe cases the exhaustion reaches an extreme degree, although even in such instances the condition is not to be regarded as hopeless. In favourable cases a change for the better may be anticipated between the twenty-first and twenty-eighth days, more usually the latter. It does not, however, take place as in typhus by a well-marked crisis, but rather by what is termed a "lysis" or gradual subsidence of the febrile symptoms, especially noticeable in the daily decline of both morning and evening temperature, the lessening of diarrhœa, and improvement in pulse, tongue, &c. Convalescence proceeds slowly and is apt to be interrupted by relapses (due not unfrequently to errors in diet), which are sometimes as severe and prolonged as the original attack, and are attended with equal or even greater risks. Should such relapses repeat themselves, the case may be protracted for two or three months, but this is comparatively rare.

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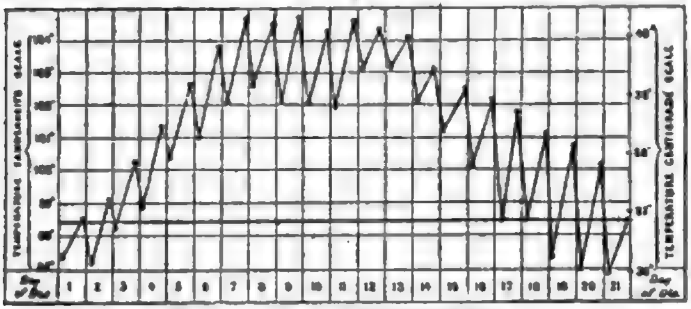
[1] A bacillus frequently noticed in certain tissues in cases of typhoid fever has not yet been satisfactorily proved to be an organism characteristic of that disease, nor even to be constantly present.



Temperature chart of typhoid fever.

Causes of death in typhoid.

Death in typhoid fever usually takes place from one or other of the following causes. (1) Exhaustion, in the second or third weeks, or later. The attending symptoms are increasing emaciation, weakness of the pulse, and cadaveric aspect. Sometimes sinking is sudden, partaking of some of the characters of a collapse. (2) Hæmorrhage from the intestines. The evidence of this is exhibited, not only in the evacuations, but in the sudden fall of temperature and rise in pulse-rate, together with great pallor, faintness, and rapid sinking. Sometimes hæmorrhage, to a dangerous and even fatal extent, takes place from the nose. (3) Perforation of an intestinal ulcer. This gives rise, as a rule, to sudden and intense abdominal pain, together with vomiting and signs of collapse, viz., a rapid flickering pulse, cold clammy skin, and the marked fall of temperature. Symptoms of peritonitis (see PERITONITIS) quickly supervene and add to the patient's distress. Death usually takes place within 24 hours. Occasionally peritonitis, apart from perforation, is the cause of death. (4) Occasionally, but rarely, hyperpyrexia (excessive fever). (5) Complications, such as pulmonary or cerebral inflammation, bedsores, &c.

Certain sequelæ are sometimes observed, the most important being the swelled leg, periostitis affecting long bones, general ill-health, and anæmia, with digestive difficulties, often lasting for a long time, and sometimes issuing in phthisis. Occasionally, after severe cases, mental weakness is noticed, but it is usually of comparatively short duration.

Mortality.

The mortality in typhoid fever varies with the character of the outbreak, the general health and surroundings of the individuals attacked, and other conditions. At one time it was regarded as, on an average, about the same as that of typhus; but under modern methods of treatment the chances of recovery are much greater, and the death-rate may be stated as about 12 per cent. or perhaps somewhat less.

Treatment.

The treatment embraces those prophylactic measures which aim at preventing the escape of sewer gases into dwelling-houses by careful attention to the drainage and plumber-work, and also secure an abundant supply of pure water for domestic use (see HYGIENE, SEWERAGE, and VENTILATION). When an outbreak of the fever occurs in a family, all such matters should be specially inquired into, and the sources of milk supply carefully scrutinized. The discharges from the bowels of the typhoid patient should be at once disinfected with carbolic acid or other similar agent, and the greatest care taken as to their disposal, with the view of obviating any risk of contamination of drinking-water, &c. The general management is conducted upon the same principles as are observed in the case of typhus, except that in typhoid fever very special care is necessary in regard to diet. Milk, the great value of which as a fever-food was first clearly set forth by Prof. Gairdner, is of eminent service in typhoid, but it must be administered with due regard to time and to the digestive powers of the patient. When given too frequently or in too great quantity it may, by its imperfect digestion, prove a source of irritation to the bowels. Even when given with every care it may fail to agree, as is proved by the presence of undigested curd in the evacuations. In such a case its admixture with lime water or with peptonizing agents may render its digestion less difficult, but sometimes its use must for a time be suspended. It is, however, rare that milk cannot be borne when carefully administered. Barley water or simple soups, such as chicken broth, beef-tea, &c., are occasionally useful either as substitutes for or adjuvants to milk. All through the fever the patient should be fed at regular periods—not, as a rule, oftener than once in one and a half or two hours—although in the intervals water or other fever-drink may be given from time to time. In convalescence the diet should still be largely milk and soft matters, such as custards, light puddings, meat jellies, boiled bread and milk, &c., but other solid foods, with the exception of fish, should be for a long time avoided. In changing the diet it is of importance to note its effect upon the temperature, which may sometimes be considerably disturbed from this cause, even after the apparent subsidence of all febrile action. Stimulants, although unnecessary in a large proportion of cases, are occasionally called for when there is great exhaustion, and in prolonged attacks. Their effect, however, should be carefully watched. They are usually best administered in the form of pure spirit.

The more prominent symptoms which mark the course of typhoid fever frequently call for special treatment. Thus, when the fever continues long, with little break in its course, the employment of remedies to control its action (antipyretics) may often be resorted to with benefit. Such drugs as quinine, salicin, salicylic acid, and salicylate of soda, kairin, antipyrin, antifebrin, &c. (in ten to thirty grain doses of one or other), may frequently break in upon the continuity of the fever, and by markedly lowering the temperature relieve for a time the body from a source of waste, and aid in tranquillizing the excited nervous system. The times for their administration are either one or two hours before the usual maximum temperature or during the period of remission. These remedies may, however, fail, or by inducing sickness or great prostration and depression of the circulation require to be discontinued. For a similar purpose the cold bath is recommended by many high authorities and is regularly employed in Germany. The method recommended by Liebermeister is this: "When the temperature rises above 104° Fahr., the patient should be placed in a bath of about 94°, which is gradually cooled down by the addition of cold water to 68° Fahr., and remain immersed for twenty or thirty minutes, the limbs being all the while gently rubbed. He should then be put back into bed." Another method is that of Dr Brand of Stettin: "When the patient's temperature attains 102° Fahr., he should be placed in a tepid bath of 70° and allowed to remain till a sense of coldness or shivering is produced, which usually occurs in from five to twenty minutes." By such means no doubt the temperature can often be reduced 2° or 3° Fahr., but it is very apt to rise again and the bath must then be repeated. It is claimed by the advocates of this method of treatment that it has been successful in diminishing greatly the mortality of typhoid fever, but they hold at the same time that its success in large measure depends upon its employment from an early stage in the disease. British physicians are much divided upon the point, many high authorities agreeing in its marked utility, while others no less eminent regard it as fraught with danger from the frequent movement of the patient from bed, the shock to the system, and the risk of hæmorrhage, pneumonia, or other complications, and as a plan of treatment difficult of being carried out in ordinary practice. Although employed in some fever hospitals and with apparent success, it has not yet commended itself for general adoption. Other methods of applying cold, while probably less effectual than the bath, are much more available, as, for example, the tepid or cold pack, the frequent sponging of portions of the body with cold water, or the application of icebags to the head. The present writer has resorted to these methods in many cases of typhoid fever, with the effect of markedly lowering a high temperature. When diarrhœa is excessive it may be restrained by such remedies as chalk, bismuth, Dover's powder, &c. Hæmorrhage is dealt with by preparations of ergot, or by acetate of lead, gallic acid, or other styptics. In the event of perforation of the bowel opium is the only means available to lessen the distress attending that fatal occurrence.

In the convalescent stage, and even after apparently complete recovery, the utmost care should be observed by the patient as to diet, all hard and indigestible substances being dangerous from their tendency to irritate or reopen unhealed ulcers, and bring on a relapse of the fever or cause a sudden perforation. Lastly, the general health demands careful attention for a length of time, in view of the remoter risks of chest and other diseases already alluded to.

Relapsing Fever.

This is a continued fever occasionally appearing as an epidemic in communities suffering from scarcity or famine. It is characterized mainly by its sudden invasion, with violent febrile symptoms, which continue for about a week and end in a crisis, but are followed, after another week, by a return of the fever.

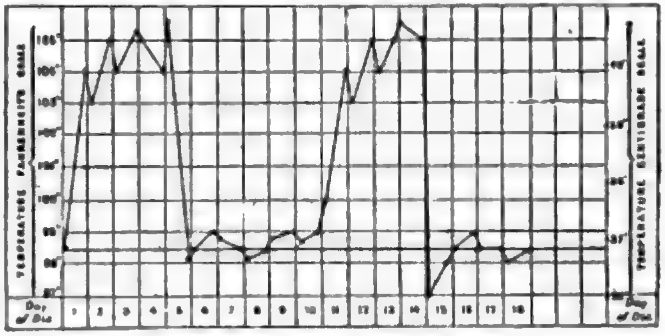
This disease has received many other names, the best known of which are famine fever, short fever, synocha, bilious relapsing fever, recurrent typhus, and spirillum fever. As in the case of typhoid, relapsing fever was long believed to be simply a form of typhus. The distinction between them appears to have been first clearly established in 1826, in connexion with an epidemic in Ireland. Outbreaks of relapsing fever have occurred in all parts of the world at times and in places where famine has arisen; but the disease has been most closely observed and studied in epidemics in Great Britain and Ireland, Germany, Poland, Russia, America, and India. It has frequently been found to prevail along with an epidemic of typhus fever.

Causes of origination.

Relapsing fever is highly contagious, and appears, like typhus, to be readily communicated by the exhalations from the body. With respect to the nature of the contagion, certain important and interesting observations have been made. In 1873 Obermeier discovered in the blood of persons suffering from relapsing fever minute organisms in the form of spiral filaments of the genus *Spirochæte* (see vol. xxi. p. 399, fig. 1, n), measuring in length [illegible] to [illegible] inch and in breadth [illegible] to [illegible] inch, and possessed of rotatory or twisting movements. This organism has received the name of *Spirillum obermeieri*. It appears to be present in abundance during the height of the febrile symptoms, and is not seen during the interval until the relapse is impending, when it is again present as before. This observation has been confirmed by numerous investigators, and it has been found that inoculation with the blood containing these *Spirilla* produced the symptoms of relapsing fever in both men and animals. Comparatively little is as yet known of the life-history of these organisms, and the question whether they are to be regarded as the prime source of the disease or as mere accompaniments affords ground for difference of opinion (see Pathology, vol. xviii. p. 403); nevertheless their discovery and the conditions of their presence already mentioned are noteworthy facts in reference not only to the pathology of this fever but also to the general doctrine of infectiveness in disease-processes. The most constantly recognized factor in the origin and spread of relapsing fever is destitution; but this cannot be regarded as more than a predisposing cause favouring the reception and propagation of the morbific agent, since in many lands widespread and destructive famines have prevailed without any outbreak of this fever. Instances, too, have been recorded where epidemics were distinctly associated with overcrowding rather than with privation. Relapsing fever is most commonly met with in the young. One attack does not appear to protect from others, but rather, according to some authorities, engenders liability.

Its contagiousness.

The extreme contagiousness of relapsing fever has occasionally been shown by its spreading widely when introduced into a district, even among those who had not become predisposed by destitution or other depressing conditions. The contagion, like that of typhus, appears to be most active in the immediate vicinity of the patient and to be greatly lessened by the access of fresh air. It is capable of being conveyed by clothing. The incubation of the disease is about one week. The symptoms of the fever then show themselves with great abruptness and violence by a rigor, accompanied with pains in the limbs and severe headache. The febrile phenomena are very marked, and the temperature quickly rises to a high point (105°-107° Fahr.), at which it continues with little variation, while the pulse is rapid (100-140), full, and strong. There is intense thirst, a dry brown tongue, bilious vomiting, tenderness over the liver and spleen, and occasionally jaundice. Sometimes a peculiar bronzy appearance of the skin is noticed, but there is no characteristic rash as in typhus. There is much prostration of strength. After the continuance of these symptoms for a period of from five to seven days, the temperature suddenly falls to the normal point or below it, the pulse becomes correspondingly slow, and a profuse perspiration occurs, while the severe headache disappears and the appetite returns. Except for a sense of weakness, the patient feels well and may even return to work, but in some cases there remains a condition of great debility, accompanied with rheumatic pains in the limbs. This state of freedom from fever continues for about a week, when there occurs a well-marked relapse with scarcely less abruptness and severity than in the first attack, and the whole symptoms are of the same character, but they do not, as a rule, continue so long, and they terminate in a crisis in three or four days, after which convalescence proceeds satisfactorily. Second, third, and even fourth relapses, however, may occur in exceptional cases.



Temperature chart of relapsing fever.

Mortality, &c.

The mortality in relapsing fever is comparatively small, about 5 per cent. being the average death-rate in epidemics (Murchison). The fatal cases occur mostly from the complications common to continued fevers. The treatment is essentially the same as that for typhus fever (see above). (J. O. A.)

TYPOGRAPHY

Part I.—Historical.

TYPOGRAPHY (writing by types) is the art of printing (cast-metal) movable types on paper, vellum, &c. It is quite distinct, not only from writing, but from xylography or wood-engraving, *i.e.*, the art of cutting figures, letters, or words on blocks of wood and taking impressions from such blocks, by means of ink or any other fluid coloured substance, on paper or vellum.

Possibly the earliest attempt to describe the art of typography is that in the *Donatus* issued by Peter Schoeffer, perhaps before 1456, the colophon of which says that it was finished "Arte nova imprimendi seu caracterizandi [from *character* = letter] . . . absque calami exaratione." Fust and Schoeffer in the Mainz psalter of 1457 said that it was formed by an "adinventio artificiosa imprimendi ac caracterizandi absque calami ulla exaratione." The colophon of the *Catholicon* of 1460 is more precise, and says that the book was printed "non calami, stili, aut pennæ suffragio, sed mira patronarum formarumque concordia, proporcione, ac modulo." In 1462 Albrecht Pfister had "gedrucket" the *Four Histories*. In the *Liber Sextus Decretalium*, published in 1465, Fust and Schoeffer say that it was completed "non atramento ["atramento communi," in the Justinianus of 1468 and 1472], plumali canna neque ærea, sed artificiosa quadam adinventione imprimendi seu caracterizandi," a phrase which they slightly varied in Cicero's *Officia*, issued in the same year: "non atramento, plumali canna neque ærea, sed arte quadam perpulcra." The edition of St. Jerome's *Epistles* of 1470 is said to have been completed by an "ars impressoria," the *Decretum Gratiani* of 1472 by an "ars quædam ingeniosa imprimendi," the *Dyalogus* of 1478 by an "ars magistra." We find further—"ars sancta" or "divina," "nova ars scribendi," "novum excribendi genus prope divinum," "sculptoria archetyporum ars," "ars mirifica formandi," "ars excusoria," "nova imprimendi ratio," "ars pressuræ," "chalcotypa ars," "chalcographia" (1472 and later), "chalcographia excusoria impressoriaque," "libraria impressio," "empryntynge" (Caxton, 1482), "prênterei" (Schoeffer, 1492), "truckery" (1505), "impression des livres" (1498), and "prenten."

The early printers called themselves, or were called by others, "librorum prothocaragmatici" (*Gramm. Rhythm.*, 1468), "impressores librorum," "exsculptor librorum" (Jenson, 1471), "chalcographus" (1473; Hain, 13036), "magister artis impressoriæ," "boeckprinter"; and during the 16th century we find them still frequently called "chalcotypus" and "chalcographus."

The types were at first designated more by negative than positive expressions. In 1468 they were called "caragma," later on "caracter" or "character," "archetipæ notæ" (1473; Hain, 13036), "sculptoria archetyporum ars," "chalcotypa ars," "formæ," "artificiosissimæ imprimendorum librorum formæ." We soon hear also of the process and material by which they were produced. The *Grammatica* of 1468, published by Schoeffer, says that it was "cast" (sum fusus libellus). In 1471 "æneæ formulæ" are spoken of; and Bernardus Cenninus and his son say that they had printed the Virgil "expressis ante calibe caracteribus et deinde fusis literis" (with letters first cut into steel and then cast). In 1473 Friedrich Creusner at Nuremberg says that he had "cut" (sculpsit) the work of Diogenes (Hain, 6192). Johan Zeiner of Ulm says in 1474 that he had perfected a book, not with the pen, but with letters of metal (stagneis caracteribus). In 1474 Joh. Ph. de Lignamine speaks of "metallicæ formæ." In 1476 Husner of Strasburg represents the Nider as being printed with "letters cut of metal (litteris sculptis artificiali certe conatu ex ære)." Nicolas Jenson printed in 1480 with letters "cut and cast" (sculptis ac conflatis).

The word *typographus* does not seem to occur before 1488, when it was used in the preface of P. Stephanus Dulcinius Scalæ to the *Astronomicon* of Manilius, printed in that year at Milan by Antonius Zarotus;[1] in 1498 Erasmus uses it in a letter (dated 13th Feb.) to Christianus, a Lübeck merchant;[2] and in 1517 Johan Schoeffer applies the word to himself in the colophon of the Æneas Sylvius published by him. But of the use of the word *typographia* no earlier instance is known than 1520, in which year Gerardus Noviomagus (=Geldenhaurius) in his *Lucubratiuncula de Batavorum Insula* (pref. to Nicol. Buscoducensis, dated 1520) says: "inventa Germanorum . . . bombarda videlicet, typographia, pyxis chartaque nautica;" and Johan Schott, a printer of Strasburg, in the *Geogr. Ptolem.* published by him, describes his grandfather, Johan Mentelin, as "primus typographiæ inventor." Gerardus, it may be added, borrowed the whole passage from Pet. Montanus (li. 1 *Adag.*, published c. 1504), who has chalcographia instead of typographia. Meerman indeed[3] speaks of a use of the word typographia (or at least of typographus) earlier than 1520, and refers to the preface of Bernardinus Veronensis in the edition of Tibullus, Catullus, and Propertius published at Venice in 1493 by Symon Bevilaqua, "at least," Meerman adds, "as it (the preface) is read in the *Annal. Typogr.* of Maittaire, i. 560, 2d ed." But on page 560 Maittaire quotes the first two lines of Bernardinus's preface (till *dicit*) and then adds: "Græcis characteribus destitutus, typographus necesse habuit hiatus in commentario hic illic relinquere," which is evidently Maittaire's own remark, not that of Bernardinus. The present writer at least has been unable to find such a passage in the Tibullus.

Although the art of writing and that of block-printing both differ widely from printing with movable metal types, yet this last process seems to have been such a gradual transition from block-printing, and block-printing in its turn to have been such a natural outcome of the many trials that were probably made to produce books in some more expeditious manner than could be done with handwriting, that a cursory glance at these two processes will not seem out of place, all the less as a discussion on the origin and progress of typography could hardly be understood without knowing the state of the literary development at the time that printing appeared.

First attempts at printing.

The art of printing, *i.e.*, of impressing (by means of certain forms and colours) figures, pictures, letters, words, lines, whole pages, &c., on other objects, as also the art of engraving, which is inseparably connected with printing, existed long before the 15th century. Not to go back to remoter essays, there is reason to suppose that mediæval kings and princes (among others William the Conqueror) had their monograms cut on blocks of wood or metal in order to impress them on their charters. Such impressions from stamps are found instead of seals on charters of the 15th century. Manuscripts of the 12th century show initials which, on account of their uniformity, are believed to have been impressed by means of stamps or dies.[4] But the idea of multiplying representations from one engraved plate or block or other form was unknown to the ancients, whereas it is predominant in what we call the art of block-printing, and especially in that of typography, in which the same types can be used again and again.

East Asiatic printing.

Block-printing and printing with movable types seem to have been practised in China and Japan long before they were known in Europe. It is said that in the year 175 the text of the Chinese classics was cut upon tablets, which were erected outside the university, and that impressions were taken of them, some of which are said to be still in existence. Printing from wooden blocks can be traced as far back as the 6th century, when the founder of the Suy dynasty is said to have had the remains of the classical books engraved on wood, though it was not until the 10th century that printed books became common. In Japan the earliest example of block-printing dates from the period 764-770, when the empress Shiyau-toku, in pursuance of a vow, had a million small wooden toy pagodas made for distribution among the Buddhist temples and monasteries, each of which was to contain a dhârani out of the Buddhist Scriptures entitled "Vimala nirbhasa Sûtra," printed on a slip of paper about 18 inches in length and 2 in width, which was rolled up and deposited in the body of the pagoda under the spire. In a journal of the period, under the year 987, the expression "printed" book" (*suri-hoñ*) is found applied to a copy of the Buddhist canon brought back from China by a Buddhist priest. This, of course, must have been a Chinese edition; but the use of the term implies that printed books were already known in Japan. It is said that the Chinese printed with movable types (of clay) from the middle of the 11th century. The authorities of the British Museum exhibit as the earliest instance of Corean books printed with movable types a work printed in 1337. To the Coreans is attributed the invention of copper types in the beginning of the 15th century; and an inspection of books bearing dates of that period seems to show that they used such types, even if they did not invent them.[1]

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[1] Maittaire, *Annales Typogr.*, i. 508, note 1.

Opp., iii. col. 24.

[3] *Orig. Typogr.*, i. p. 32, note cx.

[4] Passavant, *Le Peintre-Graveur*, i. 18, Leipsic, 1860-64; John Jackson, *Wood-Engraving*, London, 1839; Bucher, *Gesch. der techn. Künste*, p. 362 sq.

From such evidence as we have it would seem that Europe is not indebted to the Chinese or Japanese for the art of block-printing, nor for that of printing with movable types.

MS. period.

In Europe, as late as the second half of the 14th century, every book (including school and prayer books), and every public and private document, proclamation, bull, letter, &c., was written by hand; all figures and pictures, even playing-cards and images of saints, were drawn with the pen or painted with a brush. In the 13th century there already existed a kind of book trade. The organization of universities as well as that of large ecclesiastical establishments was at that time incomplete, especially in Italy, France, and Germany, without a staff of scribes and transcribers (*scriptores*), illuminators, lenders, sellers, and custodians of books (*stationarii librorum*, *librarii*), and *pergamenarii*, *i.e.*, persons who prepared and sold the vellum or parchment required for books and documents. The books supplied were for the most part legal, theological, and educational, and are calculated to have amounted to above one hundred different works. As no book or document was approved unless it had some ornamented and illuminated initials or capital letters, there was no want of illuminators. The workmen scribes and transcribers were, perhaps without exception, caligraphers, and the illuminators for the most part artists. Beautifully written and richly illuminated manuscripts on vellum became objects of luxury which were eagerly bought and treasured up by princes and people of distinction. Burgundy of the 15th century, with its rich literature, its wealthy towns, its love for art, and its school of painting, was in this respect the centre of Europe, and the libraries of its dukes at Brussels, Bruges, Antwerp, Ghent, &c., contained more than three thousand beautifully illuminated MSS.

Classes of writing.

In speaking of the writing of the manuscripts of the 15th and two preceding centuries, it is essential to distinguish, in each country, between at least four different classes of writing, and two of these must be again subdivided each into two classes. All these different kinds of writing were, in the first instance, taken as models for cutting such portions of text as were intended to illustrate and explain the figures in block-books, and afterwards as models for the types used in the printing of books and documents.

(1) The *book hand*, that is the ordinary writing of legal, theological, and devotional books, was used by the official transcribers of the universities and churches. These men had received a more or less learned education, and consequently wrote or transcribed books with a certain pretence of understanding them and of being able to write with greater rapidity than the ordinary caligrapher. Hence their writing may be called (*a*) the *current* or *cursive book hand*, of which a good many illustrations may be found in Wilh. Schum, *Exempla Codicum. Amplon. Erfurtensium.* Quite distinct from this current writing, and much clearer and more distinct, is (*b*) the *upright* or *set book hand*, which was employed by some writers who worked for universities and churches, and also by a good many who may be presumed to have worked in large cities and commercial towns for schools and the people in general without university connexion. (2) In the *church hand* (Gothic or black letter) were produced transcripts of the Bible, missals, psalters, and other works intended for use in churches and private places of worship. This writing we may again subdivide into two classes,—(*a*) the *ornamental* or *caligraphic* writing, found exclusively in books intended for use in churches or for the private use of wealthy and distinguished persons, and (*b*) the ordinary *upright* or *set church hand*, employed for less ornamental and less expensive books. (3) The *letter hand* may be said to be intermediate between the set literary book hand and the set literary church hand, and to differ but little from either. It was employed in all public documents of the nature of a letter. (4) The *court* or *charter hand* was used for charters, title-deeds, papal bulls, &c.

15th-century books, written.

Dypold Laber (Lauber), a teacher and transcriber at Hagenau in Germany, is known to have carried on a busy trade in manuscripts just about the time of the invention of printing. His prospectuses, in handwriting of about the middle of the 15th century, announce that whatever books people wish to have, large or small, "geistlich oder weltlich, hübsch gemolt," are all to be found at Dypold Lauber's the scribe. He had in stock *Gesta Romanorum, mit den Viguren gemolt*; poetical works (*Parcival, Tristan, Freidank*); romances of chivalry (*Der Witfarn Ritter*; *Von eime Getruwen Ritter der sin eigen Hertze gab umb einer schönen Frowen willen*; *Der Ritter under dem Zuber*); Biblical and legendary works (*A Rimed Bible*; *A Psalter, Latin and German*; *Episteln und Evangelien durch das Jor*; *Vita Christy*; *Das gantze Passional, winterteil und summerteil*; devotional books (*Bellial*; *Der Selen Trost*; *Der Rosenkrantz*; *Die zehn Gebot mit Glosen*; *Small Bette-Bücher*); and books for the people (*Gute bewehrte Artznien-Bücher*; *Gemolte Loss-Bücher*, *i.e.*, fortune-telling books; *Schachtzabel gemolt*). The lower educational books consisted for the most part of the *Abecedaria*, containing the alphabet, the Lord's prayer, the creed, and one or two prayers; the *Donatus*, a short Latin grammar extracted from the work of Ælius Donatus, a Roman grammarian of the 4th century, and distinctly mentioned in a school ordinance of Bautzen of 1418; the *Doctrinale*, a Latin grammar in leonine verse, compiled by Alexander Gallus (or De Villa Dei), a minorite of Brittany of the 13th century; the *Summula Logica* of Petrus Hispanus (afterwards Pope John XXI.), used in the teaching of logic and dialectics; and Dionysius Cato's *Disticha de Moribus*, and its supplement called *Facetus*, with the *Floretus* of St Bernard, used in the teaching of morals. As helps to the clergy in their attempts to educate the lower classes, and as a means of assisting and promoting private devotion, there were picture books accompanied with an easy explanatory text, for the most part representations of the mystic relation between the Old and New Testaments (typology). Among these books the *Biblia Pauperum*[2] stands first. It represents pictorially the life and passion of Christ, and there exist MSS. of it as early as the 13th century, in some cases beautifully illuminated.[3] A richly illuminated MS. of it, executed in the Netherlands c. 1400, is in the British Museum (press-mark, King's, 5), and also fragments of one of the 14th century (press-mark, 31,303). A remodelling and development of this work is the *Speculum Humanæ Salvationis*, a work in rhyme of the 14th century, which in forty-five chapters represents the Bible history interwoven with Mariolatry and legend. Of this work the Paris national library and arsenal library each possesses a MS. composed in 1324, whereas the British Museum has nine MSS. (six being illuminated) of the 14th and 15th centuries, written in the Netherlands, Germany, France, and England, one (press-mark, 16,578) bearing the distinct date 1379 and another (press-mark, Egerton, 878) that of 1436. A work of a similar nature is the *Apocalypsis*, of which at least two recensions with illustrations may be pointed out. One gives the text as we know it, with or without commentary, for which *cf.* Brit. Mus., 17,333 (French), 18,633 (French, but written in England), Reg. 2 D. xiii., and 22,493 (French),—all four early 14th century. Another is more a short history or biography of St John, but the illustrations follow those of the former work very closely; *cf.* Brit. Mus., 19,896 (15th century, German). It is this last recension which agrees with the block-book to be mentioned hereafter. Other devotional works are the *Ars Moriendi*, the *Antichrist*, and other works which will be found mentioned among the block-books.

Block-Printing or Xylography.

Block-printing.

When all this writing, transcribing, illuminating, &c., had reached their period of greatest development, the art of printing from wooden blocks (block-printing, xylography) on silk, cloth, &c., vellum, and paper made its appearance in Europe. It seems to have been practised, so far as we have evidence, on cloth, &c., and vellum as early as the 12th century,[4] and on paper as far back as the second half of the 14th century, while it was largely employed in the early part of the 15th in the production of (1) separate leaves (called *briefs*, from *breve*, scriptum), containing either a picture (*print*, *prent*, shortened from the Fr. *emprint*, *empreinte*, and already used by Chaucer, *C. T.*, 6186, six-text, D. 604, *printe*, *prente*, *preente*, and in other early English documents; also called in colloquial German *Helge*, *Helglein*, or *Halge*) or a piece of text, or both together;

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[1] See Ern. Satow, "On the Early Hist. of Printing in Japan," in *Trans. Asiat. Soc. of Japan*, x. 48 *sq.*; and Stan. Julien, "Documents sur l'Art d'Imprimer," &c., in *Journ. Asiat.*, 4ème ser., ix. 505.

[2] We find this title applied to at least three works,—(1) the well-known block-book, of which we speak below, (2) a treatise "in qua de vitiis et virtutibus agitur," and (3) a work in rhyme by Alexander Gallus.

[3] See Laib and Schwarz, *Biblia Pauperum*, Zurich, 1867.

[4] Weigel, *Anfänge*, i. 10.

and of (2) whole block-books, sometimes consisting of half picture and half text, or wholly of text, or altogether of picture.[1] It is, however, certain that about 1400 xylography was known all over Germany, Flanders, and Holland.

In these blocks, as in wood-engraving now, the lines to be printed were in relief. The block, after the picture or the text had been engraved upon it, was first thoroughly wetted with a thin, watery, pale brown material, much resembling distemper; then a sheet of damp paper was laid upon it, and the back of the paper was carefully rubbed with some kind of dabber or burnisher, usually called a *frotton*, till an impression from the ridges of the carved block had been transferred to the paper. In this fashion a sheet could only be printed on one side (anopisthographic); and in some copies of block-books we find the sides on which there is no printing pasted together so as to give the work the appearance of an ordinary book. There are only a few block-books which do not possess this characteristic, as the *Legend of St Servatius* in the royal library of Brussels, *Das Zeitglöcklein* in the Bamberg library (*cf.* Falkenstein, p. 49), *Das geistlich und weltlich Rom* at Althorp and Gotha (*cf.* Falkenstein, p. 46); but these belong to the end of the 15th century, and therefore to a later period than the ordinary block-books. Consequently, if a man wanted to set up as a printer of briefs or books, he needed no apparatus but a set of wood-blocks and a rubber.

Block-printers.

Formerly it was the general opinion that playing-cards had been the first products of xylography; but the earliest that have been preserved to us are done by hand, while the printed ones date from the 15th century, therefore from a period in which woodcuts were already used for other purposes. It is believed that some of the wood engravings and block-books were printed in monasteries. In a necrology of the Franciscan monastery at Nördlingen, which comes down to the beginning of the 15th century, this entry occurs: "VII. Id. Augusti, obiit Frater h. Luger, laycus, optimus incisor lignorum"; and on some of the engravings we find the arms of certain monasteries, which may, however, merely mean that they were printed for, not in, those monasteries. The registers of Ulm mention several wood-engravers (*formschneider*),—in 1398 a certain Ulrich; in 1441 Heinrich Peter von Erolzheim, Joerg, and another Heinrich; in 1442 Ulrich and Lienhart; in 1447 Claus (Nicolas), Stoffel (Christopher), and Johann; in 1455 Wilhelm; in 1461 Meister Ulrich, &c. In a register of taxes of Nordlingen we find from 1428 to 1452 a certain Wilhelm Kegeler mentioned as *briefdrücker*; in 1453 his widow is called *alt briefdrückerin*; and in 1461 his brother Wilhelm is registered for the same craft. At Mainz there was a printer, Henne Cruse, in 1440. At Nuremberg we find in 1449 Hans, a *formschneider*, while his son Junghans exercised the same industry from 1472 to 1490. Hans von Pfedersheim printed at Frankfort in 1459, and Peter Schott at Strasburg in 1464. A certain George Glockendon exercised the same trade at Nuremberg till 1474, when he died, being succeeded by a son and afterwards by a grandson. In Flanders a Jan de Printere was established at Antwerp in 1417; and printers and wood engravers (*houte bildsnyters*) worked there in 1442 (*Privileges of the Corporation of St Luke* at Antwerp). At Bruges *printers* and *beeldemakers* (makers, engravers of images) were enumerated in 1454 among the members of the fraternity of St John the Evangelist. The printers of playing cards seem to have constituted a separate class. These entries show that about the middle of the 15th century there were men who exercised the art of wood-engraving and printing as a trade or craft. It seems also certain that wealthy persons and religious institutions were wont to possess sets of blocks, and, when occasion arose, they printed a set of sheets for presentation to a friend, or in the case of monasteries for sale to the passing pilgrim. A printer of briefs or block-books had no need to serve an apprenticeship; any neat-handed man could print for himself. We learn from the inventory of the possessions of Jean de Hinsberg, bishop of Liége (1419-1455), and his sister, a nun in the convent of Bethany, near Mechlin, that they possessed "unum instrumentum ad imprimendas scripturas et ymagines," and "novem printe lignee ad imprimendas ymagines cum quatuordecim aliis lapideis printis." These entries would seem to indicate that people purchased engraved blocks of wood or of stone from the woodcutter rather than books from a printer.

Early dated wood-engravings.

The earliest dated woodcut that we know of is the St Christopher of 1423, preserved in the library of Lord Spencer at Althorp. The Mary engraving, which is preserved at Brussels and apparently bears the date mccccxviii., is now declared to be of 1468, the date having been falsified. The next date after that of the St Christopher is 1437, found on a woodcut preserved in the imperial library at Vienna. It was discovered in 1779 in the monastery of St Blaise in the Black Forest, and represents the martyrdom of St Sebastian, with fourteen lines of text. The date, however, is said by others to refer to a concession of indulgences. A woodcut, preserved in the library at Vienna, which represents St Nicolas de Tolentino, has the date 1440, but written in by hand; as the saint was canonized in that year, it may refer to that event. Another in the Weigel collection representing the bearing of the cross, St Dorothea and St Alexis, has the date 1443, also written in by hand, though the woodcut is considered to belong to that period. These are the only known wood-engravings with dates anterior to the second half of the 15th century. But there exist a good many woodcuts which, from the style of the engraving, are presumed to be of an earlier date, and to have been printed partly in the fourteenth and partly in the first half of the 15th century. J. D. Passavant[2] enumerates twenty-seven, all of German origin and preserved in various libraries in Germany, while in the *Collectio Weigeliana* (vol. i.) no fewer than 154 are recorded, some of which are to be ascribed to the Netherlands. We know of the existence of at least five engravings which may be ascribed to the Netherlands:—(1) representing the Virgin Mary, with Dutch inscriptions, in the museum at Berlin; (2) representing the Virgin Mary spoken of above, in the library at Brussels; (3) representing St Anthony and St Sebastian, in the Weigel collection; (4) a St Hubert and St Eustatius, in the royal library at Brussels; (5) representing the Child Jesus, in the library at Berlin; (6) the Mass of St Gregory, with indulgence, in the Weigel collection (*cf.* i. 195).

Block-books of German origin.

Of block-books of probable German origin the following are known:—

(1) The *Apocalypsis*, or *Historia S. Johannis Evangelistæ ejusque Visiones Apocalypticæ* (Germ. *Das Buch der haymlichen Offenbarungen Sanct Johans*). Of this work six or seven editions are said to exist, each containing forty-eight (the 2d and 3d edition fifty) illustrations, on as many anopisthographic leaves, which seem to have been divided into three quires of eight sheets each. The first edition alone is without signatures.

(2) *Ars Moriendi.* Of this work some authors think that there are early German editions, among others that spoken of below as the 2d Dutch edition. Certainly German is the edition of Hans Sporer of Nuremberg, 1473, in the public library at Zwickau, of another by Ludwig zu Ulm, in the Paris national library, and of that described in *Collectio Weigel.* (ii. 16), where also other, but opisthographic, editions are described.

(3) *Ars Memorandi*; thirty leaves, folio, printed on one side, fifteen leaves being letter-press and fifteen plates.

(4) *Salve Regina*, bears the name of its engraver, Lienhart czu Regenspurck. It is composed of sixteen leaves; two leaves (signature *a*) are wanting in the only copy known of it, which was in the Weigel collection (ii. 103).

(5) *Vita Christi*; thirty-two leaves, sm. 8vo. Two copies in the Paris library (Sotheby, ii. 143).

(6) *The Ten Commandments for Unlearned People* (*Die zehn Bott für die ungelernte Leut*). Ten leaves are preserved in the library at Heidelberg bound up with a manuscript (No. 438).[3]

(7) *The Passion of Our Lord*; sixteen leaves, in the Weigel collection (Sotheby, ii. 141).

(8) *The Antichrist* (*Der Enndchrist*); twenty-six leaves, small folio (Sotheby, ii. 38; Weigel, ii. 111). Copies, Lord Spencer and coll. Weig.

(9) *The Fifteen Signs of the Last Judgment*; twelve engravings, usually bound up with the engravings of *The Antichrist* (Sotheby, ii. 42). Copy, Lord Spencer. There is also an edition published at Nuremberg in 1472 by Junghannss Priffmaler.

(10) *Symbolum Apostolicum*; small quarto, seven leaves printed on one side only, and containing twelve woodcuts with German inscriptions. The only copy of it known is preserved in the library of Munich (Sotheby, ii. 148).

(11) *The Legend of St Meinrad*; forty-eight leaves. The only copy known is preserved in the Munich library (Sotheby, ii. 150).

(12) The *Acht Schalkheiten*, of which eight leaves were in the Weigel collection (i. 112; Sotheby, ii. 154).

(13) The *Fable of the Sick Lion*; twelve leaves, preserved in the library at Heidelberg (No. 438; see Sotheby, ii. 159, pl. lxxxvi.).

(14) *Defensorium Inviolatæ Virginitatis b. Mariæ Virginis*; sixteen leaves fol. The unique copy is in the British Museum. On the first leaf are the initials of the printer F[riedrich] W[althern] and the date 1470 (Sotheby, ii. p. 63).

(15) The same work, twenty-seven leaves, large folio, with the imprint "Johannes eysenhüt impressor Anno ab incarnacōis dñice M° quadringentesimo septuagesimo j°" (*cf.* Sotheby, ii. 72). Copy in the British Museum.

(16) *The Dance of Death* (*Dance Macabre*; *Der Doten Dantz*); twenty-seven leaves (Sotheby, ii. 156).

(17) *Die Kunst Ciromantia* of Dr Johan Hartlieb (Sotheby, ii. 84).

(18) *Der Beichtspiegel* or *Confessionale*; eight engravings (Sotheby, ii. 145). Copy in the royal library at The Hague.

(19) The Apostles' Creed; seven leaves, folio. Copy at Wolfenbuttel.

(20) The Credo, in German; twelve leaves, quarto. Copy in the royal library at Munich.

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[1] We have also evidence that sometimes the picture or figures were printed from blocks, space being reserved for the text, to be added afterwards by hand (see Bernard, *Origin.*, i. 102).

[2] *Le Peintre-Graveur*, i. 27 sq.

[3] See Joh. Geffcken, *Der Bildercatechismus des 15 Jahrh.*, Leipsic, 1855, quarto; Sotheby, ii. 160.

Propugnacula, seu Turris Sapientiæ; one sheet, plano, Brit. Mus. (Sotheby, ii. 164).

Of Netherlandish origin

Block-books of Netherlandish origin are:—

(1) *Biblia Pauperum*; forty leaves (each bearing a signature; *a* to *v*, ·*a*· to ·*v*·). As many as seven editions have been distinguished by Sotheby (i. 43; see also Holtrop, *Monum. Typ.*, p. 3).

(2) *Ars Moriendi*;[1] twenty-four leaves, small folio, thirteen containing text, eleven plates (see Sotheby, i. 69; Holtrop, p. 8).

(3) *Canticum Canticorum, Historia seu Providentia B. Virginis Mariæ ex Cantico Canticorum*; sixteen leaves, in fol. (Sotheby, i. 77; Holtrop, p. 6).

(4) *Liber Regum, seu Historia Davidis*; twenty leaves, folio (Sotheby, i. 120b). Some consider this to be a German work.

(5) *Exercitium super Pater Noster*, by Henricus de Pomerio; ten leaves, small folio (Sotheby, ii. 137; Holtrop, p. 10).[2]

(6) *Temptationes Demonis Temptantis Hominem de Septem Peccatis Mortalibus*; a single large folio leaf printed on one side. Two copies, one in British Museum, the other in the library at Wolfenbüttel.

(7) *Vita Christi*, or the *Life and Passion of Christ*; thirty-six cuts, originally printed in a press on six anopisthographic leaves, 8vo. In the library at Erlangen (see Campbell, *Annales*, 746).

(8) *Historia Sanctæ Crucis*; a fragment of one leaf (with signature *g*), preserved in the Weigel collection (ii. 92), which seems to be a proof-sheet only.

(9) *Alphabet* in figures (Holtrop, p. 11; Sotheby, i. 122).[3]

(10) *Pomerium Spirituale*, by Henricus de Pomerio or Henry Bogaert; twelve leaves, having twelve woodcuts accompanied by MS. text, in the library at Brussels (Holtrop, *Mon. Typ.*, p. 9). It bears the date 1440 in two places; but some contend that this refers to the date when the book was written,[4] not when the engravings were printed.

Besides the works of Sotheby, Holtrop, and Weigel, already quoted, consult W. M. Conway, *The Woodcutters of the Netherlands in the 15th Century*, Cambridge, 1884; Heineken, *Idée Générale*, Leipsic, 1771; J. Ph. Berjean, *Facsimiles of the Biblia Pauperum, Canticum Canticorum, Speculum*, London, 1859-1861; and Id., *Catal. Illustré des Livres Xylogr.*, London, 1865.

Early Printing at Mainz.

When we, for the moment, leave out of sight the question as to when, where, and by whom the art of printing with movable metal types was invented, and take our stand on well-authenticated dates in such printed documents as have been preserved to us, we find that the first printed date, 1454, occurs in two different editions of the same letters of indulgence issued in that year by Pope Nicholas V. in behalf of the kingdom of Cyprus.

Nicholas V.'s indulgence of 1454.

These two editions are distinguished respectively as the 31-line and the 30-line indulgence. The former, of which three different issues with the printed date mccccliiii., and a fourth with the printed date mcccclv., are known to exist, claims priority[5] from a chronological point of view over the latter, of which one issue with the printed date mccccliiii., and two issues with the printed date mccccl quinto, are known to exist, because one of the sold copies that has been preserved was issued at Erfurt on 15th November 1454, whereas of the 30-line indulgence the earliest sold copy that has as yet come down to us was issued at Cologne on 27th February 1455, though it distinctly has the printed date mccccliiii., but altered with the pen to mccccliiiij. In the 31-line indulgence occur (1) a large church type usually regarded as identical with that of the 36-line Bible, and used for the rubrics of the absolutions, for the word with which the document commences, and for the Christian name of the pope's legate; (2) a smaller text or brief type, which was afterwards very closely imitated, if not actually used, at Eltville, in printing the 1472 edition of the *Vocabularius ex quo* and an edition of the *Summa de Articulis Fidei* of Thomas Aquinas; (3) a large initial V and two large initials M, which differ from each other. In the 30-line indulgence occur (1) a large church type, which is used as in the 31-line indulgence, and is usually regarded as identical with that of the 42-line Bible; (2) a smaller text or brief type, of which as yet no further trace has been found; (3) a large initial U, and two large initials M, which differ from each other, the first being identical with the initial M of the second absolution of a 33-line indulgence printed by Peter Schoeffer in 1489 for "Raymundus Peyraudi, archidiaconus Alnisiensis in ecclesia Xanton," who issued it at the order of Pope Innocent VIII., "pro tuicione orthodoxe fidei contra Turchos." These two different editions are usually regarded as having been printed at Mainz; and, so long as there is no evidence to the contrary, we may assume that such was really the fact. But we must at the same time conclude that about November 1454 there were at least two rival printers at work there,—(1) the printer of the 31-line indulgence, whose name has not yet transpired, but who may have been Johan Gutenberg, perhaps subsidized by Johan Fust; (2) the printer of the 30-line indulgence, who was no doubt Peter (Schoeffer) de Gernsheym, on account of the connexion of this indulgence with that of 1489, which was unquestionably printed by him. Latterly four written copies of the same indulgence have been found, which respectively bear the dates,—Frankfort, 10th April 1454 (in the possession of Herr Lais, Wiesbaden); Frankfort, 11th April 1454 (Frankfort archives); 11th July 1454 (place unknown; Darmstadt archives); Lubeck, 6th October 1454. As their dates precede by a few weeks only the earliest known printed date (15th November 1454), they mark, perhaps, the exact time when printing made its appearance at Mainz in an already advanced state of perfection.

Mainz print

Early types and books at Mainz.

In following up the basis afforded by the above indulgences we may give a short chronological view of the early printing at Mainz, so far as it is at present known, referring for minute details to J. H. Hessels, *Gutenberg: Was he the Inventor of Printing?* 1882, p. 150 *sq.*

TYPES 1 (large church type) and 2 (smaller brief type), used by an unknown printer, 1454.

(i.) 31-line indulgence; three different issues (A, B, C), with the printed year mccccliiii., and one issue (D) with the printed year mcccclv. All printed on vellum. Of issues A and B no sold copies have yet come to light. Three unsold copies of each are preserved at (1) Brunswick, (2) Wolfenbuttel, and (3) Hanover (Culemann). Of issue C eight sold copies are known to exist in various libraries, with dates from Nov. 15 1454 to Apr. 30 1455. Also four unused copies have been discovered. Of issue D ten sold copies with dates from Mar. 7 1455 to Apr. 30 1455 and four unused copies are known.

TYPE 1, *continued*; for type 2 see below.

(ii.) *Manung widder die Durke.* An almanac for Jan. 1455, in 4to, 5 leaves, 20 and 21 uneven lines. The only copy known was discovered at Augsburg, and is now in the Munich library.

(iii.) *Conjunctiones et Oppositiones Solis et Lunæ.* A calendar for 1457, a broadside sheet, printed on one side. The upper half of the only copy known was discovered at Mainz, and is now in the Paris library.

(iv.) *Der Cisianus* (not Cislanus) *zu Dutsche.* A broadside sheet, printed on one side, 36 lines, besides separate head-line. The Tross copy, mentioned in Suppl. to Brunet's *Manual* (1878, s.v. "Cislanus"), was bought in 1870 for the Cambridge university library.

(v.) and (vi.) *Donatus.* Two different editions of 14 (?) leaves each, 27 lines (B. Mus., C. 18 e 1, Nos. 2 and 5).

(vii.) *Donatus* of 30 lines, 12 (?) leaves; a fragment of the 8th (?) in the Mainz library.

(viii.) 36-line Bible. 2 vols. fol. 882 leaves, with 2 columns of 36 lines each on a page. Some bibliographers call this the Pfister Bible, assuming that Pfister printed it. The Paris library possesses a paper copy, and also a separate copy of the last leaf, which bears the MS. date 1461. Other copies exist in Lord Spencer's library, in the Brit. Mus., at Jena, Leipsic, Antwerp, &c.[6]

TYPES 3 (large church type) and 4 (smaller brief type), used by Peter Schoeffer de Gernssheym, 1454-1455.

(i.) 30-line indulgence; one issue (A) with the printed year mccccliiii., and two issues (B, C) with the printed year mccccl quinto. All printed on vellum. Of issue A only one copy has been discovered, now in Lord Spencer's library. It was sold at Cologne on Feb. 27 1455, the printed date mccccliiii. having been altered with the pen to mccccliiiij. Of issue B two sold copies, with dates Apr. 11 and 29 1455, are in the Berlin library and the Brit. Mus. Of issue C two sold copies, with dates Feb. 22 and Apr. 24 1455, are at Hanover (Culemann) and Wolfenbuttel. An unsold copy is at Hanover (Culemann).

TYPE 3, *continued* (till about 1457); of type 4 no further trace is found.

(ii.) *Donatus* of 24, 25, or 26 lines, 24 (?) leaves; one leaf (the 8th or 9th ?) in the Mainz library.

(iii.) *Donatus* of 32 lines, 14 (?) leaves, the 10th (?) in the Mainz library.

(iv.) *Donatus* of 33 lines, two leaves in the Paris library.

(v.) *Donatus* of 35 lines, folio; printed, according to the colophon, "per Petrum de Gernssheym, in urbe Moguntina cum suis capitalibus."

(vi.) 42-line Bible (also called Mazarine Bible), printed before Aug. 15 1456, as the binder of the paper copy in the Paris library states that he finished its rubrication on that day. 2 vols. fol., 641 leaves of 2 columns of 42 lines each, except that in some copies the columns of pp. 1-9 contain 40 lines only, while the 10th page has 2 columns of 41 lines each, though the difference in the number of lines makes no difference in the space which they occupy.[7]

(vii.) 42-line *Cantica ad Matutinas.* The first and only leaf known is in the Paris library. It is printed on vellum, and corresponds in every respect to the 42-line Bible, having double columns, 42 lines, &c.

The above four types and the books printed with them (besides a few others printed by Albrecht Pfister at Bamberg) are the only ones that stand in close connexion with the question regarding the introduction, or the possible invention, of printing at Mainz. It has been pointed out above that one of the initial M's of the 30-line indulgence of 1454 occurs again in an indulgence of 1489, printed by Schoeffer; hence types 3 and 4 and the books printed with them must be ascribed to this printer, in spite of the fact that the capital P found in the indulgence does not seem to occur again in the 42-line Bible. No further trace of the brief type 4 has yet been found, and perhaps Schoeffer melted it down for his other types. As Schoeffer, in the colophon of the *Donatus* (v.) which bears his name alone, says that it was printed "cum suis capitalibus," and as these capitals gradually disappear after 1459 and the type of the 42-line Bible is no longer found after 1456, we must presume that the seven incunabula mentioned above were printed by Peter Schoeffer alone before he entered (in 1457) into partnership with Johan Fust.[1]

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[1] Heineken enumerates six editions, of which one has inscriptions in German. See also an article by Guichard, in *Bull. du Bibliophile*, Paris, 1841.

[2] See also W. M. Conway, *Notes on the Exercitium super Pater Noster*, 1887.

[3] There is one copy in the British Museum and another in the library at Basel, this last having the date 1464 engraved on the letter A, which is mutilated in the former. A similar alphabet preserved at Dresden seems to be a copy made in Germany.

[4] Mr W. M. Conway is of a different opinion; see *Notes on Exercitium*. Dumortier testifies to having seen another copy unaccompanied by MS. ("Notes sur l'Imprimerie," in *Bull. Acad. Roy. de Belg.*, vol. viii., 1841).

[5] No inferences can be drawn from this priority, as it merely rests on the date of a sold copy that has come to light.

[6] See Hessels, *Gutenberg*, p. 160; and Bernard, *Origine*, ii. 31.

[7] For other copies, see Bernard, *Origine*, i. 164, 177-192; and Hessels, *Gutenberg*, 170.

There is no such certainty as regards types 1 and 2 and the books printed with them. If the 31-line indulgence may be assumed to have been printed at Mainz, its printer was in all probability Johan Gutenberg, though it would seem from a lawsuit of 1455 (see p. 690 below) between him and Fust that in that year Gutenberg had not yet printed anything, and in 1454 (1455) Fust evidently called him to account for not having produced anything. Certain circumstances point to Albrecht Pfister as the printer of the eight incunabula in the left-hand column. First, he undoubtedly printed with type 1 in that city as early as 1461, for on 14th February of that year he issued in that type an edition of Boner's *Edelstein* (88 leaves, fol., with wood engravings), and printed with the same type at least eight other works,[2] one of which was issued in 1462, the seven others without a date. Secondly, most of the copies of the 36-line Bible were at one time or another preserved in the libraries of Bavaria, and a great number of fragments have been discovered in monasteries in that country, even in a register of the abbey of St Michael at Bamberg of the year 1460. Thirdly, a transfer of type from Gutenberg to Pfister is contrary to all analogy in the infancy of printing, when every printer started with a type of his own making. But, as there is no direct evidence as to who really possessed types 1 and 2 before 1460, we have not felt justified in assigning the 31-line indulgence and the other seven incunabula (including the 36-line Bible) to Pfister.

Catholicon type. It is alleged that, in consequence of the lawsuit between Gutenberg and Fust, the former was deprived of all tools, &c., which he had made, or is supposed to have made, with the money which the latter had advanced to him, and that afterwards a certain Dr Homery or Humery, a syndic of Mainz, lent him fresh money to enable him to establish another printing office. This allegation is made on the strength of a letter of obligation (of 26th February 1468), given by Dr Homery to Adolph, the archbishop of Mainz, by which he acknowledges to have received from the said archbishop "several forms, letters, instruments, implements, and other things belonging to the work of printing, which Johan Gutenberg had left after his death, and which had belonged and still did belong to him (Dr Homery)." It is presumed that with these types, which we may call the Mainz type No. 5, Gutenberg printed (i.) Joannes de Balbis, *Catholicon*, 1460, 373 leaves, folio, 2 columns of 66 lines each, copies of which exist in the Cambridge university library, three in the British Museum, two in the Paris library, in Lord Spencer's library, in the Wolfenbüttel and Mainz libraries, &c.; (ii.) Matthæus de Cracovia, *Tractatus Rationis*, 22 leaves, 4to, 30 lines, three copies of which are in the British Museum, one at Althorp, one in the Cambridge library, two in the Paris library, &c.; (iii. and iv.) Thomas Aquinas, *Summa de Articulis Fidei*, two editions in 4to, the first of 13 leaves and 34 lines,—two copies of which are in the British Museum, one in Lord Spencer's, the Cambridge library, &c.—and the second of 12 leaves and 36 lines,—copies in the British Museum and the Paris library; and (v.) indulgence of 1461 of 15 lines.

On 18th January 1465 Adolph II., archbishop of Mainz, appointed "Johan Gudenberg, on account of his grateful and willing service, his servant and courtier (*dhiener und hoffgesind*) for life, promising to supply him with clothing and each year 20 'malter' of corn and 2 'fuder' of wine." It has always been inferred from this that Gutenberg had quitted Mainz and gone to Eltville (Elfeld) to reside at the archbishop's court, and that, his dignity as courtier preventing him from printing himself, he passed the *Catholicon* types on to Henry Bechtermuncze at Eltville. But recent researches have shown that Gutenberg remained at Mainz till his death in 1468. We certainly find in 1467 the *Catholicon* type with some additions (already found in the indulgence of 1461) at Eltville near Mainz, in the hands of Henry and Nicholas Bechtermuncze and Wigandus Spyes de Orthenberg, who finished on 4th November of that year (vi.) *Vocabularius ex quo* (a Latin-German vocabulary) in 4to, 166 leaves, 35 lines, the only known copy of which is in the Paris library, and (vii.) *Vocabularius ex quo*, second edition, with colophon dated 5th June 1469, 4to, 165 leaves, 35 lines, copies of which exist in Lord Spencer's library, at Blenheim, and in the Paris library. Now it is asked how the Bechtermunczes could have been using the *Catholicon* type in 1467, if we assume that it was this type to which Homery refers in his letter of obligation as being in his possession. Some, therefore, conclude that the *Catholicon* and the four other works in the same type were printed at Mainz by Henry Bechtermuncze, who may afterwards have transferred his printing office to Eltville. In that case it is difficult to see what type Homery could refer to, unless it were type 2, a close imitation of which, if not the actual type, was used by Nicholas Bechtermuncze at Eltville in printing (12th March 1472) a third edition of the *Vocabularius ex quo*, 166 leaves, 35 lines, copies of which are preserved in the Paris and Hamburg libraries, and an edition of Thomas Aquinas, *Summa de Articulis Fidei*, 12 leaves, 35 lines (Munich library).

It is necessary to point out that for nearly seventy years eight books—(1) *Prognostication* or *Calendar*; (2) Hermann de Saldis, *Speculum Sacerdotum*; (3) *Tractatus de Celebratione Missarum*; (4) a work in German treating of the necessity of councils; (5) *Dialogus inter Hugonem Cathonem et Oliverium super Libertate Ecclesiastica*; (6) Sifridus de Arena, *Determinatio Duarum Quæstionum*; (7) Id., *Responsio ad Quatuor Quæstiones*; (8) *Klagspiegel*, or *New geteutscht Rechtbuch*—have been ascribed to Gutenberg on the strength (*a*) of the date 1460, which was said to be found in the *Prognostication* in the Darmstadt library, and (*b*) of a so-called rubrication alleged to be in a copy of the *Tractatus de Celebratione Missarum*, in which "Johannes dictus a bono monte" and Johannes Numeister are represented as offering this work on 19th June 1463 to the Carthusians at Mainz. But the date in the *Prognostication* has been falsified from 1482 into 1460, and the rubrication in the *Tractatus* is a forgery.[3] The eight books are now considered to have been printed by Erhard Reuwich.

When we set aside the above works, there is no further difficulty as regards the history of Mainz printing. Fust and Schoeffer worked together from 1457 to 1466, starting in August 1457 with an edition of the *Psalterium*, printed in large missal types, which, as far as we know, is the first printed book which bears a date, besides the place where it was printed and the name of the printers. It was reprinted with the same types in 1459 (the second printed book with date, place, and name of printer), in 1490, and in 1502 (the last work of Schoeffer, who had manufactured its types). In 1459 Fust and Schoeffer also published Gul. Durantus, *Rationale Divinorum Officiorum*, with the small type (usually called Durandus type) with which they continued to print long afterwards. In 1460 they published the *Constitutiones* of Pope Clement V., the text printed in a type (Clement type) about a third larger than the Durandus. This type was, however, in existence in 1459, as the colophon of the Durandus is printed with it.[4]

Spread of Typography.

Spread of typography. Having explained the early printing of Mainz, in so far as it bears upon the controversy (see below) as to where and by whom the art of printing was invented, we can follow its spread to other countries. After Mainz it was first established in 1460 at Strasburg, where the first printers were,—1. Johann Mentelin, who completed a Latin Bible in that year, according to a rubrication in a copy at Freiburg in the Breisgau; 2. Adolph Rusch de Inguilen, who is presumed to be the printer of the undated books with a singularly-shaped R,[5] c. 1464; 3. Henricus Eggestein, 1471; 4. George Husner; 5. Martin Flach, &c. In 1461 at Bamberg, where the first printer was Albrecht Pfister, who in that year published Boner's *Edelstein*, though it is still doubtful whether he did not print earlier (see above); 2. Joh. Sensenschmidt, c. 1480. 1465 at Subiaco; first and only printers Conrad Sweynheym and Arnold Pannarts, who completed in that year an edition of Cicero, *De Oratore*, and Lactantius, and removed to Rome in 1467. 1466 at Cologne, the printers being—1. Ulrich Zell, who published in that year Chrysostom, *Super Psalmo Quinquagesimo Liber Primus*, though it is presumed that he printed in 1463; 2. Arnold Ther Hoernen, 1470; 3. Johannes Koelhoff of Lübeck, 1470, who printed the *Cologne Chronicle* in 1499; 4. Nicolaus Götz, 1474; 5. Goiswinus Gops, 1475; 6. Petrus de Olpe, 1476 (not 1470); 7. Conradus Winter of Homburg, 1476; 8. Joh. Guldenschaaf, 1477; 9. Henricus Quentel, 1479, &c.[6] 1467 at Eltville; first printers Nicolas and Henry Bechtermuncze and Wygandus Spyes de Orthenberg, who completed in that year a *Vocabularius ex quo*. 1467 at Rome; first printers Conrad Sweynheym and Arnold Pannarts from Subiaco, who published an edition of Cicero's *Epistolæ ad Familiares*, and Ulrich Hahn or Udalricus Gallus, who issued on 31st December 1467 Turrecremata's *Meditationes*. 1468 at Augsburg; first printer Günther Zainer or Zeyner. Same year at Basel; first printer Berthold Rot of Hanau. Same year at Marienthal; Brothers of the Common Life. 1469 at Venice; printers,—1. Johannes of Spires; 2. his brother Vindelinus of Spires; 3. Christopher Valdarfer; 4. Nicolas Jenson, &c. The further spread of typography is indicated by the following data:—1470 at Nuremberg (Johan Sensenschmidt, Friedr. Creusner, Anton Koberger, &c.), Berona or Beromünster in Switzerland (Helyas Helye *alias* De Llouffen), Foligno (Emilianus de Orfinis and Johannes Numeister), Trevi (Johann Reynard), Savigliano

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[1] See for details, Hessels, *Gutenberg*, p. 166 sq.

[2] See Hessels, *Gutenberg*, p. 161 sq.

[3] See Hessels, *Gutenberg*, pp. 107-114.

[4] See further Bernard, *Origine de l'Imprimerie*, i. 216 sq.

[5] M. Philippe, *Origine de l'Imprimerie à Paris*, p. 219, mentions two books printed in this type, which contain manuscript notes to the effect that they were purchased in 1464 and 1467, so that Inguilen should be placed before Eggestein.

[6] Johan Veldener, who is said to have printed at Cologne, was never established there, but at Louvain (1473-77), Utrecht (1478-81), and Culenborg or Kuilenburg (1483-84); see Holtrop, *Mon. Typ.*, pp. 42, 47, 109.

(Hans Glim), Paris (first printers the three partners Ulrich Gering, Michael Friburger, Martin Krantz); 1471 at Spires, Bologna, Ferrara, Florence, Milan, Naples, Pavia, Treviso, Savigliano (?); 1472 at Esslingen, Cremona, Mantua, Padua, Brescia, Parma, Monreale (Mondovi), Fivizzano, Verona, Iesi (?), St Ursino (?); 1473 at Lauingen, Ulm (perhaps as early as 1469), Merseburg, Alost, Utrecht, Lyons, Messina, Buda; 1474 at Louvain, Genoa, Como, Savona, Turin, Vicenza, Valencia (?); 1475 at Lübeck, Breslau, Blaubeuren, Burgdorf, Trent, Cracow (?), Modena, Reggio (in Calabria), Cagli, Caselle or Casale, Pieve (Piove) di Sacco, Perugia, Piacenza, Saragossa; 1476 at Rostock, Bruges, Brussels, Angers, Toulouse, Polliano (Pogliano); 1477 at Reichenstein, Deventer, Gouda, Delft, Westminster, Lucca, Ascoli, Palermo, Seville; 1478 at Oxford, St Maartensdyk, Colle, Schussenried (in Würtemberg), Eichstädt, Geneva, Vienne, Trogen (?), Chablis, Cosenza, Prague, Barcelona; 1479 at Erfurt, Würzburg, Nimeguen, Zwolle, Poitiers, Toscolano, Pinerolo, Novi, Lerida, Segorbe; 1480 at London, St Albans (or in 1479), Oudenarde, Hasselt, Reggio (in Modena), Salamanca, Toledo, Nonantola, Friuli (?), Caen; 1481 at Passau, Leipsic, Magdeburg, Treves, Urach, Casale di San Vaso, Saluzzo, Albi, Rougemont (?); 1482 at Reutlingen, Memmingen, Metz, Pisa, Aquila, Antwerp, Promentour, Zamora, Odense; 1483 at Leyden, Kuilenburg (Culenborg), Ghent, Chartres, Chalons-sur-Marne (?), Troyes, Gerona, Stockholm; 1484 at Bois-le-Duc, Siena, Udine, Soncino, Winterberg, Klosterneuburg, Rennes, Loudéac; 1485 at Heidelberg, Ratisbon, Pescia, Vercelli, Tréguier or Lantreguet, Salins, Burgos, Palma, Xeres; 1486 at Münster, Stuttgart, Chiavasco, Voghera, Casal Maggiore, Abbeville, Brünn, Schleswig; 1487 at Ingolstadt, Gaeta, Rouen, Murcia; 1488 at Stendal, Viterbo, Gradisca, Besançon, Constantinople; 1489 at Hagenau, San Cucufat (near Barcelona), Coria, Pamplona, Tolosa, Lisbon; 1490 at Orleans, Grenoble, Dôle; 1491 at Hamburg, Nozzano, Goupillières, Angoulême, Dijon, Lantenac; 1492 at Zinna, Valladolid, Leiria; 1493 at Lüneburg, Cagliari, Freiburg (in Breisgau), Urbino, Acqui; 1494 at Oppenheim, Monterey, Braga; 1495 at Freisingen, Freiberg, Scandiano, Forlì, Limoges, Schoonhoven (monastery Den Hem), Wadstena, Cettinje; 1496 at Offenburg, Provins, Granada; 1497 at Munich, Barco, Carmagnola, Avignon; 1498 at Tübingen, Perigueux, Schiedam, Tarragona; 1499 at Montserrat, Madrid; 1500 at Olmütz, Pforzheim, Sursée, Perpignan, Valenciennes, Jaen. Printing was introduced into Scotland in 1505 by the establishment of Andrew Millar at Edinburgh,[1] and into Ireland, at Dublin, in 1551. As for non-European countries and towns, printing was established in Mexico in 1544, at Goa about 1550, at Tranquebar in 1569, Terceira in the Azores 1583, Lima 1585, Manila and Macao (China) 1590, in Hayti in the beginning of the 17th century, at Puebla in 1612, Cambridge (Mass.) 1638, Batavia 1668, Tiflis 1701, Germantown 1735, Ceylon 1737, Halifax (Nova Scotia) 1766, Madras 1772, Calcutta 1778, Buenos Ayres 1789, Bombay 1792, in Egypt (at Alexandria, Cairo, and Gizeh) in 1798, at Sydney 1802, Cape Town 1806, Montevideo 1807, Sarepta 1808, Valparaiso 1810, Astrakhan 1815, in Sumatra and at Hobart Town and Santiago (in Chili) in 1818, in Persia (at Teheran) in 1820, and at Chios about 1821.[2]

Customs of early printers.

Till the moment (say 1477) that printing spread to almost all the chief towns of Germany, Italy, Switzerland, France, the Netherlands, Spain, England, not a single printer carried away with him a set of types or a set of punches or moulds from the master who had taught him, but, in setting up his printing office, each man cast a set of types for his own use, always imitating as closely as possible the handwriting of some particular manuscript which he or his patron desired to publish. When we compare Schoeffer's 30-line indulgence of 1454 with a manuscript copy of the same indulgence dated 10th April 1454, now in the hands of a private collector at Wiesbaden, we see that the types used in printing that document were specially cast for the purpose after the model of the handwriting employed for the written copies. We know also that the types of the 36-line and 42-line Bibles and those of the psalter of 1457 are the closest possible imitations of the ornamental church handwriting customary at the time of their production. Also, when we compare the 31-line indulgence of 1454 with the German block-book called the *Eundtchrist*, and both in their turn with the German MSS. of that period (especially the manuscript portions in the printed copies of the indulgences), we see that the cutter of the text type of the indulgence, as well as the engraver of the block-book, formed his characters according to some German handwriting (book hand) of the period. This imitation extended, not only to the shape of the letters, but likewise to all those combinations of letters (double *p*, double *f*, double *s*, *st*, *ti*, *tu*, *re*, *cu*, *ct*, *si*, *de*, *co*, *ci*, *te*, *ce*, *or*, *ve*, *po*, *fa*, *he*, *be*, &c.) and contractions (for *pro*, *-um*, *-em*, *-en*, *the-*, *uer*, *-bus*, *-bis*, *sed*, *am*, *tur*, *qui*, *quæ*, *quod*, *secundum*, &c.) which were then, and had been for many centuries, in use by scribes. In most, if not all cases, the MSS. which the printers imitated were indigenous to the place where they settled. Thus the first printers of Subiaco, though they were Germans and had most probably learned the art of casting types and printing at Mainz, clearly cut their types after the model of some Italian MS. which was free from any Gothic influence, but written in a pure Caroline minuscle hand, differing but slightly from the Caroline minuscles which the same printers adopted two years afterwards at Rome. The first Paris printers started in 1470 with a type cast in the most exact manner, on the model of the Caroline minuscle handwriting then in vogue at Paris. John de Westphalia, who introduced printing into Belgium, used from the beginning a type which he calls Venetian. Where therefore there is a great similarity, but no absolute identity, between the types of two printers (*e.g.*, Schoeffer and Ulr. Zell), it should be attributed to the similarity of the handwritings which the printers followed rather than to any attempt on their part to imitate each other's types. To this universal system (clearly discernible in the first twenty-five years of printing) of each printer setting up business with a new type cast by himself, there are, according to the conjectures of a good many bibliographers, only two exceptions. One is Albrecht Pfister (see above); the other is the Bechtermunczes of Eltville (see above).

Unevenness of lines

Another most important feature in the earliest books is that the printers imitated, not only the handwriting, with all its contractions, combined letters, &c., but all the other peculiarities of the MSS. they copied. There is in the first place the unevenness of the lines, which very often serves as a guide to the approximate date of a book, especially when we deal with the works of the same printer, since each commenced with uneven lines, and gradually made them less uneven, and finally even. This unevenness was unavoidable in manuscripts as well as in block-books; but in the earliest printed books it is regarded as evidence of the inability of the printers to space out their lines. If this theory be correct, this inability was perhaps owing to the types being perforated and connected with each other by a thread, or to some other cause which has not yet been clearly ascertained. But it is not impossible that the unevenness was simply part and parcel of the system of imitating MSS., and that only gradually (about 1473 or 1474, but in some cases later) printers began to see that even lines looked better than uneven. This seems clear when we observe that the imitation of MSS. was carried so far that sometimes things which deviated from the work of the scribe, but had accidentally been printed in, were afterwards erased and altered in conformity with the MS. The Paris library, for instance, possesses two copies of the *Liber Epistolarum* of Gasparinus Pergamensis (printed at Paris in 1470) in both of which the initial G of the first line and the initial M of the fourth line were printed in, and, whilst they have been allowed to remain in one of the copies, in the other they were regarded as a fault and replaced by a rubricated L and M.

Initials.

In the second place the initials of books or the chapters of books in MSS., and again in block-books and the earliest products of printing, were always, or at least in most cases (they are printed in the indulgences of 1454), omitted by the scribe and the printer, and afterwards filled in by the rubricator. As the latter artists were sometimes illiterate and very often filled up the gap by a wrong initial, we find in a good many MSS. as well as early printed books small letters written either in the margin or in the blank left for the initial, to guide the rubricator. In most cases where these letters (which are now called initial directors) were written in the margin, they were placed as much as possible on the edges of the pages in order that they might be cut away by the binder as unsightly; but in a vast number of incunabula they have remained till the present day.[3] After a few years these initial directors were in a good many books printed in (in lower-case type) with the text. In all cases, whether written or printed, they were meant to be covered by the illuminated initial; but, as a matter of fact, the latter very seldom covers the initial director so completely as to make it invisible, and in a good many cases the intended illumination was never carried into effect.

Hyphens

With respect to the hyphens, which were used in the 1454 indulgences and the 36-line and 42-line Bibles, always outside the printed margin, some of the earliest printers did not employ them at the moment that they started their presses, and in the case of some printers the non-use or use of hyphens, and their position outside or inside the printed margin, serve as a guide to the dating of their products. After about 1472 they become more uniform in their shape and more generally used.

Signatures

The use of signatures is confined in MSS. mostly to mark the quires, and in block-books to mark each sheet or page; they do not occur in printed books before 1472 (at least in no earlier book with a date), when they appear in Joh. Nider's *Præceptorium Divinæ Legis*, published by Johan Koelhoff at Cologne.

Catchwords.

Catchwords (*custodes*) were used for the first time about 1469 by Johannes of Spires, at Venice, in the first edition of Tacitus.

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[1] See Rob. Dickson, *Introd. of Art of Print. into Scotl.*, Aberdeen, 1885.

[2] On the introduction of printing in various towns, consult Henry Cotton, *A Typog. Gazet.*, 8vo, Oxford, 1831 and (second series, 8vo, Oxford) 1566; (P. Deschamps) *Dict. de Géogr. à l'Usage du Libraire*, 8vo, Paris, 1870; R. C. Hawkins, *Titles of the First Books from the Earliest Presses Established in Different Cities in Europe*, 4to, New York, 1884.

[3] The university library of Basel possesses a collection of the earliest Paris books still bound in their original binding, in which these initial directors are written not only on the outer edges but on the inner sides of the pages, and so close to the back that they can only be seen by stretching the books wide open.

Pagination or rather foliation was first used by Arn. Ther Hoernen, at Cologne in 1471, in Adrianus's *Liber de Remediis Fortuitorum Casuum*, having each leaf (not page) numbered by figures placed in the end of the line on the middle of each right-hand page.

The practice among early printers of imitating and reproducing MSS. was not abandoned till many years after the first printed book (1454) made its appearance; and, looking at the books printed, say from 1454 to 1477, from our present standpoint of daily improvement and alteration, the printing of that period may be said to have been almost wholly stagnant, without any improvement or modification. If some printers (for instance, Sweynheym and Pannarts at Subiaco and Rome, and Nicolas Jenson at Venice) produced handsomer books than others, this is to be attributed to the beauty of the MSS. imitated and the paper used rather than to any superior skill. Generally speaking, therefore, we shall not be very far wrong in saying that the workmanship of Ketelaer and De Leempt's first book, published at Utrecht *c.* 1473, and that of Caxton's first book issued at Westminster in 1477, exhibit the very same stage of the art of printing as the 1454 indulgences. If therefore any evidence were found that Ketelaer and De Leempt and Caxton had really printed their first books in 1454, there would be nothing in the workmanship of these books to prevent us from placing them in that year. And conversely, if the indulgences of 1454 had been issued without a date or without any names to indicate their approximate date, their workmanship would invariably induce bibliographers to ascribe them to *circa* 1470, if not somewhat later. Even after 1477 the alterations in the mode of printing books proceeded very slowly and almost imperceptibly. It came to be no longer a universal system for printers to begin business by casting a type for themselves, but some received their types from one of their colleagues. And, though there were still many varieties of types, one sort began to make its appearance in two or three different places. The combinations of letters were the first to disappear; but the contractions remain in a good many books even of the 17th century.

Some theories have been based on, and others have been considered to be upset by, the supposition that the early printers always required as much type as printers of the present day, or at any rate so much as would enable them to set up, not only a whole quire of 4 or 5 sheets (=8 or 10 leaves=16 or 20 pages), but even two quires (=40 pages). Consequently calculations have been made that, for instance, the printer of the 42-line Bible required a fount of at least 120,000 characters.[1] But, though the *Speculum Humanæ Salvationis* seems to have been printed by whole sheets (2 pages), there are numberless proofs that many early books were printed page by page, even when in small 4to. For instance, in some books it has been observed that portions of the types with which the text of the first, second, or third pages of a quire had been printed were used to "lock up" the types employed for the later pages of the same quire, as is evident from the blank impressions of such portions being found on these later pages. Again, in some books two, three, or four blank leaves are found at the end, showing a miscalculation of the printer. Moreover, the numerous itinerant printers of the 15th century, who established a press for a short time wherever they went, prove that the furniture of the earliest printing offices must have been of no great extent.

The Invention Controversy.

Now that we have traced the art of printing from the moment (1454) that it made its appearance in a perfect state at Mainz, and have followed its spread to all the chief places of Europe till 1500, we must take notice of the controversy which has been carried on for nearly four hundred years as to when, where, and by whom the art was invented. For this purpose we will gather up into a chronological sequence (*a*) a few of the most important expressions used by the earliest printers in their colophons, (*b*) whatever documentary evidence there may be on the subject, and (*c*) some accounts of the earliest authors on the subject. (The letters A, B, &c., are for the sake of convenient reference.)

The earliest testimony (A) to which we may refer is the notarial instrument, dated 6th November 1455, of the lawsuit between Fust and Gutenberg, whereby the former sought to recover 2026 guilders from the latter in repayment of 1600 guilders (800 advanced in 1450 or 1449 and another 800 in 1452), with the interest thereon. Fust speaks here[2] of "the work" (line 24), and of "our common work" (line 60); Gutenberg speaks of "tools" in preparation, "workmen's wages, house-rent, vellum, paper, ink, &c." (lines 37-40), of "such work" (41), and of "the work of the books" (42); whereas the judges speak of "the work to the profit of both" (49), and "their common use" (60). (B) In the earliest[3] book published with a date (the Mainz psalter, issued 14th August 1457 by Fust and Peter Schoeffer) it is said that it was perfected at Mainz by an "adinventio artificiosa imprimendi ac caracterizandi absque calami ulla exaratione" (repeated and varied later; see p. 681 above). (C) In 1460 the *Catholicon* was published at Mainz, without the name of the printer; but the colophon, after stating that the book was printed at Mainz, which town God's mercy had deigned to prefer above other nations of the earth, adds (D) that the book was printed and completed "non calami, stili, aut pennæ suffragio, sed mira patronarum formarumque concordia, proporcione, et modulo." This work is considered to have been printed by Gutenberg, and the mention of God's mercy is regarded as an allusion to the invention of printing. The phrase is, however, also found in the *Liber Sextus Decretalium*, in the *Summa* of Thomas Aquinas, and in the *Clementinæ*, published respectively on 17th December 1465, 6th March, and 8th October 1467, by Fust and Schoeffer. (E) On 17th January 1465 Adolph II., archbishop of Mainz, by a public decree, appointed Gutenberg as his servant in reward for "his services," but he does not speak of him as the inventor of printing, nor even as a printer. (F) In the *Grammatica Rhythmica*, published in 1466 by Fust and Schoeffer, the third line of the colophon runs: "Hinc Nazareni sonet oda per ora Johannis," which was formerly regarded as an allusion to Johann Fust or Johann Gutenberg, but which more probably refers to Johann Brunnen or Fons, the author of the grammar. (G) On 26th February 1468 Dr Homery wrote to the archbishop of Mainz the letter quoted above, from which it may be inferred that Gutenberg had been a printer, though not a word is said as to his being the inventor of printing. (H) In 1468 Schoeffer reprinted Fons's *Grammatica*, and in the colophon it is said: "At Moguntina sum fusus in urbe libellus meque (the book) domus genuit unde caragma venit." (I) Schoeffer published on 24th May 1468 the first edition of *Justiniani Imper. Institutionum Juris Libri VI., cum Glossa.* To this were added by way of colophon some verses commencing: "Scema tabernaculi, &c.," in which it is said that (the ornament of the church) Jesus "hos dedit eximios sculpendi in arte magistros . . . Quos genuit ambos urbs Moguntina Johannes, librorum insignes prothocaragmaticos," which is regarded as an allusion to Johann Gutenberg and Johann Fust as first printers. (K) In the same year (1468) Johannes Andreas, bishop of Aleria, says, in the dedication of his edition of St Jerome's *Epistles*, published in that year (13th December) at Rome, to Pope Paul II., that "Germany is to be honoured for ever as having been the inventress of the greatest utilities. Cardinal Cusa wished that the sacred art of printing, which then (under Cardinal Cusa, who died 11th August 1464) seemed to have arisen in Germany, were brought to Rome." (L) In 1470 Guil. Fichet, in an octastichon inserted in the Paris edition of 1470 of the *Letters* of Gasparinus of Bergamo, exhorts Paris to take up the almost divine art of writing (printing) which Germany is acquainted with. In the same year Erhard Windsberg writes to the same effect in an epigram inserted in the *Epistolæ Phalaridis* published at Paris about 1470. (M) In 1471 Ludov. Carbo speaks, in the dedication of the *Letters* of Pliny to Borso, duke of Modena, of the Germans having invented printing. Nicolaus Gupalatinus speaks (Venice, 1471) of a German being the inventor of printing, and Nicolaus Perottus of the art which had lately come from Germany. (N) On 21st May 1471 Nicolas Jenson published an edition of Quintilian, edited and revised by Ognibene de Lonigo (Omnibonus Leonicenus), who in the preface speaks of its printer as "librariæ artis mirabilis inventor, non ut scribantur calamo libri, sed veluti gemma imprimantur, ac prope sigillo, primus omnium ingeniose demonstravit." (O) About 1472 the first three printers of Paris published Gasparinus Pergamensis's *Orthographiæ Liber*, to which is prefixed (in the copy of the university of Basel) a letter, dated 1st January, from Guillaume Fichet, prior of the Sorbonne, to Robert Gaguin, in which he says that "it is rumoured in Germany that not far from the city of Mainz a certain Johann Gutenberg (Johannes, cui cognomen Bonemontano) first of all invented the art of printing (impressoriam artem), by means of which books are made with letters of metal, not with a reed (as the ancients did), nor with the pen (as is done at present)." (P) On 14th July 1474 Joh. Philippus de Lignamine published at Rome *Chronica Summorum Pontificum Imperatorumque*, in which we find, between two entries, relating one to 14th July 1459 and the other to 1st October 1459, an undated paragraph in which it is said that Jacobus with the surname of Gutenberg of Strasburg and a certain other one named Fustus, "imprimendarum litterarum in membranis cum metallicis formis periti, trecentas cartas quisque eorum per diem facere innotescunt apud Moguntiam Germanie civitatem." The same is said of Mentelin, and (under 1464) of Conrad Sweynheym, Arnold Pannarts, and Udalricus Gallus. (Q) On 23d May 1476 Peter Schoeffer issued the third edition of the *Institutiones* of Justinian, with the same imprint as in the edition

From book colophons, &c.;

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[1] See Bernard, *Origine de l'Impr.*, i. 164, who was a printer himself and speaks very strongly on this point.

[2] We quote from the text of the instrument as published by J. D. Koehler, *Ehren-Rettung Johann Guttenberg's*, Leipsic, 1741.

[3] The earliest is perhaps the *Donatus* issued by Peter Schoeffer, possibly before 1456, the colophon of which says that it was finished: "Arte nova imprimendi seu caracterizandi . . . absque calami exaratione."

of 1468 (see testimony I), but with the addition that Mainz is the "impressoriæ artis inventrix elimatrixque prima." (R) In 1478 an edition of the *Fasciculus Temporum* was issued at Cologne, in which it is stated under the year 1457 that the printers of books were multiplied on earth, deriving the origin of their art from Mainz. The earlier editions merely stated that the printers of books were multiplied on earth. (S) In 1483 Matthias Palmerius of Pisa published at Venice the *Chron. Euseb.*, in which under the year 1457 it is stated that students owe a great debt to Germany, where Johannes Guttenberg zum Jungen, knight of Mainz, invented the art of printing in 1440. (T) In the same year Jac. Phil. Foresta of Bergamo published *Supplementum Chronicorum*, in which he says under the year 1458 that the art of printing books was first discovered in Germany, according to some by Guthimberg of Strasburg, according to others by Faust (see P), according to others by Nicolas Jenson (see N). (V) On 6th March 1492 Peter Schoeffer published the *Niedersächsische Chronik* of Conrad Botho, saying in the colophon that it was "geprent . . . in . . . Mentz, die eyn anefangk is der prentery." (X) At the end of 1494 two Heidelberg professors, Adam Wernher and Joh. Herbst, composed some Latin verses in honour of Johannes Gensfleisch (a family name by which Gutenberg was known, and which was turned into the Latin Ansicarus), whom they called "primus librorum impressor" and "impressoriæ artis inventor primus."[1] (Y) In 1499 Jacobus Wimpheling (born at Schlettstadt 1450, died 1528) published (at Mainz, by P. Friedberg) an *Oratio in Memoriam Marsilii ab Inghen* (d. 1396), in which he, on leaf 22a, praises Joannes Ansicarus in verse on account of his invention at Mainz. (Z) These verses are preceded by an epitaph on Johann Gensfleisch, "artis impressoriæ inventor" and "repertor," written in Latin by Adam Gelthus, a relative of Gutenberg. (AA) In the same year Polydore Vergil (*De Inventoribus Rerum*, Venice, 1499, lib. ii. cap. 7) says that a certain Peter [Schoeffer ?], a German, invented in 1442 the art of printing at Mainz in Germany, as he had heard from the latter's countryman; this statement was repeated in a Venice edition of 1503. In later editions "Peter" was altered to "Joh. Gutenberg." (BB) In the same year Koelhoff, printer at Cologne, published *Cronica van der hilliger Stat van Coellen*, in which on fol. 312b it is said: (1) The art of printing was found first of all in Germany at Mainz about the year 1440; (2) from that time till 1450 the art and what belonged to it were investigated; (3) and in 1450, when it was a golden year (jubilee), they began to print, and the first book that they printed was the Bible in Latin, in a large letter, resembling that with which at present missals are printed. (4) Although the art was found at Mainz in the manner in which it is generally employed now, yet the first prefiguration was found in Holland from out the *Donatuses* which were printed there before that time, and from and out of them was taken the beginning of the aforesaid art, and it was found much more masterly and exact (*subtilis*) than that other manner was, and has become more and more artistic. (5) Omnibonus wrote in a preface to Quintilian, and in some other books too, that a Walloon from France, named Nicol. Jenson (see N), discovered this art; but that is untrue, for there are those still alive who testify that books were printed at Venice before Nicol. Jenson came there, and began to cut and make letters. (6) But the first inventor of printing was a citizen of Mainz, named Junker Johan Gudenburch. (7) From Mainz the art was introduced first of all into Cologne, then into Strasburg, and afterwards into Venice. (8) The origin and progress of the art were told to the writer verbally by Ulrich Zell of Hanau, still printer at Cologne (*anno* 1499), through whom the said art came to Cologne. (CC) In 1501 Jacob Wimpheling (see Y), who stated in his *Oratio Querulosa contra Invasores Sacerdotum, Flaminum*, &c., published at Delft c. 1495, that chalcography had been invented at Mainz, published a work (*Germania*, Strasburg, Joh. Prüss, 1501) in which he says (on p. 43) that the invention was made at Strasburg by Johann Gutenberg of Strasburg, and that it was perfected at Mainz. (DD) In 1503 Johann Schoeffer (the son of Peter Schoeffer and the grandson of Johann Fust) published an edition of Hermes Trismegistus, in which he represents himself as one of the most distinguished citizens of Mainz, descended from the most fortunate race who invented the art of printing. (EE) In 1504 Ivo Wittig, who was a relative of Gutenberg, and a canon and the keeper of the seal of the St Victor cathedral near Mainz (of which Gutenberg had been a lay member), erected in the house "Zum Gutenberg" a memorial stone and an epitaph to Joh. Gutenberg of Mainz, "qui primus omnium litteras ære imprimendas invenit." (FF) In 1505, in the German translation of Livy published by Johann Schoeffer (see KK), the dedication to the emperor Maximilian, which was probably written by Ivo Wittig (see EE), speaks of Johann Güttenbergk as inventor of printing (1450) and Johann Faust and Peter Schoeffer as improvers of the art. This work was reprinted six times (1514, 1523, 1533, 1551, 1553) with the same dedication; but in 1509 the *Breviarium Moguntinum* says that it was printed at the expense and trouble of Johann Schoeffer, whose grandfather (*i.e.*, Johann Fust) was the first inventor and author of the art of printing (see DD). (GG) In 1505 Jacob Wimpheling, in his *Epithoma Germanorum* (Strasburg, 1505), asserts (on leaf xxxviii b. and xxxix a.) that in 1440 Johann Gutenberg of Strasburg invented there the art of printing. And in 1507, in his *Catal. Episcoporum Argent.* (Strasburg, 1507), he says that the art was invented, though in an imperfect manner, by a certain Strasburger, who afterwards went to Mainz and joined others working and trying the same art, where it was, under the guidance of Johann Gensfleisch, perfected in the house "boni montis" (Gutenberg). This he repeated in 1515. (HH) About 1506 Johannes Trithemius wrote his *Chronicon* of Spanheim, published at Frankfort in 1601, in which he says (p. 366) that the art of printing books was discovered afresh at Mainz by Johan Gutenberg, who, after having spent all his property in accomplishing the new invention, perfected it by the advice and assistance of Johann Fust. The first propagator of the new art was, after the inventor, Peter Schoeffer. (II) In 1515 Johann Schoeffer published Joh. Trithemius's *Compendium sive Breviarium Historiæ Francorum*, and said in the colophon that the book was published at Mainz, the first inventress of the art of printing, by Johann Schoeffer, grandson of the late Johann Fust, the first author of the said art, who finally from his own genius commenced to excogitate and to investigate the art in 1450, and in 1452 perfected it and commenced printing, assisted by many necessary inventions of Peter Schoeffer von Gernsheim, his servant and adopted son. Johann Fust and Peter Schoeffer kept this art secret, binding all their servants and domestics by oath never to reveal it; but in 1462 it was spread by the same domestics into divers countries. (KK) On 9th December 1518 the emperor Maximilian accorded to Johann Schoeffer the privilege of printing Livy (1518-1519), and says in it that "he has learned and been advised on the faith of worthy testimonies that the ingenious invention of chalcography was effected by the printer's grandfather." (LL) In 1519 Joh. Thurmayer Aventinus (1474-1534) wrote that "in 1450 Joannes Faustus, a German, a citizen of Mainz, invented a new kind of writing, called chalcography, and completed it in two years; it was kept secret by him and Peter Schoeffer, his son-in-law, but divulged in Germany ten years afterwards by Faust's servant, Johannes Guttenberger, a Strasburger." (MM) In a pedigree of Lourens Janszoon Coster of Haarlem and his descendants, drawn up not later than 1520, it is asserted that in 1446 "he brought the first print into the world." This document, of which the date 1446 seems to have been altered into 1440, is preserved in the Haarlem town library. (NN) In 1520 Johan Schott, a printer at Strasburg and grandson of Johan Mentelin, the first printer of that town, published an edition of Ptolemy, at the end of which he printed the arms of his grandfather with the following legend: "Insigne Schottorum Familiæ ab Friderico Rom. Imp. III. Joan. Mentelio primo Typographiæ Inventori ac suis concessum: Anno Christi 1466." Apart from the assertion that Mentelin was the inventor of printing, we may remark that the emperor Frederick III. raised Mentelin to the rank of a nobleman in 1466 and granted him new arms. (OO) About 1533 the Neapolitan Mariangelo Accorso, who had resided at the court of Charles V., wrote on an edition of *Donatus* (in the possession of Aldus Manutius, jun.) that "Joh. Faust of Mainz first discovered the art of printing with metal types, which afterwards he made of lead; his son Peter Schoeffer added afterwards much to polish the said art. This *Donatus* and *Confessionalia* were printed first of all in 1450. Faust derived the suggestion from a *Donatus* printed before in Holland from an engraved block." This paragraph is found on p. 411 of the *Biblioth. Apost. Vaticana* of Angelo Roccha (Rome, 1591). Some consider its latter part to have been derived from the *Cologne Chronicle* (BB), and it seems probable that it was a mixture of some of the above testimonies. (PP) In 1536 Johan Schott (see NN) published *Historien Handt-Buchlein* (Strasburg, 1536), in which (on leaf b^1 and b^2) he says that "Hans Mentlin of Strasburg invented the art, which, through infidelity, was brought to Mainz." On the strength of this and other statements (CC, GG, NN) the bicentenary of the Strasburg invention was celebrated there in 1640. (QQ) In 1541 Joh. Arnold (Bergel or) Bergellanus, who had settled as press-reader at Mainz two years previously, published his *Encomium Chalcographiæ* (Mainz, Fr. Behem, 1541, 4to), in which the lawsuit between Fust and Gutenberg (A) is alluded to for the first time. Bergel had read Tritheim's books (HH), in which the invention is ascribed to Johann Gutenberg with two coadjutors, Johann Faust and Peter Schoeffer, which he (Bergel) had heard confirmed in conversations with Mainz citizens; he had also seen some old tools prepared for the work by the originators which were still in existence. Gutenberg invented it in 1450. (RR) About 1561 Jan Van Zuren (born at Haarlem in 1517) and Dirk Volkerts Coornhert (born at Amsterdam in 1522) established a printing office at Haarlem. Of the former it is alleged that he had compiled a work on the invention of printing, which is presumed to have been lost during the siege of Haarlem in 1573. It was not publicly spoken of till 1628, when Peter Scriverius published his *Laurecrans voor Laurens Coster*. Scriverius had only found the

From documentary evidence.

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[1] These verses were not published at the time, but in the 19th century by F. J. Mone, *Quellensamml. der Landesgesch.*, iii. 163, from the contemporary MS of Adam Wernher, preserved in the archives of Carlsruhe.

title, preface, and introduction, in which Van Zuren contended that the first foundations of the art were laid at Haarlem, and that it afterwards accompanied a foreigner to Mainz. In this introduction he does not mention the name of the inventor, nor a date, but points in indefinite terms to the house of the inventor as still existing. (SS) In the same year (1561) Van Zuren and Coornhert published an edition of the *Officia Ciceronis*, in which the latter, in a dedication to the magistracy of Haarlem, refers to the rumour that the art of printing books was invented first of all at Haarlem, and was brought to Mainz by an unfaithful servant and much improved there. He adds that very old and dignified persons had often told him, not only the family of the inventor, but also his name and surname, and had explained the first crude way of printing, and pointed out to him the house of the first printer. (TT) In 1566 Luigi Guicciardini, a Florentine nobleman who had visited the Netherlands and had resided many years at Antwerp, finished a description of the Netherlands (published in 1567), in which, alluding to Haarlem, he speaks of the invention there according to the assertions of the inhabitants, the evidence of some authors, and other remembrances; the inventor died before the perfection of his art; his servant went to Mainz, where he perfected the art, and hence the report that it was invented there. (VV) About 1568 (it is calculated) Hadrianus Junius wrote his *Batavia*, published at Leyden in 1588, with two prefaces, dated, the one from Leyden, 6th January 1575, the other from Delft *ad annum salutis* 1575. On p. 253 he says that the opinion that the forms of the letters whereby books are printed were first discovered at Mainz is very inveterate, but old and eminent inhabitants of Haarlem had assured him that they had heard from their ancestors that there lived at Haarlem, more than 128 years before, in a decent house then existing, near the market-place, opposite the royal palace, Lourens (son of) Jan, surnamed Coster, who, while walking in the wood near Haarlem, began to shape beechen bark first into figures of letters, by which, reversely impressed one by one on paper, he composed one or two lines to serve as an example for the children of his son-in-law. When this succeeded, he began to contemplate greater things, and first of all invented, assisted by his son-in-law Thomas (son of) Peter, a more gluey and substantial kind of ink (as the ordinary ink was found to blot), with which he printed whole tablets with pictures, with the letters added. Junius had seen books of this kind printed by Coster (the beginnings of his labours) on the rectos of the leaves only, not on both sides; the book was written (in Dutch) by an anonymous author, and entitled *Speculum Nostræ Salutis*, in which care was taken that the blank versos could be pasted together, so that the blank pages should not present any unsightliness. Afterwards (Coster) changed the beechen characters into leaden, and the latter again into tin ones. Very ancient wine-pots cast of the remains of these types were still to be seen in the house of Lourens, which was afterwards inhabited by his great-grandson Gerard (son of) Thomas, who had died an old man a few years before. When the new merchandise attracted purchasers everywhere, workmen were added to (Lourens's) household, among whom was a certain John (whether, as was suspected, Faust, or another of the same name, Junius did not inquire), who was bound to the work of printing by oath. But, when he thought he knew the art of joining the letters and of casting the types, &c., he stole away, when everybody had gone to church, the whole apparatus of the types and the tools prepared by his master, and hastened to Amsterdam, thence to Cologne, until he arrived at Mainz, where he could remain in safety, and, having opened a work-office, issued within the space of one year, about 1442, the *Doctrinale* of Alexander Gallus and the *Tracts* of Petrus Hispanus, printed with the same types which Lourens had used at Haarlem. Junius recollects that Nicolaus Gale, his tutor, a man of firm memory and venerable old age, had told him that as a boy he had often heard a certain bookbinder Cornelis (a man of more than eighty years of age, who had been an under-workman in the same office) narrating the story of the invention (as he had heard it from his master), the polishing and increase of the crude art, &c., and cursing those nights which he had passed, during some months, with the culprit in one bed. The burgomaster Quirinus Talesius admitted to Junius that he had formerly heard nearly the same from the mouth of the same bookbinder. (XX) In 1628 Scriverius in his *Laurecrans* (see RR) placed the date of the Haarlem invention as far back as 1428, and mentioned as its inventor Lourens Janszoon, sheriff of Haarlem. He asserts that the art of printing appeared, "not in the manner as it is used now, with letters cast of lead and tin, but a book was cut leaf for leaf on wooden blocks," and the Haarlem inventor was robbed in 1440 by Johan Gutenberg. Scriverius based the date 1428 upon a Hebrew *Chronicle* compiled by Joseph ben Meir (born 1496, d. c. 1575), and published in 1554 at Sabionetta by Cornelius Adelkind, where, under the year of the Jewish era 5188 (=1428), the author mentions a book (without giving the title) printed at Venice and seen by him. Scriverius, being convinced that this could only refer to a book printed at Haarlem, applied the entry to a xylographic *Biblia Pauperum*, of which he gave a description, together with several other block-books and early printed books. (YY) In 1639 Boxhorn pushed the date of the Haarlem invention back to 1420, referring, as his authority, to the same *Chronicle* of Rabbi Joseph. Since that time the date of the Haarlem invention has been variously placed between 1420 and 1430.

Other claimants.

Later testimonies are mere repetitions of earlier statements.[1] We need not say much about the story of Antonio Cambruzzi, who asserted that Pamfilo Castaldi invented printing at Feltre, in Italy, in 1456, and that Fausto Comesburgo, who lived in his house in order to learn the Italian language, learned the art from him and brought it to Mainz; this story, however, has found so much credence that in 1868 a statue was erected at Feltre in honour of Castaldi. Nor need we speak of Kuttenberg in Bohemia, where John Gutenberg is asserted to have been born and to have found the art of printing. We may also pass over Johann Fust, later on called Faust (testimonies P, T, DD, FF, II, KK, LL, OO), as we know from the Mainz lawsuit of 1455 (A) that he had simply assisted Gutenberg with loans of money. We may also pass over Johann Mentelin of Strasburg (testimonies NN, PP), only remarking here that he had already printed a Bible in 1460, and that he is mentioned in Strasburg registers as a chrysographer or gold-writer from 1447 to 1450; but of his whereabouts between 1450 and 1460 there is no record. That he had gone, or had been called, after 1450 by Gutenberg to Mainz has been asserted but not proved, and there is no reason why he should not be one of the two Johannes alluded to as the *prothocaragmatici* of Mainz in the Justinian of 1468 (testimony L). That Nicolas Jenson came to be regarded in certain circles and for a time as the inventor of printing is owing to testimony N being misunderstood. There remain, therefore, to be considered the testimonies which bear on the rival claims of Haarlem and Mainz. The controversy between Germany and Holland was publicly started as early as 1499 by the *Cologne Chronicle* (testimony BB), that between the two towns mentioned not publicly before 1561 (testimony RR); while no rival inventor to Gutenberg was mentioned publicly and in print earlier than 1588 (testimony VV).

Claims of Gutenberg.

Let us first consider the claims of Germany and Mainz as centred in the person of Henne (=Hans or Johann) Gensfleisch, called Gutenberg or Gudenberg, the latter name derived from his mother, whose maiden name was Elsa Wyrich, who lived in the "Hof zum Gutenberg" at Mainz. He is supposed to have been born at that town about 1400. He is first mentioned in a Mainz document, dated 16th January 1430. In a document of 28th March 1430 he is spoken of as being "not in Mainz." Documents from 14th March 1434 to 18th September 1444 prove him to have been at Strasburg during that time, and documents dated respectively 17th October 1448, 6th November 1455, 21st June 1457, 10th April 1461, show that he was in or near Mainz on those days. By a decree of 17th January 1465 the archbishop of that town rewarded him for "his services," and in the bond of Dr Homery, dated 26th February 1468, he is spoken of as dead. There are, moreover, six forged documents (including some relics of an ancient press bearing the date 1441) respectively dated 24th March 1424, 1437, 3d July 1453, 20th July 1459, 19th June 1463, and an entry in an anniversarium which has been applied to Gutenberg, but does not concern him (see Hessels, *Gutenberg*).

In former years, when printing was believed to have been invented in 1440, the records of the Strasburg lawsuit of 1439, between Gutenberg and some Strasburg artisans about certain industrial undertakings (as the art of polishing stones, the manufacture of looking-glasses), were considered to prove the invention of printing at Strasburg, not, however, by Mentelin, as had been thought by some (testimonies NN, PP), but by Gutenberg. The records came to light about 1740, just when Schoepflin, the principal discoverer, had been commissioned to search for documents of this kind. Doubts may be suggested as to their genuineness, but they have all perished, partly during the revolution of 1793 and partly during the siege of Strasburg in 1870. However, nobody would now assert that printing was invented in 1439 or at Strasburg; and those who still believe that Gutenberg was the inventor of printing refer to them only as showing that he was a mechanic as early as 1439, and that he understood the art of pressing.[2]

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[1] Over a hundred of them have been collected by Ger. Meerman, *Origines Typogr.*, ii. p. 58 *sq.*

[2] See Hessels, *Gutenberg*, pp. 23, 185, &c.

The first document that connects Gutenberg with the art of printing is the notarial instrument of 6th November 1455 (testimony A). But it says nothing of an invention or a new mode of printing. And yet the occasion was such as to make it almost imperative on Gutenberg to mention it, for he had spent 1600 guilders of Fust's money, apparently without printing anything,[1] and was on the point of being robbed by the latter and having taken away from him all that he had made and done to give effect to his idea or invention. In the next testimony (B), *i.e.*, the earliest Mainz books with printed dates (1457 to 1467), there is evidence that the new art of printing is not only not kept secret but fully appreciated at Mainz, and its importance fully realized and advertised; but, though they speak of a "nova ars imprimendi" and an "adinventio imprimendi," there is not a syllable as to a Mainz invention or inventor. In testimonies C and D (the *Catholicon* of 1460) there is again not one word about an invention or an inventor, or about Mainz. Yet Gutenberg is supposed to have printed the *Catholicon*; and it is incredible that he, who had been wronged and robbed by his two rivals (Fust and Schoeffer), should agree with them in explaining and proclaiming the new art, but never with one word assert his claim to the honour and profit of the invention, if he had made any, and should even omit his name, whereas he saw his two rivals never neglect to print their names in full on every book which they published. Those who believe that Gutenberg was the inventor of printing suggest that he kept silent, as otherwise his creditors would have seized his copies and his printing office. But this explanation cannot be accepted; for the verbose colophon at the end of a gigantic folio book like the *Catholicon*, published at a time when there were perhaps not more than three printing offices in the world, was calculated to draw attention to its printer and his residence, not to conceal him. Testimony F (1466) is no longer regarded as having any reference to Gutenberg or the invention of printing. H (1468) was formerly thought to mean: "I, the book, am cast (*i.e.*, its types are cast) in the Mainz city, and the house whence the type came (=where the type was invented) produced me." But of late years it has been shown that the author of the book, Johann Fons, was Peter Schoeffer's press-corrector. And, as he no doubt resided in Schoeffer's house, the two lines evidently mean: "I am a little book cast in Mainz, and I was born (=written) in the same house whence the type comes[2] (=where I am printed)." Testimony I (also of 1468) speaks of two Johannes (Gutenberg and Fust) as the "prothocaragmatici librorum quos genuit urbs Moguntina." But this certainly means, not that the first printers of books were born at Mainz, but that the two Johannes were the chief printers of books (born) produced at Mainz.

When we now place together the clear documentary testimonies (A to I) of the first fourteen years of printing (1454 to 1468) at Mainz, we see that they all come from Mainz itself. Everybody connected with the art speaks of it in the most public and unreserved manner; its importance is as fully realized and advertised during that period as it is in the present day; the German nation is even congratulated on possessing it; there is never any secrecy about it; once (about 1456) it is even called a new art. But, in the midst of all this publicity, the art which Mainz and Germany possess is never said to have been invented at Mainz. The supposed Mainz inventor (Gutenberg) even speaks himself on two occasions (in the lawsuit of 1455 and in the *Catholicon* of 1460), but never says that he had made an invention. The archbishop, too, speaks publicly of Gutenberg in 1465 (testimony E), and rewards him for services, but does not speak of him as the inventor of printing, nor even as a printer. Nor does Dr Homery, in his letter to the archbishop (testimony G), in which he refers to Gutenberg's printing apparatus, call him the inventor of printing.

In 1468 we enter on a new phase in the history of the invention. Even if we reject testimony I as being merely local, testimony K (1468) speaks of the art of printing as having arisen in Germany. This testimony, however, does not come from Germany, nor from Mainz, but from Italy, and is supposed to owe its inspiration to the two German printers who had established a printing office at Subiaco in 1465, and in 1467 at Rome, and who most likely learned their craft at Mainz. But, as the two printers are mentioned in the testimony, and as it does not speak of Gutenberg, nor of Mainz, it is far more likely that it was merely derived from the colophons of Fust and Schoeffer, or from something that Cardinal Cusa had heard during his embassies in Germany. To the Mainz colophons we must also ascribe (*a*) the two testimonies of 1470 (L) and (*b*) the three of 1471 (M), all five of which come from France and Italy. At last, in 1472, we find in testimony O the invention of printing ascribed to Gutenberg of Mainz, but it is mentioned as a rumour, and comes from France. Guil. Fichet of Paris, who gives it, is supposed to have heard the rumour from the three German printers who commenced printing at Paris in 1470. But, as two of them had resided, immediately before they came to Paris, in the university of Basel, and are supposed to have learned their art there, the rumour is ascribed to "Bertolff von Hanauwe," who appears in the lawsuit of 1455 as Gutenberg's servant, and who was printing at Basel in 1468. Perhaps it came rather from information which Fichet obtained from the St Victor cathedral, near Mainz, as he speaks of the art having been invented not far from that town. Testimony P (1474) again comes from Italy, from Rome, and was perhaps derived from one of the German printers settled there at that time. It merely speaks of Gutenberg, Fust, and Mentelin as printers, but says not a word which even touches upon the invention of the art. In testimony Q (1476) we have definite mention of Mainz as the inventress of the art; it is given as an addition to the Mainz colophon of 1468 (see I). In 1478 Mainz is again mentioned in a Cologne testimony (R), which gives evidence of research, as it is an amplification of an earlier one in which Mainz was not mentioned. Germany, Gutenberg, and Mainz are again mentioned in the Venetian testimony S (1483), which gives for the first time 1440 as the date of the invention. In the same year we have two earlier testimonies (P and N) worked into one (T), to the effect that printing was invented either by Gutenberg or by Fust or by Jenson. Testimony V (1492), which states that printing commenced at Mainz, is practically equivalent to Q. In 1494 and 1499 we have three German testimonies (X, Y, Z) as to Gutenberg being the inventor of printing; these, however, come, not from Mainz, but from Heidelberg. Z is given by a relative of Gutenberg, Adam Gelthus; and, as the latter resided at Heidelberg, it is clear that he was the real source of the other two Heidelberg testimonies (X and Y). Two years later, when Wimpheling, the author of testimony Y, had left Heidelberg, he ascribed (CC) the invention of printing to Strasburg, though stating that Gutenberg was the inventor. Testimony AA is recorded above to show the great confusion that reigned in people's minds about the invention. We must add to these testimonies those of 1504 (EE) and 1505 (FF), which are owing to Ivo Wittig, a relative of Gutenberg, and a canon and the keeper of the seals of the St Victor cathedral, near Mainz, of which Gutenberg had been a lay member according to its *liber fraternitatis*. Thus in the period from 1468 to 1505 we have (1) several vague statements made in Italy and France as to the art of printing being known or practised or invented in Germany, statements which arose from the books and colophons published at Mainz; (2) one item of rumour in 1472 that Gutenberg invented it near that town; (3) two Mainz statements, of 1476 and 1492, and one Cologne statement, of 1478, that it was invented at Mainz; (4) three German statements, of 1492, 1494, and 1499, that Gutenberg had invented it; and (5) two Mainz statements, of 1504 and 1505, to the same effect. It is to be particularly noticed that the statements (2, 4, 5) which speak distinctly of Gutenberg being the inventor can be clearly traced to Gutenberg himself and two of his relatives.

Contradiction of Gutenberg's claim.

Seeing then how slender the basis is for the tradition that printing was invented by Gutenberg at Mainz, and that even this slender basis was not laid till fourteen years after the art had been fully established and proclaimed in that city, we cannot be surprised to find the tradition promptly contradicted. This contradiction was made in 1499 (testimony BB) in a *Chronicle* published at Cologne. To facilitate the understanding of this testimony it is divided above into eight sections. The first (taken from Hartmann Schedel's *Chronicle*, 1493), second, sixth, seventh, and eighth are no doubt due to the compiler of the *Chronicle*, and must not be connected with the third, fourth, and fifth, which, according to the compiler, are due to Ulrich Zell, a printer at Cologne, who had probably settled there about 1463, and had most likely learned his art at Mainz, as he called himself "clericus Moguntinus." As Zell's testimony leaves to Gutenberg nothing but the honour of having perfected the art, various attempts have been made to explain away this account. As long as no typographically printed *Donatus* had been found that could be fitted into Zell's account, it was argued that he meant *Donatuses* printed from wooden blocks; and this argument is brought forward even at the present time. But a practical printer like Zell must have been able to express himself to that effect if he had really meant to say so; and, as block-printing was not less practised in Germany than in Holland, we could hardly assume that things printed in Holland would have inspired the German inventor rather than the same things printed in Germany. That testimony OO speaks of a *Donatus* printed from wooden blocks may be ascribed to the notion arising at that time (c. 1533) that block-printing had given rise to typography. It has also been asserted that Holland in the *Chronicle* means Flanders; but the *Chronicle* is usually very correct in geographical matters. It has also been suggested that Zell most likely learned his art in Fust and Schoeffer's office and invented the passage to injure the reputation of Gutenberg, who had been their enemy. Finally it has been said that Zell did not suggest or write the passage at all; but it is hard to see how this can be maintained in face of the compiler's own statement to that effect. Therefore, all these sugges-

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[1] In line 42 Gutenberg distinctly declares that "he hoped that he was under no obligation to Fust to devote the first 800 guilders to the work of the books;" and, as Fust, by advancing the second 800 guilders in 1452, had become Gutenberg's partner, it seems clear that the former claimed in 1454, when the trial is calculated to have commenced, his money and interest because Gutenberg had as yet not printed anything.

[2] Venit is the present not the perfect tense.

Lourens Coster's claims.

tions failing to weaken Zell's testimony, we must see how far it can be brought into harmony with other circumstances and the testimonies MM, RR, SS, TT, VV, XX, YY, which claim the honour of the invention for Haarlem in Holland. Testimonies RR and SS do not mention the name of the inventor. But the former is a mere introduction destined for a complete book that was lost during the siege of Haarlem in 1573 before it was printed; we are, therefore, not entitled to say that Van Zuren did not know the name. SS may have omitted the name, because the publication of Van Zuren's work was in contemplation at the time that it was written. That Guicciardini (testimony TT) in 1566 did not mention the name of the reputed Haarlem inventor cannot be considered as an indication that it was not known or had not yet been "invented" when he wrote, as his accounts of the cities of the northern Netherlands are all very meagre and were for the most part derived from correspondence. In Junius's account (VV), however, we find every particular that could be desired. He begins by referring to the difficulty of vindicating the honour of the invention for Haarlem on account of the deep-rooted and general opinion that it took place at Mainz. He then mentions that Lourens (son of Jan) surnamed Coster resided at Haarlem "more than 128 years ago" and gives us to understand that in the year indicated by that phrase he invented the art of printing. As Junius's book was not published till after his death, in 1588, and the two prefaces in it are dated 1575 (he died 16th June 1575), the number 128 is supposed to go back from the date when he actually wrote his account, which he is calculated to have done about 1568. Thus we get the year 1440 as the supposed date of the Haarlem invention, though, if we based our calculation upon the date of the preface, the year 1446 or 1447 would have to be assumed. But, as Junius adds that Coster's types were stolen by one of his servants, who fled with them to Mainz, and establishing there a printing office printed within a year's time, in 1442, two books, he must, if this latter date is correct, have meant 1440. By testimonies XX and YY we see that in the 17th century the date of the Haarlem invention was first put back as far as 1428, then to 1423; and since then it has usually been regarded as 1423, especially after it was discovered that the Haarlem wood where Coster is said to have cut his wooden letters was destroyed during a siege in 1426.

The researches as regards the reputed Haarlem inventor have hitherto not been made in a manner adequate for scientific purposes. It would appear that by the pushing back of the date of the invention, in spite of Junius, to 1420-1428, two inhabitants of Haarlem have been mixed up by the Dutch authors on the subject. (1) Lourens Janszoon, who never bore the surname Coster, and whose existence seems to be authenticated by documents from 1404 to 1439, was sheriff, and a wine merchant and innkeeper, and is supposed to have died in 1439. About 1870, however, researches brought to light that there had been (2) a Lourens Janszoon Coster at Haarlem, duly authenticated by genuine official documents as a chandler and innkeeper, from 1436 to 1483, who went away from Haarlem in the latter year. The name of this man and some genealogical particulars known of him fit into the story of Junius, though there are certain particulars in Junius's account which cannot yet be properly explained.

Early Dutch types.

Junius bases his account of the Haarlem invention on three books, a Dutch edition of the *Speculum Humanæ Salvationis*, the *Doctrinale*, and the *Tracts* of Petrus Hispanus (Pope John XXI.). The first work, he said, was printed by Coster himself as a first specimen of his art, and it would seem from his words that he considered the work to be printed with wooden types. The two Dutch editions of the *Speculum*, however, were printed, like the two Latin editions of the same work, with movable metal type, though in one of the Latin editions there are twenty leaves the text of which is printed apparently from wooden blocks. The *Doctrinale* and the *Tracts* of Hispanus were printed, Junius says, at Mainz by Coster's workman with the types which he had stolen from Coster. Of the Hispanus *Tracts* no edition has yet come to light that would answer to Junius's description. But of the *Doctrinale* we have four editions, all printed in the same type (i.) as the four editions of the *Speculum*. With these same types are printed no less than six editions of the short Latin grammar of Ælius Donatus; and editions of this school-book printed in Holland were, according to Zell in the *Cologne Chronicle*, the models for the printing at Mainz, which commenced about 1450. As there are no other editions of Donatus printed in Holland that could be placed before the year 1450, the claims of Haarlem and Holland are based on them; and we will, therefore, briefly describe the types and books which must be connected with the *Specula*, *Doctrinalia*, and *Donatuses* just mentioned. In one of the editions of the *Speculum* in Dutch occur two leaves printed in a different type (ii.) from the rest of the work. This type is in its turn so very much like another type with which a work of Laur. Valla (*Facetiæ Morales*) is printed that we link it (iii.) on to the two just mentioned. Then again type iii. is, in some of its capitals, identical with a type (iv.) used for a work of Ludovicus de Roma, *Singularia Juris*, at the end of which, on the last leaf, commences another work, printed in a different type (v.). Type vi. is identical with type v., except in its capital P, which is larger. We have also works printed in two different types (vii., viii.) which both show such a great family likeness to each other and to types i. to vi. that it would not be advisable to separate them without evidence that they do not belong to the same office. With these eight types, which we cannot at present separate, forty-seven different books were printed, so far as we know at present. In type i.:—four editions (two in Latin,[1] two in Dutch) of the *Speculum Humanæ Salvationis*, a work which consists of woodcuts with explanatory text underneath; a Dutch version of *The Seven Penitential Psalms*; one *Donatus* of 27 lines; two editions of *Donatus* of 28 lines; a *Liturgical Book* in 16mo; three editions of *Donatus* of 30 lines; one *Donatus*, in French, of 29 and 30 lines on a page; four editions of *Doctrinale* of 32 lines; one *Catonis Disticha* of 21 lines. In type ii.:—two leaves only (49 and 60) of one of the Dutch editions of the *Speculum*. In type iii.—Laurentius Valla, *Facetiæ Morales*, &c. In type iv.:—four editions of *Donatus* of 24 lines; Lud. (Pontanus) de Roma, *Singularia Juris*; Lud. (Pontanus) de Roma (?), *Treatise on Canonical Law* (?). In type v.:—Pius II., *Tractatus et Epitaphia* (printed at the end of the *Singularia Juris*); Guil. de Saliceto, *De Salute Corporis*; one *Donatus* of 26 lines; five editions of *Donatus* of 27 lines; one *Doctrinale* of 26 lines; one *Doctrinale* of 28 lines; one *Doctrinale* of 29 lines; one *Doctrinale* of 32 lines; *Catonis Disticha*; Guil. de Saliceto, *De Salute Corporis*, together with Turrecremata, *De Salute Animæ*; Pius II., *Tractatus de Amore*, &c.; Pindar of Thebes, *Iliados Homericæ Epitome, cum Præfatione Pii II.*; another edition of the same work. In type vi.:—one *Donatus* of 26 lines; one *Donatus* of 27 lines. In type vii.:—one *Donatus* of 27 lines. In type viii.:—an *Abecedarium* of two leaves and a *Donatus* of 31 lines.[2]

Type v. must have been in existence before 13th September 1474, as there is evidence that a copy of the *Saliceto*, printed in that type, was bought for the monastery of St James at Lille by its abbot Conrad du Moulin, who filled that office from the end of 1471 to 13th September 1474. As a work in this type (the *Tracts and Epitaphs* of Pius II.) is printed at the end of the *Singularia Juris* in type iv., we may assume that this type existed a considerable time before type v. As the books printed in types iv. and v. show greater progress in style and workmanship than the books printed in types i. to iii., we must assign the latter to an earlier period than the former. There is indeed positive evidence that type i. must have existed a considerable time before the end of 1473, as fragments of a *Donatus* printed in that type were used by a bookbinder at Haarlem to strengthen the binding of an account-book of the cathedral church in that town for the year 1474. From these facts alone we may safely assume that none of the forty-seven books can be dated after 1474, or, if any, only a few in types v. and vii. On the other hand, four of the works in type v. cannot be dated before 1458, as they bear the name of Pius II., who was not elected pope till that year. When we consider that there are twenty different editions of the *Donatus* printed in these types, and place an interval of about eighteen months between the successive editions, we get a period of some thirty years from about 1445 to 1474 for the issue of the twenty editions. That we reach the year 1445 by such a calculation is purely accidental; but there is evidence that in 1446 and 1451 printed[3] *Doctrinalia* were bought at Bruges and Valenciennes by Jean Le Robert, the abbot of Cambray, according to two entries in his diary, preserved in the archives at Lille. And, as we know positively that there was no printing done at Mainz before 1454, nor anywhere else so early, we can only apply these entries to the *Doctrinalia* printed in Holland in the same types as the four editions of the *Speculum* (on which Junius based the tradition of the Haarlem invention), and six editions of the Donatus which we may fit into Zell's account. That the editions of the *Speculum*, of the *Donatus*, and of the *Doctrinale* in type i. may be dated as early as 1445-1454 is clear when we compare them with the earliest products of Mainz printing, for which the *Donatuses*, according to the *Cologne Chronicle*, served as models. For instance, no difference in workmanship can be detected between the *Donatuses* printed in Holland and the three editions of *Donatus* in the 36-line Bible type and the four editions of the same in the 42-line Bible type, all seven presumably printed at Mainz and before 1456. Nor is the workmanship of the *Specula* (in type i.) or of the *Facetiæ Morales* (in type iii.) different from or later than that of the Mainz *Catholicon* of 1460.

It has been pointed out above that the first products of the art of printing were not meant to be anything but faithful imitations of manuscript books, and that no material deviations from the general plan become observable till about 1473-1477. Nowhere is the plan of the MS. period more strictly adhered to than in the forty-seven books of which we are speaking. They are all without signatures, without initial directors, without hyphens, without catchwords, that is to say, without any of those characteristics which we see gradually, one after the other, come into almost general use from 1473 (if not earlier) to 1480. The four editions of the *Speculum* are all entirely printed anopisthographically, the woodcuts at the top of the pages as well as the explanatory text (in type i.) underneath, which would hardly be the case if the books had been printed after 1471, when the printing of woodcuts, together with text in movable types, had already been known for eleven years. Their types have nothing in common with any of those used in the Netherlands after 1473, but remind us in every respect of the earlier period of the Dutch block-books and MSS. They are all, so far as we know, without any colophon (except such a word as *explicit*), which would, for a collection of forty-seven books, be incompatible with a period after 1471, but not with the earlier period of the block-books and MSS. Moreover, out of the forty-seven books no less than thirty-five are printed on vellum, which is incompatible with a period after 1471, when printing on paper had become universal, but not with the earlier period of the MSS.

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[1] Twenty leaves of one of the Latin editions are apparently printed from wooden blocks, the text as well as the engravings.

[2] For a detailed list of these books, and further particulars regarding them, see J. H. Hessels, *Haarlem, the Birthplace of Printing*, London, 1887, p. 25 *sq.*

[3] The abbot speaks of *Doctrinalia* "gette" or "jettez en molle," and the phrase is, as Bernard (*Origine*, i. 97 *sq.*) shows by eight examples from 1474—the year when printing is first officially spoken of in France—to 1593, and down to the present day, applied to typographically-printed books only.

Invention at Haarlem by Coster.

There is, therefore, no reason whatever to discredit Zell's statement in the *Cologne Chronicle* of 1499, that the *Donatuses* printed in Holland were the models, the "beginning" of the art of printing, at Mainz, nor that of Hadrianus Junius in his *Batavia*, that printing was invented at Haarlem by Lourens Janszoon Coster. The two statements were made independently of each other. That of Zell must be regarded as a direct contradiction of the vague rumours and statements about an invention of printing at Mainz in Germany by Gutenberg, which gradually crept into print in and after 1468 in Italy and France, and which found their way into Germany about 1476, after Mainz and Germany had given the greatest publicity to the existence of the art in their midst for more than twenty-two years, but had been silent about an invention and an inventor. And, though Zell accords to Mainz the honour of having improved the art and having made it more artistic, he denies it the honour of having invented or begun it, and this latter honour was never claimed by that town before 1476. Junius's account is the embodiment of a local tradition at Haarlem, the first written traces of which we have in a pedigree (testimony MM) of the family of the reputed Haarlem inventor, which must have existed at least as early as 1520. His account has been indirectly confirmed by the finding of several fragments at Haarlem, all belonging to the groups of books mentioned above, but still more by the discovery of several fragments of the *Donatuses* printed in the *Speculum* type, all used as binder's waste by Cornelis, the bookbinder, the very man whom Junius alleges to have been the servant of Coster. As the case stands at present, therefore, we have no choice but to say that the invention of printing with movable metal types took place at Haarlem about the year 1445 by Lourens Janszoon Coster.

Early Types and their Fabrication.

We must now take notice of two theories or traditions which have been current for a long time as to some intervening stage between the art of block-printing and the art of printing with movable cast types.[1] One theory or tradition would have it that the inventor of printing, after the idea of single, individual, movable types had arisen in his mind, practised his new invention for some considerable time with wooden types, and that he came only gradually to the idea of movable types cast of metal.

Wooden types.

Junius gives us to understand that in his opinion the Dutch *Speculum* was printed with such wooden types. Of Johann Gutenberg it was asserted that he printed his first Bible with wooden types. The Mainz psalter, printed in 1457 by Joh. Fust and Peter Schoeffer, was alleged to have been printed with wooden types, in which case the 4th edition, published in 1502, and even the 5th edition of 1516, would be printed with wooden types, the same being used for them as for the editions of 1457 and 1459. Theod. Bibliander was the first to speak (in 1548) of such types and to describe them: first they cut their letters, he says, on wood-blocks the size of an entire page; but, because the labour and cost of that way was so great, they devised movable wooden types, perforated and joined one to the other by a thread.[2] Bibliander does not say that he had ever seen such types himself, but Dan. Speckle or Specklin (died 1589), who ascribed the invention to Mentelin, asserts that he saw some of these wooden types at Strasburg.[3] Angelo Roccha asserted in 1591 that he had seen at Venice types perforated and joined one to the other by a thread, but he does not say whether they were of wood or of metal.[4] In 1710 Paulus Pater asserted that he had seen wooden types made of the trunk of a box-tree, and perforated in the centre to enable them to be joined together by a thread, originating from the office of Fust at Mainz.[5] Bodman, as late as 1781, saw the same types in a worm-eaten condition at Mainz; and Fischer stated in 1802 that these relics were used as a sort of token of honour to be bestowed on worthy apprentices on the occasion of their finishing their term.

Besides those who believed in these wooden types from the fact that the letters (especially in the *Speculum*) vary among themselves in a manner which would not be the case had they been cast from a matrix in a mould, there were authors and practical printers who attempted to cut themselves or to have cut for them some such wooden types as were alleged to have been used by the early printers. Some of them came to the conclusion that such a process would be quite practicable; others found by experiment that it would, in the case of small types, be wholly impossible. Up to the present time no book or document has come to light which can be asserted to have been printed with such single, movable, wooden types. But nearly all the experiments to which we have alluded were made with the idea that the inventor of printing, or the earliest printers, started, or had to start, with as large a supply of type as a modern printer. This idea is erroneous, as it is hardly any longer denied that, for a good many years after the first appearance of the art, printers printed their books (large or small) not by quires (quaternions or quinternions) but page by page.[6] Therefore, all considerations of the experimenters as to the impracticability of such wooden types, on account of the trouble and length of time required for the cutting of thousands of types, fall to the ground in face of the fact that the earliest printers required only a very small quantity of type, in spite of the peculiar forms (combined letters, letters with contractions, &c.) which were then in vogue.

Sculpto-fusi types.

The other theory would have it that between block-printing and printing with movable cast types there was an intermediate stage of printing with "sculpto-fusi" types, that is, types of which the shanks had been cast in a quadrilateral mould, and the "faces," *i.e.*, the characters or letters, engraved by hand afterwards. This theory was suggested by some who could not believe in wooden types and yet wished to account for the marked irregularities in the types of the earliest printed books.

Gerardus Meerman, the chief champion of this theory, based it, not only on the words of Celtes (*Amores*, iii. 3), who in 1502 described Mainz as the city "quæ prima sculpsit solidos ære characteres," but on the frequent recurrence of the word *sculptus* in the colophons of the early printers (for Jenson and Husner of Strasburg, see p. 681 above). Sensenschmid in 1475 said that the *Codex Justinianus* was "cut" (*insculptus*), and that he had "cut" (*sculpsit*) the work of Lombardus, *In Psalterium*. Meerman also explained the account of the invention of printing by Trithemius[7] as meaning that, after the rejection of the first wooden types, the inventors discovered a method of casting the bodies only of all the letters of the Latin alphabet from what they called matrices, on which they cut the face of each letter; and from the same kind of matrices a method was in time discovered of casting the complete letters of sufficient hardness for the pressure they had to bear, which letters they were before—that is, when the bodies only were cast—obliged to cut.[8] In this way Meerman explained that the *Speculum* was printed in sculpto-fusi types, although in the one page of which he gives a facsimile there are nearly 1700 separate types, of which 250 alone are e's. Schoepflin claimed the same invention for Strasburg, and believed that all the earliest books printed there were produced by this means. Both Meerman and Schoepflin agreed that engraved metal types (*literæ in ære sculptæ*) were in use for many years after the invention of the punch and matrix, mentioning among others so printed the Mainz psalter, the *Catholicon* of 1460, the Eggestein *Bible* of 1468, and even the *Præceptorium* of Nider, printed at Strasburg in 1476. But the great difficulty connected with the process of first casting the shanks and afterwards engraving the faces of the types has become apparent to those who have made experiments; and it seems more probable that the terms *sculpere, exsculpere, insculpere* are only a figurative allusion to the first process towards producing the types, namely, the cutting of the punch, which is artistically more important to the fabrication of types than the mechanical casting,—all the more as Schoeffer in 1468 makes his *Grammatica Vetus Rhythmica* say, "I am cast at

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[1] We do not allude to Tritheim's assertion that the *Catholicon* of 1460 was printed from wooden blocks; for this story, which he declares he had heard from Peter Schoeffer, if it were true, would belong to the history of block-printing. Nor need we speak of Bergellanus's verses (1541), in which he distinctly alludes to carved blocks.

[2] *Commentatio de Ratione Communi Omnium Linguarum et Literarum*, Zurich, 1548, p. 80.

[3] *Chron. Argent.*, MS., ed. Jo. Schilterus, p. 442.

[4] *De Bibliotheca Vaticana*, Rome, 1591, p. 412.

[5] *De Germaniæ Miraculo*, Leipsic, 1710, p. 10.

[6] See, for instance, W. Blades, *Life of Caxton*, i. 89.

[7] *Annales Hirsaugienses*, ii. 421. "Post hæc inventis successerunt subtiliora, inveneruntque modum fundendi formas omnium Latini alphabeti literarum, quas ipsi matrices nominabant, ex quibus rursum æneos sive stanneos characteres fundebant, ad omnem pressuram sufficientes, quos prius manibus sculpebant."

[8] *Origines Typographicæ*, The Hague, 1765, Append., p. 47.

Mainz," an expression which could hardly be anything but a figurative allusion to the casting of the types.

Granting that all the earlier works of typography preserved to us are impressions of cast-metal types, there are still differences of opinion, especially among practical printers, as to the probable methods employed to cast them. It is considered unlikely that the inventor of printing passed all at once to the perfect typography of the punch, the matrix, and the mould. Bernard[1] considered that the types of the *Speculum* were cast in sand, as that art was certainly known to the silversmiths and trinket-makers of the 15th century; and he accounts for the varieties observable in the shapes of various letters on the ground that several models would probably be made of each letter, and that the types, when cast by this imperfect mode, would require some touching up or finishing by hand. He exhibits a specimen of a word cast for him by this process which not only proves the possibility of casting types in this manner but also shows the same kind of irregularities as those observable in the types of the *Speculum*.

But here again it is argued that in types cast by this or any other primitive method there would be an absence of uniformity in what founders term "height to paper." Some types would stand higher than others, and the low ones, unless raised, would miss the ink and not appear in the impression. The comparative rarity of faults of this kind in the *Speculum* leads one to suppose that, if a process of sand-casting had been adopted, the difficulty of uneven heights had been surmounted either by locking up the forme face downwards, or by perforating the types either at the time of casting or afterwards, and holding them in their places by means of a thread or wire. To this cause Ottley attributed the numerous misprints in the *Speculum*, to correct which would have involved the unthreading of every line in which an error occurred. And, as a still more striking proof that the lines were put into the forme one by one, in a piece, he shows a curious printer's blunder at the end of one page, where the whole of the last reference-line is put in upside down, thus:—

Hoe noe bespot slapende ende niet wakende.
Genesis ix capitel.

A "turn" of this magnitude could hardly have occurred if the letters had been set in the forme type by type.

Another suggested mode is that of casting in clay moulds, by a method very similar to that used in the sand process, and resulting in similar peculiarities and variations in the types.

Ottley, who was the chief exponent of this theory, suggested that the types were made by pouring melted lead or other soft metal into moulds of earth or plaster, after the ordinary manner used from time immemorial in casting statues of bronze and other articles of metal. But the mould thus formed could hardly avail for a second casting, as it would be scarcely possible to extract the type after casting without breaking the clay, and, even if that could be done, the shrinking of the metal in cooling would be apt to warp the mould beyond the possibility of further use. Ottley therefore suggests that the constant renewal of the moulds could be effected by using old types cast out of them, after being touched up by the graver, as models,—a process which he thinks will account for the varieties observable in the different letters, but which would really cause such a gradual deterioration and attenuation in the type, as the work of casting progressed, that in the end it would leave the face of the letter unrecognizable as that with which it began. It would therefore be more reasonable to suppose that one set of models would be used for the preparation of all the moulds necessary for the casting of a sufficient number of types to compose a page, and for the periodical renewal of the moulds all through the work, and that the variations in the types would be due, not to the gradual paring of the faces of the models, but to the different skill and exactness with which the successive moulds would be taken. It is evident that the sand and clay methods of casting types above described must be slow. The time occupied after the first engraving of the models in forming, drying, and clearing the moulds, in casting, extracting, touching up, and possibly perforating the types required for one page, would exceed the time required by a practised xylographer for the cutting of a page of text upon a block. But he that has gone through the trouble of casting separate movable types has a clear gain over the wood-block printer in having a fount of movable types, which, even if the metal in which they were cast were only soft lead or pewter, might be used again and again in the production of any other page of text, while the wood-block can only produce the one page which it contains. Moreover, only one hand could labour on the xylographic block; but many hands could be employed in the moulding and casting of types, however rude they might be. Bernard states that the artist who produced for him the few sand-cast types shown in his work assured him that a workman could easily produce a thousand such letters a day. He also states that, though each letter required squaring after casting, there was no need to touch up the faces.

Polytype.

There remains yet another suggestion as to the method in which the types of the rude school may have been produced. This may be described as a system of what the founders of sixty years ago called polytype, which is a cast or facsimile copy of an engraved block, matter in type, &c.

Lambinet,[2] who is responsible for the suggestion, based upon a new translation of Trithemius's narrative, explains that this process really means an early adoption of stereotype. He thinks that the first printers may have discovered a way of moulding a page of some work—an *Abecedarium*—in cooling metal, so as to get a matrix-plate impression of the whole page. Upon this matrix they would pour a liquid metal, and by the aid of a roller or cylinder press the fused matter evenly, so as to make it penetrate into all the hollows and corners of the letters. This tablet of tin or lead, being easily lifted and detached from the matrix, would then appear as a surface of metal in which the letters of the alphabet stood out reversed and in relief. These letters could easily be detached and rendered mobile by a knife or other sharp instrument, and the operation could be repeated a hundred times a day. The metal faces so produced would be fixed on wooden shanks, type high, and the fount would then be complete. Lambinet's hypothesis was endorsed by Firmin-Didot, the renowned type-founder and printer of Lambinet's day. But it is impossible to suppose that the Mainz psalter of 1457, which these writers point to as a specimen of this mode of execution, is the impression, not of type at all, but of a collection of "casts" mounted on wood.

Shape of earliest type.

Whatever value there may be in the above theories with regard to the movable types of the first printer, certain it is that the shape and manufacture of the types used as early as *c.* 1470 do not seem to have differed materially from those of the present types.

This is evident (1) from the shape of the old types which were discovered in 1878 in the bed of the river Saône, near Lyons, opposite the site of one of the 15th-century printing houses of that city, and which there is reason to believe belonged once to one of those presses, and were used by the early printers of Lyons; (2) from a page in Joh. Nider's *Lepra Moralis*, printed by Conrad Homburch at Cologne in 1476, which shows the accidental impression of a type, pulled up from its place in the course of printing by the ink-ball, and laid at length upon the face of the forme, thus leaving its exact profile indented upon the page; (3) from an entirely similar page (fol. 4^b) in *Liber de Laudibus ac Festis Gloriosæ Virginis*, Cologne, *c.* 1468. From the small circle appearing in the two last-mentioned types, it is presumed that the letters were pierced laterally by a circular hole, which did not penetrate the whole thickness of the letter, and served, like the nick of modern types, to enable the compositor to tell by touch which way to set the letter in his stick. The fact that in these two cases the letter was pulled up from the forme seems to show that the line could not have been threaded.

Vinc. Fineschi, *Notizie Storiche sopra la Stamperia di Ripoli* (Florence, 1781, p. 49), gives an extract from the cost-book of the Ripoli press, about 1480, by which it appears that steel, brass, copper, tin, lead, and iron wire were all used in the manufacture of types at that period.[3]

History of the earliest types

The history and nomenclature of the earliest types are practically a continuation of the history and nomenclature of the characters figured in the earliest block-books, wood-engravings, and MSS. For instance, Gothic type was first seen about the year 1445; but it should not be forgotten that the Gothic writing, of which that type was an imitation, was already known and used about the second half of the 12th century. Again, the pure Roman type, which appeared about 1464, is nothing but an imitation of what in palæography is called the Caroline minuscule, a handwriting which was already fully developed towards the end of the 8th century. Consequently, details as to the history and development of the various types properly belong to the study of PALÆOGRAPHY (*q.v.*).

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[1] *Origine de l'Imprimerie*, i. 40

[2] *Origine de l'Imprimerie*, Paris, 1810, 2 vols. 8vo, i. 97.

[3] On the above theories and types consult T. B. Reed, *Old English Letter Foundries*, pp. 8-26.

The broad outlines of the history of the earliest types are as follows:—

Gothic.

Gothic type, of the angular or pointed kind, was first used by the Haarlem printer of the *Speculum*, *Donatus*, &c. (see specimen No. 1, taken from the British Museum copy of the *Speculum Humanae Salvationis*, mixed Latin edition), presumably *c.* 1445. An entirely similar but larger type (No. 2, taken from the British Museum copy of Ludovicus [Pontanus] de Roma, *Singularia*) was used, presumably by the same printer, *c.* 1465-1470. Gothic type appeared in Germany as a church type in 1454, in the 31-line indulgence, presumably printed by Johan Gutenberg at Mainz (No. 3, from the Göttingen copy), and in the 30-line indulgence (No. 4, taken from the British Museum copy), printed by Peter Schoeffer at Mainz. Type No. 3 was also used about the same time for the 36-line Bible and type No. 4 for the 42-line Bible. Two much larger Gothic types appeared in the psalter of 1457, published by Fust and Schoeffer (see Bernard, *Origine*, pl. vii.). In Italy Gothic type appears in 1468 (No. 5, taken from the British Museum copy of Cicero, *De Oratore* published at Rome by Ulr. Hahn, 15th December 1468, in small Roman type, with imprint in Gothic), but in a more rounded form; it is practically the ordinary Italian writing influenced by the Gothic. In France Gothic began to be used in 1473; in England it appears first in Caxton's type about the year 1480.[1] It was employed extensively in a great many of the earliest presses all over Europe, and continued to be used largely at all times, especially for Bibles, law books, royal proclamations, &c., and even to this day it is the national character of Germany. It is now usually called *lettre de forme*, *black letter* or *English* in English-speaking countries, *lettre Flamand* in Holland, and *fractur* in Germany.

Bastard Italian or Roman.

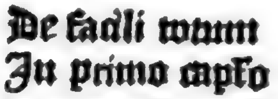
Bastard Italian or bastard Roman was introduced in 1454 at Mainz in the 31-line (No. 6) and 30-line (No. 7) indulgence. It is also called *lettre de somme*, some think from the *Summa* of Thomas Aquinas, printed in the type of the Bible of 1462 by Fust and Schoeffer. Varieties of this kind of type were, like the Gothic, much used by the earliest printers, as, for instance, the printer of the 1460 *Catholicon*, *i.e.*, by Mentelin of Strasburg, *c.* 1460, and by Ulrich Zell at Cologne, *c.* 1466, &c. In England it appeared in the first three books printed (1478, 1479) at Oxford (No. 8, taken from the British Museum copy of Jerome's *Expositio in Simbolum Apostolorum*, wrongly dated 1468 for 1478).

Roman.

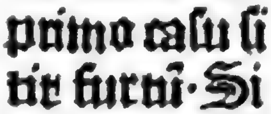
Roman type, the Caroline minuscule of palæography, was first used in Germany about 1464, at Strasburg, by the printer whose fount of type is known by a peculiarly shaped R, and who on that account is usually called "the R printer" (No. 9, taken from the British Museum copy of Durandus, *Rationale*, of which the Basel library possesses a copy which was bought in 1464).[2] In Italy it appears in 1465 at Subiaco (see Bernard, pl. xii., No. 19), at Rome in 1467 (*op. cit.*, pl. xii., No. 20), but in all its purity at Venice in 1469, used by Johannes of Spires (*op. cit.*, pl. xii., No. 23), and at Paris in 1470 (*op. cit.*, pl. xiii., No. 25). In England it was not used before 1518, when Richard Pynson printed Pace's *Oratio in Pace Nuperrima* (see facsimile in Reed's *Type Foundries*, p. 92).

Burgundian.

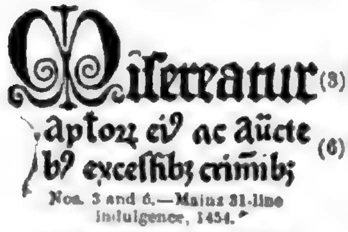
Burgundian type, or *gros batarde* or *secretary*, was first used about 1470-72 by Colard Mansion at Bruges (No. 10, taken from the British Museum copy of *La Controversie de Noblesse*, *c.* 1471-72). With a somewhat similar type (No. 11, taken from the British Museum copy of the *Recuyell*) William Caxton is presumed to have printed, likewise at Bruges, a set of five books, of which the *Recuyell of the History of Troye*, a translation of a work by Raoul le Fèvre, is the best known and was probably printed *c.* 1471.[3] To this same class belong the first type (No. 12, from the British Museum copy of the *Dictes*) used in England by William Caxton for the printing of *Dictes and Sayings of the Philosophers* (18th November 1477), and that used by the printer of St Albans (No. 13, taken from the Cambridge university library copy of Aug. Dactus, *Elegancie*). It was an imitation of the manuscript hand of the English and Burgundian scribes of the 15th century, and, after having figured for a long time in several of the early London and provincial presses, was about 1534 entirely superseded by the English black letter.' To this class of type belong also the later *lettre de civilité* (*c.* 1570), the *script* (*lettre coulée*, *lettre de finance*, Dutch *geschreven schrift*), *set court*, *base secretary*, and *running secretary* types.


De facili totum
Jn primo capto

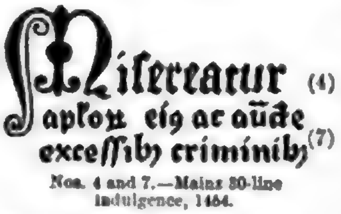
No. 1.—*Speculum* type, *c.* 1445 (?).


primo casu ſi
tit furti·Si

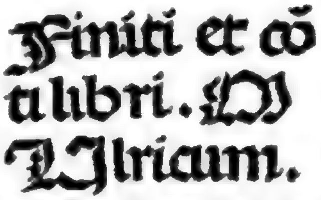
No. 2.—Pontanus type, *c.* 1470 (?).


Miſereatur (3)
aptoꝝ eiꝰ ac aũcte (6)
bꝰ exceſſibꝫ crim̄ibꝫ

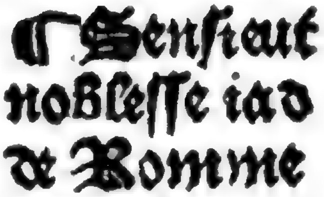
Nos. 3 and 6.—Mainz 31-line indulgence, 1454.


Miſereatur (4)
aptoꝝ eiꝰ ac aũcte
exceſſibꝫ criminibꝫ (7)

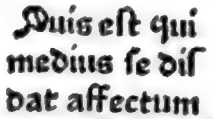
Nos. 4 and 7.—Mainz 30-line indulgence, 1454.


Finiti et cō
tulibri. M
Ulricum.

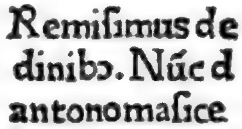
No. 5.—Cicero, *De Oratore*, 1468.


Senſieut
nobleſſe iad
de Romme

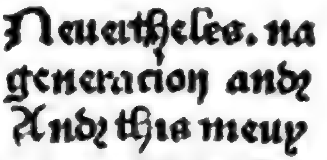
No. 10.—*Controversie de Noblesse*, *c.* 1471-72.


Quis eſt qui
medius ſe diſ
dat affectum

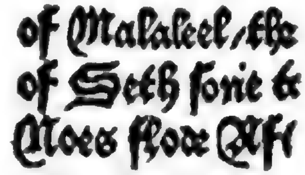
No. 8.—Jerome's *Expositio* (1468), 1478.


Remiſſimus de
dinibꝫ. Nūc d
antonomaſice

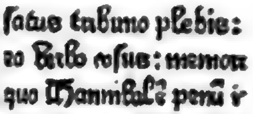
No. 9.—Durandus, *c.* 1464.


Neuertheles. na
generacion andꝛ
Andꝛ this meuy

No. 11.—*Recuyell of the Hist. of Troye*, *c.* 1471.


of Malaleel/the
of Seth ſone &
Moes flode Aft

No. 12.—*Dictes and Sayings*, 1477


ſatus tribuno plebis:
ro Bello fuſus: memor
quo Hanniball penū r

No. 13.—Aug. Dactus, *Elegancie*, 1479.

On the types before 1500, consult also the facsimiles in Holtrop's *Mon. Typ. des Pays-Bas*, The Hague, 1868; R. C. Hawkins, *First Books and Printers of the Fifteenth Century*, New York, 1884; William Blades, *The Life of Caxton*, London, 1861-63; Bernard, *Origine de l'Imprimerie*, Paris, 1853, vol. i., plates iii.-xiii.; Placidus Braun, *Notitia de Libris ab Artis Typogr. Inventione usque ad Annum 1479 Impressis*, Augsburg, 1788; H. Noel Humphreys, *Hist. of the Art of Printing*, fol., London, 1867. The types after 1500 can best be learned from the catalogues of type-founders, among which those of Messrs Enschedé of Haarlem occupy a foremost place. Of others we may mention—*Indice dei Caratteri nella Stampa Vaticana*, 4to, Rome, 1628; *Epreuves des Caractères qui se trouvent chez Claude Lamesle*, 4to, Paris, 1742; *Épreuves des Car. de la Fonderie de Claude Mozet*, 8vo, Nantes, 1754; *Les Car. de l'Imprimerie par Fournier le Jeune*, 8vo, Paris, 1764; *Proef van Letteren, Bloemen, &c., van Ploos van Amstel*, 8vo, Amsterdam, 1767; *Épreuve de Car. de Jacques François Rosart*, 8vo, Brussels, 1771; *Schriften . . . bey J. H. Prentzler*, 4to, Frankfort-on-Main, 1774; *Épreuves des Car. de la Fond. de J. L. Joannis*, 8vo, Paris, 1776; *Epreuves des Car. de la Fond. de J. L. de Boubers*, 8vo, Brussels, 1777; *Proeve van Letteren welke gegooten worden door J. de Groot*, 8vo, The Hague, 1787; *Pantographia*, by Edmund Fry, 8vo, London, 1799; and *Manuale Typographico*, by G. Bodoni, 4to, Parma, 1818.

Subsequent to 1500.

Printers after 1500.

Though the *Cologne Chronicle* of 1499 denies to Mainz the honour of the invention of the art of printing, it was right in asserting that, after it had been brought there from Holland, it became much more masterly and exact, and more and more artistic. During the first half century of printing a good many printers distinguished themselves by the beauty, excellence, and literary value of their productions. We may mention as such:—Johan Fust and Peter Schoeffer at Mainz; Johan Mentelin and Heinrich Eggestein at Strasburg; Ulrich Zell at Cologne; Sweynheym and Pannarts at Subiaco and at Rome; Nicolas Jenson at Venice; Anton Koberger at Nuremberg; Ketelaer and De Leempt at Utrecht; Johan Veldener at Louvain, Utrecht, and Kuilenburg; Gerard Leeu at Gouda; Johan of Westphalia at Louvain; and William CAXTON (*q.v.*) at Westminster.

Very soon the demand for books increased, and with it came a reduction in their prices. This caused a decline in the execution of printing, which begins to be appreciable about 1480 in some localities, and may be said to have become general towards the end of the 15th century. At all times, however, we find some printers raise their art to a great height by the beauty of their types and the literary excellence of their productions. Among the later printers we may mention the Aldi of Venice (1490 to 1597; see

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[1] See Blades, *Life of Caxton*, pl. xvii.
[2] See Jules Philippe, *L'Imprimerie à Paris*, p. 219.
[3] Cf. Blades, *Life of Caxton*.

MANUTIUS, vol. xv. p. 512); G. B. Bodoni of Parma (1768-1813; see vol. iii. p. 849); John Amerbach at Basel (1492-1516); John Froben at Basel (1496-1527; see vol. ix. p. 791); John Baskerville at Birmingham (1750-1775; see vol. iii. p. 421); the house of Wechel, first at Paris (c. 1530-1572), afterwards at Frankfort; Christopher Plantin at Antwerp (1554-1589), but continued long after under the firm *Officina Plantiniana* (see vol. xix. p. 176); the Elzevirs, first at Leyden, afterwards at Amsterdam (1580-1680; see vol. viii. p. 156); Antoine Verard at Paris (1485-1513); Josse Bade at Paris (1495-1535; see BADIUS, vol. iii. p. 228); and the Estiennes at Paris (1502-1598; see STEPHENS, vol. xxii. p. 534).

History of Modern Types.

ic The Italic type[1] is said to be an imitation of the handwriting of Petrarch, and was introduced by Aldus Manutius of Venice for the purpose of printing his projected small editions of the classics. The cutting of it was entrusted to Francesco da Bologna, an artist who is presumed to be identical with the painter Francesco Francia or Raibolini. The fount is a "lower case" only, the capitals being Roman in form. It contains a large number of tied letters, to imitate handwriting, but is quite free from contractions and ligatures. It was first used in the *Virgil* of 1500. Aldus produced six different sizes between 1501 and 1558. It was counterfeited almost immediately in Italy, at Lyons, and elsewhere. Originally it was called Venetian or Aldine, but subsequently Italic type, except in Germany and Holland, where it is called "cursive." The Italians also adopted the Latin name "characteres cursivi seu cancellarii." In England it was first used by Wynkyn de Worde in Wakefield's *Oratio* in 1524. The character was at first intended and used for the entire text of classical works. When it became more general, it was employed to distinguish portions of a book not properly belonging to the work, such as introductions, prefaces, indexes, notes, the text itself being in Roman. Later it was used in the text for quotations, and finally served the double part of emphasizing certain words in some works, and in others, chiefly translations of the Bible, of marking words not rightly forming a part of the text.

k. Greek type (*minuscules*) first occurs in Cicero, *De Officiis* printed at Mainz in 1465 by Fust and Schoeffer. The fount used is rude and imperfect, many of the letters being ordinary Latin. In the same year Sweynheym and Pannartz used a good Greek letter for some of the quotations in their edition of *Lactantius* (see, for instance, leaves 11a, 19a, 36a, 139, 140); but the supply was evidently short at first, as some of the larger quotations in the first part of the book were left blank to be filled in by hand. The first book wholly printed in Greek minuscules was the *Grammar* of Lascaris, by Paravisinus, at Milan in 1476, in types stated to have been cut and cast by Demetrius of Crete. The fount contains breathings, accents, and some ligatures. The headings to the chapters are wholly in capitals. The *Anthologia Græca* of Lascaris was printed at Florence in 1494 wholly in Greek capitals (*litteræ majusculæ*), and it is stated in the preface that they were designed after the genuine models of antiquity to be found in the inscriptions on medals, marbles, &c. But as late as 1493 Greek type was not common, for in that year the Venice printer Symon Bevilaqua issued *Tibullus*, *Catullus*, and *Propertius* with blanks left in the commentary for the Greek quotations. In England Greek letters appeared for the first time in 1519 in W. de Worde's edition of Whitenton's *Grammatica*, where a few words are introduced cut in wood. Cast types were used at Cambridge in Galen's *De Temperamentis*, translated by Linacre, and printed by Siberch in 1521, who styles himself the first Greek printer in England; but the quotations in the Galen are very sparse, and Siberch is not known to have printed any entire book in Greek. The first printer who possessed Greek types in any quantity was Reginald Wolfe, who held a royal patent as printer in Greek, Latin, and Hebrew, and printed in 1543 two *Homilies* of Chrysostom, edited by Sir John Cheke, the first Greek lecturer at Cambridge. In Edinburgh, in 1563, and as late as 1579, the space for Greek words was left blank in printing, to be filled in by hand. In 1632 Cambridge applied to Oxford for the loan of a Greek fount to print a Greek Testament, and the same university made an offer in 1700 for the purchase of a fount of the king's Greek at Paris, but withdrew on the French Academy insisting as a condition that every work printed should bear the imprint "characteribus Græcis e typographeo regio Parisiensi." It should not be forgotten that the large number of ligatures in the Greek of that day made the production of a fount a serious business. The Oxford Augustin Greek comprised no fewer than 354 matrices, the great primer 456, and even one fount showed 776 different sorts. The Dutch founders effected a gradual reduction of the Greek typographical ligatures. Early in the 19th century a new fashion of Greek, for which Porson was sponsor and furnished the drawings, was introduced, and has remained the prevailing form to this day.

Hebrew. The first Hebrew types are generally supposed to have appeared in 1475 in Petrus Niger's *Tractatus contra Perfidos Judæos* (leaf 10), printed by Conrad Fyner at Esslingen. De Rossi states that a Hebrew work in four folio volumes entitled *Arba Turim* of Rabbi Jacob ben Asher, was printed in 1475 at Pieve di Sacco in Austrian Italy, while in the same year, a few months earlier, Salomon Jarchi's *Comment. on the Pentateuch* appeared at Reggio in Italy, printed in the Rabbinical character. Numerous other Hebrew works followed before 1488, in which year the first entire Hebrew Bible was printed, with points, at Soncino, by a family of German Jews. The first English book in which any quantity of Hebrew type was used was Dr Rhys's *Cambro-Brytannicæ Cymraecæve Linguæ Institutiones*, printed by Thomas Orwin in 1592, though already in 1524 Greek characters, but cut in wood, were used by W. de Worde in Wakefield's *Oratio*. But the Hebrew fount made use of in Walton's *Polyglott* in 1657 was probably the first important fount cut and cast in England, though there were as yet no matrices there for Rabbinical Hebrew. In the beginning of the 18th century Amsterdam was the centre of the best Hebrew printing in Europe.

Arabic. The first book printed in Arabic types is said to be a *Diurnale Græcorum Arabum*, printed at Fano in Italy in 1514.[2] Two years later P. P. Porrus's *Polyglott Psalter*, comprising the Arabic version, was printed at Genoa; and two years later a *Koran* in Arabic is said to have been printed at Venice. In 1505 an *Arabic Vocabulary* at Granada had the words printed in Gothic letters with the Arabic points placed over them; and in other presses where there were no Arabic types the language was expressed in Hebrew letters or cut in wood. De Guignes and others mention a fount of Arabic used by Gromors in Paris in 1539-40 to print Postel's *Grammar*. In England some Arabic words were introduced in Wakefield's *Oratio* of 1524, but apparently cut in wood. In Minsheu's *Ductor in Linguas*, 1617, the Arabic words are printed in Italic characters. Laud's gift of Oriental MSS. to Oxford in 1635, and the appointment of an Arabic lecturer, were the first real incentives to the cultivation of the language by English scholars. Previous to this it is stated that the Raphelengius Arabic press at Leyden had been purchased by the English Orientalist, William Bedwell; but, if it was brought to England, it does not appear to have been immediately made use of. The Arabic words in Thomas Greave's *Oratio de Linguæ Arabicæ Utilitate*, printed at Oxford in 1639, were written in by hand.

Syriac. Syriac type, probably cut in wood, first appeared in Postel's *Linguarum XII. Alphabeta*, printed in Paris in 1538; but the characters are so rude in form and execution as to be scarcely legible. In 1555, however, Postel assisted in cutting the punches for the Syriac Peshito New Testament, printed at Vienna in 4to, the first portion of the Scriptures, and apparently the first book, printed in that language. In 1569-72 Plantin at Antwerp included the Syriac New Testament in his *Polyglott*, and reissued it in a separate form in 1574. In England Syriac was usually expressed in the earlier works in Hebrew characters. But in 1652, when the prospectus and preliminary specimen of Walton's *Polyglott* were issued, we find Syriac type in use.

Armenian. Of the Armenian character the press of the Vatican possessed a good fount in 1591, when Angelo Roccha showed a specimen in his *Bibliotheca Apostolica Vaticana*. A psalter is said to have been printed at Rome in 1565, and Rowe Mores mentions doubtfully a liturgy printed at Cracow in 1549. Armenian printing was practised in Paris in 1633; but the Armenian bishops, on applying to France for assistance in printing an Armenian Bible in 1662, were refused, and went to Rome, where, as early as 1636, the press of the Propaganda had published a specimen of its Armenian matrices. The patriarch, after fifteen months' residence in Rome, removed to Amsterdam, where he established an Armenian press, and printed the Bible in 1666, which was followed in 1668 by a separate edition of the New Testament. In 1669 the press was set up at Marseilles, where it continued for a time, and was ultimately removed to Constantinople. In England the first Armenian type was that presented by Dr Fell to Oxford in 1667. The alphabet given in the prolegomena of Walton's *Polyglott* was cut in wood.

Ethiopic. Of Ethiopic the earliest type appeared in Potken's *Psalter and Song of Solomon*, printed at Rome in 1513. The work was reprinted at Cologne in 1518 in Potken's *Polyglott Psalter*. In 1548 the New Testament was printed at Rome by some Abyssinian priests. The press of the Propaganda issued a specimen of its fount in 1631, and again in Kircher's *Prodromus Coptus* in 1636. Erpenius at Leyden had an Ethiopic fount, which in 1626 was acquired by the Elsevirs. Usher attempted to procure the fount for England; but, his attempt failing, punches were cut and matrices prepared by the London founders for the London *Polyglott*, which showed the Psalms, Canticles, and New Testament in the Ethiopic version.

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[1] These paragraphs on the various types are for the most part taken from T. B. Reed's *History of the Old English Letter Foundries*, London, 1887, p. 50 sq.

[2] See Panzer, vii. 2.

Coptic. Of Coptic the press of the Propaganda possessed a fount, and a specimen was issued in 1636, in which year also Kircher's *Prodromus Coptus* appeared from the same press. In England David Wilkins's edition of the New Testament was printed in 1716 from Coptic types cast with matrices which Dr Fell had presented to Oxford in 1667. The alphabets shown in the introduction and prolegomena to the London *Polyglott* of 1655 and 1657 were cut in wood.

Samaritan. Of Samaritan the press of the Propaganda had a fount in 1636, and the Paris *Polyglott*, completed in 1645, contained the entire Pentateuch in type the punches and matrices of which had been specially prepared under Le Jay's direction. The fount used for the London *Polyglott* in 1657 is admitted to have been an English production, and was probably cut under the supervision of Usher.

Slavonic. With Slavonic type a psalter was printed at Cracow as early as 1491, and reprinted in Montenegro in 1495. The only Slavonic fount in England was that given by Dr Fell to Oxford, and this, Mores states, was replaced in 1695 by a fount of the more modern Russian character, purchased probably at Amsterdam. The *Oratio Dominica* of 1700 gives a specimen of this fount, but renders the Hieronymian version in copper-plate. **Russian.** Modern Slavonic, better known as Russian, is said to have appeared first in portions of the Old Testament printed at Prague in 1517-19. Ten years later there was Russian type in Venice. A Russian press was established at Stockholm in 1625, and in 1696 there were matrices in Amsterdam, from which came the types used in Ludolph's *Grammatica Russica*, printed at Oxford in that year, and whence also, it is said, the types were procured which furnished the first St Petersburg press, established in 1711 by Peter the Great. Mores notes that in 1778 there was no Russian type in England, but that Cottrell was at that time engaged in preparing a fount. It does not appear that this project was carried out, and the earliest Russian in England was cut by Dr Fry from alphabets in the *Vocabularia*, collected and published for the empress of Russia in 1786-89. This fount appeared in the *Pantographia* in 1799.

Etruscan. A fount of the Etruscan character cut by William Caslon about 1733 for Swinton of Oxford was apparently the first produced. Fournier in 1766 showed an alphabet engraved in metal or wood. In 1771 the Propaganda published a specimen of their fount, and Bodoni of Parma in 1806 exhibited a third in his *Oratio Dominica*.

Runic. Runic types were first used at Stockholm in a Runic and Swedish *Alphabetarium*, printed in 1611. The fount, which was cast at the expense of the king, was afterwards acquired by the university. About the same time Runic type was used at Upsala and at Copenhagen. Voskens of Amsterdam had matrices about the end of that century, and it was from Holland that Francis Junius is supposed to have procured the matrices which in 1677 he presented to Oxford. This fount appears in the *Oratio Dominica* of 1700, and in Hickes's *Thesaurus*, 1703-5, and it remained the only one in England.

Gothic. Matrices of Gothic type were presented to Oxford by Francis Junius in 1677, and a fount of them was used for the *Oratio Dominica* of 1700 and in Hickes's *Thesaurus*. A different fount was used for Chamberlayne's *Oratio Dominica*, printed at Amsterdam in 1715. Caslon cut a fount which appeared in his first specimen in 1734. This and the Oxford fount were the only two in England in 1820.

Scandinavian. Founts of Icelandic, Swedish, and Danish were included in Junius's gift to Oxford in 1677, and were, perhaps, specially prepared in Holland. The first-named is shown in the *Oratio Dominica* of 1700 and in Hickes's *Thesaurus*. Printing had been practised in Iceland since 1531, when a *Breviary* was printed at Hoolum, in types rudely cut, it is alleged, in wood. In 1574, however, metal types were provided, and several works produced. After a period of decline, printing was revived in 1773, and in 1810 Sir George M'Kenzie reported that the Hoolum press possessed eight founts of type, of which two were Roman, and the remainder of the common Icelandic character, which, like the Danish and Swedish, bears a close resemblance to the German.

Anglo-Saxon. For the Anglo-Saxon language the first type was cut by John Day in 1567, under the direction of Archbishop Parker, and appeared in Ælfric's *Paschal Homily* in that year and in the *Ælfredi Res Gestæ* of Asser Menevensis in 1574. Anglo-Saxon type was used by Browne in 1617, in Minsheu's *Ductor in Linguas*; and Haviland, who printed the second edition of that work in 1626, had in 1623 made use of the character in Lisle's edition of Ælfric's *Homily*.

Irish. The first fount of Irish character was that presented by Queen Elizabeth to O'Kearney in 1571, and used to print the Catechism which appeared in that year in Dublin, from the press of Franckton. But the fount is only partially Irish, many of the letters being ordinary Roman or Italic. It was used in several works during the early years of the 17th century, and as late as 1652 in Godfrey Daniel's *Christian Doctrine*, printed in Dublin. The Irish seminaries abroad were better supplied with Irish type. A new type was cut by Moxon, and appeared in 1681 in Boyle's New Testament, printed by Robert Everingham.

Music. The earliest specimen of music type occurs in Higden's *Polychronicon*, printed by De Worde at Westminster in 1495. The square notes appear to have been formed of ordinary quadrats, and the staff-lines of metal rules imperfectly joined. In Caxton's edition of the same work in 1482 the space had been left to be filled up by hand. The plain chant in the Mainz psalter of 1490, printed in two colours, was probably cut in wood. Hans Froschauer of Augsburg printed music from wooden blocks in 1473, and the notes in Burtius's *Opusculum Musices*, printed at Bologna in 1487, appear to have been produced in the same manner; while at Lyons the missal printed by Matthias Hus in 1485 had the staff only printed, the notes being intended to be filled in by hand. About 1500 a musical press was established at Venice by Ottavio Petrucci, at which were produced a series of mass-books with lozenge-shaped notes, each being cast complete with a staff-line. In 1513 he removed to Fossombrone, and obtained a patent from Leo X. for his invention of types for the sole printing of figurative song (*cantus figuratus*). Before 1550 several European presses followed Petrucci's example, and music type was used, among other places, at Augsburg in 1506 and 1511, Parma in 1526, Lyons in 1532, and Nuremberg in 1549. In 1525 Pierre Hautin cut punches of lozenge-shaped music at Paris. Round notes were used at Avignon in 1532. In England, after its first use, music-printing did not become general till 1550, when Grafton printed Marbecke's Book of Common Prayer, "noted" in movable type, the four staff-lines being printed in red and the notes in black. There are only four different sorts of notes used,—three square and one lozenge. About 1660 the detached notes hitherto employed began to give place to the "new tyed note," by which the heads of sets of quavers could be joined. But at the close of the 17th century music-printing from type became less common, on account of the introduction of stamping and engraving plates for the purpose.

Printing for the blind. Printing for the blind (compare vol. iii. p. 826) was first introduced in 1784 by Valentin Haüy, the founder of the asylum for blind children in Paris. He made use of a large script character, from which impressions were taken on a prepared paper, the impressions being so deeply sunk as to leave their marks in strong relief and legible to the touch. Haüy's pupils not only read in this way, but executed their own typography, and in 1786 printed an account of their institution and labours as a specimen of their press. The first school for the blind in England was opened in Liverpool in 1791, but printing in raised characters was not successfully accomplished till 1827, when Gall of the Edinburgh asylum printed the Gospel of St John from angular types. Alston, the treasurer of the Glasgow asylum, introduced the ordinary Roman capitals in relief, and this system was subsequently improved upon by the addition of the lower-case letters by Dr Fry, the type-founder, whose specimen gained the prize of the Edinburgh Society of Arts in 1837. Several rival systems have competed in England for adoption, of which the most important are those of Lucas, Frere, Moon, Braille, Carton, and Alston; the last-named, as perfected by Dr Fry, seems likely to become the recognized method of printing for the blind in all European countries.

Initials. As regards initials in the earliest printed books, see above, p. 686. The trouble and cost involved in the use of the initial director early suggested the use of wood-cut initials, and Erhard Ratdolt of Venice, about 1475, is generally supposed to have been the first printer to introduce the *literæ florentes*, called also *lettres tourneures*, or *typi tornatissimi*, which eventually superseded the hand-painted initials. Caxton introduced one or two kinds in 1484. Among the earliest to be used are the so-called Lombardic initials or capitals. The more elaborate initials, such as those used in the Mainz indulgences and psalter, by Aldus at Venice, by Johann Schoeffer at Mainz in 1518, by Tory and the Estiennes at Paris, by Froben at Basel, and by the other great printers of their day, were known as *lettres grises*. Besides these, the ordinary "two-line letters" or large plain capitals came into use; and these were generally cast, whilst the ornamental letters were for the most part engraved on wood or metal.

Ornaments and flowers. Type ornaments and flowers began, like the initials, with the illuminators, and were afterwards cut on wood or metal. The first printed ornament or vignette is supposed to be the scutum or arms of Fust and Schoeffer in their edition of the Bible of 1462. There is no vignette in the Subiaco *Lactantius* of 1465 (as stated by Mr Reed, *Letter Foundries*, p. 82). In Holtrop's *Monum. Typogr. des Pays-Bas* may be seen borders used by some of the earliest printers of Holland (1475-1490) which would not look bad even in the present time. Caxton in 1490 used ornamental pieces to form the border for his *Fifteen O's*. At the same time the Paris printers engraved still more elaborate border pieces. At Venice entire frames were engraved in one piece, while Aldus as early as 1495 used tasteful head-pieces cut in artistic harmony with his *lettres grises*. Early in the 16th century we observe detached ornaments and flourishes which have evidently been cast from a matrix.

Literature.—Besides the works of Berjeau, Bernard, Blades, Hawkins, Hessels, Holtrop, Noel Humphreys, Koehler, Jules Philippe, T. B. Reed, Sotheby, Weigel, &c., already mentioned, consult also Bigmore and Wyman, *A Bibliography of Printing*, London, 1880; Geo. Wolfg. Panzer, *Annales Typog.*, Nuremberg, 1793, &c.; Lud. Hain, *Repertorium Bibliog.*, Stuttgart, 1826-38; Holtrop, *Cat. Librorum Sæc. XVº Impressorum in Bibl. Regia Hagana*, The Hague, 1856; M. F. A. G. Campbell, *Ann. de la Typog. Néerlandaise au XVº Siècle*, The Hague, 1874; Rob. Sinker, *A Cat. of the XV. Century Printed Books in the Library of*

Trinity College, Cambridge, Cambridge, 1876; W. Th. Lowndes, *Bibliographer's Manual*, ed. by Henr. G. Bohn, London, 1858, &c.; J. C. Brunet, *Manuel du Libraire*, Paris, 1860 (four earlier editions); Th. F. Dibdin, *Bibliotheca Spencerriana*, London, 1814, &c., and his other works; Ennen, *Katalog der Incunabeln in der Stadt-Bibliothek zu Köln*; Schoepflin, *Vindiciæ Typog.*, 1760; Meerman, *Origines Typog.*, The Hague, 1765; Dupont, *Hist. de l'Impr.*, Paris, 1869; Firmin-Didot, *Hist. de la Typog.*, Paris, 1882; E. Duverger, *Hist. de l'Invention de l'Impr.*, Paris, 1840; P. Lambinet, *Origine de l'Impr.*, Paris, 1810; Ch. Ruelens, *La Légende de St Servais*, Brussels, 1873, 8vo; J. P. A. Madden, *Lettres d'un Bibliographe*, Paris, 1868-78; Wetter, *Krit. Gesch. der Erfindung der Buchdruckerkunst*, Mainz, 1836; A. de Vries, *Éclaircissemens sur l'Histoire de l'Inv. de l'Impr.*, The Hague, 1843; Jos. Ames, *Typogr. Antiquities* (augmented by W. Herbert), London, 1785-90; T. C. Hansard, *Typographia*, London, 1825; Thomas, *Hist. of Printing in America*, Albany, 1874; Th. L. Devinne, *The Inv. of Print.*, London, 1877; W. Skeen, *Early Typography*, Colombo, 1872; Sam. Palmer, *A General Hist. of Print.*, London, 1732; W. Young Ottley, *Inquiry concerning the Inv. of Print.*, London, 1863; Henry Bradshaw, *A Classified Index of the 15th Century Books in the Collection of the late M. J. de Meyer*, London, 1870; Id., *Hist. of the Founts of Type and Woodcut Devices used by Printers in Holland in the Fifteenth Century*, London, 1871; Id., *The Printer of the Historia S. Albani*, Cambridge, 1868; A. Von der Linde, *Haarlem Legend*, London, 1870; Id., *Gutenberg*, Stuttgart, 1881; Id., *Gesch. der Erfind. der Buchdruckerkunst*, Berlin, 1886; Schaab, *Gesch. der Erfind. der Buchdruckerk.*, Mainz, 1830; K. Falkenstein, *Gesch. der Buchdruckerk.*, Leipsic, 1856; Lorck, *Handb. der Gesch. der Buchdruckerk.*, Leipsic, 1882; K. Faulmann, *Illustr. Gesch. der Buchdruckerk.*, Vienna, 1882; M. Denis, *Wiens Buchdruckergesch. bis 1560*, Vienna, 1782; C. R. Hildeburn, *A Century of Printing—The Issues of the Press in Pennsylvania, 1685-1784*, Philadelphia, 1887; and J. Garcia Icazbalceta, *Bibliog. Mexicana del Siglo XVI.*, Mexico, 1887. The titles of other works on the invention, progress, and process of printing, &c., may be learned from the lists of books on such subjects in the works already quoted. (J. H. H.)

PART II.—PRACTICAL.

Printing has been defined to be the act, art, or practice of impressing letters, characters, or figures on paper, cloth, or other material, the definition being based on the etymology (Old Fr. *empreindre*, from Lat. *imprimere*). Technically the same definition might be applied to such arts as those of calico and oilcloth printing, and even of moulding, embossing, coining, and stamping; but in point of fact these are never understood when the word "printing" is employed. There is also printing without pressure, such as photographic printing. The use of a pigment or ink must be regarded as an indispensable element. The application of the term is therefore confined to the use of pressure and a pigment for literary and pictorial purposes. As thus defined, printing includes three entirely different processes—not inaptly called the polygraphic arts—viz., chalcography or copperplate printing (compare ENGRAVING, vol. viii. p. 439 *sq.*), LITHOGRAPHY (*q.v.*) or chemical stone-printing, and typography or letterpress printing. The last-named is that to which the present article is confined.

The difference between the three methods lies essentially in the nature or conformation of the surface that is inked, and which afterwards gives a reproduction or image in reverse on the material to be impressed. In copperplate printing the whole of a flat surface is inked, and a portion of the ink sinks into an incision or trench, in which it still remains after the surface is cleansed. When pressure is brought to bear, this ink is transferred to the paper, giving an impression of a line. In lithographic printing the flat surface is protected except at certain places, where it is slightly coated with the ink, which practically leaves the stone quite level, but also marks a line when pressure is brought to bear. In typography the printing surface is in relief. It alone receives ink, the remainder being protected by its lower level. Any kind of printing done from a relief surface belongs to letterpress printing, such as a woodcut, a casting in metal, india-rubber, celluloid, xylonite, &c. (or "stereotype"), or a deposition by electricity (or "electrotype"). The typographic method requires a surface that is more difficult to form than either of the other two. In lithography the surface may be obtained by merely writing or drawing on the stone; in copperplate printing the line may be immediately incised into or scratched on the plate; but for letterpress printing the surface between the lines in relief has to be cut away. Hence the tediousness of wood-engraving, in which all the surface of the block has to be removed except those parts that are to be printed from and which form the black lines in the impression; and the conformation of a type surface is similar.

Typography, however, has many compensating advantages. Impressions are taken with much greater facility. The inking appliance glides over the relief lines to be printed from, whereas it would cling to the entire surface of the stone or the metal; hence much greater pressure would be required in these cases. The unprintable part of the stone in lithography has to be damped, so as to repel the ink; the same portion has to be inked and then cleaned off in copperplate printing; but in letterpress printing the ink only that has to be transferred to the paper needs to be applied to the type. When the design has been drawn on the stone or scratched into the copper, the result does not admit of any further application beyond that at first contemplated. But in letterpress printing the surface may be of a composite character. It may be formed of single pieces representing the several letters, and these, when once formed, may be employed in endless combinations. Only by such means are cheap newspapers and books possible. Before the invention of typography (as in the East to the present day), the different pages of a book were printed from wooden blocks, cut after the manner of a wood-engraving. Blocks of this kind are of no use for printing after their first purpose has been fulfilled. They must necessarily be made very slowly and with much labour. In forming a page of a book, on the other hand, by the typographic method there need (excluding necessary wear and tear) only be the cost of "composing" the types and of "distributing" them into their proper receptacles, from which they may be re-taken many times to form other compositions.

Types: their Material Characteristics.

Book-fount.

Exclusive of such printing surfaces as wood-blocks and casts, the letters, marks, and signs with which letterpress printing is executed are called *types*, a proportioned quantity of each of the letters of the alphabet in any one body or face forming a *fount*. A book-work fount contains single letters, diphthongs, ligatures (such as ff, fl), accented letters, figures, fractions, points, reference marks, dashes or metal rules (as ———), leaders (as ……), braces (⏞), and signs (as &, £). It also includes quadrats,—pieces of metal of various widths, which do not print, but are used to compensate for the shortness of occasional lines, as at the close of a paragraph—and spaces, which separate words and letters. There are thus about 226 separate characters in every ordinary English book-work fount.

Bill of type.

The table used by type-founders to regulate the number of each of the several sorts in a fount is called a *bill of type*. The sorts are supplied by English type-founders in certain definite proportions, depending upon the number of lower-case m's. A bill of 3000 m's usually contains the following:—

Lower-case.		Figures, &c.		Capitals.		Small Caps.	
m	3,000	,	4,500	A	700	A	450
a	9,000	;	800	B	450	B	270
b	2,000	:	600	C	500	C	350
c	4,000	.	3,000	D	550	D	350
d	5,000	-	1,000	E	750	E	450
e	14,000	?	300	F	450	F	300
f	3,000	!	200	G	450	G	270
g	2,000	'	800	H	450	H	300
h	6,000	(	400	I	900	I	450
i	9,000	[	200	J	300	J	200
j	500	*	250	K	300	K	200
k	800	†	100	L	550	L	300
l	5,000	‡	100	M	650	M	300
n	8,000	§	100	N	550	N	350
o	8,000	‖	100	O	550	O	350
p	2,400	¶	70	P	500	P	270
q	600			Q	200	Q	120
r	7,000	1	700	R	500	R	330
s	8,000	2	600	S	600	S	350
t	10,000	3	600	T	800	T	420
u	4,500	4	500	U	350	U	240
v	1,500	5	500	V	350	V	200
w	2,500	6	500	W	550	W	270
x	500	7	500	X	200	X	120
y	2,500	8	500	Y	350	Y	200
z	300	9	500	Z	150	Z	120
&	300	0	700	Æ	100	Æ	60
ff	400	£	200	Œ	100	Œ	60
fi	500						
fl	300	é	200	½	150	SPACES.	
ffl	200	à	200	⅓	150	Thick	20,000
ffi	300	â	100	¼	150	Middle	8,000
æ	200	ë	100			Thin	8,000
œ	100			⅔	50	Hair	3,000
—	500	All other	100	¾	50	Em qds.	3,000
——	150	accents		⅛	50	En qds.	6,000
———	100	each		⅜	50	⏞ ea.	20
————	80	&, @, ℔, lb,	50	⅝	50	⏞	25
…	100	each		⅞	50	⏞	25
……	100	☞	30	[illegible]	50	⏞	25

Large quads, one-tenth of fount. Italic, one-tenth of Roman.

Such a fount would weigh about 750 ℔ if of pica size, 480 ℔ if long primer, 400 ℔ if bourgeois, 330 ℔ brevier, 280 ℔ minion, 220 ℔ nonpareil. The numbers of the respective letters are based on the requirements of the English language;[1] other languages of course require different proportions. In Latin and French, for instance, q and u would be deficient, h in excess, and w needless. The number of the respective letters may be, and sometimes is, apportioned by weight; for example, in one of the "schemes" of founts used by type-founders a fount of 125 ℔ Roman with, as its complement, 10 ℔ Italic, includes 8 oz. of E, M, C; 9 oz. of T; 8 ℔ of e; 5 ℔ each of a, h, n, o, t; and so on, down to 3 oz. of z. To estimate the quantity of type required for a page, the number of square inches it contains is measured and divided by 4, the quotient being the approximate weight of the matter in pounds. In small founts, however, 50 per cent. is added, and in large ones 30 to 40 per cent., to allow for the letters generally left in the cases, not being required in the job, and for sorts, &c. These figures, although useful, are only approximative, the proportion of the several ingredients of type-metal used by different founders for the various sizes of type greatly varying the calculation.

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[1] There is a tradition in one of the oldest English foundries that this scale originated in a laborious calculation of the comparative number of different letters used in setting up a lengthy debate in the House of Commons, it being supposed then that the purest English was spoken there. The scale is, however, frequently found defective in practice. It is a curious fact, for instance, that the matter of Charles Dickens's works will empty the vowel boxes long before those of the consonants, and that Lord Macaulay's stateller style will run with like persistency on consonants.

Parts of a type. Each of the parts of a type has a technical name. In the annexed diagram (fig. 1) of the capital letter M the darkest space *a, a, a, a,* is called the *face*; and only that part of the type touches the paper in printing. The face is divided into the *stem*, marked 1, which comprises the whole outline of the type M; the *serifs*, or the horizontal lines marked 2, which complete the outline of the letter; the *beard*, consisting of the bevel or sloping part marked *b, b*, and the *shoulder* or flat portion below *b*. The shank is the entire body of the letter, *d*, the front part (that shown) being known as the *belly* and the corresponding part behind as the *back*. The spaces at *h* and *h* are the *counters*, which regulate the distances apart of the stems in a line of type. The hollow groove extending across the shank at *e, e* is the *nick*, which enables the workman to recognize the direction of the type and to distinguish different founts of the same body. The absence of this simple expedient would retard the operation of composing types by fully one-half. The earliest type-founders did not know the use of the nick. In some letters, such as j and f, a part of the face overhangs the shank; this is called the *kern*. The groove *g* divides the bottom of the type into two parts called the *feet*. An impression from that part of a type on which it stands would be as =. Types must be perfectly rectangular, the minutest deviation rendering them useless. Any roughness at the sides is called *burr*, and any injury to their faces a *batter*. Smoothness, sharpness of angle, and perfection of finish are also prime requirements. A line of types, when viewed along the back, presents the appearance of a solid bar of metal.

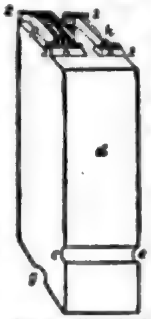

Fig. 1.—Finished type.

Species of letter. Types which have the face cast in the middle of the shank, as a, c, e, m, &c., and thus leave an open space above them corresponding to that below, caused by the beard, are known as *short letters*. Those whose stem extends to the top of the shank, as b, d, f, &c., are called *ascending letters*. Those that have a stem extending over the shoulder, as g, p, &c., are called *descending letters*. Those that are both ascending and descending, and extend over the whole of the shank, as Q and j, are *long letters*. Small letters and figures cast upon the upper part of the shank, as 1^{e}, are called *superiors*; those very low down on the shank are *inferiors*, as H_{1}. Types that are very heavy and massive in appearance are called *fat-faced*; those that are fine and delicate, *lean-faced*. A type whose face is not in proportion to the depth of the shank (*e.g.*, a small pica cast on a pica body) is a *bastard type*.

Specimens of principal bodies. Types are of various sizes, ranging from those used in printing pocket Bibles to those for large placards. The variation is confined to the superficial dimensions of their ends, or *bodies*, as they are called. Each body has a distinctive name. The following are specimens of the principal bodies of ordinary types, and show the relation of the various bodies one to another—

Printing h

Canon—17½ lines to the foot.

Printing has b

Double great primer—25½ lines to the foot.

Printing has been

Double English—33 lines to the foot.

Printing has been defined to

Double Pica—41½ lines to the foot.

Printing has been defined to be

Great primer—51½ lines to the foot.

Printing has been defined to be the ac

English—64 lines to the foot.

Printing has been defined to be the act, art, or

Pica—71½ lines to the foot.

Printing has been defined to be the act, art, or prac

Small pica—83 lines to the foot.

Printing has been defined to be the act, art, or practice of

Long primer—89 lines to the foot.

Printing has been defined to be the act, art, or practice of i

Bourgeois—102½ lines to the foot.

Printing has been defined to be the act, art, or practice of impress

Brevier—111 lines to the foot.

Printing has been defined to be the act, art, or practice of impressing

Minion—122 lines to the foot.

Printing has been defined to be the act, art, or practice of impressing lett

Emerald—138 lines to the foot.

Printing has been defined to be the act, art, or practice of impressing letters,

Nonpareil—143 lines to the foot.

Printing has been defined to be the act, art, or practice of impressing letters, charact

Ruby—166 lines to the foot.

Printing has been defined to be the act, art, or practice of impressing letters, characters, or fig

Pearl—178 lines to the foot.

Printing has been defined to be the act, art, or practice of impressing letters, characters, or figures on paper, cloth,

Diamond—207 lines to the foot.

Printing has been defined to be the act, art, or practice of impressing letters, characters, or figures on paper, cloth, or othe

Gem—222 lines to the foot.

Printing has been defined to be the act, art, or practice of impressing letters, characters, or figures on paper, cloth, or other.

Brilliant—239 lines to the foot.

Size of types. It is a confusing and inconvenient anomaly that the types made by different English founders vary in size, although they bear the same name. The above figures refer to the types of Messrs Miller and Richard, the royal type-founders for Scotland; but other eminent makers supply, for instance, long primer which is 89½, 90, or 92 lines to the foot. This has been remedied in America by an agreement on the part of the founders to adopt one standard pica, to divide that pica into a certain number of equal parts, and to cast all their types as multiples of one of these parts. They divide the pica into twelve points, and the point is the unit upon which the system is based. There is also another practical advantage in this multiple system: each type bears a simple proportion to the others, and therefore can be used in exact combination. Thus pearl is 5, nonpareil 6, minion 7, brevier 8, bourgeois 9, long primer 10, small pica 11, and pica 12 points. In Germany, France, and other countries of the Continent a uniform system of points has been adopted, based on a scale of 133 "Ciceros" (corpus 12) to 60 centimetres. The types which most nearly correspond to those already mentioned are:—

	Point Ems to Foot.	Size in Centimetre.		Point Ems to Foot.	Size in Centimetre.
Perl 5	162·15	·1879	Borgis 9	90·06	·3383
Nonpareille 6	135·12	·2256	Garmond 10	81·07	·3759
Colonel 7	115·83	·2632	Cicero 12	67·56	·4511
Petit 8	101·34	·3008			

The number of lines given to the foot in the above specimens of bodies is the theoretic and practically the only approximative standard. The height of types varies slightly with different founders, the mean being $\frac{11}{12}$ in. The old Scotch height is about $\frac{1}{16}$ in. higher. Types lower than the ordinary dimension are said to be *low to paper*, and if surrounded by higher types will not give a perfect impression. Spaces and quadrats were formerly only three-fourths of an inch in height; but, since electrotyping has become so common, they are almost invariably cut high, *i.e.*, up to the shoulder of the type. Six lines of pica and twelve lines of nonpareil each cover an inch in depth. It is, however, not possible to know the size of a type in a printed page by placing a rule measure upon it, as many books are not set solid: the lines are not close together, but leaded out with pieces of lead, to make them cover a larger space. A communication of great importance contributed to a newspaper may be set up in the same type as the leading article; but if not leaded it will appear to the non-technical reader to be in a smaller character.

The width of pages or columns, in the technical language of the printing office, is expressed according to the number of "ems," that is, of a pica m,—the square of the depth of pica. As the latter is one-sixth of an inch, the em is the same width, and a page of twenty-four ems wide is equal to one 4 inches wide. The columns of this *Encyclopædia* are 19 ems wide.

Varieties of face. According to the purpose for which they are used, types are divided into two classes—book type, including Roman and Italic, and job type, including a multitude of fanciful forms of letters, chiefly founded on the shape of the Roman and Italic letters, and intended to be more prominent, delicate, elegant, &c. It is impossible to enumerate all the varieties of the latter class, as additions are being constantly made and once popular styles always going out of fashion. The leading varieties are the antiques, which are Roman letters with strokes of nearly uniform thickness, as **M**; sanserifs or grotesques, which have no serifs, as **M**; blacks, as **M**; and scripts, which represent the modern cursive or Italian handwriting, as *M*. Black letter is now only a jobbing type in English-speaking countries, although, as stated in the historical section of this article, it was the first character used in printing. It is still used in Germany, with certain modifications, as the principal text-letter for books and newspapers. A comparison of the numerous reproductions that have been issued of Caxton's works with any modern line of black letter will show how greatly the form and style have been altered within a period of four centuries. The present style of Roman type dates only from about the first quarter of the 18th century. Previously the approved shape was as follows:—

Printing has been defined to be the act, art, or

The use of this type was revived by Whittingham of the Chiswick Press about 1843, and it has since become a favourite form, under the name of old style. Some of the punches cut by the first notable English type-founder, William Caslon (1692-1766), have been preserved and types are being constantly cast from them. Nearly all founders now produce modernized old style. For the recent revival of old style printing, see p. 710 below.

Large letters, such as are employed for large bills and posters, are made of wood, chiefly rock maple, sycamore, pine, and lime. These are cut up, planed to the required size, and then engraved, generally by special machinery, this being a business quite distinct from that of letter-founding. The larger letters are designated as two line, three line, four line, &c.,—meaning twice, thrice, or four times the depth of face of pica or great primer, &c.

Type metal. Type metal is an alloy, of which lead is the principal ingredient; but, owing to its softness, antimony and tin are added (see vol. ii. p. 129 and vol. xiv. p. 878). A patent type metal (Besley's) was invented in 1855 in which the mixture consisted of lead, regulus of antimony, tin, nickel, copper, and bismuth. Nearly all type is now made with some of these metals superadded. Ductility, hardness, and toughness are the prime requisites of a type metal.

Making of types. The earliest printers made their own types, and the books printed from them can now be distinguished with almost as much certainty as handwriting can be identified. The modern printer has recourse to the type-founder. The first step in the making of type is cutting the letter on the end of a piece of fine steel, forming the punch (see fig. 2), which is afterwards hardened. This is an operation requiring great care and nicety (there being comparatively few adepts at it), in order that the various sorts in a fount may be exactly uniform in width, height, and general proportions to each other. A separate punch is required for each character in every fount of type, and the making of them is the most expensive branch of type-founding. During the process of its manufacture the punch is frequently tested or measured by delicate gauges to insure its accuracy. When finished it is held over a light, the flame of which blackens the letter, and thus enables an impression, called a *smoke proof*, to be stamped on paper. When the letter is perfect, it is driven into a piece of polished copper, called the *drive* or *strike* (fig. 3). This passes to the justifier, who makes the width and depth of the faces uniform throughout the fount. They must then be made to line exactly with each other. When completed, the strike becomes the matrix (fig. 4), wherein the face of the type is made. This method of making a matrix has until now been in almost universal use in Great Britain. It is, however, a very slow and costly process. In America the great majority of matrices are made otherwise. If the design of the fount to be produced is original, it is often cut by hand or by an engraving-machine on the piece of metal which is to form the matrix. If, on the other hand, an existing fount has to be copied, the matrix is made by electro-deposition. A perfectly good type is selected, and inserted in a mould specially made, called a *fusible mould* (fig. 5). Sufficient metal of a more fusible nature than the type is cast round it, and forms a shape similar to that of the ordinary matrix. This fusible cast is then placed in a box protected by glass and gutta-percha, in order that the copper deposit may be kept square and to the proper dimensions. This arrangement also limits the deposition to the face. The box is immersed in the copper electrotyping solution, in which it may be left until the deposit of metal has increased to a thickness at which it may be backed up with copper, or it is left until it reaches the full thickness, which is about $\frac{1}{16}$ of an inch. It is then fitted in line, set, position, and height. The minutest imperfection or blemish is reproduced by the deposition, and the type cast from such a matrix is a perfect counterpart of the original. A school of type-engravers has recently sprung up in the United States, cutting exclusively on metal and producing ornamentation and finish which the punch-cutters cannot rival. It is expected that in the course of time the electrotype matrix will nearly supersede that made in the old-fashioned way with the punch. In the ordinary method the mould in which the body of the type is formed is made of hardened steel in two parts; one part is fastened to the machine and is stationary, while the other is movable so that it may be adjusted for the proper width of the letters, as one is wider than another. The combined matrix and mould are then adjusted to the type-casting machine, which manufactures types at the rate of from 25 to about 120 per minute, according to the body. The metal is kept fluid by a little furnace underneath and is injected into the mould by a pump, the spout of which is in front of the metal pot. The mould is movable, and at every revolution of the wheel it comes up to the spout, receives a charge of metal, and flies back with a fully formed type in its bosom; when the upper half of the mould is lifted, a type is ejected. The spring in front holds the copper matrix in close proximity to the mould. The letter a, for instance, stamped in the matrix is directly opposite the aperture in the mould which meets the spout of the pump. When a due proportion of a's are cast, another matrix with b stamped on it takes its place, and so on throughout the whole fount. The types, however, are not finished when they leave the machine. There will be found attached to each a wedge-shaped *jet* (fig. 6), somewhat similar to that on a bullet cast in a hand-mould. These are picked off by boys at the rate of from 2000 to 6000 per hour. A burr which still adheres to the shoulder of the type is taken off by the rubbers, who rub the sides on circular stones or on files. The types afterwards go to the setters, who arrange them in long lines ready for the dresser, and he slips them into a long stick, turns them on their face, and, after duly fastening them, cuts with a plane a groove in the bottom, which forms the feet. (These processes are now frequently performed by a machine, which produces types that do not require rubbing or dressing.) The types are then dressed and the picker takes them in hand, in order to pick out each defective letter with the aid of a magnifying glass. They are finally made up into parcels of a convenient size, called *type-founders' pages*, weighing about 8 lb each.

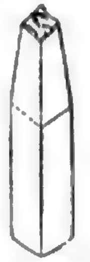
FIG. 2.—Punch.

FIG. 3.—Drive.

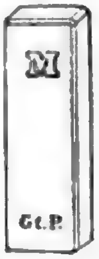

FIG. 4.—Matrix.

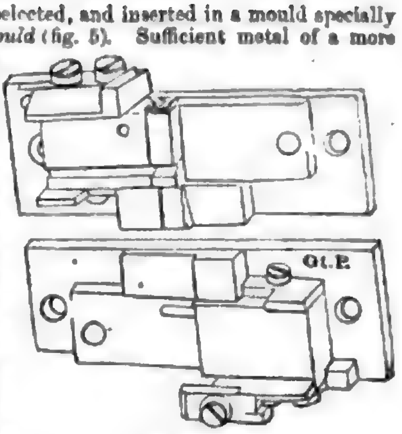

FIG. 5.—Mould.

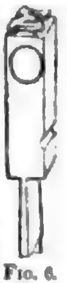
FIG. 6. Type with jet.

Automatic type-casting and finishing machine. Subjoined is a description of a machine for performing automatically the various operations of casting and finishing type which was invented about twenty years ago by Messrs J. R. Johnson and J. S. Atkinson. In this apparatus the metal is fused, injected into the mould, the cast letter turned out, rubbed or planed, first on one side and then on the other, the feet cut out and smoothed, the dressed sides planed alternately, and the finished letter set up on a stick ready for use by the printer. The casting machine and the dressing machine are in reality distinct, though mounted on a common frame. The whole is driven by a steam-engine or other prime mover. The casting machine consists of a furnace covered by a shallow pot holding the fused metal. In this is a pump, and the mould is placed opposite its nozzle. The mould being adjusted and the matrix in its place, the molten metal is injected and then solidifies, forming a perfect type, but with jet attached. This letter is then thrust out, and the mould closes again for another jet of molten metal. All this is effected by one revolution of the axle of the machine. The letters pass through a channel one by one into the dressing machine. On arriving there they have each of their sides planed in succession by being held against cutters. When one side is made true with respect to the set of the letter on its face, it is passed over a second cutter, which planes the second side absolutely parallel to the first. After this the type is carried in a line at right angles to its former course past a series of similar cutters, which plane out the foot, further smooth its surface, and plane each of the two dressed sides in succession; this completes the dressing or finishing of the types, which, continuing on their course, pass upon a composing stick and are ready for the printer. The line of types presents the appearance of a solid bar of metal, so true, flat, and square are the surfaces of the several separate letters. This machine has been considerably improved by Mr P. M. Shanks. The new machine is of simpler construction and its parts are more compact. It does not produce better type, nor work quicker,—the speed in all type machines being regulated by the time required to cool the volume of metal, which, when on the machine, is assisted by having water percolating through the heated parts of the mould. The working of the new machine is more readily grasped by the manipulator, and there is considerable reduction in its cost.

Type-Setting or Composing.

We may now describe the manipulation of the types in the printing office, and for the sake of conciseness reference must be made only to the operations connected with ordinary book-work. These differ in details from the methods in use in the other two departments of the printing business,—news-work and job-work.

Type-case. The types, received from the foundry in the packages called *pages*, are placed in shallow trays called *cases*. These contain compartments or *boxes*, each of which is appropriated to some particular *sort* or character. The cases when in use stand on *frames* or sloping desks. The case at the top is the *upper case*, and that below the *lower case*. The former contains ninety-eight equal-sized boxes, appropriated principally to the capital and small capital letters; the latter has fifty-three boxes of various sizes, appropriated to the lower-case sorts. The difference in the size of the boxes corresponds to the difference of quantity of letters in a fount, as already stated,—the lower-case e for instance having the largest box. The localization of the letters, &c., is a subject on which opinions differ, the object being to bring the letters most frequently required nearest to the hand of the compositor as he stands at work. As a man picks out from the boxes seldom less than 1500 letters per hour and distributes or replaces on the average about 5000 per hour, it is necessary that the most economical allocation of the boxes should be adopted. The system of allocating the various types is called the *lay* of the case; fig. 7 illustrates the plan used in the principal English book offices; but there are many deviations.

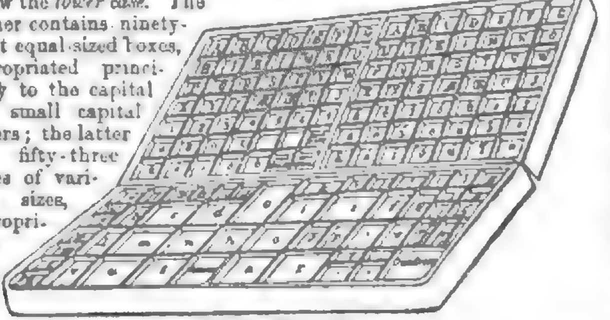

FIG. 7.—Type-case.

Composing. The types when taken from the cases are arranged in lines or "composed" in an instrument called a *composing stick*, made of iron, brass, or gun metal. The slide in the middle is movable so as to accommodate varying lengths of lines. In the composing room the frames are arranged in rows, supporting the cases. The compositor fixes the "copy," or document which he is to repeat in type, in a convenient place before his eye, and on some part of the case that is seldom used. In his left hand he holds the composing stick, and with the thumb and first finger of the right hand lifts the letters from the boxes, and arranges them in the composing stick, every letter, point, or sign being picked out separately. In this operation he is much assisted by the use of a *setting-rule*, a thin brass or steel plate which, being removed as successive lines are completed, keeps the type in place. When so many words and parts of words as will nearly fill the line have been composed, it is made the exact length required by inserting or diminishing the space between the several words. This is called *justifying* the line and is effected by means of the spaces already mentioned. If the work is not "solid"—that is, if the lines are not close together—the strips of metal called *leads* are used. They vary in thickness, but always form aliquot parts of pica body. A good compositor must possess intelligence and a reasonable amount of general knowledge: he must be able to read his copy with readiness, and to understand its meaning, in order to punctuate it properly. He should be able to spell correctly, as some copy is almost undecipherable in regard to separate letters, while other copy is incorrectly spelt. When the composing stick is filled, the type is lifted on to a *galley*, a shallow tray of wood or metal, two or three sides of which are flanged, for the purpose of supporting the type, when the galley is slightly inclined. Stickful after stickful of type is placed on the galley until it is full. The matter is then fastened up, a proof taken at the proof press, and the work of the *reader* or corrector of the press—described below—begins. The proof, marked with the necessary corrections, is given back to the compositor, in order that he may make the required alterations in the type.

Imposing. The type, being duly corrected, is made up into pages of the required length (unless the author has desired to see proof in *slip*). It is then *imposed*, that is, the pages are arranged in such a manner that, when printed and the sheet folded, they will fall in due numerical sequence. The impression from any arrangement of pages will be the reverse of that in which they are laid down. If an ordinary four-page newspaper supplement be opened and spread out with the first page uppermost, it will be found that on this side the order of pages is 4, 1; when turned the pages are 2, 3. The type pages must be ranged in the reverse way, as 1, 4; 3, 2. Thus the fourth page is placed alongside the first, because both must be printed together on the outside; the third page is to the left, and the second to the right, because in books the odd page—the *verso*—is always to the right. For a quarto a sheet of paper is folded twice, that is once across its breadth and then once in a perpendicular direction down the middle. It contains four leaves, and if these are printed on both sides eight pages. The two sides of a sheet are called the outer and inner formes respectively. A sheet of octavo is folded three times, making 8 leaves or 16 pages. The size of a book depends, not only upon the number of times the sheet has been folded, and described accordingly as 4to, 8vo, 12mo, &c., but upon the size of the sheets. The dimensions of the papers commonly used in book-printing are:—imperial, 22 × 30 inches; super royal, 20½ × 27½; royal, 20 × 25; medium, 19 × 24; demy, 17½ × 22½; double crown, 20 × 30; double foolscap, 17 × 27; post, 15½ × 19½. Hence to say that a book is a quarto merely gives no precise indication of its dimensions, as a quarto of one size of paper may be smaller than an octavo of another; it is also necessary to know the size of the sheets of which it is composed.

Signatures. When a printed book is opened, it will be found that at the foot of certain pages there is usually a letter and at the foot of another a letter and a figure, as B, B 2; further on another letter and another letter and figure. On going through the book it will be seen that the letters are in regular alphabetical order, and occur at regular intervals of eight, twelve, sixteen, &c., pages. These designate the several sheets of which the book is composed and are called *signatures*, so that a sheet may be designated B, and the pages of which it consists are thereby sufficiently indicated. (Occasionally, as in the present work, numbers are used instead of letters.) These signatures assist the binder in folding, as they occupy a certain specified place in each sheet; hence to ascertain if the sheet has been folded properly it is only necessary to examine the position of the signature. The binder also is thus assisted in *gathering* or collating together the sheets of a volume in proper order. Signature A is omitted, because it would be on the title or first page, and would be both unnecessary and unsightly. By old custom J, V, and W are discarded, I and J, U and V being originally used indiscriminately by printers, while W was written UU or VV. When the alphabet is exhausted, a new one is commenced, distinguished by a figure precedent, as 2 B, 2 C, &c.

Forme. The pages of types are arranged in proper order on a flat table, covered with stone or metal, called the *imposing stone*, and are then ready to be made into a *forme*, that is, in such a state that they can be securely fastened up and moved about. The forme is enclosed in an iron frame or *chase*, subdivided by a cross bar. The portions of the type are separated by *furniture*, which may be of metal or wood or both. It is of the same height as the chase, but lower than the type, and therefore does not print, but forms the margin of the printed pages. At the sides of the two sections of the formes are pieces of furniture of a tapering shape, called *side-sticks*, and at the top and bottom corresponding pieces, called *foot-sticks*. Small wedges, called *quoins*, are inserted and driven forward by a mallet and a *shooting-stick*, so that they gradually exert increasing pressure upon the type. Other mechanical means for locking up are also occasionally adopted. When sufficiently locked up, the whole is quite as firm and portable, however many thousands of pieces of metal it may consist of, as if it were a single plate. In this rapid sketch we purposely omit mention of several operations which, though important and indispensable, are only of interest to the workman.

Type-setting machines. For many years endeavours have been made to construct machines for type-setting which should obviate hand labour. Picking out the types separately from their boxes and arranging them singly in the composing stick is an irksome and monotonous operation, and one which it might be thought comparatively easy to perform by automatic machinery. But of the many different composing machines that have been invented less than half a dozen have stood the test of practical experience. These have been confined to special classes of work, and it is open to doubt whether the nimble fingers of a good compositor, aided by the brains which no machinery can supply, do not favourably compare on the ground of economy with any possible mechanical arrangement. On the other hand, employers and makers of machines allege that owing to the opposition of the men machine type-setting has not had fair play. However that may be, it is undeniable that a composing machine is still rare in printing offices, and where employed it is only as an auxiliary to the ordinary labour of the men. It deserves to be mentioned that nearly the whole of the *Times*, with the single exception of the advertisements, has for years past been set up by machinery, and that more than 10,000 pages of the present edition of the *Encyclopædia Britannica* have also been so set up. We have not space to describe with any minuteness the construction of composing machines. In the Fraser machine (fig. 8), one of the simplest of its class, which has been made use of to the extent already mentioned in the present work, the types are contained in a series of grooved trays A, in the upper part of the machine, the trays having previously been filled by complementary apparatus called the *distributor*. In these trays the types are kept in position, and pressed towards the front part of each tray, by slips of metal attached by cords to the box-wheels B; each of these contains a spring of sufficient strength to press the line of types steadily forward against the separators C, which are formed with an inverted shoulder, under which the front type in each line passes. The keys are connected by levers to the separators, and the depression of any key causes the corresponding separator to descend, carrying with it the front type of the line into the grooved face-plate, down which it slides into the composing stick G. Immediately the finger is lifted from the key the spiral spring D raises the separator to its original position, and the next type in the line takes the place of the one just released, and so in succession as fast as the keys can be pressed. Under the keys runs a rod connected by a crank motion with the pusher G, which, with every depression of a key, pushes forward the line of type in the composing stick, thus making room for the next letter. The matter is thus set in one continuous line, ready to be divided into lines of the required length either by the operator at the machine or by another hand working in conjunction. The speed of the machine varies from 6000 to 12,000 types per hour, but is regulated solely by the skill of the operator, as the machine will work as fast as the keys can be pressed. The composing machines now employed at the *Times* office are an improved form of an apparatus invented by Charles Kastenbein, and introduced there in 1872. The operator sits in front of four rows of keys one above the other, something like the manuals of an organ, but only about 3 feet wide. Each of the keys corresponds to a type or character. The types are kept in tin tubes placed vertically at the top of the machine. The depression of a key works a series of levers, and an iron finger pushes the undermost type from its tube, when it falls into a groove formed in a conducting plate, narrowing at the bottom to its apex. Immediately below is a receptacle, and by the action of a treadle the type is pushed along a channel. Other letters follow, the matter being thus set up in a long line, on a groove of the width of an em quad, and running from left to right. The type when it first comes into the groove is in an upright position, but in passing along it becomes twisted, so that the letters stand at an angle of about 45° when they reach the point at which they are justified. This groove communicates at its dexter extremity with the justifying galley,—a simple apparatus, something of the nature of a composing stick and galley combined. Then the type is divided into portions or lines of the required length and justified in the galley, which is adjustable to the width of the required length. As the long line approaches him, the justifier with a small bodkin accelerates a portion large enough in his judgment to fill the width of his column. When this is done he presses his foot on the treadle under him, and thereby causes the line to be pushed into the galley. The line is justified by spaces and quads, and enough type is then taken for another line The speed depends on the operator, and varies from 6000 to 13,000 types per hour, the average being about 8000, with two operators,—a justifier and a compositor being also necessary These machines are worked in the *Times* office at the rate of a column of solid minion an hour. The machine occupies a floor space of only about 4 feet wide by 2 deep.

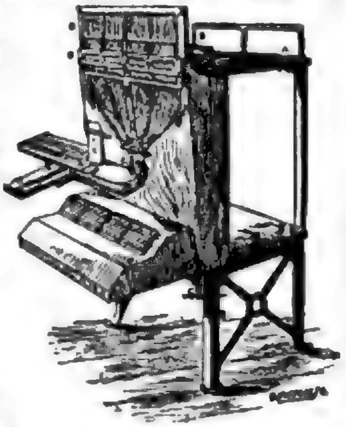

FIG. 8.—Fraser composing machine.

Another machine at present in use is that of Mr Robert Hattersley of Manchester. It probably furnished the general scheme of others in use. One of the most ingenious machines of the kind is that of Mr Alexander Mackie of Warrington, its general principle being the adoption to setting up types of the Jacquard card of the power loom, which weaves automatically the most intricate patterns of cloth. The apparatus consists of three parts,—two used for preparing the "card" or ribbon, which directs the third in the operation of type composing. The perforator is like a small cottage pianoforte. When the keys are struck they produce a perforation, and the ribbon is made to move aside a little, so that a new surface may be presented for puncturing. The composer is a circular iron table, 4 feet in diameter, having round its periphery a number of boxes divided into sections, each of which holds one kind of type. On a slightly lower plane is a wheel carrying little brass tables, hinged at one end. When the machine is in motion, the types are pushed out on to the table, which passes with its freight round its course until it comes to the point of delivery, when the types are swept off. The rising of the table, and the drawing out of the types, are guided by the perforated paper. Hence the machine sets types without a human compositor. When once the ribbon is perforated, it may be used over again for subsequent editions of the same work, which may be in a different size of type. These machines are only in use in the office of the inventor.

As has been already described under REPORTING (vol. xx. p. 406), the parliamentary reports of some newspapers are set up entirely without copy,—by the ear, not by the eye. It has been found that by the aid of the machine the matter can be set up half as fast again as it could be written out: the average speed of the composing machine is 230 lines per hour when the copy is dictated to the operator, whereas the most skilful workman setting at case in the usual way can do but 50 lines per hour.

Logotypes.

For many years it was a favourite idea with inventors, especially those who were not practical printers, that great economy might be gained in composition by the use of word-characters or "logotypes," instead of single letters. The constant repetition of many words seemed to suggest that they might be cast in one piece. Combinations suitable for affixes and suffixes, as ad-, ac-, in-, -ing, -ment, &c., it was also suggested, should be used instead of the single component letters. The suggestion has, however, not been carried out, at least to any considerable extent. The chief practical objection to it is that it involves the use of cases with an inconveniently large number of boxes. The more the variety of characters is multiplied the more "travel" of the compositor's hand over the cases is necessary for picking them up, and by so much is the speed of his work retarded. Logotypes, too, are more liable to accident; when one letter is damaged the combination is rendered useless.

Correcting type.

The correction of the type is a subject that should be understood by all who have to do with printing, as many mistakes are made on the part of authors which a little technical knowledge would prevent. In the course of setting any *copy* or MS. which may be given him the compositor unavoidably picks up some wrong letters, or mistakes the words in the copy before him, or fails to follow the style prescribed for the work. These are called *printer's errors*. When the compositor has finished his task, a first proof of the matter is taken. This proof is read through and compared with the copy by the proof reader or *corrector of the press* and an assistant, the *copy-holder* or reading boy. The proof is then sent back to the compositor and the latter is required to correct all the inaccuracies indicated therein—in fact, to attend to all the directions given by the reader—and this has to be done at his own cost if he is working on piece—that is, paid by results according to work done—or by the employer if he is working "on establishment wages" or paid by time. Another proof called a *revise* is now taken; this is carefully compared with the previous proof. If the corrections have not all been made, the revise is marked accordingly, and sent back to the compositor, who is required to remedy the imperfections. When the proof is deemed accurate, or "clean," it is sent, generally along with the copy, to the author,—being now termed an author's proof. Finally, in the printing office the matter is carefully re-read and compared with the last author's proof by the press reader, who signs it and on his responsibility the type is printed off.

Distributing type.

The operation of distributing the types is the converse of that of composing: it in de-composing the forme and returning the several letters to their proper boxes in the case. It is done, as already mentioned, with remarkable rapidity. The forme is first washed over with an alkaline or other detergent to remove the ink from its surface, and then laid down on the imposing surface, unlocked, and damped; this assists the cohesion of the type, after the chase, furniture, side sticks, &c., are removed. The compositor then takes in his left hand, supported by a setting rule, a portion of type in lines, and with the right hand takes a word or so between the finger and thumb, letting each letter drop separately into its proper box. There is hardly any operation which so strikes a spectator as distributing, for a competent distributor literally showers the types into their receptacles. The types are held upside down, that is, with the nicks uppermost; hence the letters of each word are read from left to right like ordinary matter when printed, but the words are of course dealt with in the inverse order.

Distributing machines of many different kinds have been invented.

Type-distributing machines.

They may be divided into two classes,—those worked entirely by keys or notes, like the pianoforte, and those in which the distributing is to a certain extent done automatically. For the former class only the type in ordinary use in printing offices is required. For the latter the type requires to be specially prepared, each character having a distinctive nick or nicks upon it, which correspond with the particular channel of the machine it is intended to occupy, and by which it is guided to its special compartment. Kastenbein has produced a distributor which may be described as a composing machine reversed. The matter to be decomposed is placed at the top in its appropriate tray or fixed galley, the sides of which are adjustable to fit any measure, the back being so constructed that it may be advanced to keep the matter always up to the front. As the matter is pressed towards the front, the first letter of it is brought in contact with a steel pusher, behind it being an aperture communicating with the channel of the guide plate. The matter is read by the operator; and he touches the key corresponding to the letter that comes first. Thus the types are conveyed one by one to the guide plate or conductor. It has grooves furnished with little gates or switches, like the points of a railway, and these direct the types into their proper channels. The tubes into which the types are deposited are placed at the foot of each groove. Thus every time a key is depressed the switches move, the pusher sends the type to be distributed out of the line, it falls through the aperture, and, passing down the channels in the guide plate, reaches the proper tube. The speed is to a certain extent dependent upon the skill of the operator, but averages between 3500 and 4000 per hour. A good compositor can by hand alone distribute as many letters as this. But for the purposes of the composing machine, hand distributed types would have to be set up again, as the composing machine is supplied not from ordinary cases but from tubes of type. In the Fraser distributing machine (fig. 9) the page of matter to be distributed is placed on the upper part of the machine at H, whence by suitable apparatus it is moved line by line towards the separator I in front. The matter is there read by the operator, and as each letter comes in contact with the separator the corresponding key is pressed and the type is conveyed to the guide plate, where a series of switches guide it to its proper compartment in the tray of the composing machine.

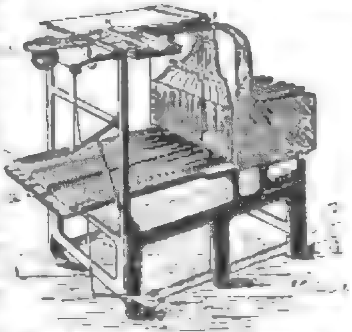

FIG. 9.—Fraser distributing machine.

Stereotyping, Electrotyping, &c.

Advantages of stereotyping.

The method of reproducing and multiplying letter-press printing surfaces by taking casts of them, or stereotypes, has greatly conduced to the progress of typography,—much more so, indeed, than might be realized by those who are unacquainted with the practical details of the art. Stereotyping (*στερεός*, fixed or solid; *τύπος*, type or forme) is the method of taking casts from a fixed or movable forme; thus, printing from stereotypes is distinguished from typography, in which impressions are taken from movable types. It does not supersede type-founding, but supplements it, for a page of reading matter requires first of all to be set up letter by letter, and then the casts or plates are taken, each of which may be printed from with nearly as much perfection as from the original forme. Hence a printing surface may be reproduced to an almost infinite extent, and the means of production of impressions on the press or machine are increased in proportion to the number of casts taken. It ensures an accurate copy of an original text, whereas in reproduction by resetting the movable types there is a liability to deviation. When only a cast is worked from, any accident may be repaired by taking another cast, and the cost is slight compared with that of composing over again. A smaller quantity of type may be used in an office where this process is used; a portion of a work may be set up, a cast taken, and the types returned to the cases. The plates are more easily stored than movable formes, and are not liable to the danger, as in the latter, of types falling out. Above all, the mould may be bent to any curve required, and a circular cast obtained, which may be fastened round the cylinder of a machine (see *infra* in regard to rotary printing).

Process of stereotyping.

The process of stereotyping, divested of merely technical details, is as follows. From a forme of matter, which may be wholly or in part composed of movable types, a matrix or mould is taken. The original is in rilievo; the mould consequently is in intaglio. From this the stereo plate is cast, and it of course is again in rilievo. This in turn may likewise become an original, and casts may be taken from a plate, or other casts from the same mould. The first books were printed from solid wooden blocks, each of which formed a page. Then came the era of typography, in which these pages were composed, mosaic-like, of movable types. Now has succeeded the period of stereotyping, in which pages formed of single blocks—but of metal, not of wood—are used. The two essential parts are therefore, the making of the matrix and of the cast, which is composed of an alloy something like that for type metal. The mould may be of plaster of Paris or papier-mâché; the latter being the simplest material, and that almost universally used, need alone be here referred to. The following account of the process, when carried out on the smallest possible scale, is sufficient perhaps to show the general principles of the art. The papier-mâché for the mould, called *flong*, is made by uniting several sheets of paper with a paste made of wheaten flour, starch, and alum, to which whiting is added. These ingredients are often varied; the general object in using them is to obtain a paste which will stand a high temperature without burning. A sheet of brown paper is laid down on a smooth surface and pasted over; blotting paper is laid on that and pressed down, then pasted over, and a sheet of tissue paper added, which is also pasted, and another sheet of tissue paper placed on the top. This is well smoothed and pressed to give the incorporated material greater firmness and cohesion. Next, to prepare the forme for being moulded, it is surrounded with metal "clumps" of the height of the type, placed close to the matter, and then oiled to prevent the flong sticking to it. The latter is then thoroughly damped, to render it quite plastic. The forme being on a level surface, the flong is laid upon it, and on that a piece of linen. The surface is next well beaten all over with a long-handled brush, till the flong sinks into all the declivities of the forme and receives a deep impression of it. This is a process requiring experience and practice. The linen being removed, a piece of very stout paper is laid on the top, and also beaten down, so as to strengthen the flong, and the moulding is finished. The next point is to dry the mould.

In the most rudimentary method a combined drying and casting press is used. It consists of a flat iron surface, with a lid attached to one end by hinges. Over the surface is a cross-head fitted with a screw; pressure may be exerted on anything placed between, the arrangement being like that of a screw letter-copying press. The cross-head can be moved to one side when it is necessary for the lid to be lifted up. Underneath the press is a series of gas jets, by means of which the bed plate is heated. The press stands on supports, but is attached to them only by an axle, and it can be readily changed from the horizontal to the vertical position. The lid of the box is raised and the forme with the flong upon it placed on the centre of the iron surface. After being covered with a blanket, the lid is screwed down upon the whole, and, the gas being lighted, the forme and mould are heated for a few minutes, after which the lid is raised, the steam evaporates, and the flong, which has now become the matrix, is thoroughly dry. In large stereotyping foundries, after the flong has been well beaten upon the forme, until the impression of the types is plainly seen on the back, it is baked and dried (the forme still underneath) on a long thick iron slab, called a *hot chamber*, because it is heated from within by steam. The matrix is then removed from the forme, and any superfluous margin cut away or trimmed; after this the matrix is dusted with powdered French chalk and is ready for being cast from.[1] A method has lately come into use for obviating the necessity of keeping the matrix on the type while it is being hardened by drying by heat, whereby the type is injured. The matrix is dried separately, being removed when moist from the forme, as soon as the impression is obtained. It is then placed on a bed of sand heated by gas. The forme is never heated, and there is a great saving of time, because the drying can be done in two minutes. The matrix is laid on the bed of the casting box face upwards, with gauges around it to determine the height or thickness of the cast. The lid is put down and screwed tightly, and the position of the press altered from the horizontal to the upright. The metal is then poured in and the press restored to its former position. The matrix is carefully raised and the plate exposed. It has only to be "trimmed," the superfluous metal cut away, and the back planed, to be ready for mounting on a block of wood to make it type high.

Stereotyping for a Walter press;

In stereotyping for the Walter and similar presses the process is as follows. The forme is laid on the table of the moulding machine and the flong placed on it and thoroughly beaten in by hand or passed through a moulding machine, which performs the same operation. The forme is next placed on a heating surface, and when nearly dried the matrix is removed from it and again dried. It is then placed in the casting box, which is curved to the circumference of the cylinder of the press. The box, being on a swivel, is set upright. The metal is now poured in from a ladle and the plate cast. It is allowed to stand a minute and then taken out, still hot, and placed upon a "finishing saddle" of the same circular form as the back of the plate, and secured by clamps and screws. An angular-shaped knife or chisel, fixed in a carriage, is moved by a handle in a semicircular direction across the surface of the plate, in order to remove superfluous portions of metal and to form a bevel whereby the plate can be subsequently clamped on the machine. If necessary the plate may be smoothed at the back by a specially-contrived planing machine. The plate is now ready for being placed on the printing machine. Each single operation can be performed with the utmost possible despatch. If the organization is sufficiently perfect, the time for making a plate, from the moment when the forme comes down from the machine-room to that wherein the perfect plate is set on the machine, need only be about eight minutes.

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[1] These matrices can be preserved for several years, and the stereotyping process postponed until actually required.

For news-papers.

In newspaper establishments where stereotyping is thus adopted the pages are not all made up simultaneously: some are kept open till the last for the latest telegrams. The moment a page is completed and locked up in its chase it is sent down to the foundry, and as many casts taken as there are printing machines to be set going. One page follows another with rapidity, the first being placed in position on the machine, while the later ones are in the foundry. When all the plates are finished and fixed in their places, six, eight, or ten machines may be simultaneously printing at the rate of nearly 12,000 per hour each. The enormous increase in the circulation of the great daily newspapers would have been impossible but for the extraordinary facilities for rapid production provided by stereotyping. This process is also of special utility to the newspaper printer in the case of telegrams arriving late. In machines which printed from the type, late telegrams could only be inserted by a "stop-press"; that is, the printing was interrupted while the alteration was being made. But, when the papier-mâché casts of the pages have been taken, the type itself is liberated and sent back to the composing room, so that, if later news arrives while the machines are running, the foreman printer alters the page, a fresh cast of it is taken, and a machine started without interrupting the production for a moment. The London evening papers have usually five editions, and for every edition fresh casts are made of one or more of the pages.

Celluloid and ndia-ubber tereos.

Quite recently the substance called celluloid has been introduced instead of the metal referred to previously. A mould is made of yellow oxide of lead and glycerin formed into a semi-fluid paste, which is applied to the surface of the type. The matrix is placed on a powerful press and a heated sheet of celluloid about $\frac{1}{16}$ of an inch thick is laid on it. When pressure is applied, a perfect facsimile is obtained, and it is ready to be printed from when mounted in the usual way. Whereas a good electrotype from a wood block averages six hours in its production, a cast in celluloid can be got in less than an hour. These blocks are very tough and many thousands more of impressions can be printed from them than from stereotypes without their showing signs of wear. For small stamps india-rubber is used as a stereotyping material, and afterwards vulcanized. These stamps, being flexible, print on rough surfaces which would not take an impression from ordinary stereotypes. With a flexible surface, too, much less pressure is required.

rinting means [illegible]

Machines have been invented to do away with the use of types altogether. The principle is to punch the characters successively on some substance which will act like the flong and become a mould from which stereo plates may be cast. In an apparatus recently introduced the flong is a prepared piece of millboard, which is placed in front of the steel punches. The latter are driven into the flong with lightning speed and great accuracy. By turning a handle all the Roman punches are changed to Italic; by another a set of sanserif or other founts comes into play. For setting time-tables and logarithms the apparatus is said to save ninety per cent. over the ordinary system of hand-setting. The obstacle to the more general use of it is the difficulty of correcting errors. In another machine the punches are driven into a block of teak wood. They are cast to thicknesses which are the multiple of a "point"; hence by a simple calculation they may be spaced out to the exact number of points chosen for the length of the line, and every line leaves the machine justified. The block when complete is removed and a stereotype taken, which can be printed as in the ordinary method of typography.

ectro-ping.

For the reproduction of wood engravings electrotyping has nearly superseded stereotyping, as it produces much better copies. For obtaining plates of type matter it is also better than stereotyping, as many thousands of impressions may be taken without reducing the sharpness of an electro, while ordinary stereotype would be almost worn out by printing a much smaller number. This arises from the superior hardness and toughness of copper, of which the surface of the electro is formed. Electrotyping, however, is costlier and slower.

The forme to be electrotyped is placed upon a level plate, and surrounded with type-high clumps or metal furniture, and then floated with plaster of Paris, which prevents the mould of wax (to be afterwards made) from penetrating too far into the interstices of the spaces. The forme is next brushed with finely powdered blacklead or plumbago. The moulding composition is made of melted wax, with the addition of a little blacklead. This is poured into a shallow metal moulding tray, to which two pieces of stout wire are soldered, in order that it may be afterwards suspended in the depositing trough. After the composition is cooled and set its surface is brushed with blacklead, and it is then ready for moulding. The moulding press may be something like a letter-copying press, or, in a large establishment, may consist of a powerful hydraulic or other press capable of exercising a pressure of many tons. The forme is placed exactly under the centre of the platen, with the moulding tray containing the wax, slightly warm, upon it. An impression is then taken, and the mould afterwards separated from the forme. The mould has next to go through the process of *building*, that is, heated wax is dropped upon such portions as should be more deeply sunk in the finished electrotype plate, namely, the places where "whites" are to appear in the print. The mould, having been finished, has to be blackleaded, plumbago being a conductor of electricity, while wax is a non-conductor. The material is well brushed in, filling all the interstices of the forme; and the entire surface of the mould must be properly covered, to ensure a perfect deposit of the copper. To facilitate this operation, a blackleading machine is used in large establishments. The forme is placed upon a carriage formed of transverse bars and is moved backwards and forwards by a handle and rounce to bring it under the blacklead brush. After the mould is blackleaded, the back of the moulding pan is coated with wax, to prevent the copper from being deposited upon it. The mould is now quickly immersed in one of the compartments of the battery. The process of depositing a copper solution upon the blackleaded surface of the mould is continued until a solid plate is formed, which, though it is scarcely thicker than a finger nail, being about $\frac{1}{16}$ inch, forms, when properly backed, the best and most enduring surface for letterpress printing that has been discovered.

The moulding tray containing the mould is hung on the brass rod of the depositing trough facing a plate of copper, and the connexion of the battery made: that is, the mould is attached to one pole of the battery and the plate of copper to the other. The copper, so to speak, is decomposed on the one hand and recomposed on the other: in other words, the current of electricity being complete, and the mould submerged in the sulphate of copper solution, the deposition of copper on the mould at once commences. Here it remains until the deposit is sufficient, the time usually occupied being from 8 to 12 hours, according to the state of the solution and the strength of the batteries. The dynamo-electro machine, which is now employed in large houses, very materially reduces this period; otherwise Smee's batteries are generally used. When the deposit, or, as it is called, the *shell*, formed on the wax mould is of proper thickness, it is disengaged from the wax,—the mould being placed with its back on an inclined board, and boiling water poured over the shell, which melts the surface of the wax, except a thin coating, the removal of which is effected by placing the mould and shell on a steam heating table. Thus the wax mould is destroyed, and it is not possible to obtain more than one shell from a mould, whereas the stereotype process enables almost any number of casts to be taken from the same matrix. The shell, being too thin and fragile to be printed from, is next backed, or filled up with metal of a somewhat softer kind than stereo metal. The shell, after being further cleaned, is lowered on to the top of a vessel of molten type metal; and, when the solder previously used to unite the copper and the metal has fused, the latter is poured over it in a molten state until it is covered. The plate is washed, dried, and polished, the back roughly planed to a surface parallel to the front, the edges squared, and all imperfections made good. The thickness of a plate is usually a pica or $\frac{1}{6}$th inch. It is mounted as an ordinary stereotype plate. Within the last few years the process has been greatly facilitated by the employment of specially contrived apparatus, and illustrations can be produced in three hours from the time the mould is made. Curved electros are produced, as well as curved stereos, for use in rotary printing. Facing with nickel by the electroplating process is now largely adopted for hardening stereotypes and electrotypes and rendering them more durable. This process also prevents the deterioration of such plates by the action of the acids or other chemical reagents often present in printing inks, such as cyanide of potassium in red ink and nitric acid in some blue inks.

Poly-typing.

Polytyping is a method invented in France about the end of the 18th century, but now seldom practised in the United Kingdom. The apparatus somewhat resembles a pile-driver. It has two upright guides about six feet high, and a pulley at the top, which elevates by means of a rope a heavy plate, on which the matrix is placed in an inverted position. At the foot of the machine there is a substantial iron bed, upon which the operator places some molten metal. He then pulls the rope until the matrix, with its weight attached, is elevated to the top of the machine, when it is suddenly allowed to fall. The result is similar to that made on a medal by means of a die,—a perfect reproduction of the matrix in relief, which is mounted on a metal stand to type height. The results are excellent, as the plastic metal is forced into the finest lines of the matrix. Duplicates of a block can be thus produced more rapidly than by the ordinary stereotype process; and another advantage is that the intaglio parts are much deeper,—a point of some importance in printing. The matrix may be made from the block by the electrotyping process.

Substitutes for Wood-Engraving.

Process blocks.

Formerly the only available method of obtaining illustrations which could be printed on the letter-press in conjunction with type was that of wood-engraving. At the present time a number of comparatively new processes are in operation, in which the engraving is done almost automatically by the adoption of chemical processes and the well-known principles of photography. Engravings of this kind are called in the trade *process blocks*, or sometimes *zincotypes*, owing to the metal of which they are formed. There is space here for only the barest possible account of the processes.

Typo-etching.

In the first method, which is sometimes called *typo-etching*, the drawing is made with ordinary lithographic ink on stone, or on paper and transferred to stone. It is then re-transferred to a plate of polished zinc by the ordinary lithographic process. Zinc is employed on account of its cheapness and its ready solubility in the acids used for etching. It has properties similar to those of the lithographic stone in taking up the ink and the water. The transfer is made to adhere to the plate by being passed through a lithographic press; the paper is then stripped off; and the whole of the ink is left on the plate, which is inked up as a litho stone with a view to render the lines as solid and strong as possible to resist the acid. The covering of the lines is strengthened by dusting powdered asphalt or some other suitable material over the plate, which is warmed just sufficiently to incorporate the asphalt with the ink. The plate is next placed in a bath of acid (its back and other parts, where the acid is not required to act, being protected by varnish), in order that the unprotected parts, or those which are to form the whites of the finished picture, may be dissolved away. In order to prevent the acid eating not only straight down into the plate but on the sides of the furrows it forms, and thus undermining them, an ingenious device has been adopted. As soon as the etching has proceeded to a very slight depth, the plate is removed from the bath, washed, and heated. The ink and other protective medium are thus melted and run down the sides of the little furrows formed by the acids and thereby protect them from further action. Inking and dusting with resinous material are repeated, and etching resumed, until the depressions of the block have been brought to the proper depth. The etching is carried on in troughs to which a rocking motion is given, so that the acid flows to and fro in waves over the surface, and little bubbles of gas, &c., are carried away. Where large spaces of white occur, the metal is cleared away by a drill; after the block has been mounted type high, it is ready for the printer.

Tone blocks.

This process is only available for the production of "line blocks," *i.e.*, those in which the original drawing is done in lines or dots, as for an ordinary woodcut. The highest achievement of process blocks has been the production of *tone blocks*, which may be made direct from oil-paintings, water-colours, photographs, drawings in chalk, wash, pencil, &c., or indeed from anything from which a photographic negative can be taken. The exact nature of the processes is a trade secret, but the rationale is given in Mr Truman Wood's *Modern Methods of Illustrating Books* (London, 1887), to which we are indebted for the following details. The problem is to translate, as it were, the light and shade of the negative into solid outlines of black and white. The shades must be lines of various breadths or of various distances apart, or spots or grain of various degrees of fineness or closeness. In a surface-block any part that touches the paper prints, and any part that does not touch the paper does not leave any mark at all. The photographic image is continuous; there are no outlines in it, the picture being formed of graduated tints or shades, ranging from the white of the paper up to the darkest colour that the process employed can give. To make a block for letter-press printing the graduated tints of the photograph have to be broken up into stipple or grain, and it must be a stipple closest in the shadows, gradually becoming more open through the range of the intermediate tones, and vanishing altogether in the highest lights. To describe the ingenious methods adopted to secure this end would involve an account of several photographic operations which would be out of place here. In one process, perfected by Meisenbach of Munich in 1882, grained negatives are produced by placing a transparent screen, on which a suitable grain is imprinted, in contact with the negative or the positive to be copied, and then photographing the two together. The negative is transferred to a plate of suitable material, which is graved or etched in the usual manner, to form a typographic block. Another device is to print from the original negative upon a piece of silk, the threads of which break up the picture into a regular grain. The positive on the silk is then photographed and a printing block made. These blocks require from their very low relief delicate and careful printing, but are made to give excellent results.

Typographic etching.

A process of typographic etching has been invented by Messrs Dawson, in which the design is drawn with an etching needle on a brass plate covered with a wax etching ground, in the same manner as for an ordinary etching. The metal is therefore bared at the lines, which are separated by ridges and spaces of wax. These spaces are strengthened by the addition of melted wax, which runs up to the edges of the lines, but does not run over on to them as might be expected, filling them up. The supply is continued until the spaces between the lines, representing the whites of the finished print, have been raised to a height sufficient to give the necessary relief, when an electrotype is taken. This electrotype forms the printing surface.

Shanks's process.

Shanks's process is a device for producing pictures simply by the use of mechanism, and is an application of the eidograph. The plate to be drawn upon is moved under the drawing implement, which is a rapidly revolving cutter, and the plate on its carrier is mounted on the end of a series of levers in the same way as the slide rest of a lathe, so as to have motion in two directions, one at right angles to the other, and consequently by a combination of the two to have motion in any direction in the same plane. If a plate of a suitable substance, such as hardened plaster of Paris, be mounted on the carrier, and the bracing point at the other end of the lever be moved over the lines of a drawing, the cutter will plough a little furrow, which will follow these lines. When the plate is finished, a stereotype is taken from it and forms the printing surface. The lines of the casts are remarkably strong owing to the conformation of the furrow of the mould, and they can be printed on fast rotary machines. The weather charts given in some newspapers are produced by this process. A block with the recurring outlines being made, plates are moulded from it, so that the details alone have to be separately cut upon future plates. Mr Shanks's method is remarkably simple and expeditious, and the results are economical and trustworthy.

Press-Work and Presses.

The characteristic of printing, as already pointed out, is that the pigment—the ink—with which the printing surface of the type is coated is transferred to the paper or other material by pressure. The manner in which this pressure is exerted gives rise to two classes of machinery,—those in which the platen and the cylinder respectively are employed. After the paper is placed on the type, in the one case a flat plate of iron moves parallel to the forme and comes in contact with it, causing the impression on the paper, while in the other case a cylinder revolves over the surface, which travels in gearing with the cylinder.

Space does not permit of any sketch, however slight, of the origin and progress of type-printing machinery. We can only refer to what may be regarded as representative appliances in present use. In America all kinds of apparatus for printing are called "presses", in England, however, an appliance of a more automatic character than the hand-press is usually called "a machine." As the hand-press is now almost obsolete, this distinction will probably be abandoned, and the shorter and more expressive word "press" be applied to all. Venturing to adopt this suggestion, we may say that of platen presses there are the hand-press, the treadle platen press, and the steam or other power-driven press.

Hand-press.

Fig. 10 is a view of the Albion press. It is wholly of iron and steel. Although this press is nearly superseded, it is desirable to point out its component parts, as they indicate the general principles on which all typographic machinery is based. The flat plane on which the type is laid is called the *bed* of the press; the other flat plane which moves vertically and presses the paper on the type is the *platen*. These are the two essential parts of the press. The platen is perfectly smooth and level on its under surface, in order to give the whole of the type forme an equable pressure. It is mounted in a strong iron frame, with a cross-piece or head. The platen is propelled by a piston, which moves up and down. The power is gained by bringing an inclined bar of steel perpendicular to the direct line of pressure, and in doing so the piston is forced down. This steel bar is the *chill*, shaped like an elbow. At one end is a bar or handle which, on being pulled towards the operator, straightens the chill or brings it into the vertical position. At the sides are guide-plates fixed into the frame, to preserve the parallelism of the platen, for the slightest vibration or lateral movement would prevent a clear sharp impression being taken. There are appropriate appliances, such as a helical spring, fixed on the head of the press, whereby the platen raises itself when the pressure is not required. In order to bring the forme readily under the platen, and to withdraw it so that it may be inked and the sheet to be printed placed in position, the table is mounted on a carriage, that runs on two rails by turning a handle connected with two endless bands. The paper is fixed to certain marks on the *tympan*, a kind of metal frame hinged on to the carriage, when it is in a sloping position. This ensures the paper being printed in the exact place required. The tympan, over which calico or parchment is stretched, is double, and contains within it a pad of paper or a piece of blanket, to moderate the force of the impression of the platen. To it is hinged another metal frame, the *frisket*, which is covered with paper, cut to correspond with the shape of the type forme on the press. The ink is applied with a cylinder or *roller*, which revolves in an iron frame, and is covered about an inch thick with a composition of glue and treacle or of glycerin or other substance. The ink is spread out with a palette knife or similar appliance on a table adjoining the press, and by repeatedly revolving the roller over it, it becomes coated with an extremely thin film of ink. The roller is then moved over the surface of the forme on the press, until sufficient ink has been transferred to it. This is called *rolling*, and is a very important part of press-work, for if inefficiently performed there will be too much ink on the impression, or even blotches, which are called *monks*, or the print will be too pale or grey in places, such imperfections being called *friars*. The sheet of paper to be printed is next laid on the tympan, to pins serving as guides. The frisket is folded down on the tympan, which is in turn folded down on the forme with the right hand, while with the left the handle is turned and the press carriage brought under the platen. The bar is pulled by the right hand, the handle turned the reverse way with the left hand, the carriage brought out again, the tympan raised, the frisket opened, and the printed sheet removed, the tympan being ready to receive another white sheet. The frisket serves, among other things, to keep the edges and parts of the sheet not required to be printed from being discoloured by contact with the ink or the sides of the forme, and to aid in steadying the sheet when the tympan is depressed and in the removal of the sheet when it is raised. Such is a bare outline of the method of printing at a hand-press,—one necessarily imperfect from a technical point of view, but sufficient to indicate the essentials of the operation.

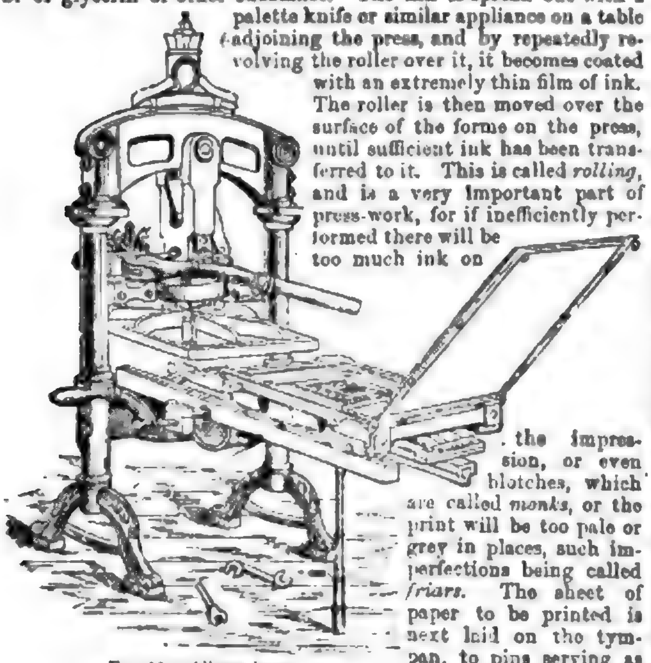
Fig. 10.—Albion press.

Another press which has been much used is the Columbian,—a name given to it by its inventor, Clymer, an American. The power is gained by an ingenious combination of levers. Two of these are connected by a rod with the bar handle, which is in itself a lever. The platen is attached to the head by a strong iron bolt, the descent being made steady and regular by vertical guides. It is counterbalanced by a powerful lever or beam, having an adjustable weight shaped like an eagle, which raises it automatically. In the bar handle is a screw stop by means of which the length of the lever rod can be adjusted and its pressure, or the *pull*, perfectly regulated.

Nine distinct processes have thus to be gone through in order to print one side of a sheet of paper at a hand-press:—(1) inking the roller, (2) inking the forme, (3) laying the sheet on the tympan, (4) folding down the tympan, (5) running in the forme under the platen, (6) taking the impression by depressing the platen, and then immediately afterwards allowing it to raise itself by means of the counterpoise or spring, (7) running out the forme, (8) lifting the tympan and frisket, and (9) removing the sheet. The object of successive improvers of the printing press has been to render the apparatus more automatic, or to substitute for it a "machine" that will reduce these nine operations to the minimum. In modern machines this has been effected to the extent of rendering necessary only three of them—(1) laying on or "feeding" the sheets, (2) applying the motive power, (3) taking off or delivering the sheets; and rotary machines both feed and deliver themselves automatically. Nearly all cylinder machines have a delivery apparatus, and quite recently an appliance for the automatic feeding to them of single sheets of paper has been invented.

With respect to the platen press we notice first that which is capable of being driven by a rotating shaft or wheel. It should be observed that the adoption of the rotatory principle was essential to the acceleration of speed. This was recognized by the projector of the machine[1] press, William Nicholson, and by Frederick Koenig, who first brought the invention into use and constructed a practical press. The essential arrangements of every machine are four, their respective objects being (1) to feed in the paper, (2) to ink the forme, (3) to print the sheet, and (4) to deliver or take it off.

Treadle platen press.

The treadle platen press is the simplest of machine presses capable of being worked by a wheel. When other motive power is not available it is driven by a treadle, like that of a lathe. The type forme is usually secured by clamps on an almost vertical bed (fig. 11), and the platen rocks backwards and forwards, being thus brought in contact with the type on the bed. Just before the impression is taken, the two surfaces are momentarily parallel. The inking is effected by small composition rollers, adjusted in a roller carrier swinging on a pivot. The rollers receive ink from a "fountain" or duct of ink at the top of the machine, below which is an arrangement, such as a revolving disk, for distributing the ink. The constant motion of the rollers and of the revolving ink disk is equivalent to the manual movements of the operator who "rolls" at the hand-press. The rollers are carried by self-acting appliances over the face of the forme, and return to the ink table to be replenished with ink, after which the impression takes place. The sheet to be printed is placed in proper position on the platen, which is covered with paper or parchment, and is secured there during the movement of the platen by movable fingers called *grippers*. The platen on advancing brings the paper in contact with the type forme; after the printing it returns to its original position, when the sheet is removed and another sheet adjusted ready for being printed. The treadle platen press is only adapted for work on paper of small size, up to half sheet demy, but within this limit it is greatly superior to the hand-press. If sufficiently strong and well built, it gives a far more powerful impression, and it occupies about a sixth of the space. Its great merit, however, is its superior speed. The hand press, when worked by two men, one rolling the types and one pulling the handle of the press, produces only about 250 impressions per hour. The treadle press is worked by a boy, who has only to depress the treadle with his foot, and lay on and take off the sheets with his hands, and he can work at the rate of more than 1000 per hour. The treadle press is also superior to the hand-press in the uniformity of its results, since the automatic inking ensures a greater regularity in the colour of the impressions than with the old hand-inking process.

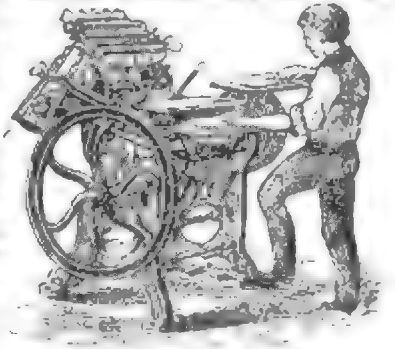
Fig. 11.—Minerva press.

Double platen press.

The ordinary or "double" platen press was, in principle, very similar to the hand-press. It was about 13 feet long. The platen, in the centre, was massive, as the machine printed sheets as large as double demy, and it had a perpendicular motion, being guided in grooves and worked by a connecting rod fixed to a cross beam and crank, which acquired its motion from the main shaft. In other respects the machine differed from the hand-press in having two type beds or coffins and two inking tables arranged at the ends of the carriage, which travelled backwards and forwards, being worked by a drum underneath. The paper to be printed was laid to marks on the frisket, and this was hinged on the tympan, which in turn was fastened to the end of the coffin by hinges or joints. The frisket and tympan were opened by running up bars at suitable positions. After a newly printed sheet was removed, another was placed on the frisket, which as the carriage moved ran down the bars and closed on the sheet, which then received its impression. This arrangement was dangerous to the boys who had to lay on the sheets.

Formerly it was thought that the very finest printing could not be done by a cylinder impressing a forme in the progress of its reciprocating motion, for that was liable to slur or blur the impression. Hence platen presses were employed for the best work. Of recent years engineers have brought the cylinder press to such perfection that there is not the slightest danger, under the superintendence of a capable man, of any slur. Working quite as well as the platen press, the cylinder press is enormously quicker and more productive; it requires less driving power; and much better inking is obtained, which is all-important for fine woodcut printing. Accordingly, for even the best illustrated book-work, the platen power-press is now almost entirely superseded by the cylinder.

Cylinder machines are of two kinds,—(1) presses in which the type is on a flat plane and (2) those in which the type, or more correctly the impressing surface, is cylindrical. The first are called *cylinder* presses, the second—a development of the first—the *rotary* web presses.

The simplest kind of mechanical press is called the single

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[1] The best account of its invention is contained in a series of articles by Mr William Blades in the *Printers' Register*, 1883-84, and Th. Goebel's *Friedrich Koenig und die Erfindung der Schnellpresse* (Stuttgart, 1883). This last has been translated into French by Paul Schmidt, *F. Koenig et l'Invention de la Presse Mécanique* (Paris, 1885).

Single-cylinder press.

cylinder or one-sided machine, which has been recently brought to the highest state of perfection by Mr Samuel Bremner. It is generally used for commercial and fine book-work on one side of the paper. There are different varieties of cylinder machines, distinguished by trade-marks or the names of their makers; but the general principles, apart from details, are practically identical. There is a strong cast-iron frame, with bearings to carry the cylinder, which runs across the machine transversely, nearly in the centre. The cylinder revolves by gearing connected with a main shaft, which also works the other moving parts. This shaft is turned by a wheel for hand or steam power. The table for [illegible] carrying the type is also provided with a flat inking board of wood or iron, used for distributing the ink. It travels backwards and forwards, that is, with a reciprocating motion. At one end of the machine is the feeding-board, on which the pile of paper to be printed is placed. The layer-on places each sheet against metal marks, consisting of rectangular pieces of steel or brass mounted on a bar underneath, which rises and falls according as the sheet is being laid to and taken away from them. When placed against these marks, [illegible] spring covered "lay," the sheet is seized by grippers or light metal claws fixed on a bar inside the cylinder. These clutch the sheet and carry it forward round the cylinder, which in its revolution brings it finally in contact with the type forme moving forward underneath, when the impression is effected. Immediately after the grippers release their hold, and the sheets are removed singly by an attendant called a taker-off, or by a mechanical automatic arrangement called a flyer, and deposited on the taking-off board. At the end of the machine farthest from the laying-on board is fixed a trough, which contains the ink; it is fitted with the duct roller of iron, which revolves by means of a band or ratchet-wheel and pawl. A flat bar or knife with a thin edge is set up against the metal roller lengthwise by adjusting screws, which regulate the passage of the ink, and permit a thin film to pass the knife. A composition roller, called a vibrator, is fixed underneath, which takes off the ink that has already been deposited on the duct roller and leaves a ridge or strip of it on the inking slab. As the carriage returns, this strip of ink is distributed on the inking table by rollers placed diagonally across the machine. The diagonal position gives them a varying motion; hence they are called wavers. The inking of the forme is done by another set of rollers called [illegible], placed near the impression cylinder. The inking rollers receive their ink from what is distributed on the table and coat the type while it is passing underneath them.

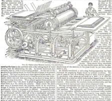

FIG. 12.—Single-cylinder Bremner machine, with [illegible]

Advantages of single-cylinder machines over hand-presses.

Thus the nine operations of the hand-press requisite to print one impression are greatly reduced. The bed carrying the type to and fro from the point of impression moves mechanically, superseding the running in and out of the carriage by the rounce and handle of the hand-press. The inking table, although independent, forms part of the type table, and some of the rollers distribute and others ink, this again being done mechanically and without a second operator. The platen and the tympan, as well as the frisket by which the impression is given, are in effect combined in the cylinder, which ensures by gearing the pressure being applied during the motion of the table itself. The laying on of the sheet upon the tympan and folding it down on the forme are superseded by the presentation of the paper to the grippers; and the taking-off of the sheet after raising the tympan is superseded by removing it when released by the grippers and laying it on the adjacent table,—both comparatively easier operations and done much more rapidly. Indeed both laying-on and taking-off may be done automatically, as is explained below. The result is that, while two men [illegible] enabled to print a sheet of book-work on one side of the paper at the speed of 250 an hour at the hand-press, machines of this class worked by one operator print about 1200 per hour. Even this comparison does not convey a complete idea of the increasedly productiveness of the cylinder machine over that of the press. By the latter, the largest sheet practically that could be printed was double demy, 35 × 22½ inches, the dimension of which is 800 square inches; single-cylinder machines are now made to print eight sheet double crown, the dimension of which is 4000 square inches. These sheets being afterwards cut up into double crown sheets, the productiveness of the machine to the press would be, per hour, about 3000 to 250.

As already mentioned, a self-acting feeding apparatus has been invented for supplying single sheets to cylinder machines. The pile of paper is laid on a feeding board or table, between gauges. A pneumatic tube takes up one sheet at a time; it is then fed down tapes to a point at which india-rubber fingers bring it to the side lay of the machine, and it is printed with perfect accuracy of register. Once started, the machine works automatically, and the services of both layers-on and takers-off are dispensed with.

We may now describe that class of machines in which the paper is printed on both sides, or perfected, during one passage through the machine. The Applegath and Cowper or ordinary machine has two impression cylinders, having a continuous rotary motion towards each other. The frame is [illegible] long, breadth about 10 feet, and the width of the machine about 8 feet, these dimensions depending upon the size of the sheet to be printed. The table or carriage is double, containing two beds for the two formes of type, to impress the two sides of the paper, and two distributing tables for the ink. At each end is a complete roller apparatus, consisting of duct, duct roller, vibrator, and wavers. Close to the large cylinders on each side are the inking rollers. The table has a reciprocating motion, as in a single-cylinder machine. The distinctive feature is the ingenious manner in which the sheets are printed first on one side and then on the other. This is effected by carrying them over cylinders and drums by means of tapes. The pile of sheets stands on a high table placed at one end. The sheet is fed into the apparatus and fed round an entry drum; thence it is carried round the large right-hand impressing cylinder, and underneath this, on the table, which is moving at the same speed as the cylinder, is the inner forme properly inked. The paper thus receives an impression on one side. It is next fed up to the right-hand drum, which it passes over, the printed side of the sheet being then downwards. Continuing, it is brought under the second or left-hand drum and on to the left-hand impression cylinder, which it passes with the printed side still downwards, or next to the cylinder, exposing the other side to the type of the outer forme on the table underneath. The drums have thus reversed the position of the paper: the side which was outside when passing the first forme is inside when passing the second forme, which accordingly prints the sheet on the opposite or blank side. The sheet is finally run out by the tapes and delivered in the space between the large cylinders, seized by a taking-off boy, and deposited on a table or taking-off board. This press is known as the *drop-bar perfecting machine*, owing to a peculiarity of the arrangement by which the paper is conveyed into the tapes. In front of the feeding table is a rod or bar of steel, along which are fitted several metal disks or bosses about half an inch thicker than the bar itself. These can be shifted, by means of small screws, to any position along the rod to suit the size of the sheet to be printed. To this bar is fixed a short arm, with a pulley at the end, which works round a wheel attached to a cam with a dip. Every time the pulley drops into the dip, the bar descends upon the paper, which is laid to marks at the front; and the bar, possessing a rotary motion from the tapes, runs the sheet between a roller and a small drum on to the inner forme cylinder, as already stated. Other kinds of machines are distinguished as the web, having a web or a series of broad tapes which lie on the laying-on board and are fastened to a small drum underneath it. The drum has a series of small cogs, and when it is forced forward it moves the web or tapes in the same direction. The sheet, having been laid to a back mark on the tapes, is propelled between two revolving rollers and thus taken into the machine.

There are several distinct types of perfecting presses in use, but we can only notice one or two. In the Anglo-French machine, which was invented in England but improved in France, grippers are used instead of tapes and the intermediate drums for conveying the sheet from one cylinder to the other. The cylinders are on a level, but alternately rise and all, allowing the sheet to clear the forme. Quite recently a single-cylinder perfecting press has been invented. The cylinder is double the usual size and has two printing surfaces and a double set of grippers. Two sheets are printed at each revolution, the first being the white paper and the second the partly printed sheet which has immediately preceded it. The sheet is fed in as to an ordinary single side press, printed on one side, taken off, reversed, again gripped, and perfected, when it is automatically delivered on the table.

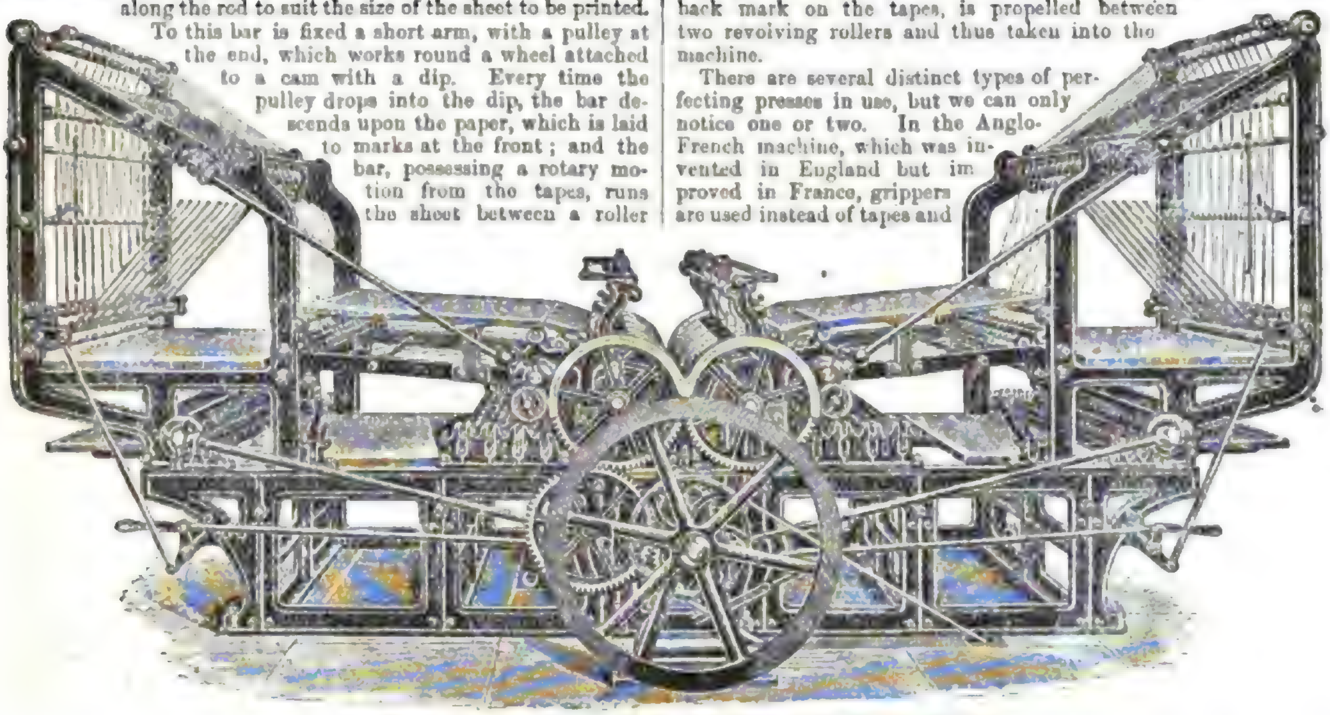
FIG. 13.—Marinoni combined perfecting and duplex single-cylinder machine.

It has been mentioned that 250 sheets or a *token* per hour, printed on one side only, represent the work of two men at the hand-press. Two youths at a perfecting machine will complete from 1200 to 2000 copies per hour, equal to 4000 impressions on one side only,—an increase of about sixteenfold. This, however, does not represent the whole of the superiority of these machines. Sheets much larger than double crown (20 × 30 inches) can hardly be worked at a press; the machine perfects a sheet nearly double this size—50 × 40 or four royal, so that the proportionate product of the machine to the press is about as 32 to 1.

Perfecting machines are not so much used for book-work as formerly. The single-cylinder machine has been brought to such perfection, and is so superior in its inking arrangements, that printers prefer it. In America nearly all machines are one-sided. For newspapers of limited circulation, however, the perfecting machine is well adapted. Complete copies of a journal are produced as soon as the machine is started; extra copies can be worked off while newsagents are waiting; and a number of sheets need not be printed off on one side to be completed when a sudden demand arises.

Fig. 13 shows a new form of French perfecting machine for printing book-work, the Marinoni combined perfecting and duplex single-cylinder machine. The improvement in this machine over the perfecting two-cylinder machine described above consists in the alteration of some mechanical parts, so that the same machine can be used for printing sheets either on both sides or on one side only. It therefore serves the purpose of two single-cylinder machines or of one perfecting machine, the change from one to the other being very simple.

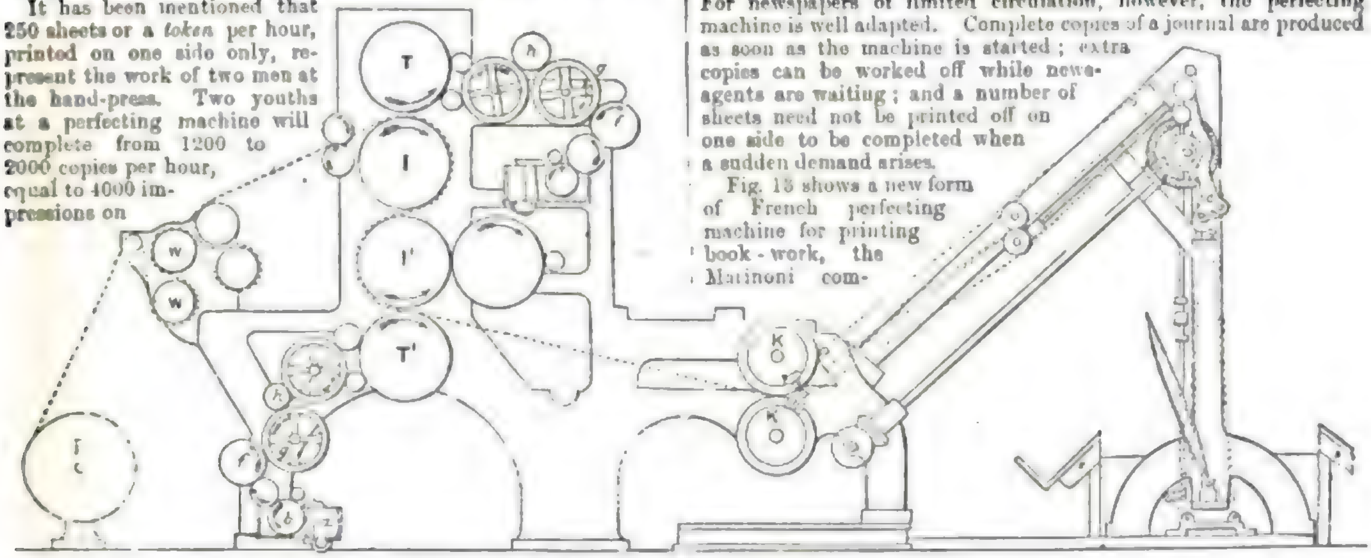

FIG. 14.—Walter machine.

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The rotary press differs essentially from the cylinder machine. In the former the printing surface and the impressing surface both rotate continuously, and the paper,—not cut up into single sheets, but carried between the two cylinders in a roll or web, like a ribbon.—receives successively an impression on each side, after which it is cut up into sheets of the proper size and folded as it is run out, the sheets being deposited on a table ready for removal.

Walter press.

As representative of this class of machines we may take the Walter press, whose mechanical arrangement is shown in fig. 14. The paper to be printed from, a continuous web about 8000 yards in length, is wound on a small roller at *P*. It is passed over a tension roller, and then over the damping cylinders *W*, *W*, and thoroughly wetted on both sides. The damping cylinders are hollow, and contain sponges from which the water is distributed by centrifugal force, the outside of the cylinder being covered with blankets. The paper next passes on to the printing cylinders T, T', on which the printing surface—not composed of movable types but of stereo plates—is fixed, and to the impression cylinders I, I'. The printing cylinders contain each the plate in curvilinear shape, constituting the forme for one side of the paper. The web is led between the printing and the impression cylinders, as shown by the dotted line. After being printed on one side by T, it travels round I and receives an impression on the other side from T', thus being "perfected." It then passes on to the cutting cylinders K, K', one of which has a serrated knife, which enters the paper, and on the application of tension divides the web, causing the peculiar saw-like edge seen in copies of journals printed on rotary machines. The paper is next carried in over tapes to the point where the complete severance takes place. Soon after they encounter a pendulous frame, which delivers them in two piles on to the tables x, x, whence they are removed. There is an ink supply trough a, which is connected with the distributing rollers by a revolving metal roller b. The distributing rollers of metal are marked f, g, h, i, and the rollers which ink the forme, made of the ordinary composition, are marked k, k.

The average rate of speed of the Walter press is 12,000 per hour, the sheets being printed on both sides. In this apparatus everything is automatic: there is self-feeding and self-delivery, the web of paper at one end being transformed into properly printed single sheets at the other. The machine requires only one man to superintend its general working, including the replacing of the web when printed and the removal of the successive piles of sheets. In respect of speed, if the perfecting machine is to the hand-press as 32 to 1, the rotary will be to the hand-press as 96 to 1. The Walter press, requiring a space of only about 14 feet by 5, is not more remarkable for its speed and economy than for its simplicity of construction and its compactness. And the same remark applies to several other machines, such as the Victory, the Hoe, and the Prestonian, which have since come into use. Their general appearance is that of a collection of small cylinders or rollers, through which the paper seems to fly at railway speed, issuing forth in two descending torrents of sheets accurately cut into lengths. Without such machinery the prodigious issues of some of the morning journals would not be possible. One daily paper averages a circulation of more than a quarter of a million. This enormous number of sheets are printed in about four hours, owing to the type matter being stereotyped and placed on several presses.

Printing from webs of paper.

Printing from webs of paper instead of single sheets will probably be adopted in the future for all newspapers and even books of large circulation. Hand-feeding is limited by the ability of the operator to lay the sheets on the feeding-board with the necessary accuracy. One chief obstacle to the more general adoption of rotary printing is the expense of stereotyping the type formes. Although a machine has been constructed in which movable types can be placed round the periphery of an impressing cylinder, it cannot compete with the Walter and other presses using stereo plates. The problem of printing directly from flat formes of ordinary types, as well as from stereotypes, with paper supplied in the roll, is one that may be commended to engineers. The saving in stereotyping in many cases would be very considerable; but, even where this is not an object, the readiness and ease with which the type could be manipulated would ensure for such an apparatus admission into offices where the large rotaries of the present day are inadmissible. It would also enable illustrated journals to be printed from the web. The pictures introduced into some of our daily journals are very rude when compared with those in periodicals printed on flat-bed machines. This is owing partly to the distortion that arises when the cast from a flat block is accommodated to a curved surface, partly to the fact that stereotyping does not give the fine and delicate reproduction that electrotyping supplies, and partly to the imperfect inking powers of the machines. Quite recently a plan has been patented whereby curved electrotypes of pictures can be fastened to blank or depressed portions of an ordinary curved stereo plate; but the method is not always practicable. With a flat-bed machine the forme to be printed from might be of a composite kind,—partly movable types, partly stereotype, and partly electrotype. One difficulty of constructing a web printing machine with a flat bed is that of turning the sheet so that it may be printed almost simultaneously on both sides. It would have to be reversed by the continued rotary movement of the cylinder. This, however, is quite within the limits of practicability, and experiments are now being made to devise a machine with this feature.

Roller composition.

For about three centuries after the invention of printing the formes were inked by leather balls. When machine presses were introduced, their earliest inventor tried to use cylinders covered with leather; but the plan was most unsatisfactory, until a subsequent inventor adopted a composition of glue and treacle, which was cast into cylinders having an inner "stock" of metal or wood. For about half a century this composition was used exclusively for both hand and machine presses. Since then glycerin has been introduced for roller making. Hansard's recipe, in use when the 8th edition of the present work was issued, was—glue 4 parts, treacle 12 parts, Paris white 1 part. But a much better composition is now formed of glue 10 parts, sugar 10 parts, and glycerin 12 parts. The glycerin has the property of always keeping the roller moist and soft, while the tendency of glue and treacle is to dry and harden. A glycerin roller lasts much longer than one of glue and treacle.

Qualities of printing ink.

Printing ink has peculiar qualities. It is required to change from the soft adhesive state in which it is applied to the type to that of a perfectly hard and dry substance after being transferred to the paper. This change of condition must be under control, and when air is excluded the ink should keep in good order any length of time. During its application to the type its solidification should be as slow as possible, and unaccompanied by the emission of any unpleasant or deleterious odour. It ought not to affect the rollers, and, having been applied to the paper, its action should be confined to a very slight penetration, just sufficient to prevent its detachment without injuring the surface of the paper. It must dry into a hard, inodorous, and unalterable solid. The ingredients of ink are burnt linseed or other oil, resin, and occasionally soap, with various colouring matters; that for black ink is usually lamp black, but charcoal and other cheaper materials are occasionally introduced. Ink is removed from types and blocks by detergents, such as potash and pearl ash; benzine is also well adapted for the purpose.

Colour Printing.

Printing in two colours.

The apparatus previously described is intended for monochrome printing, whatever be the shade of the ink. When two colours or more have to be printed in one composition, there must be a separate type forme or separate engraving, and a separate printing, for each. Many attempts have been made to print several colours simultaneously by dividing the trough or manipulating the rollers. All these have been more or less unsuccessful, with the exception of a press invented by Mr W. Conisbee, which prints from type formes in two colours. In construction it is somewhat similar to the ordinary single-cylinder machine, but is provided with two sets of inking apparatus, including ductor, wavers, and inkers, each of which acts totally independent of the rest. The cylinder is placed in the centre of the machine and makes two continuous revolutions, giving an impression for each colour. There are two type formes, each containing only the lines to be worked in one of the colours. These are in two beds adjoining one another, and, the circumference of the cylinder being equal to the length of one bed, one colour is printed by the first revolution and the other by the second. The sheet is thus printed twice without being released from the grippers, whereby perfect register is ensured. The speed is slow, averaging 300 to 400 complete impressions per hour.

Chromo-typography.

The method by which the beautiful coloured supplements issued occasionally with illustrated newspapers are printed may be slightly referred to. A copy of the artist's painting is first of all made, on a scale regulated by the size of the reproduction. This being supplied to the engraver, an outline or key block is made and proofs pulled. It is now necessary to determine the tones of colour to be used,—a process demanding great experience. The key block will, if printed first, afford a guide for the registration of the subsequent printings; sometimes, however, that is reserved for a later stage. The colours on which the subsequent printings are done must be of a transparent nature. The blocks are sometimes produced by the typographic etching process, which gives a softness, delicacy, and variety unattainable by the graver. The blending of the colours is the most delicate task the printer has to undertake. A large picture is often printed in ten or more workings, some of them in their turn intensifying and bringing previous colour workings into stronger relief, others giving shape and form to the picture. Almost to the end of the process, however, the picture will want vitality; its outlines will be hard and bare, or vague and undefined, according to the sequence of the colours. Another working may give grey tones where wanted, and may increase the depth and transparency of various parts. A deep flesh working may have a marked effect on the development; and, near the close of the series, if the entire colouring is found to be too warm, it may be corrected by over-printing very nearly the whole subject. Chromo-typography has undoubtedly made great strides during the past twenty years, its best results being shown in the coloured prints for illustrated journals. For the production of pictures for commercial and artistic purposes chromo-lithography is generally resorted to on account of its relative economy. In lithography for typographic purposes the line has to be cut and the space on both sides removed so as to leave the line alone to be charged with the ink, or the white space has to be etched away with an acid. The printing of isolated points too is easily effected from a stone, whereas most minute labour is necessary to engrave them. Typographic etching has here, however, been of great assistance. The differences of printing surface caused by the colours are met and overcome by the lithographic stone with great facility, even when the spaces are largest and most uneven; it is quite the contrary in regard to typography, wherein the work has to be charged with ink to a greater extent according to its size, and the quantity

Chromo-lithography.

of ink requisite varies with the fineness of the strokes and of their distance apart. Owing to this we see in most letter-press polychromatic prints a deficiency of transparency, of half-tints, of depth of ground, and of general harmony. Even if it were possible to make chromo-typography as easy as chromo-lithography, there would still be the obstacle of its very much greater cost, owing to the expense of the engraving and of the casts from the key block. In chromo-lithography the designer can repeat the designs for the different stones by a process that costs almost nothing. Also in the process of multiplying the blocks the deviation in the register of the successive colours is practically unavoidable. In lithography the surface to be printed is nearly level; hence the sheet is not shifted and twisted or stretched in places, as it is in typography, owing to the alternate closeness and absence of contact between the sheets and the raised and depressed surface of the block. Whatever success the letter-press method has attained of late is owing to the invention of electrotyping and process blocks, and to the improvement of machinery. For to print these pictures enormous strength and rigidity, and the most perfect arrangements for securing register, are absolutely essential.

Recent Changes.

Progress in printing.

We will now give a cursory glance at the changes that have been effected during the last twenty-five years in the processes and the products of the art of printing. That these have been of a most drastic kind may be gathered from a comparison of the appliances figured and described in the 8th or the previous editions of the *Encyclopædia Britannica* with those referred to above. The hand-press has been almost completely superseded by the machine press. Cylindrical impression has displaced platen impression, and the finest book-work and woodcut work are done on a cylinder press. In book-work, indeed, other significant changes have taken place. Whereas formerly it was deemed essential that the paper should be damped before printing, in order to get a delicate and perfect impression, some of the finest books and periodicals are now printed on dry paper, highly calendered, even the illustrated journals and some of the evening papers being so worked. Then, it was thought necessary for the safety of the type to interpose a thick soft blanket between it and the pressing surface, whether cylinder or platen; now, it is found equally safe, and far more conducive to a good impression, to make the packing as thin and hard as possible. Then, fine woodcuts were "brought up" by the use of many "overlays" and "underlays" to correct inequalities in the surface of the blocks and emphasize some of the parts; now, although the art of "making ready" has been brought to great perfection, the fewer and thinner the overlays employed the better. And it may not be irrelevant to point out that the printing of woodcuts has improved in the same degree as the engraving of them.

Improvements in newspaper printing;

In type-founding.

Printers' Specimen Exchange.

Artistic printing.

Perhaps, however, the most remarkable change is that made in newspaper printing. The highest achievement mentioned in the article "Printing" in the 8th edition of this work was the six-cylinder Hoe machine. The makers of that apparatus subsequently contrived machines of eight and ten cylinders. But they have now been wholly superseded by the rotary presses on the Walter principle. The hand feeding-in of single sheets is entirely done away with, and all newspapers of considerable circulation are printed from long reels of paper, uncut, as originally made at the paper-mill. The maximum number of copies which a machine of this class would print with ten feeding attendants and four taking away attendants would be 8000 an hour. For folding the 8000 printed copies five folding machines and at least two attendants would be required to keep pace with the printing machines. Thus nineteen men were required to print and fold 8000 copies per hour with the best machines as late as 1870. With a rotary machine doing the same or a larger quantity of work only two men are required. The cost for printing and folding 1000 copies by the Hoe machine was estimated at 1s. 4d., while with the rotary it is only about 2d. Hence the saving of wages to a newspaper issuing 200,000 copies a day on 313 working days would be nearly £3700 in a year. This, in connexion with improvements in paper, or rather the discovery of cheaper materials, bringing the price of "news" down to about 2d. per ℔—one quarter of its price a very few years ago—accounts for much of the enterprise of modern journalism. For some time after the abolition of the paper duty there was a loss on the circulation of a large-sized penny journal; now there is a considerable gain. Lately rotary presses for small jobbing work have been constructed; and before long the rotary principle will probably be rendered available for illustrated periodicals and fine book-work, printed from webs or reels of paper instead of single sheets. Great improvements have also been made in type-founding, and the Roman and Italic founts now used by English printers are equal to those of any country in the world. It is sometimes said that English *éditions de luxe* are not equal to those of the French, and that this is owing to the inferiority of the founders. This is, however, not quite true: some of the best French books are printed from English types or from types cut in the English manner. It is also the fashion to compare modern printed books with those of the Elzevirs and Baskerville. Yet as a matter of fact their best faces have been reproduced with perfect success by modern founders. From a mechanical point of view the impression given by the best machine presses to-day is undoubtedly superior to that of the hand-presses of the 17th and 18th centuries. If modern books suffer in any respect on comparison with those of former times, which are so highly prized by bibliophiles, it is owing to their want of general artistic *ensemble*, and not to any deficiency in mechanical execution. The artistic taste of English printers has, however, been greatly raised during the last few years, and a very interesting movement is going on which must produce important results in the future. In 1880 Mr Andrew W. Tuer of London organized the Printers' Specimen Exchange, a scheme intended to promote the technical education of the working printer. Each contributor to the exchange furnishes periodically a certain fixed number of typographical specimens, all alike, which are collated into sets, and again distributed to the members, each of whom gets a volume, consisting of one copy of the work of each of his fellow-contributors. By this plan they become acquainted with the progress made by their brethren, and good taste and good work are fostered and mutually encouraged. The eighth quarto volume, issued in 1887, contains nearly 400 fine specimens of typography by as many different hands. It forms also the best criterion of the character of the jobbing work done at the present day, not only in England but abroad, for the scheme is of an international character. The results of the revival in artistic printing during the last decade are especially noticeable in jobbing work. Much of this improvement is due to the superior material with which the printer is furnished, and especially to the great variety of ornamental types which have been introduced. The specimen books of the principal type-founders are splendid volumes, containing several thousand different faces. The best work of German printers is noteworthy for its studied neatness and attractiveness, tasteful and harmonious arrangement of colour and tint, a characteristic and conscientious attention to details of finish, exact register, and beauty of impression. American work excels in originality of design, brilliancy of colour, and perfect finish. English printers are closely following the best points of each of these schools of typography. There is a distinct leaning at present to the German style, but with little slavish imitation. The distinctness of English typography is maintained, while the beautiful German combination borders, produced with such profusion of late, are judiciously utilized, often in conjunction with American type. In the arrangement of colours English printers prefer the quiet harmonious tints of the Germans to the bold striking contrasts of the Americans.

Division of labour.

The vast extent of the operations of the printing fraternity at the present day is in remarkable contrast to those of the 15th century, when the making of books was an art like the sculpture of statues or the designing of buildings. Now, printing is a manufacture in which large capital and the greatest division of labour are essential. The old printers were almost entirely independent of other craftsmen. From the casting of the type to the mixing of the ink they did nearly everything for themselves. Gradually the different departments of the art were constituted separate and recognized trades. The type-founder was probably the first to secede from the concern; then printers delegated to others the making of presses; afterwards the ink and the rollers found separate and distinct manufacturers; and there arose a class of persons who, though belonging to other trades, made printing appliances a specialty, such as printers' smiths, printers' joiners, and printers' engineers. Subdivision again has taken place in regard to the operations which chiefly appertain to printing. The same man was formerly able to set up and print off the types, to fold the sheets perhaps, and even to make them up into books. The operative printer has now become either a pressman or a compositor. If he is of the first denomination, he may be classed according as he works at press or machine. If he is a machinist, he may superintend or be a "minder," or he may be a layer-on or a taker-off of the sheets. If he is a minder, he may understand only book machines or only news machines; he may know all about platens and little about cylinders; or of cylinders he may know only one kind. Entirely novel machines create a new class of artisans. There are men perfectly competent to manage a Walter press who are ignorant how to work two-colour or fine book-work machines. In the compositor's department division of labour is carried out to a still minuter degree. An old-fashioned printer would set up indifferently a placard, a title-page, or a book. At the present day we have jobbing hands, book hands, and news hands, the word "hand" suggesting the factory-like nature of the business. There are jobbing hands who confine themselves to posters, and know little about general work even in this department. Book hands comprise those who set up the titles and those who set up the body of the work. Of these latter again, while one man composes, another, the "maker-up," arranges the pages. Even the art of fitting up the furniture or "dressing the chase" is given to the "quoin-drawer overseer." News hands include advertisement hands and general hands. Some men work by day, others altogether by night; some do general book-work composition; others set up head-lines; others make up the galleys; others "prove" them.

Old Style Printing.

Old style printing.

Within the last few years there has been an interesting revival of the old style of book printing. It owes its origin to Mr Whittingham of the Chiswick Press, who in 1843 was desirous of printing in appropriate type a work of fiction the diction of which was supposed to be that of the reign of Charles II. As the original "old face" matrices of the first Caslon had been preserved, a fount was cast from them, and on getting a proof with good ink, on good paper, from a modern press the impression was found to be far superior to specimens printed from the original fount. Since then the demand for old-faced characters has steadily increased, and all founders now supply imitations of the old types. Comparing the old face and the modern characters, the latter are more regular in size, lining, setting, and colour,—using these words in the technical sense of the founder; they have finer strokes and serifs, and produce in the page a more regular and sparkling general effect. At the same time it may be conceded that legibility has been to a certain extent sacrificed to beauty and general effect. About 1882 an eminent French printer made a number of experiments to ascertain what it is that constitutes legibility in type, and found that people read with less fatigue according as the letters—(*a*) are rounder, (*b*) are more equal in thickness, (*c*) have shorter upstrokes, (*d*) are dissimilar to each other, and (*e*) are well proportioned to their own body. Drawings of letters from old books were visible and legible at a distance at which modern letters could not be distinguished. The revival has also brought about the re-introduction of antique head-pieces and tail-pieces, vignettes, and initial letters, which have been reproduced from old books by photography and typo-etching. For this kind of printing white paper has given place to toned, of a straw tint, which is often more agreeable to the eyes than the excessively bleached paper which was hitherto the fashion. Also hand-made instead of machine-made paper has to a large extent come into vogue. Its characteristic is the "deckle edge", which distinguishes it from the clean-cut edge of machine papers, and is highly prized by some bibliophiles. When extreme verisimilitude is required, this kind of printing is done on the blank leaves of real old books, some of which have been ruthlessly destroyed for this modern craze. On the whole, however, the revival of old style printing has been beneficial: it has encouraged printers to study the more artistic attributes of the productions of the great printers of the past, and has educated the public taste by presenting them with examples of the best kind of book-making.

Printing Establishment.

Departments of a printing establishment.

A large book-printing establishment contains many distinct departments, some of which have not been previously referred to and may here be summarily mentioned. The reading department, sometimes called the *closet*, consists of a number of small apartments, each furnished with a desk, a couple of stools, and a shelf for books of reference, and having for its occupants the reader and his reading-boy. There is also the warehouse, where all the printed and unprinted sheets (or "white paper" as it is called, whatever its colour) are stored. Adjacent to this are folding, cutting, hot and cold pressing, drying, and other branches, each employing separate classes of artisans. Another department is the machine-room, where, arranged in long rows with an avenue between, are the various printing machines. The men in this part of the establishment wear cotton vestments, covering all their other apparel, and caps, invariably made of paper, something like clerical birettas. The machine overseer has his box and keeps an account of the produce of each machine. Under him are the persons whose business it is to cut out overlays for the cut or illustrated formes. These men are in their way artists, for to them is attributable much of the beauty and perfection of working of each block that goes through their hands. They have by them three or four prints or "pulls" of the block, and their tools consist of scissors, paste, a sharp knife or two, and perhaps a razor-like blade set in a wooden handle. Their work is to deepen the shadows, raise the lights, lower the edges, and perform a hundred other offices for a block. Standing sentry over each machine is the machine minder; under him are the takers-off and layers-on. The engine-room and boiler-house are close by, and higher up may be the hand-press-room,—provided these appliances are used. Here are the pressmen and their apprentices. There is the storekeeper's department, fitted up with shelves, racks, and drawers, for the orderly storage of type and materials. The plate-safe or plate-room is the repository of the stereo and electro plates, each plate being kept wrapped up in paper, with a distinctive index number marked thereon. There are also rooms for casting rollers, stereotyping rooms, drying rooms for paper, hydraulic pressing rooms, sinks for washing formes, and lifts for conveying them from one department to another. There will possibly be several composing-rooms, such as the *'stab*, where all the men are paid on established weekly wages, the piece room, where they are paid by results, and the apprentices' room. There may be rooms where particular jobs are done, especially if weekly periodicals are turned out, and the names of these designate the rooms. At the end of each room is the overseer. It is also a common practice for a number of men to form themselves into a kind of business partnership called a *companionship* or *'ship*. All the transactions of the compositor may be with his own *clicker*,—the workman who is selected to keep the accounts of the partnership. From him the compositor receives his portion of copy and the necessary directions, and to him he gives the matter when it is composed. At the end of the week he "writes his bill," delivers it to the clicker, and from the latter receives at pay time the wages he has earned. The clicker gets the matter proved or "pulled" by the proof-puller, who usually does nothing else but pull proofs. He will then send the proof with the copy to the overseer, and the overseer sends it to the reading department to be corrected. The proof, when corrected, is returned through the overseer (who retains the copy) to the clicker, and he gives it to the compositor who set it up. When the type is corrected a revise is pulled, which goes through the same hands to the overseer again; and then it is despatched to the author, editor, or publisher. In a well-ordered composing-room strict silence is enjoined upon the workmen. Among the industrial pursuits there is none more monotonous and more exacting, none demanding more patience, sustained industry, and power of endurance than the compositor's art. In a large newspaper office the quantity of types picked up in a few hours is marvellous. No better illustration of this could be given than the fact that several recent issues of the *Times* have consisted of three sheets or twenty-four pages, each page comprising six columns. In one of these issues 84¾ of the 144 columns were filled with advertisements, 2559 in number, set in extremely small type; the remaining 59¼ columns contained articles, reviews, letters, reports, and paragraphs. The total length of the column aggregate was 264 feet (62 more than the height of the London Monument). If the matter comprised in the paper, instead of being broken up into columns, had been set in one continuous line it would have reached one mile 950 yards. The number of separate types used in printing this issue was calculated at over two millions, and the quantity of printed matter was reckoned to be equivalent to that contained in two octavo volumes of 480 pages each. The literary and mechanical staff of a first-rate London daily newspaper, excluding casual reporters and unattached writers on various subjects, aggregates about 300 persons.

Bibliography.—On the practice of the art and its auxiliary processes, see Southward, *Dictionary of Typography* (3d ed., London, 1875, 8vo; with the *Literary Almanack* by William Blades), and *Practical Printing: a Handbook of the Art of Typography* (3d ed., London, 1887, 2 vols., 8vo). This last is the fullest work on the subject in the English language, embracing composition, press work, stereotyping, and electrotyping, and the warehouse department of a printing office. Gould's *Letterpress Printer* (2d ed., Middlesborough, 1880, 12mo) has a short introduction by Southward, giving a sketch of the origin and progress of the different typographical processes and appliances from the beginning. See also F. J. F. Wilson, *Typographic Printing Machines and Machine Printing* (3d ed., London, 1883, 8vo); *List of Technical Terms relating to Printing Machinery* (London, 1882, 8vo); Noble, *Machine Printing* (London, 1883, 8vo) and *Principles and Practice of Colour Printing* (London, 1881, 8vo); and Wilson, *Stereotyping and Electrotyping* (London, 1880, 8vo). This last contains a history of stereotyping and electrotyping by Southward. The best works in French are—Lefèvre, *Guide Pratique du Compositeur et de l'Imprimeur* (Paris, 1855-72, 8vo, two parts; includes machine work, stereotyping, and electrotyping); Claye, *Manuel de l'Apprenti Compositeur* (3d ed., 12mo, Paris, 1883); and Monet, *Les Machines et Appareils Typographiques, suivi des Procédés d'Impression* (Paris, 1879, 8vo). The best German work, and one which from its completeness supersedes all others, is Waldow's *Illustrierte Encyklopädie der graphischen Künste* (Leipsic, 1884, lar. 8vo), containing 2798 articles and 581 illustrations, with a list of German books on typography, &c.

Periodicals.—No trade or interest in the world has, perhaps, so many representatives in the press as printing. The journals which record its progress and describe its products are unrivalled in their excellent mechanical attributes, some equalling the highest class of book-work printing and using paper of the most luxurious description. Their literary character is usually worthy of their mechanical excellence, and they comprise an immense collection of facts and speculations on the subjects involved. They also attract a class of writers who in time become specialists and do the most valuable work in historical investigation. The *Printers' Register* (monthly), begun in 1863, the oldest of the English printing trade journals, contains several valuable contributions by Mr William Blades, the biographer of Caxton, such as "Numismata Typographica," "Bibliotheca Typographica," "Books and their Enemies," "The Inventor of the Steam Printing Press," and "Early Type Specimen Books." The *Paper and Printing Trades Journal* (quarterly), begun in 1872, is printed in old style fashion, and reproduces in tone as well as in manner some of the best examples of the French and Italian schools in head and tail pieces, vignettes, and ornamental initials. In France appear *L'Imprimerie* (semi-monthly) and the *Bulletin de l'Imprimerie*; in Germany, *Archiv für Buchdruckerkunst* (monthly) and *Journal für Buchdruckerkunst*; in Italy *L'Arte della Stampa*. The United States has the *Inland Printer* (Chicago) and the *American Bookmaker* (New York). The fullest list of such journals, past and present, is Louis Mohr's *Die periodische Fachpresse der Typographie* (Strasburg, 1879). There is also an extended list, with historical annotations, in Bigmore and Wyman's *Bibliography of Printing*. (J. SO.)

TYR. See ÆSIR, vol. i. p. 211.

TYRE, the ancient צר, Greek Τύρος, the most famous of Phœnician cities, is now represented by the petty town of Súr, with about 5000 inhabitants, built round the harbour at the north end of a peninsula, which till the time of Alexander's siege was an island. The mole which he constructed to reach the island city has been widened by deposits of sand, so that the ancient island is now connected with the mainland by a tongue of land a quarter of a mile broad. The greatest length of the former island, from north to south, is about ⅞ of a mile and its area about 142 acres, a small surface for so important a town. The researches of Renan seem to have completely refuted the once popular idea that a great part of the original island has disappeared by natural convulsions, though he believes that the remains of a line of submerged wall at the south end indicate that about 15 acres more were once reclaimed from the sea and have been again lost. Confined to this narrow site—on which, moreover, place was found for the great temple of Melkarth with its courts and for all the necessities of a vast trade, for docks and warehouses, and for the great purple factories which in the Roman time were the chief source of wealth and made the town an unpleasant place of residence (Strabo, xvi. 2, 23; Pliny, v. 76)—Tyre was very closely built; Strabo tells us that the many-storied houses were loftier than those of Rome. In the Roman period the population overflowed its bounds and occupied a strip of the opposite mainland, including the ancient Palætyrus. Pliny gives to the whole city, continental and insular, a compass of 19 Roman miles; but this account must be received with caution. In Strabo's time the island was still the city, and Palætyrus on the mainland was 30 stadia off, while modern research indicates an extensive line of suburbs rather than one mainland city that can be definitely identified with Palætyrus. The ancient history of Tyre has been dealt with in the article Phœnicia; the topography is still obscure owing to the paucity of Phœnician remains. The present harbour is certainly the Sidonian port, though it is not so large as it once was; the other ancient harbour (the Egyptian port) has disappeared, and is supposed by Renan to have lain on the other side of the island, and to be now absorbed in the isthmus. The most important ruins are those of the cathedral, with its magnificent monolith columns of rose-coloured granite, now prostrate. The present building is assigned by De Vogüé to the second half of the 12th century, but the columns must be older and may have belonged to the 4th-century church of Paulinus (Euseb., *H. E.*, x. 4). The water supply of ancient Tyre came from the powerful springs of Rás al-'Ain on the mainland, one hour south of the city, where there are still remarkable reservoirs, in connexion with which curious revivals of Adonis worship have been observed by Volney and other travellers. Tyre was still an important city and almost impregnable fortress under the Arab empire. From 1124 to 1291 it was a stronghold of the crusaders, and Saladin himself besieged it in vain. After the fall of Acre the Christians deserted the place, which was then destroyed by the Moslems. The present town has arisen since the Metâwila occupied the district in 1766.

TYROL, a province of Austria, with the title of "county," lies between 10° 10′ and 13° E. long. and 45° 40′ and 47° 45′ N. lat., and is conterminous on the north-west with the Austrian province of Vorarlberg, on the north with Bavaria, on the east with Salzburg and Carinthia, on the south-east and south-west with Italy, and on the west with Switzerland. The last-named country forms in the lower Engadine an angle penetrating deeply into Tyrol. The country is entirely mountainous, being traversed by the main chain of the Alps It may be roughly divided into the valley systems of the Lech and the Inn to the north of the chain and of the Etsch or Adige (Vintschgau) and the upper Drave (Puster valley) to the south (see Alps). Its area is 10,316 square miles; its population in 1880 was 805,176, inclusive of military, showing an increase of nearly 4 per cent. since 1869. Of these 432,062 spoke German, 360,975 Italian or some Romance dialect, and the remainder some form of Slavonic; 565,468 persons were able to read and write, 56,728 to read only, leaving about 22¾ per cent. of the total population, including children, wholly illiterate. Education is strictly compulsory; but the schools are for the most part closed during the summer months, when all available hands are required in the fields and on the mountain pastures. Agriculture and forestry occupy about two-thirds of the entire population. Every householder owns a piece of cultivable land in the valley, while his goats, sheep, or cattle are driven with those of his neighbours to the mountain pastures (*Alpen*, *Almen*) which belong to the commune. Each commune has a president chosen by an elected committee of householders. The man selected cannot decline, but is bound to serve his term of office. The tenure of property is for the most part of the nature of absolute ownership. In 1880 100,393 persons of both sexes were returned as proprietors, 10,283 as tenants. The chief products are milk, butter, and cheese. Of grain-crops maize, which is largely grown in the Inn valley and Vintschgau, holds the first place. Wheat is grown in the lower valleys, barley and rye in the higher, the latter in favourable spots to a height of over 5000 feet. Potatoes are found above 6000 feet. In the Etsch valley, or district about Meran and Botzen, red and white wine of excellent quality is produced (in 1884 about 6,500,000 gallons). Of late years the cultivation of fruit has much developed, especially in south Tyrol. Silk is also produced (in 1885 1268 tons of cocoons). Game is still plentiful in the remoter valleys. In every district there are a certain number of licensed hunters, the principal game being red deer, chamois, hares, blackcock, ptarmigan, &c. Mining occupies about one-fifth of the population. At Hall near Innsbruck are important salt works, and at Brixlegg in the same valley copper and lead are smelted. Iron is worked at Fulpmes in the Stubai valley and at Prad in the Vintschgau. Zinc is found at the head of the Passeir valley. In the Middle Ages gold and silver were found in sufficient quantities to make it worth while to extract them. About 4340 square miles of the country are covered with forest, chiefly pine, fir, and larch, which, however, is felled in a recklessly wasteful way. The capital of the county is Innsbruck (*q.v.*).

The general average of comfort in Tyrol is high, and the cost of living is very moderate. The peasant and his family are clothed in stuffs spun and woven at home, from the wool and flax produced in their own neighbourhood. The people are for the most part somewhat reserved in manner, but courteous and hospitable. The savage fights which used to be a favourite pastime among the younger men are now almost, or quite, a thing of the past. In some valleys there is a good deal of musical talent; and companies of Tyrolese singers, particularly from the Ziller valley, travel about all over Germany. The zither is a favourite instrument, especially in the southern valleys; in the northern the guitar is more frequent. The religion is almost exclusively Roman Catholic; but in Innsbruck there are some hundreds of Protestants. The priests belong chiefly to the peasant class, and receive their education at Brixen and the university of Innsbruck. This contains about 600 students in the various faculties and possesses a library of some 60,000 volumes. There is a diet, or landtag, with its seat at Innsbruck, consisting of thirty-four representatives of the peasants, thirteen of the citizens, four of the prelates, ten of the nobles, three of the chambers of commerce at Innsbruck, Botzen, and Roveredo, and one of the university of Innsbruck. To the imperial reichsrath Tyrol sends eighteen members. Tyrol is garrisoned by troops recruited exclusively in Tyrol and Vorarlberg, and never, except in time of war, employed outside these provinces. Besides this there are the landwehr and the landsturm or militia.

History.—The country corresponding to modern Tyrol first appears in history when the Rhætians were subdued by Drusus and Tiberius. This nation, by some held to have been cognate with the Etruscans, occupied the valleys from the source of the Rhine to that of the Drave. To the north of them were the Vindelici, and to the east the Norici; the former were apparently separated from them by the ridges north of the Inn, the latter by the watershed between the Etsch and the Drave. Pliny (*N. H.*, iii. 24) gives the names of all the tribes. After their subjection by Rome these races became Romanized and shared the fortunes of the empire. Their position on and about the roads by which the central Alps are most easily crossed laid them especially open to inroads, and before the end of the 3d century the Alemanni had traversed the country. In the course of the next three centuries this people settled in the north-western valleys. But the peopling of the greater part of the province by Teutons was effected by the Baiuvarii, who were by the year 600 established throughout nearly the entire remainder of German Tyrol, some of the Romanized Rhætians probably being left, mixed with a few Alemannic stragglers, in the upper Vintschgau, while the Lombards pressed up from the southward and took possession of the district around Trent. The Alemanni and Baiuvarii, governed immediately by their own dukes, owned a kind of allegiance to the kings of the Franks, and ultimately became in the time of Pippin and Charles incorporated in the Frankish monarchy. The country was then divided for administrative purposes into counties (*comitatus*, *Grafschaften*), under counts, whose rank, at first merely official, in course of time became, with their office, hereditary. The most powerful among them appear to have been those of the Vintschgau, where a fertile soil and a climate less rigorous than that of the northern valleys allowed more development of wealth. In the 12th century the counts of Tirol begin to be conspicuous. This was a small district near Meran, taking its name from the ancient castle of Tirol, known in the later Roman time as Teriolis. These, in the course of the next century, acquired the lordship over nearly all the territory now contained in the province of Tyrol south of the main chain of the Alps, besides the advocacy (*Schirmvogtei*) of the wealthy sees of Brixen and Trent. Meantime the valley of the Inn and those adjoining it had come under the dominion of the counts of Andechs, a Bavarian family, who were also titular counts of Meran. The last of these died without issue in 1248. His wife's sister, Adelaide, married to Meinhard, count of Görz, was left in sole possession of nearly the whole of the province. Their son Meinhard II. (1257-1295) was connected with some of the most powerful houses in Germany; and, being a man of great ability and equal unscrupulousness, he succeeded in acquiring the few outlying portions of territory and castles still belonging to the smaller nobles, and thus consolidated Tyrol within the limits by which it has ever since been bounded. Carinthia and Styria also formed part of his domains; but their connexion with Tyrol has never been other than a personal one. Meinhard II. was succeeded in turn by his sons Otho and Henry. The latter (1310-1335), a weak and extravagant prince, seems to have done much towards organizing the government of the country. His elder daughter Margaret, known in Tyrolese history and legend as *Die Maultasche*, "the Pocket-mouth," the heiress of his territories, took as her second husband (in 1342) Louis of Brandenburg. Their son Meinhard III., who succeeded to the county on his father's death in 1361, died in 1363. Margaret thereupon made over all her possessions to the house of Hapsburg, and since that time Tyrol has formed part of the hereditary dominions of the archdukes of Austria (see AUSTRIA). The fidelity of the Tyrolese to their counts has for many centuries been proverbial. The Brenner has more than once offered them a secure line of retreat and the mountains a rampart of defence. Maximilian I. (1493-1519) had an especial affection for Tyrol. He conferred on the province its present title of *Die gefürstete Grafschaft*; he profited on more than one occasion by the refuge it afforded; he spent much of his time within it; and at his death he directed that a sumptuous monument to himself should be erected in the Franciscans' church at Innsbruck. Tyrol has more than once been the scene of sharp fighting. In 1499 the men of Graubunden or the Grisons (see SWITZERLAND) invaded the country and defeated the Tyrolese in the neighbourhood of Mals. In 1703 Max Emmanuel, elector of Bavaria, penetrated the upper Inn valley, but was driven back. During the wars of the French Revolution French and Austrian armies met more than once within the limits of the province. By the treaty of Pressburg, 1805, the province was transferred to Bavaria. On the renewal of war between Bonaparte and Austria in 1809 the people rose and expelled the Bavarians, and afterwards, under the leadership of Andrew Hofer, an innkeeper of the Passeir valley, repeatedly defeated the French, Bavarian, and Saxon forces. Innsbruck was more than once taken and retaken; and on 12th August Hofer, after defeating Marshal Lefebvre, was installed in the capital as commandant. But the ill-success of the Austrian arms elsewhere prevented any support from being sent, and by the treaty of Schönbrunn in October the Tyrolese were again given up to their new rulers. Hofer, being captured through treachery, was shot at Mantua, 20th February 1810. On the fall of Bonaparte, Tyrol reverted to the house of Hapsburg.

See A. Jäger, *Die Verfassung Tirols*, Innsbruck, 1881-85; Egger, *Die Tiroler und Vorarlberger*, Innsbruck, 1872-79; Steub, *Drei Sommer in Tirol*, Stuttgart, 1871 (2d ed.). (A. J. B.)

TYRONE, an inland county of Ireland, in the province of Ulster, is bounded N. and W. by Donegal, N.E. by Londonderry, E. by Lough Neagh and Armagh, and S. by Monaghan and Fermanagh. Its greatest length from north to south is 46 miles and from east to west 60. The total area in 1881 was 806,658 acres or about 1260 square miles. The surface is for the most part hilly, rising into mountains towards the north and south, but eastwards towards Lough Neagh it declines into a level plain. Running along the north-eastern boundary with Londonderry are the ridges of the Sperrin Mountains (Sawell 2236 feet and Meenard 2064 feet). Farther south there are a range of lower hills and Mullaghearn, to the north of Omagh (1890 feet). South of Clogher a range of hills (1265 feet) forms the boundary between Tyrone and Monaghan. On each side of the Mourne river near Omagh rise the two picturesque hills Bessy Bell and Mary Gray. The Foyle forms a small portion of the western boundary of the county, and receives the Mourne, which flows northward by Omagh and Newtown Stewart. The principal tributaries of the Mourne are the Derg, from Lough Derg, and the Owenkillew, flowing westward from Fir Mountain. The Blackwater, which is navigable by boats to Moy, rises near Five-Mile Town, and forms part of the south-eastern boundary of the county with Monaghan and Armagh. With the exception of Lough Neagh, bounding the county on the east, the lakes are small, also few in number. Lough Fea is picturesquely situated in the north-west, and there are several small lakes near Newtown Stewart. The Ulster Canal runs along the southern boundary of the county from Lough Neagh to Caledon. The substratum of the northern mountains is mica slate interspersed with primary limestone. Yellow sandstone appears in the north-west, in the centre towards Omagh, and in the south-west, where it plunges into Fermanagh. The greater portion of the central area of the county is occupied by Old Red Sandstone. The Tyrone coal-field (6 miles long by 1 to 2 broad) extends between Lough Neagh and Dungannon, all the measures being represented. The coal-field is much broken by faults and has been worked chiefly near the surface, and generally in an unskilful manner; the principal pits are near Dungannon and at Coal Island. The coal is bituminous. There are also indications of copper, iron, and lead.

Agriculture.—The hilly portions of the county are unsuitable for tillage; but in the lower districts the soil is remarkably fertile, and agriculture is generally practised after improved methods, the county in this respect being in advance of most parts of Ireland. The excellent pasturage of the hilly districts affords sustenance to a large number of young cattle. The total number of holdings in 1885 was 27,958, of which 16,469 or nearly two-thirds were each between 5 and 30 acres in extent (8365 between 5 and 15 and 8104 between 15 and 30). Only 43 were above 500 acres; 642 were between 100 and 500 acres, 2373 between 50 and 100, 3937 between 30 and 50, 2573 between 1 and 5, and 1921 did not exceed 1 acre. There were 237,528 acres under crops, including meadow and clover (255,281 acres in 1876), 318,550 acres under grass, 1765 fallow, 9378 woods, 72,071 bog and marsh, 109,539 barren mountain land, and 30,112 water, roads, fences, &c. The area under corn crops decreased between 1876 and 1885 from 115,738 acres to 105,343,—oats from 114,223 acres to 104,040, and wheat from 1166 to 1013. The areas under the other corn crops are very small and fluctuate considerably. The area under green crops between 1876 and 1885 decreased from 64,971 to 59,387 acres,—potatoes from 44,001 to 40,649, turnips from 17,157 to 15,581, mangel wurzel from 750 to 487, and other green crops from 3063 to 2670. Flax (23,901 acres in 1876) covered 16,364 acres in 1885. The area under meadow and clover in 1876 was 50,671, and in 1885 56,434, but there has been no increase since 1878. The number of horses decreased between 1876 and 1885 from 25,038 to 23,185, of mules from 71 to 49, of asses from 1124 to 921, of cattle from 176,841 to 168,072, of sheep from 45,274 to 44,434, and of pigs from 49,012 to 39,530. On the other hand, the number of goats increased from 7950 to 8984, and of poultry from 674,826 to 737,859.

According to the latest landowner's *Return* (1876), the county was divided among 2787 proprietors owning 775,285 acres at a total annual value of £426,224, the average value per acre being nearly

11a. Of the proprietors 1070 owned less than 1 acre each, the total distributed amongst them being 272 acres. The estimated extent of waste land was 4000 acres. The following possessed over 10,000 acres each—duke of Abercorn 47,615 acres, earl of Castlestuart 32,615, earl of Caledon 29,236, commissioners of church temporalities 28,002, Sir John M. Stewart 27,906, Arthur W. Cole Hamilton 16,683, representatives of Sir William M'Mahon 16,326, Sir William Verner 16,043, earl of Belmore 14,359, Thomas Arthur Hope 13,996, Lord Dorchester 12,608, Michael Smith 10,968, Louisa Elizabeth De Bille 10,455, and Thomas R. Browne 10,125.

Communication.—Besides Lough Neagh and the Ulster Canal, Tyrone has the river Foyle, which is navigable for small craft to a point opposite St Johnstone, and thence by artificial cutting to Strabane, and the Blackwater, which is navigable for boats to Moy. The Great Northern Railway intersects the county by Dungannon, Pomeroy, Omagh, Newtown Stewart, and Strabane.

Manufactures.—The manufacture of linens and coarse woollens (including blankets) is carried on. Brown earthenware, chemicals, whisky, soap, and candles are also made. There are a few breweries and distilleries, and several flour and meal mills. But for the lack of enterprise the coal and iron might aid in the development of a considerable manufacturing industry.

Administration and Population.—The county comprises 8 baronies, 46 parishes, and 2164 townlands. Formerly it returned two members to parliament, the borough of Dungannon also returning one; but in 1885 Dungannon was disfranchised and the county arranged in four divisions—east, mid, north, and south—each returning one member. It is in the north-western circuit, and assizes are held at Omagh and quarter-sessions at Clogher, Dungannon, Omagh, and Strabane. There are fourteen petty sessions districts within the county and portions of four others. The county is in the Belfast military district.

From 312,956 in 1841 the population had decreased by 1861 to 238,500, by 1871 to 215,766, and by 1881 to 197,719 (96,466 males and 101,253 females). In 1881 there were 109,793 Roman Catholics (119,937 in 1871), 44,256 Protestant Episcopalians (49,201 in 1871), 38,564 Presbyterians (42,156 in 1871), 3597 Methodists (3115 in 1871), and 1509 of other denominations (1357 in 1871). The number of persons in the county who could read and write in 1881 was 98,764, who could read only 38,783, the remainder (60,172) being wholly illiterate. Twenty-two persons could speak Irish only and 9796 Irish and English. For the seven years ending 1885 the average number of emigrants annually was 3085. The population of the principal towns in 1881 was—Strabane 4196, Omagh (the county town) 4138, Dungannon 4084, and Cookstown 3870.

History and Antiquities.—Anciently Tyrone was included in the portion of Ulster made "sword-land" by the Scots. It became a principality of one of the sons of Níall of the Nine Hostages, and from his name—Eogain—was called Tir Eogain, gradually altered to Tyrone. From Eogain were descended the O'Neals or O'Neills and their numerous septs. The family had their chief seat at Dungannon until the reign of Elizabeth, when it was burned by Hugh O'Neill to prevent it falling into the hands of Lord Mountjoy. The earldom of Tyrone had been conferred on Con Bacagh O'Neill by Henry VIII., but he was driven into the Pale by one of his sons Shan, who with the general consent of the people was then proclaimed chief. From this time he maintained a contest with English authority, but his last remaining forces were completely defeated near the river Foyle in May 1567. During the insurrection of 1641 Charlemont Fort and Dungannon were captured by Sir Phelim O'Neill, and in 1645 the Parliamentary forces under General Munro were signally defeated by Owen Roe O'Neill at Benburb. At the Revolution the county was for a long time in the possession of the forces of James II. Dungannon was the scene of the famous volunteer convention in 1782. Raths are scattered over every district of the county. There is a large cromlech near Newtown Stewart, another at Tarnlaght near Coagh, and another a mile above Castlederg. At Kilmeillie near Dungannon are two circles of stones. The monastic remains are of comparatively little interest. There are still some ruins of the ancient castle of the O'Neills, near Benburb, and among other ruined old castles mention may be made of those of Newtown Stewart, Dungannon, Strabane, and Ballygawley.

TYRTÆUS, Greek elegiac poet, lived at Sparta about the middle of the 7th century B.C. According to the legend current in later times, he was a native of the Attic deme of Aphidnæ, and was invited to Sparta, on the suggestion of the Delphic oracle, to assist the Spartans in the Second Messenian War. It is difficult, if not impossible, to determine the element of truth in this story. Herodotus at least either did not know, or disbelieved, the tradition, which meets us first in Plato (*Laws*, i. 629A), to the effect that, although Tyrtæus was by birth an Athenian, he had the Spartan citizenship conferred upon him (see Herod., ix. 35). From Plato down to Pausanias we can trace the gradual growth and expansion of the legend. Ephorus is the first to call Tyrtæus a lame poet; by later generations he is represented as a lame schoolmaster. Basing his inference on the ground that Tyrtæus speaks of himself as a citizen of Sparta (*Fr.* 2 v. 3), Strabo (viii. 4, 10) was inclined to reject the story of his Athenian origin, regarding the elegies in question as spurious. On the whole, perhaps, the conjecture of Busolt (*Gr. Gesch.*, p. 166) comes nearest to the truth: the entire legend may well have been concocted during the 5th century in connexion with the expedition sent to the assistance of Sparta in her struggle with the revolted Helots at Ithome. It is possible, as Busolt suggests, that Tyrtæus was in reality a native of Aphidna in Laconia. However this may be, it is certain from the fragments of his poems that he flourished during the Second Messenian War (*circ.* 650 B.C.)—a period of remarkable musical and poetical activity at Sparta (see TERPANDER)—that he not only wrote poetry but took part in the actual service of the field, and that he endeavoured to compose the internal dissensions of Sparta by inspiring the citizens with a patriotic love for their fatherland and its institutions.

We possess in all about twelve fragments of Tyrtæus's poetry, varying in length from one to forty-four lines. They are preserved by Strabo, Lycurgus, Stobæus, and others. We may divide them into two varieties, according to the metre and dialect in which they are composed. The first class consists of elegies in the Ionic dialect, written partly in praise of the Spartan constitution and King Theopompus (Εὐνομία), partly to stimulate the Spartan soldiers to deeds of heroism in the field Ὑποθῆκαι—the title is, however, later than Tyrtæus). The interest of the fragments preserved from the Εὐνομία is mainly historical: they form our only trustworthy authority for the events of the First Messenian War (*Fr.* 5, 6, 7). The Ὑποθῆκαι possess considerable poetic merit, in spite of the occasional monotony of their versification. Addressed to a nation of warriors, they paint in vivid colours the beauty of bravery and the shame of cowardice; there are also lines in them which reveal the soldier as well as the poet, *e.g.*, *Fr.* 10, 31-32. One striking feature is the genuinely Greek feeling for plastic beauty, showing itself in the beautiful picture of the youthful form lying dead upon the battle-field (*Fr.* 10, 27-30, and 12, 23-34; see also Symonds's *Greek Poets*, i. p. 74). The popularity of these elegies in the Spartan army was such that, according to Athenæus (xiv. 630 F), it became the custom for the soldiers to sing them round the camp fires at night, the polemarch rewarding the best singer with a piece of flesh. Of the second class of Tyrtæus's poems, marching songs, written in the anapæstic measure and the Dorian dialect, the remains are too scanty to allow of our pronouncing a judgment on their poetic merit.

See Bergk, *Poetæ Lyrici Græci*, vol. ii. pp. 8-22, Leipsic, 1882. Fragment 10 (τεθνάμεναι γὰρ καλὸν, &c.) has been translated into English verse by Campbell.

TYTLER. The surname of three Scottish writers, principally on historical subjects.

1. ALEXANDER FRASER TYTLER (1747-1813), Lord Woodhouselee, Scottish judge, was the eldest son of William Tytler (see below), and was born at Edinburgh on 15th October 1747. After passing through the High School, he was sent in 1763 to a school at Kensington taught by Dr Elphinston, the translator of Martial's *Epigrams*. He returned to Edinburgh in 1765, skilled in Latin versification, and with a competent knowledge of Italian, and a taste for drawing and natural history. He was called to the bar in 1770. His first work, a supplement to the *Dictionary of Decisions*, undertaken on the suggestion of

Lord Kames, was published in 1778, and a continuation appeared in 1796. In 1780 Tytler was appointed conjoint professor of universal history in the university of Edinburgh, becoming sole professor in 1786. In 1782 he published *Outlines* of his course of lectures, afterwards extended and republished under the title of *Elements of General History*. The *Elements* has passed through many editions, and has been translated into several European languages as well as into Hindustani. The lectures themselves were published in 1834 in Murray's *Family Library*. In 1790 Tytler was appointed judge-advocate of Scotland, and while holding this office he wrote a *Treatise on the Law of Courts-Martial*. In 1801 he was raised to the bench, taking his seat (1802) in the court of session as Lord Woodhouselee. He died at Edinburgh on 5th January 1813.

Besides the works already mentioned, he was the author of several papers in the *Mirror*, the *Lounger*, and the *Transactions of the Royal Society of Edinburgh*; he also wrote *Life and Writings of Dr John Gregory*; *Essay on the Principles of Translation*, 1790; a dissertation on *Final Causes*, prefixed to his edition of Derham's *Physico-Theology*, 1799; a political pamphlet entitled *Ireland profiting by Example*, 1799; an *Essay* on Laura and Petrarch; and *The Life and Writings of Henry Home, Lord Kames*, 1807.

2. **Patrick Fraser Tytler** (1791-1849), as the son of Lord Woodhouselee and grandson of William Tytler, may be said to have inherited a taste for literary and historical pursuits. He was born at Edinburgh on 30th August 1791, and was educated chiefly at the High School and university, being called to the bar in 1813. His earliest literary effort appears to have been a chapter or two contributed to Alison's *Travels in France* (1815); and his first independent essays were papers in *Blackwood's Magazine*. Inheriting the family talent for music, and with a facility in throwing off humorous little poems and songs, he made several contributions to Thomson's *Select Melodies of Scotland*, 1824. In 1819 he published the *Life of James Crichton of Cluny, commonly called the Admirable Crichton*, a second edition appearing in 1823. This was followed by a *Memoir of Sir Thomas Craig of Riccarton*, 1823; an *Essay on the Revival of Greek Literature in Italy*, and a *Life of John Wickliff*, published anonymously, in 1826. The *History of Scotland* was undertaken at the suggestion of Sir Walter Scott, and occupied Tytler for nearly twenty years, in the course of which he removed to London for convenience of research. The first volume appeared in 1828, and the ninth and last in 1843. The original investigations on which the work was founded gave it an authority which no previous history of Scotland possessed, and the clear and graphic style made it interesting and popular. The last few years of his life were spent in physical prostration and mental depression, and he died at Great Malvern on 24th December 1849.

During the progress of his *History* a large amount of other work came from his pen, as the following list shows:—*Lives of Scottish Worthies*, for Murray's *Family Library*, 3 vols., 1831-33; *Historical View of the Progress of Discovery in America*, 1832, and *Life of Sir Walter Raleigh*, 1833, for the *Edinburgh Cabinet Library*; *Life of Henry VIII.*, 1837; *England under the Reigns of Edward VI. and Mary*, from original letters, 2 vols., 1839; article "Scotland" in the seventh edition of the *Encyclopædia Britannica* (afterwards published separately as a school history); *Notes on The Darnley Jewel*, 1843; on the *Portraits of Mary Queen of Scots*, 1845 (privately printed); and *Memoirs of the War carried on in Scotland and Ireland, 1689-91, by General Mackay*, edited in conjunction with Hog and Urquhart, and presented to the Bannatyne and Maitland Clubs in 1833.

3. **William Tytler** (1711-1792), of Woodhouselee, writer on historical and antiquarian subjects, was the son of Alexander Tytler, writer in Edinburgh, and was born in that city on 12th October 1711. He was educated at the High School and the university, and, having adopted his father's profession, was in 1744 admitted into the society of Writers to the Signet. While successfully practising as a lawyer, he found time to devote attention to historical investigation. In 1759 he published an *Inquiry, Historical and Critical, into the Evidence against Mary Queen of Scots, and an Examination of the Histories of Dr Robertson and Mr Hume with respect to that Evidence*. This work, which warmly defended the character of the queen, met with great success. Four editions, the later ones considerably enlarged, were published in the author's lifetime; and it was translated into French. In 1783 he published the *Poetical Remains of James the First, King of Scotland*, to which he added a dissertation on the life and writings of the royal author. He wrote an essay on "Scottish Music," which was appended to Arnot's *History of Edinburgh*. His "Dissertation on the Marriage of Queen Mary to the Earl of Bothwell" and "Observations on the Vision, a Poem," appeared in the *Transactions of the Society of Antiquaries of Scotland* (1791-92). A paper in the *Lounger*, on "Defects of Modern Female Education," and an *Account of Fashionable Amusements in Edinburgh in the Seventeenth Century* complete the list of his works. He died at Edinburgh on 12th September 1792.

TYUMEÑ, a district town of West Siberia, in the government of Tobolsk, is situated at a point where the chief highway from Russia across the Urals touches the first navigable river (the Tura) of Siberia. A railway passing through Ekaterinburg and the principal ironworks on the eastern slopes of the middle Urals connects Tyumeñ with Perm, the terminus of steamboat traffic on the Kama and Volga. The Tura being a tributary of the Tobol, which joins the Irtish, a tributary of the Ob, Tyumeñ has regular steam communication with Omsk and Semipalatinsk by the Irtish (steamers penetrating as far as Lake Zaisan in Dzungaria); with Tomsk, Barnaul, and Biysk, in the Altai, by the Ob and the Tom; with Irbit—the seat of the great Siberian fair—by the Tura and the Nitsa; and by the Tobol, the Irtish, and the Ob with the Arctic Ocean and the fisheries of the lower Ob. Tyumeñ stands also at the western extremity of the Siberian highway which goes *via* Omsk, Tomsk, and Krasnoyarsk to Irkutsk. In summer the Tura sometimes falls so low that steamers have to stop 90 miles off, passengers and goods being taken thence to Tyumeñ in lighter vessels. The town is well built, and stands on both banks of the Tura, which is here spanned by a bridge. The portion on the low left bank is inhabited by the poorest class and is often inundated; the best houses are on the high right bank. The streets are unpaved, but the houses (principally wooden) are for the most part inclosed by gardens. The people, who are famed throughout Siberia for their good looks, have always been renowned for their industrial skill. Woollen cloth, linen, belts, and especially boots and gloves, are manufactured to a large amount (70,000 pairs of boots and 300,000 pairs of gloves annually). Tyumeñ carpets, although made in the simplest way and with the plainest tools, have a wide renown in Russia and Siberia, and recently have appeared in the markets of western Europe as of Oriental origin. All kinds of metal wares are made in small workshops. Sheepskins and various kinds of cloth are extensively manufactured, and the leather prepared at the tanneries (100 in number) is extensively sold all over Siberia, the Kirghiz steppe, and Bokhara. An establishment has recently been opened for the construction of barges, and a paper-mill, the first in Siberia, was opened in 1886. The trade of Tyumeñ is exceeded only by that of Irkutsk and of Tomsk. In addition to its primary schools Tyumeñ has a "real" school. The population, which is of a fluctuating character in summer, is differently estimated at 13,000, 14,500, and 18,000.

TZARSKOYE SELO. See Tsarskoye Selo.

TZETZES, Joannes, a voluminous Byzantine writer of the 12th century. See Greece, vol. xi. p. 145 *sq.*

U

U holds the twenty-first place in our alphabet. The corresponding place in the Greek alphabets was occupied by Y (with some slight variations of form). The form in the Italian alphabets was generally V. These three are only modifications of one original; but they are independent symbols with us, though Y does not represent any sound otherwise unrepresented. It will be most convenient to describe the three forms once for all.

With T we reach the end of the original Phœnician alphabet. The remaining symbols—no fewer than six with us, four in the completed Latin alphabet—are accretions, either modifications of old symbols for greater exactness or old symbols themselves which had fallen out of their proper place and were added again. The first new symbol was needed to represent the important vowel sound *u*. We have already seen that the Greeks employed the Phœnician symbols for the breaths which they did not want as symbols for the vowels which they did want. Thus we should have expected that the Phœnician vau would have been used for *u*. But vau was already employed for *w*, which was a living sound in early Greek; the form used was F (the so-called digamma), the origin of our F. What then was the origin of the symbol for *u*? In the earliest Greek we find the two forms Y and V, *e.g.*, in inscriptions of Thera. Now the Moabite form of vau is Y, which resembles the Y more than F. It is difficult to see why the presumably oldest Phœnician form should appear, not in the sixth place of the Greek alphabet, but at the end, where it must have been an arbitrary addition; and, although the Y form could be derived from F (middle steps are found), it is not easy to get F from Y. We may suppose that the two symbols, F and Y, were obtained by the Greeks from independent Phœnician alphabets, the first being kept by those Greeks who required a symbol for *w*, and did not at first need any special sign to distinguish *u* (which in the earliest Greek times known to us had the value of German *u*) from *o*; while the others took the form Y to express the modified *u*, and probably never really adopted the F, except as a numeral; it does not appear even in the very old Abu Simbel inscription written by the Ionian mercenaries of Psammitichus. It is noteworthy that in that inscription *both* the forms Y and V appear, whereas in those of Thera and Melos we have sometimes the one sometimes the other, but not both in the same inscription, and a study of the writing leads to the conclusion that the Y was felt to be the true (*i.e.*, the older) form, but that V was used more frequently for the sake of simplicity.

At Rome the single form V denoted both the vowel *u* and also the consonantal *w*. F retained its place as sixth in the alphabet, but with the value of *f*, which was unknown to the Greeks; a peculiar form, Ꮖ, in which the middle stroke has gone to the bottom, seems to have been affected by its neighbour E; this is found in Etruscan, Umbrian, and Samnite inscriptions; it has, however, the value of *w*; while a curious symbol 8 appears at the end of the Etruscan alphabet, and is also used in the Eugubine tables, with the value of *f*; the origin of this is uncertain. It may be a rounded form of the second symbol in the digraph FB (*i.e.*, FH) by which the sound F is indicated in a very old inscription (see *Rhein. Mus.*, xlii. 317); if this is so, the Latin alphabet has the first member of the digraph, the Etruscan has the second. Next, the symbol Y was added (together with Z) in the 1st century B.C. to represent more exactly, in borrowed words, the sound of Greek upsilon.

Lastly, the form U was differentiated from V. It is the uncial form, and so belongs to the general transition from the pointed to the rounded character which conduced to greater convenience of writing. Examples of it may be seen in the article on PALÆOGRAPHY; see the specimen of Latin uncial of the 5th or 6th century (vol. xviii. p. 153), and the half-uncial of the Lindisfarne Gospels, about 700 A.D. (*ibid.*, p. 159). It was clearly a matter of convenience to have separate symbols to represent sounds so distinct as *u* and *v*; but the application of the two symbols seems to have been due to chance rather than design. The form V remained in use at the beginning of words, whereas *u*, which was the uncial and cursive form, naturally was used rather in the middle; by degrees the initial form was appropriated to consonants,—perhaps, as Dr Taylor suggests (*Alphabet*, ii. 189), because the consonant is commoner at the beginning of words, or for some other reason, while the medial form was connected with vowels.

The sound which U denotes is produced by "rounding" the lips to the furthest extent consistent with a clear vowel-sound, and by raising the back of the tongue higher than for any other rounded sound. It has two varieties (like all other vowels) according as the position of the tongue is more or less tense, producing thereby a narrower or a wider aperture for the voice to pass through; whence the sounds are technically called "narrow" and "wide" respectively. The narrow sound is heard in English only when the vowel is long, as in "book," "rule," but in northern English (Scotch) "book" may be heard short. The wide sound is heard in "full," "good." The digraph *oo* is commonly used for the *u* sound, and attests the fact that the original sound of *ō* has frequently passed into *ū*, as in "good," "food," &c., written "gode," "fode" in Middle English; sometimes, however, the *oo* has come by analogy into words where *ū* is the original sound, as in "room," M.E. "roum," O.E. "rūm." Original *ū* has commonly passed into the *au* sound, spelt in English *ou* or *ow*, as in "how," "house," "mouse," "bower," for O.E. "hū," "hūs," "mūs," "būr." According to Mr A. J. Ellis, words derived from the French had in Chaucer's time the sound of French *u*; and Sir John Cheke's statement "cum *duke, tuke, lute, rebuke*, δυκ, τυκ, λυτ, ρεβυκ dicimus, Græcum υ sonaremus," seems strong for the same practice in the 16th century. In the 17th century the modern pronunciation of *u* as *iu* in "muse," "duke," "mute," "pure" had come in. Hence also we may explain the substitution of *u* for *y* in some genuine English words, as "busy" (orig. bysig). At the same time begins the corruption of *u* to the (so-called) *ŭ* sound in "but," "shut," &c.; this is not a *u* sound at all, but the neutral vowel as heard indifferently in "but," "sun," "son," "blood"; it is often confounded by writers with the true *ŭ* heard in "pull" and in the northern pronunciation of "but," "shut." For the history of the German "modified" *u* (spelt *ü*, but originally *ue*) see under Y.

UBEDA, a town of Spain, head of an administrative subdivision in the province of Jaen, stands on a gentle slope about 5 miles from the right bank of the Guadalquivir, and about 22 miles to the east of the Menjibar station on the railway from Madrid to Cordova. Under the Moorish rule it was a place of considerable consequence, its population being said to have at one time numbered 70,000. Some portions of the old walls, with towers and gates, still remain, but none of the public buildings are of great age, the oldest church, that of San

Salvador, dating from 1540–56. The population within the municipal boundaries in 1877 was 18,149

UDAIPUR [Oodeypore], or Mewár, a native state in Rajputana, India, with an area of 12,670 square miles. It extends from 23° 49′ to 25° 58′ N. lat., and from 73° 7′ to 75° 52′ E. long., and is bounded on the N. by the British territory of Ajmere; on the E. by the native states of Bundi, Gwalior, Tonk, and Partábgarh; on the S. by Banswára, Dungarpur, and Mahi Kántha; and on the W. by the Aravalli Mountains, separating it from Marwar and Sirohi. The greater part of the country is level plain. A section of the Aravalli Mountains extends over the south-western and southern portions, and is rich in minerals, but the mines have been long closed. The general inclination of the country is from south-west to north-east, the Banas and its numerous feeders flowing from the base of the Aravalli range. There are many lakes and tanks in the state, the finest of which is the Dhebar or Jaisamand, with an area of nearly 21 square miles; it is considered to be the largest sheet of artificial water in the world. There are only two metal roads in the state; the Nimach State Railway passes through the north-eastern part

In 1881 the population, exclusive of 51,076 Bhils, was 1,443,144 (males 772,635, females 670,459); Hindus numbered 1,321,521, Mohammedans 43,322, Jains 78,171, and Christians 130. The only town with over 10,000 inhabitants is Udaipur, the capital (38,214). This city is picturesquely situated on a lake 2000 feet above sea-level, and faces wooded hills. It contains the royal palace, which is a noble pile of granite and marble, built on the crest of a rocky ridge overlooking the lake, city, and valley. There are no manufactures of any importance in the state, and the crops as a rule only suffice for local wants. The principal imports are salt, piece goods, groceries, metals, medicines, sugar, ivory, and tobacco; and the exports are mostly confined to turmeric, gúr, cotton, indigo, til, opium, and cattle. The total income of Udaipur in 1885–86 was £259,624. The state was taken under the protection of the British Government in 1817, and it pays an annual tribute of £20,000. The family of the raja of Udaipur ranks highest in dignity among the Rajput chiefs of India.

UDAL (Danish *odel*) is a kind of right still existing in Orkney and Shetland, and supposed to be a relic of the old allodial mode of landholding existing antecedently to the growth of feudalism in Scotland. The udal tenant holds without charter by uninterrupted possession on payment to the crown, the kirk, or a grantee from the crown of a tribute called scat (Danish *skat*), or without such payment, the latter right being more strictly the udal right. Udal lands descend to all the children equally. They are convertible into feus at the option of the udallers.

UDALL, Nicholas (b. 1505–d. 1556[1]), author of the earliest extant regular English comedy. Udall was a typical man of the Renaissance in England, a schoolmaster by profession, a classical scholar, a translator of Terence and Erasmus, and a writer of pageants and interludes. He was high in favour at court, wrote verses for the city pageant exhibited at Anne Boleyn's coronation in 1533, and was honoured by Mary in 1554 as one that had "heretofore showed and mindeth hereafter to show his diligence in setting forth of dialogues and interludes before us for our regal disport and recreation." The severity of his discipline at Eton, where he was headmaster, has been immortalized by the quaint lines of one of his pupils, Thomas Tusser. The exact history of the production of his comedy *Ralph Royster Doyster* is not known. A printed copy wanting the title-page came to light in 1818, and we know that it was licensed to be printed in 1566. It is a distinct advance in construction on the Merry Interludes of John Heywood, but it is not a comedy in the strict English sense, being, like the interludes, essentially farcical in motive, character, and incident. Although an imitation of the Latin comedy, it is far from being a servile imitation, and abounds in fresh fun and cleverness. It has been twice reprinted,—by the Shakespeare Society (with a memoir by Mr Cooper) and in Arber's Reprints.

UDINE, a town of Italy, in the province of Udine, in a wide plain near the foot of the Carnic Alps, on the Roja, 84 miles by rail north-east from Venice and 49 miles north-west from Trieste. It is enclosed by an imposing wall of considerable antiquity, some 4 or 5 miles in circumference, and fortified with towers. In the centre, on an eminence, stands the old castle, at one time the residence of the patriarchs of Aquileia, and now used as a prison. Grouped around this is the old part of the town, with narrow crooked streets, some of which are lined with arcades. The cathedral, which is a Romanesque building with fine pillars, and an hexagonal tower bearing 14th-century sculptures, contains some interesting examples of native art (by Giovanni Martini da Udine and others). The church of S. Maria della Purità has frescos by Tiepolo. On the principal square stands the town-hall, built in 1457 in the Venetian-Gothic style, and skilfully restored since a fire in 1876; opposite is a clock tower resembling that of the Piazza di San Marco at Venice. The archiepiscopal palace and Museo Civico, as well as the municipal buildings, have some valuable paintings. Several of the palaces of the nobility have striking architectural features, and the town is adorned by many beautiful public walks. The leading industry of Udine is silk-spinning, but it also possesses manufactures of linen, cotton, hats, and paper, tanneries, and sugar refineries, and has a considerable trade. The population in 1881 was 23,254.

Udine is the *Vedinum* of Pliny: it was then a municipium, but quite an inconsiderable place compared with Forum Julii (Cividale) 11 miles to the east, or Aquileia 22 miles to south-south-east. In the Middle Ages it became a flourishing and populous city; in 1238 the patriarch Berthold made it the capital of Friuli (*q.v.*), and in 1420 it became Venetian.

UEBERWEG, Friedrich (1826–1871), best known by his *History of Philosophy*, was born on the 22d January 1826 at Leichlingen, in Rhenish Prussia, where his father was Lutheran pastor. His mother, left early a widow, devoted her scanty means to the education of her only son. Ueberweg passed through the gymnasium at Elberfeld, and studied at the universities of Göttingen and Berlin. In 1852 he qualified himself at Bonn as privat-docent in philosophy. His *System of Logic*, published in 1857 (English translation 1871), and his essay *On the Authenticity and the Order of the Platonic Writings*, crowned by the Imperial Academy of Vienna (published 1861), contributed to draw attention to him as at once a scholar and a thinker. In 1862 he was called to Königsberg as extraordinary professor, and in 1867 he was advanced to the ordinary grade. He married in 1863, and on the 9th June 1871 he died prematurely.

The chief work of his later years was his compendious *History of Philosophy*, which is unmatched for fulness of information combined with conciseness, accuracy, and impartiality of treatment. The first part appeared in 1862. An English translation, in two volumes, was published in 1872, and has gone through several editions. Ueberweg translated, in 1869, Berkeley's *Principles of Human Knowledge*, with notes, for Kirchmann's *Philosophische Bibliothek*. In philosophy Ueberweg was strongly opposed to the subjectivistic tendency of the Kantian system, maintaining in particular the objectivity of space and time, which involved him in a somewhat violent controversy with several opponents. His own mode of thought he preferred to describe as an ideal realism, which refused to reduce reality to thought, but asserted a parallelism between the forms of existence and the forms of knowledge. Beneke and Schleiermacher seem to have exercised most influence upon the development of his thought. A short memoir, by his friend F. A. Lange (author of the *History of Materialism*), gives some account of what may be called personal opinions in philosophy and theology, which did not find expression in Ueberweg's published writings.

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[1] The date of Udall's death is sometimes erroneously given as 1564, in which year his play of *Ezekias* was performed at Cambridge before Queen Elizabeth. He was buried at St Margaret's, Westminster, on 23d December 1556 (see memoir in Cooper's edition of *Royster Doyster*).

UFA, a government of south-eastern Russia, on the western slope of the Urals, has Vyatka and Perm on the N., Orenburg on the E. and S., Samara and Kazañ on the W., and comprises an area of 47,112 square miles. In virtue alike of its physical characters and of its population, which belongs chiefly to the Ural-Altaic stock, it forms an intermediate link between Europe and Asia, and it was only recently separated from the government of Orenburg, which is now limited to the eastern slopes of the Urals. Several craggy and densely wooded ridges, running from south-west to north-east parallel to the main chain of the southern Urals, occupy its eastern part. They are separated by broad and long longitudinal valleys, and rise to altitudes of from 2500 to 3500 feet above the sea; their highest peaks—Iremel (5040 feet), Nurgush, Urenga, and Taganai (3950 feet)—are above the limits of tree-vegetation, but in no case reach those of perpetual snow. The high longitudinal valleys of the Urals are the seat of an important mining industry. Southward Ufa extends over the slopes of the Obshchiy Syrt plateau, the angular space between the latter and the Urals being occupied by elevated plains (from 1000 to 1500 feet), deeply grooved by the river valleys and sometimes described as the "Ufa plateau." It slopes gently towards the depression of the Kama; and its undulating surface, especially its broad valleys (500 to 600 feet above the sea), covered as they are with a fertile soil, are being rapidly colonized by Russian settlers. Towards the Kama the fertility of the soil increases, and the black-earth regions of Menzelinsk and Birsk may be described as granaries for that part of Russia.

The geological structure of Ufa is very varied. The main ridge of the Urals consists of gneisses and various crystalline slates resting upon granites and syenites; next comes a broad strip of limestones and sandstones, the fossil fauna of which is intermediate in its lowest parts between the Upper Silurian and the Lower Devonian. These form the highest ridges of Ufa. Farther west the Devonian deposits are followed by Lower and Upper Carboniferous and "Artinsk schists," which, together with Permian deposits, cover western Ufa. Quaternary deposits are extensively developed in all the valleys, most of which were occupied by lakes during the Lacustrine period. Ufa has not the mineral resources of Perm; only traces of gold have been found in its valleys, and silver ores are absent; but its wealth in iron (Devonian) and copper (Permian) seems likely to have great mining importance in the future. The district of Zlatoust is celebrated for its granite, epidote, nephrite, and a variety of decorative stones and minerals. Coal is spread over a wide area, but only in layers too thin to make working remunerative. Fire-clay, kaolin, and sandstone for making grindstones are obtained to some extent; naphtha, sulphur, and saltpetre have been observed in several places.

Ufa belongs almost entirely to the drainage area of the Byelaya, a great tributary of the Kama, which rises in Orenburg, flows south and west till it pierces a mountain chain at Bugutchan, and then runs north and north-west, watering the high plains and receiving a number of important tributaries, among which the Sim, the Tanyp, and the Ufa are also navigable. The banks of the Byelaya are thickly peopled, and it is an important channel for trade; but it sometimes reaches so low an ebb in summer that steamers cannot proceed beyond Birsk. The Kama flows for 120 miles along the western border of the government. Marshes lie along its course, so that its banks are but thinly inhabited. Forests cover nearly half the area, but the plains on the left of the Byelaya are comparatively thinly wooded. The climate of Ufa is very continental. The average temperature at Ufa is 37° F., and the winter is extremely cold (January 5°·5 F., July 68° F.); at the Zlatoust observatory (1340 feet) the average temperature is only 32°·2 (January 2°; July 61°·8). Even in the hilly tracts of Zlatoust the annual rainfall is only 19 inches. The rivers are frozen 158 days at Ufa, and 202 about Zlatoust.

The population of Ufa is now rapidly increasing (1,793,260 in 1882, as against 1,291,020 in 1865). Only one-third of the whole is Russian, the remainder being chiefly Bashkirs (50 per cent., including Mescheriaks and Tepters), Tartars (8·4 per cent.), Tcheremisses, Tchuvashes, Mordvinians, and Votiaks. In the south the Bashkirs, Tartars, and other Ural-Altaians constitute two-thirds of the population. Among the Russians two distinct elements must be distinguished,—some 100,000 peasants, who formerly were mining serfs, and now support themselves chiefly by work in or for the mines, and nearly 620,000 agriculturists, for the most part more recent immigrants. The latter carry on agriculture on an extensive scale, and export large quantities of corn. The Bashkirs are chiefly cattle-breeders, but of late they have been driven more and more to tillage, owing to the appropriation by speculators of their extensive pasture-lands. Bee-keeping is largely carried on, and hunting is still an important source of income to the Bashkirs. In the north-east the trade in timber and the manufacture of various wooden wares are largely engaged in by the peasantry. The mining industry is advancing, notwithstanding many obstacles (see vol. xxi. p. 85); the iron-works of Zlatoust especially have a wide reputation. Flour-mills, distilleries, and tanneries come next in importance. The exports of corn, linseed, timber, wooden wares, metals, tallow, hides, and cattle are considerable, and trade is active, especially at the fairs of Menzelinsk, Ufa, and Zlatoust.

There are six administrative districts, the chief towns of which (with populations in 1884) are—Ufa (25,660), Belebei (4200), Birsk (8000), Menzelinsk (6100), Sterlitamak (8940), and Zlatoust (18,990). The loading places Tchetny and Berezovka on the Kama, and several iron and copper works (Satkinsk, Yurezañ, Katav-Ivanovsk, about 6000 inhabitants each) ought also to be mentioned.

UFA, capital of the above government, is situated at the confluence of the Ufa with the Byelaya, on high crags intersected by ravines, which are covered with gardens and orchards. The better part of the town contains a few stone buildings connected with the administration, two cathedrals, and a few churches; the remainder is a scattered aggregation of small wooden houses. There are two classical gymnasiums for boys and girls, a theological seminary, and several lower schools. The town has a few good hospitals. The manufactures are insignificant in Ufa itself, but there are several iron and copper works of importance within the district. Owing to the fertility of the neighbouring regions, and the position of the town at the junction of two important rivers, the Ufa merchants carry on a brisk export trade. The population has rapidly increased of late, reaching 25,660 in 1884.

Ufa was founded in 1574, when a fort was built on the Byelaya, three other forts being erected about the same time at Birsk, Menzelinsk, and Berezovka, to connect Ufa with the Russian settlements on the Kama. The wooden kreml of Ufa, protected by wooden towers and an outer earthen wall, had to sustain the attacks of the revolted Bashkirs and Russian serfs in 1662 and at later dates; and in 1773 Tchika, one of the chiefs of the Pugatcheff revolt, besieged it for four months.

UGANDA, a country of eastern Central Africa, to the north-west of the Victoria Nyanza. It has an area of about 34,000 square miles, extending from 1° N. lat. to the Kitangule river, and from 31° E. long. to the Nile. The country bordering the lake and to the north-west is mountainous, the mountains being arranged in low parallel chains. The hills, covered with splendid timber and abundant underwood, rise to a height of 400 feet above their valleys, through which sluggish streams flow to the lake. Farther north the country becomes a plain, and the eastern portion of Uganda, between Rubaga and the Nile, consists of undulating country, varied by deep narrow valleys. The geological formation of the country is volcanic or metamorphic; two or three feet of rich black alluvial soil form the upper strata, covering a bed of red sandy clay, often 30 feet thick. In some places porcelain earth is found, as well as large masses of mica. Ironstone is present in considerable quantities, but as yet no other metals have been discovered. The climate is mild, and the temperature remarkably uniform throughout the year; the thermometric range is from 50° to 90° F.; but the mean annual variation is only 20°. The annual rainfall is 50 inches, the greatest amount of rain occurring in March, April, May, and September, October, and November, when rain falls nearly every day, thunderstorms being frequent.

The population of Uganda is about five millions. The men are tall and well-built, and have good features and dark chocolate-coloured skin, with woolly hair. The women in their youth are good-looking. The country is divided into three provinces—Uddu in the south, Singo in the west, and Changwe in the east, to which must be added about 400 islands in the lake. The government of the country is feudal, the king being nominally supreme. Succession to the throne is hereditary, but the successor is usually a minor chosen by three hereditary chiefs, who with the young king's mother carry on the government until he is of age. The reigning family in Uganda is descended from the Wahuma tribe; the late king Mtesa professed to trace back his descent to Kintu (or Ham), the founder of the dynasty. The country is ruled by the king, three hereditary chiefs, and a council of minor chiefs,—two hereditary chiefs and a certain proportion of the others being continually in residence at Rubaga, the capital of the country. The laws are strict, and the administration of justice is conducted in an orderly manner. There is no real taxation, but the people are compelled to render feudal service to all their superiors. The Waganda may be divided into four classes, the lowest class being the slave population, consisting of prisoners taken in war and their descendants; next come the "bachopi" or peasants, who form the mass of the population; the third class are the "batongoli," or chiefs, who are recruited from the bachopi, but whose honours are not hereditary; they receive their rank for distinguished bravery in the field or for services rendered to the state, and they are the governors of the villages. The highest class is that of the "bakungu," a superior grade of chiefs, all belonging to the "luchiko" or state council, and being governors of large districts of land. The three great hereditary chiefs belong to this class, and they are supreme governors of the three great districts into which Uganda is divided. The Waganda are very warlike; all adult males are compelled to serve in the army when required, and the military organization, having its headquarters at the capital, ramifies throughout the whole land. Game is very plentiful: elephants, buffaloes, zebras, rhinoceroses, wild boars, twelve species of antelopes, lions, leopards, jackals, foxes, hyænas, hares, chimpanzees, and several species of monkeys inhabit the forest. Snakes are numerous; hippopotami, crocodiles, and otters abound in the lake and in the Nile, as also many water-rats. The principal birds are parrots, guinea-fowl, owls, vultures, adjutants, goatsuckers, kites, eagles, ducks, geese, storks, cranes, herons, gulls, scarlet flamingos, darters, the sacred and glossy ibis, and brilliantly coloured honey-birds. The principal insects are mosquitos, fleas, locusts, white and driver ants, and butterflies of many species. The domestic animals are cows, goats, and a few sheep and dogs. The Waganda live chiefly upon a vegetable diet, the banana forming the staple food; it grows everywhere, and requires little or no cultivation. The sweet potato is the chief vegetable cultivated, but coffee, sugar-cane, cassava, maize, sesame, millet, tullabone, several species of beans, and two or three kinds of pumpkins are grown to a small extent. The principal fruits are the mpafu and a species of amomum. Strangers have introduced wheat, rice, guavas, papaws, pomegranates, tomatoes, onions, and radishes. Wine is made from the banana tree, and is a staple drink. Butter and cheese are also made. A good deal of manufacture is carried on, for the people are ingenious and clever workmen, and their work is tasteful, neat, and exact. Two kinds of pottery, a coarse and a fine variety, are manufactured in considerable quantities. The basket work is extremely good, and the metal work far superior to any seen among the neighbouring tribes. The manufacture of bark-cloths, in which most of the people are clothed, is very extensively carried on, and their wood-work and boat-building are of very superior quality. Tanning, dyeing, and bead-work employ numbers of the people. There is not very much home trade in Uganda; it is limited to the barter of native manufactures. Several times a year caravans arrive from Zanzibar, bringing calico, guns, powder, files, knives, &c. The standard value of any article is reckoned by 100 cowries or an arm's length of calico and beads; hoes, salt, and fish are also employed as mediums of exchange. The language spoken in Uganda belongs to the great Bantu family, and is very rich in words. It has ten classes of nouns, the noun being the most important part of speech. Grammatical inflexions are formed by prefixes; the inflexions of verbs, adjectives, and pronouns vary according to the class of the governing noun. Adjectives agree with the substantive in number and case, and always follow the noun. There are personal, possessive, relative, demonstrative, and interrogative pronouns, and several forms of verbs. The Waganda are very good arithmeticians. The root of all multiples is ten; tallies are used as aids to the memory. The people are very musical; their voices are clear and melodious, and of considerable range. They have a great variety of tunes,—orchestral, dance, and vocal music having distinct characteristics. Their musical instruments consist of harmonicons, rattles, drums, horns, whistles, flutes, and harps. The Waganda have no images or outward symbols of their gods; and they think that the world is ruled by spirits or demons, to whom Katonga, the great creator, has deputed his power. They worship Mukasa, the god of the lake; Naduala, the god of small-pox; Chiwuka and Nenda, the gods of war; and several of the former monarchs of Uganda, who are believed to be demi-gods. A thunder spirit is also invoked. The gods of war are supposed to inhabit certain trees, and offerings are made to them before entering the war-path; like offerings are also made to the god of the lake before commencing a voyage upon its waters.

The Waganda are courteous, cleanly, given to hospitality, but drunken, and to a certain extent indolent. Their standard of morality, even judged by that of the surrounding tribes, is not high. Human life is little respected; they are untruthful and indecent. Unless moved by passion, they are not cruel; passionate, they are not revengeful. Children are well treated, as are the aged men. On account of the extensive prevalence of polygamy, women occupy a somewhat low social grade.

Uganda was first visited by Speke and Grant in 1860, and the country has since been visited by numerous Europeans, chiefly missionaries. The Church Missionary Society and the Roman Catholics have mission stations in the country. In 1886 some forty of their converts were burnt at the stake, and in the same year Bishop Hannington was murdered on the borders of the country by the orders of King Mwanga.

See Speke's *Journal*, Grant's *Walk across Africa*, Stanley's *Through the Dark Continent*, and Wilson and Felkin's *Uganda and the Egyptian Soudan*. Also a monograph "On the Waganda Tribe," by R. W. Felkin, in *Proc. Roy. Soc. Ed.*, vol. xiii., and an *Outline Grammar of the Luganda Language*, by C. T. Wilson.

UGLITCH, a district town of Russia, in the government of Yaroslavl, is situated on the upper Volga, principally on its right bank, 67 miles to the west of the capital of the province. Its historical remains are mostly associated with the prince Dmitri (see vol. xxi. p. 93). The wooden house he occupied, a church of St Demetrius "on the Blood" erected at the spot where he was killed, and a kiosk on the site of the convent where his mother was forcibly consecrated a nun,—all commemorate this chapter in the history of the rule of the boiars at Moscow at the beginning of the 17th century. An old cathedral, erected in the 13th century but subsequently restored, and containing the grave of Prince Roman, recalls a still earlier period of municipal independence. Uglitch has now become a commercial and industrial city with 11,930 inhabitants (1883), and has an important trade, being one of the chief loading places on the upper Volga. Its industries comprise the sewing of sacks for corn and flour (about one million every year) and the knitting of woollen socks; and it has a paper-mill, distilleries, copper works, and linen factories. Corn, paper, sausages with which the name of Uglitch has long been associated , candles, &c., are shipped at the town.

Uglitch is one of the oldest towns of Russia; its local annals go as far as back as the 9th century. Until the 14th century it maintained its independence as a separate principality, which extended over eastern Tver, and elected its own princes. In 1329 the sons of Prince Roman the Saint renounced their independence in favour of Moscow, and fifty years later the Uglitch princes finally sold their rights to the great prince of Moscow. The Tartars plundered the town during their invasions of 1237, 1293, and 1408, as also did the Lithuanians at a later date.

UGOLINO. See GHERARDESCA and PISA.

UGRIANS. See FINLAND, vol. ix. p. 219.

UHLAND, JOHANN LUDWIG (1787–1862), German poet, was born at Tübingen, on April 26, 1787. He studied at the university of his native place, taking jurisprudence as his special subject, but also devoting much time to literature. Having graduated as a doctor of laws in 1810, he went for some months to Paris; and from 1812 to 181 he worked at his profession in Stuttgart, in the bureau of the minister of justice. He had begun his career as a poet in 1807 and 1808 by contributing ballads and lyrics to Seckendorf's *Musenalmanach*; and in 1812 and 1813 he wrote poems for the *Poetischer Almanach* and for the *Deutscher Dichterwald*. In 1815 he collected his poems in a volume entitled *Gedichte*, which almost immediately secured a wide circle of readers, and gives him his place in German literature. To every new edition he added some fresh poems; and the sixtieth edition, published in 1875, included a number of pieces found among his papers. He wrote two dramatic works—*Ernst, Herzog von Schwaben* and *Ludwig der Baier*—the former published in 1817, the latter in 1819. These, however, are unimportant in comparison with his *Gedichte*. In some respects Uhland must be classed with the writers of the romantic school, for, like them, he found in the Middle Ages the subjects which appealed most strongly to his imagination. But his style has a precision, suppleness, and grace which sharply distinguish his most characteristic writings from those of the romantic poets. His best lyrics have the charm which belongs to the unaffected expression of delicate sentiment; and in almost all his ballads he displays a remarkable power of giving picturesque form to his conceptions of character. He was a man of pure and noble impulse, and it was in presenting scenes which awaken love, or admiration, or pity that he did the fullest justice to his powers. Uhland's poetic sympathy with some characteristics of the age of chivalry did not prevent him from sharing the best aspirations of his own time. He wrote manly poems in defence of freedom, and in the states assembly of Würtemberg he played a distinguished part as one of the most vigorous and consistent of the liberal members. In 1829 he was made a professor, at Tübingen university, of German literature and the German language, but he resigned this appointment in 1833, when it was found to be incompatible with his political duties. In 1848 he became a member of the Frankfort parliament, in which he sat as one of the most respected members of the liberal party.

Uhland was not only a poet and politician; he was also an ardent student of the history of literature. In 1812 he published an interesting essay on *Das altfranzösische Epos*; and ten years afterwards this was followed by an admirable work on Walther von der Vogelweide. He was also the author of an elaborate study of *Der Mythus von Thôr nach nordischen Quellen* (1836), and he formed a valuable collection of *Alte hoch- und niederdeutsche Volkslieder*, which appeared in 1844–45. He died on November 13, 1862. After his death his prose works were reprinted, with some additions, under the general title *Uhland's Schriften zur Geschichte der Dichtung und Sage* (1865–73), and an edition of his poems and dramas, in three volumes, was issued in 1863.

See Liebert, *Ludwig Uhland, eine Skizze* (1863); Mayer, *Ludwig Uhland, seine Freunde und Zeitgenossen* (1867); and *Ludwig Uhland's Leben, aus dessen Nachlass und aus eigener Erfahrung zusammengestellt von seiner Wittwe* (1874).

UJIJI, a town in eastern Central Africa, of considerable importance, also known by the name of KAVELE, is situated on the eastern shores of Lake Tanganyika, in 4° 55′ S. lat. and 30° 5′ E. long. It is the chief town on that lake, and is the centre of a brisk trade in ivory. Formerly it was a great slave-market. The town is of a straggling character, Arab houses of sun-dried bricks being mingled with native huts. The population, which fluctuates considerably, is very mixed, being composed of Arabs and the representatives of numerous Central African tribes. Ujiji has been visited by various European travellers, who have made it their headquarters, and it was here that Stanley found Livingstone, on October 28, 1871. Opinions vary as to the salubrity of its climate, but the balance of testimony appears to prove that during the greater part of the year it is very unhealthy.

UJJAIN, or OOJEIN, a town in the native state of Gwalior, central India, situated on the right bank of the Sipra, in 23° 11′ 10″ N. lat. and 75° 51′ 45″ E. long., 1698 feet above sea-level. In ancient times Ujjain was the great and famous capital of Málwá, one of the seven sacred cities of the Hindus, and the spot which marked the first meridian of Hindu geographers. Though much decayed, it is still a large and populous city, with considerable commerce. The modern city is surrounded on all sides by an almost uninterrupted belt of groves and gardens. In 1881 the population of the town numbered 32,932. Its trade consists chiefly in the export of opium and the import of European goods, especially cotton fabrics.

UKRAINE ("frontier"), the name formerly given to a district of European Russia, now comprising the governments of KHARKOFF, KIEFF, PODOLIA, and POLTAVA (*q.v.*).

ULCER. See SURGERY, vol. xxii. p. 683.

ULFILAS (311–381), the apostle of Christianity to the Gothic race, and, through his translation of the Scriptures into Gothic, the father of Teutonic literature, was born among the Goths of the trans-Danubian provinces in the year 311.[1] There is a tradition that his ancestors were Christian captives from Sadagolthina in Cappadocia, who had been carried off to the lands beyond the Danube in the Gothic raid of 267; but the evidence on which this rests is inadequate. An authoritative record of the outlines of his life has only been discovered within the last fifty years, in a writing of Auxentius, his pupil and companion.

At an early age Ulfilas was sent, either as an envoy or as a hostage for his tribe, to Constantinople, probably on the occasion of the treaty arranged in 332. During the preceding century Christianity had been planted sporadically among the Goths beyond the Danube, through the agency in part of Christian captives, many of whom belonged to the order of clergy, and in part of merchants and traders. Ulfilas may therefore have been a convert to Christianity when he reached Constantinople. But it was here probably that he came into contact with the Arian doctrines which gave the form to his later teaching, and here that he acquired that command over the Greek and Latin tongues which equipped him for his labours as a translator. For some time before 341 he worked as a "lector" or reader of the Scriptures, probably among his own countrymen in Constantinople, or among those attached as *fœderati* to the imperial armies in Asia Minor. From this work he was called to return as missionary bishop to his own country, being ordained by Eusebius of Nicomedia and "the bishops who were with him" in 341. This ordination of Ulfilas as missionary bishop by the chiefs of the semi-Arian party is at once an indication of their determination to extend their influence by active missionary enterprise and evidence that Ulfilas was now, if he had not been before, a declared adherent of the Arian or semi-Arian party. He was now thirty years of age, and his work as "bishop among the Goths" covered the remaining forty years of his life. For seven of these years he wrought among the Visigoths beyond the Danube, till the success which attended his labours, and the growing numbers of his flock, drew down the persecution of the still pagan chief of the tribe. This "sacrilegus judex" has been identified with Athanaric, a later persecutor, probably without sufficient ground. The persecution was so severe that, to save his flock from extinction or dispersion, Ulfilas decided to withdraw both himself and his people from its range. With the consent of the emperor Constantius, he led them across the Danube, "a great body of the faithful," and settled in Mœsia at the foot of the range of Hæmus, and near the site of the modern Tirnova (348). Here they developed into a peace-loving pastoral people.

The life of Ulfilas during the following thirty-three years is marked only by one recorded incident, his visit to Constantinople in 360, to attend the council convened by the Arian or Homoian party. His work and influence were not, however, confined to his own immediate flock, but radiated by means of his writings (homilies and treatises), and through the disciples he despatched as missionaries, among all the tribes of the Gothic stock beyond the Danube. By this time probably he had made some progress with his version of the Scriptures, and copies of parts of it would begin to circulate. Thus the church beyond the Danube, which had not been extinguished on Ulfilas's withdrawal, began to grow once more in numbers and importance, and once more had to undergo the fires of persecution. Catholic missionaries had not been wanting in the meanwhile, and in the indiscriminate persecution by

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[1] Krafft gives 313 as the date, Waitz 318.

Athanaric between 370 and 375 Catholics and Arians stood and fell side by side. The religious quarrel either accentuated, or was accentuated by, political differences, and the rival chiefs, Athanaric and Frithigern, appeared as champions of Paganism and Christianity respectively. Then followed the negotiations with the emperor Valens, the general adhesion of the Visigoths under Frithigern to Arian Christianity, the crossing of the Danube by himself and a host of his followers, and the troubles which culminated in the battle of Adrianople and the death of Valens (378). The part played by Ulfilas in these troublous times cannot be ascertained with certainty. It may have been he who, as a "presbyter Christiani ritus" conducted negotiations with Valens before the battle of Adrianople; but that he headed a previous embassy asking for leave for the Visigoths to settle on Roman soil, and that he then, for political motives, professed himself a convert to the Arian creed, favoured by the emperor, and drew with him the whole body of his countrymen,—these and other similar stories of the orthodox church historians appear to be without foundation. The death of Valens, followed by the succession and the early conversion to Catholicism of Theodosius, dealt a fatal blow to the Arian party within the empire. Ulfilas lived long enough to see what the end must be. Hardships as well as years must have combined to make him an old man, when in 381 he was sent for to Constantinople. The emperor had summoned him, for what purpose cannot be clearly ascertained. A split seems to have taken place among the Arians at Constantinople. Party riots were too familiar there, and a fierce dispute over a theological dogma, however abstruse, placed the peace of the city, if not the security of the palace, in jeopardy. Ulfilas was summoned to meet the innovators, and either by argument or by influence to induce them to surrender the opinion which caused the dispute. His pupil Auxentius describes how, "in the name of God," he set out upon his way, hoping to prevent the teaching of these new heretics from reaching "the churches of Christ by Christ committed to his charge." No sooner had he reached Constantinople than he fell sick, "having pondered much about the council," and before he had put his hand to the task which had brought him he died, probably in January 381. A few days later there died, also in Constantinople, his old enemy and persecutor, Athanaric.

The Arianism of Ulfilas was a fact of pregnant consequence for his people, and indirectly for the empire. It had been his lifelong faith, as we learn from the opening words of his own testament—"Ego Ulfilas semper sic credidi." If, as seems probable from the circumstances of his ordination, he was a Semi-Arian and a follower of Eusebius in 341, at a later period of his life he departed from this position, and vigorously opposed the teaching of his former leader. He appears to have joined the Homoian party, which took shape and acquired influence before the council of Constantinople in 360, where he adhered with the rest of the council to the creed of Ariminum, with the addendum that in future the terms *ὑπόστασις* and *οὐσία* should be excluded from Christological definitions. Thus we learn from Auxentius that he condemned Homoousians and Homoiousians alike, adopting for himself the Homoian formula, "filium similem esse patri suo." This Arian form of Christianity was imparted by Ulfilas and his disciples to most of the tribes of the Gothic stock, and persisted among them, in spite of the persecution, hatred, and political disasters it involved, for two centuries.

The other legacy bequeathed by Ulfilas was of less questionable value. His version of the Scriptures (see GOTHIC LANGUAGE, vol. x. p. 852) is his greatest monument as a way-breaker and a scholar. By it he became the first to raise a barbarian tongue to the dignity of a literary language; and the skill, knowledge, and adaptive ability it displays make it the crowning testimony of his powers as well as of his devotion to his work.

The personal qualities of the man may be inferred from his pupil's description of him as "of most upright conversation, truly a confessor of Christ, a teacher of piety, and a preacher of truth,—a man whom I am not competent to praise according to his merit, yet altogether keep silent I dare not."

Literature.—Waitz, *Das Leben des Ulfilas*, 1840; Krafft, *Kirchengeschichte der Deutschen Völker* Abth. i., 1854; Id., article "Ulfilas," in Herzog's *Realencyklopädie*, vol. xvi., 1865; Id., *De Fontibus Ulfilae Arianismi*; Bessell, *Das Leben des Ulfilas*, 1860; C. A. Scott, *Ulfilas, Apostle of the Goths*, 1885. See also "Gothic Language" under GOTHS.

(C. A. S.)

ULM, an ancient and important commercial town in Würtemberg, and an imperial fortress of the first class, is situated on the left bank of the Danube, in a fertile plain at the foot of the Swabian Alps, 45 miles to the south-east of Stuttgart and 63 miles to the north-west of Munich. The town, quaintly built with narrow and confined streets, still preserves the dignified and old-fashioned appearance of an ancient imperial town, and contains many mediæval buildings, both of historic and of artistic interest. Among these, besides numerous handsome private houses, are the town-house, of the 16th century, in the Transition style from late Gothic to Renaissance; the Kornhaus and market-buildings; the Ehingerhaus or Neubronnerhaus, now containing the industrial museum; the "new building," erected in 1603 on the site of a palace of Charlemagne; and the commandery of the Teutonic order, built in 1712–18 on the site of a habitation of the order dating from the 13th century. By far the most important and conspicuous building in Ulm, however, is the magnificent early Gothic cathedral, next to the cathedral of Cologne the largest church in Germany, and capable of containing 30,000 people. Begun in 1377, and carried on at intervals till the 16th century, the building was long left unfinished; but in 1844 the work of restoration and completion was undertaken, and has steadily progressed ever since. Ulm cathedral has double aisles and a pentagonal apsidal choir, but no transepts. Its length (outside measurement) is 464 feet, its breadth 159 feet; the nave is 136 feet high and 47½ wide; the aisles, which are covered with rich net-vaulting, are 68 feet in height. The massive and richly decorated square tower in the centre of the west façade, for centuries terminated by a temporary spire, is now being completed according to the original plans, by the addition of an octagonal story and a tall open spire, which is to be carried up to the height of 534 feet. The towers of the choir have also been rebuilt in the course of the present restoration; they are 282 feet high. The interior, which is unusually well lighted, produces an impression of much dignity from the great height of the nave, the absence of obtrusive decoration, and the massive manner in which the walls and piers are treated. It contains some fine stained glass, the largest organ in Germany (1856), and a number of interesting old paintings and carvings by Syrlin, Engelberger, and other masters of the Swabian school. The cathedral belongs to the Protestant Church. Trinity Church dates from 1617–21; and there are also a Roman Catholic church and a modern synagogue in the town. The Danube, joined by the Iller just above the town and by the Blau just below, becomes navigable at this point, so that Ulm occupies the important commercial position of a terminal river-port. The trade, especially in wood and grain, has an upward tendency; and the Ulm market for leather and cloth is also rising in importance. Ulm is famous for its vegetables (especially asparagus), barley, beer, pipe-bowls, and sweet cakes (Ulmer Zückerbrot). Bleaching, brewing, and brass-founding are carried on, as well as a large miscellany of manufactures, including hats, metal goods, agricultural implements, tobacco and cigars, cement, paper, and chemicals. The population in 1886 was 33,611.

The various routes which converge at Ulm have made it at all times a strategic point of great importance, and it has long been a fortress of the first rank. In 1844–59 the German Confederation carefully fortified it with walls, ramparts, and ditches, and in 1876 the new German empire added a very comprehensive outer girdle of detached forts, culminating in the powerful citadel of Wilhelmsburg. The defensive works embrace also the Bavarian town of Neu-Ulm (7823 inhabitants), on the opposite bank of the Danube, united with the older city by two stone bridges. Ulm is thus the basis of operations for the German army behind the Black Forest, and can easily shelter a force of 100,000 men; its peace garrison is 5600.

Ulm is mentioned as early as the year 854. It subsequently became a free imperial city, and the leading town in Swabia. In the 15th century it attained the summit of its prosperity, and ruled over a district of many square miles, with a population, rural and urban, of about 60,000. Towards the end of the Middle Ages it frequently appears at the head of various Swabian leagues. In 1530 it adopted the Augsburg Confession. In 1803 it passed to Bavaria, and in 1810 to Würtemberg. In 1805 General Mack, with 33,000 Austrians, capitulated to Napoleon at Ulm. Ulm is remarkable in the history of German literature as the spot where the "meistersänger" lingered longest, preserving, without text and without notes, the traditional lore of their craft. In 1830 there were twelve "meistersänger" alive at Ulm; but in 1839 the four survivors formally made over their insignia and guild property to a modern singing society, and closed the record of "Meistergesang" in Germany. The last formal meeting of the Nuremberg "meister" took place in 1770.

ULPIANUS, Domitius, Roman jurist, was of Tyrian ancestry, but the time and place of his birth are unknown. He made his first appearance in public life as assessor in the *auditorium* of Papinian and member of the council of Septimius Severus; under Caracalla he was master of the requests. Elagabalus deprived him of his functions and banished him from Rome, but on the accession of Alexander (222) he was at once recalled and reinstated, and finally became the emperor's chief adviser and præfectus prætorio. His curtailment of the privileges granted to the prætorian guard by Elagabalus provoked their enmity, and several times he only narrowly escaped their vengeance; ultimately, in 228, he was murdered in the palace, in the course of a riot between the soldiers and the mob.

Ulpian's period of literary activity extended from about 211 to 222 A.D. His works include *Ad Sabinum*, a commentary on the *jus civile* in over fifty books; *Ad Edictum*, a commentary on the Edict, in eighty-three books; collections of Opinions, Responses, and Disputations; books of Rules and Institutions; treatises on the functions of the different magistrates,—one of them, the *De Officio Proconsulis Libri X.*, being a comprehensive exposition of the criminal law; monographs on various statutes, on testamentary trusts, and a variety of other works. His writings altogether have supplied to Justinian's *Digest* about a third of its contents, and his commentary on the Edict alone about a fifth. As an author he is characterized by doctrinal exposition of a high order, judiciousness of criticism, and lucidity of arrangement, style, and language. *Domitii Ulpiani Fragmenta*, consisting of twenty-nine titles, were first edited by Tilius (Paris, 1549). There are modern editions by Hugo (Berlin, 1834) and Böcking (Bonn, 1836), the latter containing fragments of the first book of the *Institutiones* discovered by Endlicher at Vienna in 1835.

ULRICI, Hermann (1806–1884), one of the most active philosophical writers in Germany since Hegel's death, was born at Pförten, Prussia, on March 23, 1806. Educated for the law, he gave up his profession upon the death of his father in 1829, and after four years of further study, devoted to literature, philosophy, and science, qualified as a university lecturer. In 1834 he was called to a professorship at Halle, where he remained till his death on the 11th January 1884. His first works were in the domain of literary criticism. His treatise *On Shakespeare's Dramatic Art* (1839) has been translated into English. In 1841 he published a work *Ueber Princip u. Methode der Hegelschen Philosophie*, in which he subjected Hegel's system to a severe criticism. The critical attack was continued in the *Grundprincip der Philosophie* (1845–6), which at the same time expounds his own speculative position; to this must be added as complementary his *System der Logik* (1852). His later works, dealing with perennial problems of philosophy, have found a more extended circle of readers. Such are *Glauben und Wissen* (1858), *Gott und die Natur* (1862, 3d ed. 1875), *Gott und der Mensch* (2 vols., 1866–73, 2d ed. 1874). From 1847 onward Ulrici was associated with the younger Fichte in the editorship of the *Zeitschrift für Philosophie*.

His philosophical standpoint may be characterized as a reaction from the pantheistic tendency of Hegel's idealistic rationalism towards a more pronouncedly theistic position. The Hegelian identity of being and thought is also abandoned and the truth of realism acknowledged, an attempt being made to exhibit idealism and realism as respectively incomplete but mutually complementary systems. Ulrici's later works, while expressing the same views, are largely occupied in proving the existence of God and the soul from the basis of scientific conceptions, and in opposition to the materialistic current of thought then popular in Germany.

ULSTER. See Ireland.

ULTRAMARINE, a magnificent blue pigment, which occurs in nature as a proximate component of Lapis Lazuli (*q.v.*). Lapis lazuli has long been known as a precious stone, and highly valued as such, and as early at least as the 11th century the art of extracting a blue pigment from it was practised. From the beginning of the 16th century this pigment began to be imported into Europe from "over the sea," as *azurrum ultramarinum*. To extract it, the stone, after having been powdered coarsely, is heated to redness and thrown into cold water to facilitate its conversion into a very fine powder, which is next treated with dilute acetic acid to remove the carbonate of lime which is present in almost all specimens. The insoluble blue residue is mixed up into a "dough" with a composition of resin, pitch, and linseed oil, and this dough is then kneaded under water, which is renewed as long as it runs off with a blue colour. The blue liquor, when allowed to stand, deposits a fine precipitate, which is collected, washed, dried, and sold as ultramarine. As the yield amounts to only 2 to 3 per cent. of the mineral used, it is not surprising to learn that the pigment used to be weighed up with gold. It was valued chiefly on account of its brilliancy of tone and its inertness in opposition to sunlight, oil, and slaked lime (in fresco-painting).

Lapis lazuli has the composition of a double silicate of lime and soda combined with sulphates and sulphides of the metals named. Of the many analyses made (compare Lapis Lazuli) we quote the following, carried out by Schultz in Rammelsberg's laboratory:—combined sulphur (not SO_3), 3·16; combined sulphuric acid, SO_3, 5·67; silica, 43·26; alumina, 20·22; oxide of iron, calculated as Fe_2O_3, 4·20; lime, 14·73; soda, 8·76.

In 1814 Tassaer observed the spontaneous formation of a blue compound, very similar to ultramarine, if not identical with it, in a soda-furnace at St Gobain, which caused the "Société pour l'Encouragement d'Industrie" to offer a prize for the artificial production of the precious colour. The problem was solved almost simultaneously by Guimet and by Christian Gmelin, then professor of chemistry in Tübingen; but while Guimet kept his process a secret (it has indeed never become known) Gmelin published his, and thus became the originator of an industry which flourishes to this day chiefly in Germany. There are very few ultramarine works in other countries, and none, as far as we know, in Great Britain. The raw materials used in the manufacture are—(1) iron-free kaolin, or some other kind of pure clay, which should contain its silica and alumina as nearly as possible in the proportion of $2SiO_2 : Al_2O_3$ demanded by the formula assigned to ideal kaolin (a deficit of silica, however, it appears can be made up for by addition of the calculated weight of finely divided silica); (2) anhydrous sulphate of soda; (3) anhydrous carbonate of soda; (4) sulphur (in the state of powder); and (5) powdered charcoal or relatively ash-free coal, or colophony in lumps. The numerous modes of manufacture may be viewed as modifications or combinations of three processes.

(1) In the *Nuremberg process* the soda is used as sulphate, or partly as such and partly as carbonate. The following recipe gives an idea of the proportions in which the materials are used:—kaolin (calculated as anhydrous matter) 100 parts; calcined sulphate of soda 83 to 100 (or 41 of sulphate and 41 of carbonate); charcoal 17; powdered sulphur 13. These ingredients are mixed most intimately; they are then rammed tight into fire-clay crucibles and kept at a nearly white heat for 7 to 10 hours, access of air being prevented as far as possible. The product obtained is a greyish or yellowish green mass, which is soaked in and washed with water; the porous residue is ground very fine in mills, again washed, dried, and again ground in the dry state and passed through sieves. The product at this stage has a green colour, and is sometimes sold as "green ultramarine," although it has not a high standing amongst green pigments. For its conversion into blue ultramarine it is heated with sulphur in the presence of air to a relatively low temperature. Of the various apparatus used for this important stage of the manufacture, the easiest to describe is a large muffle, heated from the outside. On its floor the green ultramarine is spread out to a depth of 2½ to 3 inches, and heated (with closed doors) to a

temperature at which sulphur powder when thrown in catches fire spontaneously. This temperature being maintained, a shovelful of sulphur is thrown in and allowed to burn off while the mass is being constantly agitated with iron rakers. Another dose of sulphur is then added, and so on until a sample taken out is found to have come up to the highest attainable brilliancy and depth of blue. The product is then lixiviated with water, which removes a deal of sulphate of soda formed in the process; it is then ground up very fine, and finally subjected to elutriation to produce a graduated series of ultramarines of different degrees of fineness. In some works the process of sulphuration is divided into two or more periods, after each of which the product is washed, dried, and ground before being returned to the muffle to produce a higher degree of homogeneity.

(2) In the *carbonate of soda process* the soda is used solely, or at least principally, in the carbonate form. The following is one of many recipes:—kaolin (calculated as anhydrous matter) 100; carbonate of soda 100; charcoal 12; sulphur 60. The mixture is heated in a reverberatory furnace to form in the first instance a white mass, which is so porous that it readily passes, by oxidation, into green and partly even into blue ultramarine. Green ultramarine, saleable as such, cannot be produced in this manner. The half-blue product is finished by sulphuration pretty much as explained above for the Nuremberg process. Well-made soda-ash ultramarine has a richer colour than the Nuremberg variety.

(3) *Silica ultramarine* is soda-ash ultramarine in whose preparation a quantity of finely divided silica, equal to 5 to 10 per cent. of the weight of the kaolin, has been added. It is distinguished by a reddish tinge, which is the more fully developed the greater the proportion of added silica. It is more highly proof against the action of alum solution than non-siliceous ultramarine is.

Since 1873 the Nuremberg works have been producing four varieties of magnificently violet ultramarine. The mode of manufacture has not transpired. At the Paris Exhibition in 1867 a magnificent block of ultramarine exhibited by the Kaiserslautern works attracted attention. In its manufacture the roasting (blueing) process is said to have been continued for three weeks.

Artificial, like natural, ultramarine has a magnificently blue colour, which is not affected by light nor by contact with oil or lime as used in painting. Hydrochloric acid at once bleaches it with liberation of sulphuretted hydrogen gas and milk of sulphur. The natural pigment is proof against dilute acetic acid and solution of alum; the artificial pigment is even alum-proof only in a higher or lower relative sense. Hence there is room for progress in one direction at least. The composition of the pigment is quite similar to that of lapis lazuli; but the constitution of both is still a chemical enigma. It is remarkable that even a small addition of zinc-white (oxide of zinc) to the reddish varieties especially causes a considerable diminution in the intensity of the colour, while dilution with artificial precipitated sulphate of lime ("annalin") or sulphate of baryta ("blanc fix") acts pretty much as one would expect. Ultramarine being very cheap (it sells at 7d. to 10d. per lb), it is largely used for wall painting, the printing of paper hangings and calico, &c., and also as a corrective for the yellowish tinge often present in things meant to be white, such as linen, paper, &c. Large quantities are used in the manufacture of paper, and especially for producing that kind of pale blue writing paper which is so popular in Great Britain. Only the very finest ultramarine can be used for paper tinging, because the least admixture of coarse particles becomes visible in the paper as dark spots or stains.

ULUGH BEG, Mirza Mohammed ben Shah Rok (1394–1449), astronomer, grandson of Timur (*q.v.*), succeeded his father as prince of Samarkand in 1447, after having for years taken part in the government, and was murdered in 1449 by his eldest son. He occupied himself with astronomical pursuits, and erected an observatory at Samarkand, from which were issued tables of the sun, moon, and planets, with an interesting introduction, which throws much light on the trigonometry and astronomical methods then in use (*Prolégomènes des Tables Astronomiques d'Oulong Beg*, ed. by Sédillot, Paris, 1847, and translated by the same, 1853). The serious errors which he found in the Arabian star catalogues (which were simply copied from Ptolemy, adding the effect of precession to the longitudes) induced him to redetermine the positions of 992 fixed stars, to which he added 27 stars from Al Sûfi's catalogue, which were too far south to be observed at Samarkand. This catalogue, the first original one since Ptolemy, was edited by Th. Hyde at Oxford in 1665 (*Tabulæ Longitudinis et Latitudinis Stellarum Fixarum ex Observatione Ulugbeighi*), and in 1843 by Baily in vol. xiii. of the *Memoirs* of the Royal Astronomical Society.

ULVERSTON, a market-town in the north-west of Lancashire, England, is picturesquely situated near Morecambe Bay, on the borders of the Lake district, 9 miles north-east of Barrow-in-Furness, and 256 north-west of London. The town bears small evidence of its great antiquity. The principal streets branch from the market-place, and the houses built of stone are generally rough-cast and whitened. A rivulet flows through the town. The church of St Mary, founded in 1111, retains the south door of the original building in the Transition style, but the greater portion of the structure is Perpendicular, of the time of Henry VIII. It consists of chancel, nave, aisles, south porch, and embattled western tower, and contains an altar-tomb with recumbent figure of Walter Sandys of Conishead, dated 1588. After the destruction of Furness Abbey, Ulverston succeeded Dalton as the most important town in Furness, but the rapid rise of Barrow within recent years has relegated it to quite a secondary place. Formerly it had a considerable trade in linens, checks, and ginghams, but this has greatly fallen off. It possesses, however, large iron and steel works (North Lonsdale Iron and Steel Company), a large chemical work, an extensive paper manufactory, a bolt manufactory, breweries, tanyards, and wooden hoop manufactories. The population of the urban sanitary district (area 3120 acres) in 1871 was 7607, and in 1881 it was 10,008.

Early in the 12th century the lordship of Ulverston came into the possession of Stephen, earl of Boulogne, afterwards king of England, by whom it was presented to the monks of Furness Abbey as part of the endowment. In 1196 the *ville* of Ulverston was granted by the abbot of Furness to William de Lancaster, first baron of Kendal. In 1280 it obtained the charter of a market. The town became escheated to the abbot of Furness as chief lord in 1342, but this escheatment was suspended by Edward II. in favour of John de Coupland, who captured David II. of Scotland at the battle of Durham. After his death it reverted to the abbey. It is now in the possession of the family of Buccleuch.

ULWAR, an alternative form of Alwar (*q.v.*).

ULYSSES. See Odysseus.

UMAN, a district town of Russia, in the south of the government of Kieff, is now a small industrial and trading town, with 15,400 inhabitants, many of whom are Jews, who carry on an active trade in the export of corn, spirits, &c. It has a remarkable park (290 acres), planted in 1796 by the orders of Count Potocki, in connexion with which a gardening school is maintained.

Umañ was founded towards the beginning of the 17th century as a fort against the raids of the Tartars. The Cossacks of the Ukraine, who kept it, revolted against their Polish rulers about 1665, and had to sustain a fierce siege. In 1674 it was plundered and most of its inhabitants murdered by the Ukrainians and Turks, during the wars for the hetmanship. In 1712 its last inhabitants were transferred by Peter I. to the left bank of the Dnieper. But by the end of the 18th century, when it again became the property of the Potockis, it was repeopled and became one of the busiest trading towns of Little Russia. In 1768, when the Cossacks revolted anew against their Polish serf proprietors, they took Umañ and murdered most of its inhabitants.

UMBALLA, an alternative form of Ambálá (*q.v.*).

UMBER. See Pigments.

UMBRELLA now means a portable protector from rain, while the name parasol is given to the generally smaller, lighter, and more fanciful article carried by ladies as a sun-shade. But primarily the umbrella (*ombrella*, Ital. dim. from Lat. *umbra*, shade) was a sun-shade alone,—its original home having been in hot brilliant climates. In Eastern countries from the earliest times the umbrella was one of the insignia of royalty and power. On the sculptured remains of ancient Nineveh and Egypt there are representations of kings and sometimes of lesser potentates going in procession with an umbrella carried over their heads; and throughout Asia the umbrella had, and still has, something of the same significance. The Mahratta princes of India had among their titles "lord of the umbrella." In 1855 the king of Burmah in addressing the governor-general of India termed himself "the monarch who reigns over the great umbrella-wearing chiefs of the Eastern countries." The baldachins erected over ecclesiastical chairs, altars, and portals, and the canopies of thrones and pulpits, &c., are in their origin closely related to umbrellas, and have the same symbolic significance. In each of the basilican churches of Rome there still hangs a large umbrella.

Among the Greeks and Romans the umbrella (*σκιάς*, *σκιάδειον*, *umbraculum*, *umbella*) was used by ladies, while the carrying of it by men was regarded as a sign of effeminacy. Probably in these southern climes it never went out of use, and we find from allusions by Montaigne that in his day its employment as a sun-shade was quite common in Italy. The umbrella was not unknown in England in the 17th century, and was already used as a rain protector. Michael Drayton, writing about the beginning of the 17th century, says, speaking of doves :—

> "And, like umbrellas, with their feathers
> Shield you in all sorts of weathers."

Although it was the practice to keep an umbrella in the coffee-houses early in the 18th century, its use cannot have been very familiar, for in 1752 Colonel Wolfe, writing from Paris, mentions the carrying of them there as a defence against both rain and sun, and wonders that they are not introduced into England. The traveller Jonas Hanway, who died in 1786, is credited with having been the first Englishman who habitually carried an umbrella. That practice he began thirty years before his death ; at first he was singular, and his habit was derided, but he lived to see his example commonly followed.

The umbrella as at first used, based on its Eastern prototype, was a heavy ungainly article which did not hold well together, and no little ingenuity has been exercised to bring it into the elegant, compact, and strong form which is now quite common. The early umbrella had a long handle, with ribs of whalebone or cane, very rarely of metal, and stretchers of cane. The jointing of the ribs and stretchers to the stick and to each other was very rough and imperfect. The covering material consisted of oiled silk or cotton, heavy in substance, and liable to stick together in the folds. Gingham soon came to be substituted for the oiled cloth, and in 1848 William Sangster patented the use of alpaca as an umbrella covering material. One of the most notable inventions for combining lightness, strength, and elasticity in the ribs of umbrellas was the "Paragon" rib patented by Samuel Fox in 1852. It is formed of a thin strip of steel rolled into a U or trough section, a form which gives great strength for the weight of metal. The use of such ribs, combined with the notched rings and runners which give a separate hinge and joint to each rib and stretcher, and with the thin but tough covering materials now in use, has principally contributed to the strength, lightness, and elegance which ordinary umbrellas now present. Umbrella silk is principally made at Lyons and Crefeld ; but much of it is so loaded in dyeing that it cuts readily at the folds. Textures of pure silk or of silk and alpaca mixed have better wear-resisting properties.

UMBRIA (*Ὀμβρική*, *Ὀμβρικοί*, *Οὔμβροι*, UMBRI). The early Greeks applied the name *Ὀμβρική* to all central and northern Italy. Herodotus (iv. 49) speaks of it somewhat vaguely, as if it extended up to the Alps. The Umbrians probably extended across central Italy from sea to sea down as far as Latium. Pliny (iii. 13, 19) tells us that the Umbri were considered the most ancient nation of Italy (antiquissima gens Italiæ), by which he probably means, of the Italian stock. The Greek writers included under the name of Umbria the district known in later times as Picenum. Pseudo-Scylax makes Umbria march with Samnium, and describes Ancona as a city of Umbria. The Umbrians seem to have found the Siculi and Liburni in occupation of the land into which they advanced, the former holding the parts lying towards the interior, the latter people the district along the Adriatic. The Umbrians were one of the chief peoples of that branch of the Indo-European family who had entered Italy from the north and driven out and absorbed the older inhabitants. They were more closely connected with the Samnites and Oscans than with the Latin stock, as is shown by their language. Their possession of the fertile regions of upper Italy exposed them to the constant assaults of fresh bodies of invaders, pressing on over the Alps, and perhaps likewise from the seaboard. Their force was extended over a wide area, and thus too weak to withstand the attacks from various sides to which they were exposed. Thus their extensive territory was gradually reduced by the successive encroachments of other peoples. First came the Etruscans, who according to Herodotus (i. 94) were Lydians, who established themselves in the land of the Umbrians. From which side of Italy they made their invasion, whether from the mouth of the Po or from the western coast of what later became Etruria, or whether from both, we have no means of determining. That the Umbrians did not yield without a struggle we cannot doubt. It was only after three hundred of their towns had been captured by the Etruscans that they succumbed. Nevertheless they still retained considerable influence in upper Italy, which, according to Strabo (v. 216), continued down to the time of the Roman conquest. For he says that there was a large Umbrian element in the Roman colonies in the region of the Po, as also some Etruscan. For, according to him, the Umbrians and Etruscans lived in a continual rivalry for the pre-eminence, so that if the one people made an expedition northwards, the other determined not to be outdone. So when the Etruscans had marched against the barbarians who dwelt near the Po, and had soon again been expelled owing to their effeminacy, the Umbrians in turn marched against the conquerors of the Etruscans. In consequence of this alternating struggle for these regions they planted many colonies, some Etruscan, others Umbrian. Most of the colonies were Umbrian because the Umbrians lay closer to the disputed territory. Thus, even though they lost the sovereignty, the Umbrian race probably continued to form a considerable portion of the population of a wide extent of country. At all events, at the time of the Gaulish inroad the Etruscans seem to be in possession of the mouth of the Po. At this time, therefore, Umbria as a state consisted of the region bounded on the W. by the Tiber, on the S. by the Sabines, on the E. by Picenum and the Adriatic, while on the N. it extended close up to the southern or Spinetic mouth of the Po. Scylax describes the Etruscans as extending from the Tyrrhenian Sea to the Adriatic, and represents them as in possession of the ancient Greek town of Spina. How much farther south the Etruscan sway had once reached we cannot determine, but that they had once held this region, as far as Ravenna at least, is rendered probable by the tradition that Ravenna had been founded by a colony of Thessalians who, not brooking the insulting treatment which they received from the Etruscans, gladly admitted some Umbrians, who thus became the possessors of the city. When the great Gaulish inroad took place at the beginning of the 4th century B.C. Etruscans and Umbrians alike suffered severely. Some of the Celtic tribes crossed the Po and formed permanent settlements. The Ananes settled in the Apennines, the Boii between the former and the Adriatic; next came the Lingones; and finally the Senones occupied the seaboard of the Adriatic as far as the Rubicon. This region in Roman times was known as the Ager Gallicus (Polybius, ii. 16). But it was not only in the north and west that the Umbrians had been driven back. The early Greeks had included under the name of Umbria the district along the Adriatic, afterwards known as Picenum. This consisted of a fertile region, extending from beyond Ancona to the river Matrino. It is not improbable that the Picentes issued from the Sabine region. Tradition alleged that the Picentes, led by the woodpecker (*picus*) of Mars, marched forth to occupy what is now the March of Ancona. But it was probably only after a long struggle that this conquest was effected, for from another tradition we learn that the Sabines, after carrying on war against the Umbrians for a long time, at length vowed a sacred spring, and dedicated all the produce of the year to the gods. Then at length they became victorious (Strabo, v. 250). Thus, by the advance of the Gauls from the north and the Picentes from the south, the Umbrians were shut off from the seaboard, and confined to the district known as Umbria in historical times. When Rome began the consolidating of Italy, Umbria consisted of the region bounded by the Ager Gallicus on the N., by Etruria (the Tiber) on the W., by Picenum on the E., and by the Sabines on the S. The Umbrians kept a desperate hold of this district, which lies between the two arms of the Apennines. This position indicates of itself that they had been driven before stronger foes. Henceforward they play but an insignificant part in Italian history. This is explained by the physical formation of their country. It is an extremely mountainous region, with a few small plains between, which were noted for their fertility. Hence arose a number of small but thriving communities, none of which had the capacity of developing into a leading state such as Rome became for the Latins. Their want of seaports likewise excluded them from trade, the mouths of all the rivers which flowed from their country being in the hands of their enemies.

Of the Umbrians' political and municipal organization little is known. In addition to the city (*tota*) they seem to have had a larger territorial division in the *tribus* (trifu, acc.) as we gather from Livy (xxxi. 2, per Umbriam quam tribum Sapiniam vocant; *cf.* xxxiii. 37) and from the Eugubine Tables (trifor Tarsinater, vi. b. 54). From the fertility of their land their communities were very prosperous. The olive and vine flourished in their valleys; they grew spelt abundantly; and the boars of Umbria were famous. Ancient authors describe the Umbrians as leading effeminate lives, and as closely resembling their Etruscan enemies in their habits (Theopompus, fragm. 142; Pseudo-Scymnus, 366–8). It is almost certain that each race influenced and modified the other to a large extent. Mommsen has pointed out that the names of many towns in Etruria are Umbrian, a fact which shows how persistent even after conquest was their influence in that region. On the other hand, we have conclusive proof of strong Etruscan influences in Umbria. For instance, they undoubtedly borrowed their alphabet and the art of writing from the Etruscans. Their writing runs from right to left. The alphabet consists of nineteen letters. It has no separate symbols for O, G, Q; the aspirates φ and χ are wanting; on the other hand, it possesses forms for Z and V, and has likewise the Etruscan *f* (8). It also has a symbol d peculiar to itself for expressing the sound of palatal *k* when followed by either *e* or *i*. It is also very probable that they borrowed the art of coining money from Etruria. Two towns are known to have issued coins, which consist entirely of bronze, and belong almost entirely to the series of *æs grave*. The most important is that of Tuder (Todi), which must have been a place of some note. It was a strong fortress on the left bank of the Tiber on the confines of Etruria. Iguvium (Gubbio), which struck coins after the standard of Tuder, was a strong place likewise on the western or Etruscan side of the Apennines. The fact that it is only in towns on the side next Etruria that a coinage is found indicates that it was from the Etruscans they borrowed the art. The Umbrians counted their day from noon to noon. But whether they borrowed this likewise from the Etruscans we do not know (Pliny, ii. 77). In their measuring of land they employed the *vorsus*, a measure common to them and the Oscans (Frontinus, *De Limit.*, p. 30), 3⅓ of which went to the Roman *jugerum*. When the Romans undertook the conquest of Italy, the most feeble resistance of all was offered to them by the Umbrians. In the great struggle between the Samnite confederacy and Rome Umbria played an insignificant part. It is probable that all through the Second Samnite War their sympathies were altogether on the side of their Samnite kinsmen, and that some assistance was afforded by individual communities. It is not unlikely therefore that it was with a view to keep the Umbrians in check that the Romans planted a colony at Nequinum on the Nar, whose inhabitants were known as Nartes Interamnates, and who are included with the Etruscans, Iapydes, and Tadinates in the list of persons who were forbidden to be present at the sacred rites of Iguvium. At length in 308 B.C. the Umbrians made a vigorous effort to aid the Samnites, which, had it taken place earlier in the war, might have had the most important influence on the issue of the struggle. As it was, it came too late; the Etruscans had already laid down their arms. The Umbrians, who threatened to march on Rome, were intercepted by Rullianus with the Roman army from Samnium on the upper Tiber, a step which the Samnites now broken could not prevent; and this was sufficient to disperse the Umbrian levies. When the Third Samnite War broke out, the Umbrians took no active part in its operations; but how their sympathies lay is evident from their affording a ready passage to the Samnite army under Gellius Egnatius on its march to Etruria, 296 B.C. When the battle of Sentinum (295) finally crushed the Samnites and Etruscans, Umbria remained in the hands of the Romans. Henceforward the process of Latinizing went on steadily, for by the 1st century B.C. we find them employing the Latin alphabet in copies of the ancient sacerdotal ritual of Iguvium (see EUGUBINE TABLES). We know that the Oscan language only finally expired in the 1st century of our era, and there is no reason for believing that the Umbrian had disappeared much earlier. When the Romans conquered the Senones, 280 B.C., the Ager Gallicus was restored to Umbria, and both together formed under the empire the sixth region of Italy.

Strabo (v. 227) regards Ravenna as the boundary of Umbria. The Via Flaminia passed up through it from Ocriculum to Ariminum, along which lay the important towns of Narnia (Narni) Carsulæ (Carsigliano), Mevania (Bevagna), Forum Flaminii, Nuceria, and Forum Sempronii. To the east lay Interamna (Terni), the probable birthplace of Tacitus, Spoletium (Spoleto), and the most important town of Camerinum on the side of the Apennines towards Picenum. On the side towards Etruria lay Tuder (Todi), Iguvium, which occupied a very advantageous position close to the main pass through the Apennines, Ameria (Amelia), and Hispellum (Spello); on the Clitumnus (Clitunno) was Assisium (Assisi), the birthplace of Propertius, whilst far to the north lay Sarsina, the birthplace of Plautus. For the position of the country in the time of Augustus, see vol. xiii. Plate V.

See Bréal, *Les Tables Eugubines*, 1875; Bücheler, *Umbrica*, 1883; Kirchhoff, *Griech. Alphabet*, 4th ed., 1887; Head, *Historia Numorum*, 1887. (W. RI.)

UMMERAPOORA, another form of AMARAPURA (*q.v.*).

UNAO, a British district in the Lucknow division of Oudh, India, under the jurisdiction of the lieutenant-governor of the North-Western Provinces. The area of the district is 1768 square miles, and it is bounded on the N. by Hardoi, E. by Lucknow, S. by Rai Bareli, and W. by the Ganges. Unao is very flat, and has no features of particular interest. Rich and fertile tracts, studded with groves, alternate with stretches of waste land and plains of barren *usar*, the whole being intersected with small streams, the water from which is extensively used for irrigation. The Ganges is the only navigable river in the district. The temperature varies from about 75° to 103° in the hot weather, and from 46° to 79° in the cold season. The average annual rainfall is about 34 inches.

In 1881 the population was 899,069 (males 461,167, females 437,902); of these 830,342 were Hindus, 68,677 Mohammedans, and 49 Christians. Unao, the capital and administrative headquarters, 9 miles north-east of Cawnpore, had 9509 inhabitants. The cultivated area of Unao amounted in 1885–86 to 598,131 acres, and 289,356 acres were returned as cultivable. The principal crops are rice, wheat, and other food grains, cotton, sugar-cane, and indigo. The cultivation is mainly dependent on irrigation. The principal exports are grain of all kinds, gúr, ghi, tobacco, and a little indigo and saltpetre; and the chief imports are piece goods, salt, iron, cotton, spices, &c. The gross revenue of the district in 1885–86 amounted to £183,083, the land yielding £144,914. During the mutiny of 1857–58 Unao was the scene of several severe engagements between General Havelock's little army and the rebels. On the death of Rájá Jasa Sinh, one of the leading rebels, and the capture of his two sons, the whole family estates were confiscated, and the villages either restored to their former owners or given to other landholders for their loyalty.

UNDULATORY THEORY. See OPTICS and WAVE THEORY.

UNGVAR, chief town of the county Ung, in the north-east of Hungary, stands on the river Ung. It is the seat of the bishop of Munkács, and has a fine Greek cathedral, an episcopal seminary, a lyceum, a gymnasium, and also a teachers' college, a county hall, and an interesting ancient castle. The town and district produce good wine in large quantity, and abound in mineral springs. There is a good trade in timber and china clay. The population in 1886 was 13,460.

UNICORN, an animal with one horn. The name is applicable and has sometimes been applied to the rhinoceros, which is, for example, the Sumatran unicorn of Marco Polo. But the figure usually associated with the name is the well-known heraldic one of an animal with the form of a horse or ass, save that a long straight horn with spiral twistings, like the tusk of the narwhal, projects from its forehead. The belief in the existence of a one-horned animal of this kind goes back to Aristotle (*Part. An.*, iii. p. 663), who names as one-horned "the oryx and the Indian ass." Later descriptions of the Indian unicorn, *e.g.*, that of Ælian (*Nat. An.*, xvi. 20), are plainly influenced to some extent by accounts of the rhinoceros, but the authority of Aristotle determined the general form ascribed to the animal. The twisted horn, of which Ælian already speaks, seems to have been got by referring to Aristotle's unicorn actual specimens taken from the narwhal; see Yule's *Marco Polo*, ii. 273. The ancient and mediæval lore of the subject may be seen in Bochart, *Hierozoicon*, iii. 26. The familiar legend that the unicorn could be taken only by the aid of a virgin obtained currency through the *Physiologus* (see vol. xix. p. 7). The English Bible, following the Septuagint (μονόκερως), renders the Hebrew *rĕēm* (ראם) by "unicorn." But two horns are ascribed to the *rĕēm* in Deut. xxxiii. 17, and the Hebrew word reappears in Arabic as the name of the larger antelopes, probably the *Antilope leucoryx*, while in Assyrian the *rīmu* appears to be the wild ox. There are recent fossil remains in the Lebanon both of *Bos primigenius* and *Bison urus*, though both have been long extinct in Palestine.

UNITARIANISM. The term Unitarianism in its widest sense includes certain lines of the great religious and theological movement or revolution of the Reformation in the 16th century, when this is regarded as the commencement of the process of the humanization of theology and ethics on the basis of the autonomy of the human mind. In another sense the term stands for a set of theological opinions, more or less variable, and yet in their general drift connected, some of them as old as Christianity, and one section of which only is indicated by the term when used as synonymous with Antitrinitarianism. But there is another meaning of the term, a still narrower one, and to Unitarianism in this sense this article must be confined. We must limit ourselves to a brief account of Unitarianism as it appears in ecclesiastical organizations in separation from the orthodox churches. This treatment of the subject is of course incomplete, and would be misleading were the incompleteness not expressly announced. For a marked feature of the late history of the Unitarian churches is the growing tendency they exhibit of working out to their logical results some of the wider principles of the Reformation to which they ultimately owe their origin, rather than the design of formulating and propagating systems of theology. To not a few modern Unitarian leaders the bond which connects them with a specifically Unitarian organization is the spirit and tendency of the larger movement for which it happens to provide freer play than the orthodox churches, while they repudiate the imputation of belonging to a dogmatic sect. Modern Unitarians have also, both in Europe and America, emphatically and successfully resisted the inclination of some of their number to lay down, though in the most general terms, a creed of Unitarianism. Indeed, in opposing this inclination, it might sometimes seem as if the only essential article of Unitarianism were the maintenance of free inquiry in religion,—an impression, however, which a careful study of the history of Unitarian thought would remove. In the same way such a study would show that Unitarian churches are in agreement on many points of doctrine with early and recent theologians of all churches and sects.

This brief sketch of Unitarianism, as it has appeared in organized religious societies, takes us into but a few countries, and covers but a limited space of time. Poland, Transylvania, England, and America are the only countries in which Unitarian congregations have existed in any numbers or for any length of time. Elsewhere, either the law of the land has rendered their existence impossible, or they have been unnecessary in consequence of the substantial adoption by the existing churches of their principles and doctrines. The former was the case in Italy, Switzerland, Germany, and England in the 16th and 17th centuries, the latter to a certain extent in England in the 18th century, still more in Germany in the 18th and 19th centuries, and in Holland in the present century, as also to a large extent in France in the Reformed Church.

Poland (1565–1658).—The Unitarians, under the names of Arians, Samosatenians, Pinczowians, were formed into a separate church in 1565 by their exclusion as Antitrinitarians from the synods of the Trinitarian Protestants. Very early in the progress of the Reformation in Poland individuals had arrived at heterodox opinions on baptism and the Trinity, very much under the influence of the heterodox Italian refugees in Switzerland, some of whom visited Poland (Lelio Sozzini, 1551 and 1558; Paul Alciati, 1561; G. V. Gentile, 1561; Biandrata, 1555). Gonesius and Gregory Pauli were the first to openly preach Antitrinitarian doctrine. After their separation from the orthodox, the Polish Unitarians developed divergent views as to the nature of Christ, as to the lawfulness of paying divine worship to Him, as to the subjects of baptism (infants or adults), and as to the relation of Christians to the state. On the first point some were Arians and others Humanitarians, while those who claimed divine worship for Christ were called *Adorantes* and those of the opposite view *Nonadorantes*. An epoch in the history of the party was made by the arrival of Fausto Sozzini at Cracow in 1579 (see SOCINUS). He succeeded in converting the great majority of the churches to his views and in silencing the dissentients. Henceforth the Polish Unitarians adopted the Socinian practice of paying worship to Christ, the Socinian view of the necessity of baptism and of the Christian's duty towards the state. They rapidly became a numerous and powerful body in Poland, distinguished by the rank of their adherents, the ability and learning of their scholars, the excellence of their schools, and the superiority and wide circulation of their theological literature. Racow, the theological centre of the Socinians, with its school and printing presses, obtained a world-wide fame. It was there that the *Racovian Catechism* was published (1605 in the Polish language, 1608 in German, and 1609 in Latin). But before the death of Fausto Sozzini (1604) the situation of the Unitarians became more difficult, and in 1611 the Jesuits obtained their first open triumph over them. In the rapid course of the Catholic reaction, which was not resisted by the orthodox Protestants as long as the Socinian heretics only suffered, the church and school at Lublin, the most important place next to Racow, were first put down (1627), and Racow, with its church, school, and printing-press suffered the same fate in 1638. The final blow to the whole body followed in 1658, when all adherents of "the Arian and Anabaptist sect" were commanded to quit the kingdom within two years. A few renounced their faith, but the large majority fled into Transylvania, Prussia, Silesia, Holland, and England.

Transylvania (1568-1887).—Next to Poland Transylvania was the most important seat of Unitarianism. It was there the name was first used by the sect as its own designation, and it is there only that the sect has had a continuous existence down to our own time. It is generally considered that the Italian refugee Biandrata was the founder of Transylvanian Unitarianism, but the present representatives of the body claim for it a nobler and domestic origin. Biandrata attended John Sigismund as a physician in 1563, and under his influence Unitarianism made rapid progress. In 1568 its professors, favoured by the king and many magnates, after separating from the orthodox church, constituted themselves a distinct body under the distinguished man Francis David, who is now regarded as the apostle of true Transylvanian Unitarianism. Their principal centre was Klausenburg (Kolozsvár), where they had a large church, a college, and a printing-press. But the same conflict between a more radical and a more conservative tendency which appeared amongst the Unitarians of Poland greatly disturbed the churches of Transylvania, particularly with regard to the worship of Christ. On the side of the *Adorantes* was Biandrata, and on that of the *Nonadorantes* David. The party of David succumbed to force and fraud, and he himself died in prison a martyr to his convictions. Gradually the Socinian view prevailed, though in 1618 an old order to worship Christ required reinforcement. In the latter half of the 18th century the more logical view of David entirely disappeared. Under the Austrian dynasty the Unitarians were often exposed to great trials, until Joseph II. secured to them their rights and privileges. An official confession of faith of the year 1787 remains, with some modifications, essentially Socinian. But of late years the Transylvanian Unitarians have been in close relation with their co-religionists in England and America, some of the ministers having been educated at Manchester New College, and in consequence their theology is becoming essentially modern. The number of members was 32,000 in 1789, in 1847 40,000, distributed in 104 parishes with 120 pastors. Their present number is 53,539 in 106 parishes. Their chief centres are Kolozsvár, Thorda, and Keresztur, where they have excellent schools.

England (1773–1887).—For two and a half centuries previous to the rise of organized Unitarianism in England, opinions commonly called by this name found numerous individual advocates and some martyrs. John Bidle (1615–62) published catechisms of Unitarian doctrine, translated Socinian works, and publicly discussed and preached an English form of Socinianism. But the severity of the law against Antitrinitarians, coupled with the gradual growth of free opinion in the Established Church and amongst the Presbyterian congregations, made the formation of separate Unitarian churches impossible, and, as was felt, less necessary for another hundred years. The adoption of a completely Humanitarian view of Christ's person by a few solitary individuals (Lardner 1730, Priestley 1767, Lindsey 1773), assisted by the awakened earnestness of the time, led to their formation. Lindsey resigned a valuable living in Yorkshire, and gathered the first professedly Unitarian church in London. Other clergymen followed his example, and amongst the Presbyterians several ministers, like Joseph Priestley, exchanged their Arian for Humanitarian views. This process went on with deep permanent effects in some of the Dissenting academies. In the year 1791 was formed the Unitarian Book Society for the distribution of literature, and several provincial associations originated about the same time. In 1806 the Unitarian Fund Society was established, with the object of promoting Unitarian Christianity by direct mission work. In 1818 arose another society for protecting the civil rights of Unitarians. These various societies were consolidated in 1825 under the name of the British and Foreign Unitarian Association, which has now its headquarters in the building formerly used as Lindsey's chapel and residence in Essex Street, London. Early in this century nearly the whole of the old Presbyterian congregations, which, unlike those of the Baptists and Independents, had undogmatic trust-deeds, passed through the stages of Arminianism and various forms of Arianism into Socinianism in its peculiar English and mainly Priestleian form. The penal laws against Antitrinitarianism, which had long been obsolete, were repealed in 1813, and in 1844 the right of Unitarians to the chapels which they held in succession from their Presbyterian forefathers was legally secured to them by the Dissenters' Chapels Act without altering their undogmatic trust-deeds. Though these congregations, popularly known as Unitarian, on principle declined to restrict the progress of thought by imposing on either their ministers or members any dogmatic statements of belief, the generality of them adopted with some modifications the theological system of Priestley, which was a combination of Locke's philosophy with the crudest rationalistic supernaturalism. With the rise of a more spiritual philosophy in Germany, which bore fruit in England and America before the close of the second decade of the century, the theology of English Unitarianism underwent a radical change, very much in the first instance under the influence of Dr Channing's writings. Without at all sacrificing its critical and rational bent, a deeper emotional and spiritual element was introduced into it, which gradually, at the cost of some years of internal conflict, dispossessed the purely external and supernaturalistic Socinian and Priestleian legacy. English Unitarian theology was thereby brought into close sympathy with modern scientific theology in Germany and elsewhere. This great and saving transformation was mainly due directly to James Martineau, J. J. Tayler, and J. H. Thom, aided by the writings of Channing and then of Theodore Parker. One consequence of the greater substantial agreement of the present theology of the larger number of the Unitarian churches with the scientific theology of the century is that not a few representatives of these churches disclaim the name Unitarian as one tending to perpetuate divisions which have really no right to continued existence. The main reason for continued separation from the larger liberal churches, whether Established or Dissenting, earnestly urged by many Unitarians of this class, is the use in those churches of theological formularies which modern theology regards as of historic interest only. The number of congregations in England and Wales generally described as Unitarian is about 300, nearly half of which date from between 1662 and 1750, and nearly all of which have undogmatic trust-deeds. Their constitution is purely congregational. For the education of their ministers they have Manchester New College, London (strictly undenominational), the Unitarian Home Missionary Board, Manchester, and Carmarthen College, supported and managed by the Presbyterian Board in London, but practically independent and Unitarian. The organs of the body are *The Inquirer*, *The Christian Life*, *The Unitarian Herald* (weeklies), and *The Christian Reformer* (monthly). In Scotland there are 7 Unitarian congregations and 2 Universalist, the latter being, as in America, Unitarian in doctrine. In Ireland the number is about 40, being nearly all Presbyterian in constitution. They are much stronger in the north than in the south of Ireland. In the north Antitrinitarian views began to spread about 1750; but the first congregation at Dublin traces its Unitarianism back to Thomas Emlyn, who was imprisoned for his Arian opinions in 1702 at the instigation of orthodox Dissenters.

United States (1815–1887).—In the United States Unitarianism had no organized existence previous to 1815, and as in England at the present time the name has always covered great differences of opinion within a common outline of belief or common drift of religious thought. Historical American Unitarianism represents "the liberal wing of the Congregational body." Of the existing 370 churches 120 or more were originally the parish churches founded by the Puritan Congregationalists, which, like the Presbyterian congregations in England, passed gradually from Calvinism through Arminianism to Unitarianism, of which Harvard College became the spiritual centre. In 1812 there was but one church in America professedly Unitarian (that of King's Chapel, Boston), though the ministers of Boston generally held Unitarian views. In 1815 Belsham's account of the "State of the Unitarian Churches in America" (in his *Life of Lindsey*, London, 1812) led to a controversy, the issue of which was the distinct avowal of Unitarian principles on the part of the liberal clergy of New England. Dr Channing came forward as the prophet and champion of American Unitarianism, though the older he grew the more emphatically he repudiated sectarianism in every form. The Congregational body was thereby split into two sections, one of which styled themselves Unitarian Congregationalists. In 1825 the American Unitarian Association was formed, mainly for the diffusion of Unitarian literature and the support of poor congregations. At that time the Unitarian churches numbered about 122. Twenty years later they were some 280, while now they are about 370. The theological colleges of the body are the Divinity School of Harvard University, which is, like Manchester New College, undenominational, and the Theological School of Meadville. As in England so in America the theology of Unitarians has passed through marked changes, which have been attended by conflicts more or less acute. From 1815 to about 1836 a Biblical, semi-rationalistic semi-supernaturalistic theology prevailed, in the heart of which Channing's elevated ethical ideas were fermenting and slowly preparing a new birth. From 1836 forces such as Biblical criticism, Carlyle and Emerson's "transcendentalism," and Theodore Parker's "absolute religion" opened the era of modern theology, bringing American Unitarianism into living touch with the philosophy and theology of Germany. An effort in 1865 to bring the right and left wings of the body into a closer confederation with a more pronounced profession of Christianity led to the formation of a Free Religious Association on the broad basis of the love of truth and goodness. In the Western States the same controversy as to the basis of religious association has been raging for more than ten years. In May 1886 a resolution was passed by the Western Unitarian Conference by a majority of more than three-fourths adopting a purely ethical and non-theological basis. This led to a split in the body, and the formation of a new Western Association on a distinctly Christian platform. The left wing of American Unitarians show greater sympathy with recent scientific speculation and less fear of pantheistic theories than is the case with English Unitarians. The organs of the body are *The Unitarian Review* (Boston), *The Christian Register* (Boston), and *The Unitarian* (Chicago).

Literature.—On Unitarianism in general, see Fock, *Der Socinianismus*, Kiel, 1847; Wallace, *Antitrinitarian Biography*, London, 1850; *Unitarianism exhibited in its Actual Condition*, edited by J. R. Beard, London, 1846. On Socinianism and Unitarianism in Poland and Transylvania: the above works; the historical sketch of Thomas Rees in his translation of the *Racovian Catechism*, London, 1818. J. J. Tayler in *Theological Review*, Jan. 1869; *Report of an Official Visit to Transylvania*, by Alexander Gordon, London, 1879. On Unitarianism in England. Wallace's and Beard's works; J. J. Tayler, *A Retrospect of the Religious Life of England*, London, 1845, 3d ed., 1876; James Martineau, *The Three Stages of Unitarian Theology*, London, 1869; Bonet-Maury, *Early Sources of English Unitarian Christianity*, English trans., London, 1884; *Unitarian Christianity, Ten Lectures on the Positive Aspects of Unitarian Thought and Doctrine*, with preface by Rev J. Martineau, D.D., London, 1881. On Unitarianism in America: Fock; Beard; J. H. Allen, *Our Liberal Movement in Theology*, 2d ed., Boston, 1883; *The Year-Book of the Unitarian Congregational Churches for 1887*, Boston, 1886; Count Goblet d'Alviella, *The Contemporary Evolution of Religious Thought in England, America, and India*, English trans., 1885. (J. F. S.)

UNITAS FRATRUM. See MORAVIAN BRETHREN.

UNITED BRETHREN IN CHRIST, a body of Protestant Christians in the United States of America, which in 1886 included 4332 organized churches (4078 in 1877), 185,103 members (143,881 in 1877), 1378 itinerant ministers, 890 local preachers, 3169 Sunday schools, with 28,547 teachers and 179,729 scholars. The total value of church property held by the denomination was $3,345,064; the sum raised for salaries, church building expenses, colleges, missions, and the like made a total of $842,700. The organization of the church is Episcopal (six bishops, two of them missionary), but its polity combines features of the Methodist, Congregational, and Presbyterian systems. The creed may be described as Arminian. The members are prohibited from joining secret societies and from using alcohol or engaging in its manufacture or sale. In connexion with the denomination are a theological institution (39 students), ten colleges, and nine academies or seminaries of a higher grade, with 62 professors, 64 other teachers, and 2486 students. There are 49 annual conferences, 46 of them in the United States. Two missions in the Sherbro country in West Africa have 6 American missionaries, 9 churches, and 2631 members; in Germany there are 10 German missionaries, with 20 churches and 615 members.

The denomination originated in the labours of P. W. Otterbein (1726–1813), a native of Germany, who came as a missionary to Lancaster, Pa., in 1752, and settled at Baltimore in 1774. He became associated with Martin Boehm, a Mennonite preacher, and also co-operated with the Methodist preachers when they came to Pennsylvania. The first annual conference was held in 1800.

UNITED KINGDOM, THE, OF GREAT BRITAIN AND IRELAND is the official title, adopted in 1801, now applied to England, Scotland, and Ireland (see GREAT BRITAIN). The total area is returned as 77,657,065 acres, or 121,339 square miles,—England and Wales embracing 37,370,041 acres (whereof Wales 4,721,633), Scotland 19,467,077, and Ireland 20,819,947. The accompanying table gives the population of the counties according to the census of 1881, and their parliamentary representation as determined by the Redistribution Act of 1885. In the enumeration of the Scottish members of parliament, groups of burghs are included in the counties containing the burghs whence they are respectively named, while it is to be observed that Kinross county is united with Clackmannan, Nairn with Elgin, and Selkirk with Peebles. The addition of the nine university representatives (England, 5; Scotland, 2; Ireland, 2) brings the total membership of the House of Commons to 670.

For the Islands in the British Seas the figures are as follows:—Isle of Man—141,263 acres, population 53,558: Channel Islands—48,322 acres, population 87,702.

Counties.	Population in 1881.	M.P.s 1885.
ENGLAND.		
Bedford	149,473	3
Berks	218,363	5
Buckingham	176,323	3
Cambridge	185,594	4
Chester	644,037	13
Cornwall	330,686	7
Cumberland	250,647	6
Derby	461,914	9
Devon	603,595	13
Dorset	191,028	4
Durham	867,258	16
Essex	576,434	11
Gloucester	572,433	11
Hants	593,470	12
Hereford	121,062	3
Hertford	203,069	4
Huntingdon	59,491	2
Kent	977,706	19
Lancaster	3,454,441	57
Leicester	321,258	6
Lincoln	469,919	11
Middlesex	2,920,485	47
Monmouth	211,267	4
Norfolk	444,749	10
Northampton	272,555	7
Northumberland	434,086	8
Nottingham	391,815	7
Oxford	179,559	4
Rutland	21,434	1
Shropshire	248,014	5
Somerset	469,109	10
Stafford	981,013	17
Suffolk	356,893	8
Surrey	1,436,899	22
Sussex	490,505	9
Warwick	737,339	14
Westmoreland	64,191	2
Wilts	258,965	6
Worcester	380,283	8
York	2,886,564	52
	24,613,926	460
WALES.		
Anglesey	51,416	1
Brecon	57,746	1
Cardigan	70,270	1
Carmarthen	124,864	3
Carnarvon	119,349	3
Denbigh	111,740	3
Flint	80,587	2
Glamorgan	511,433	10
Merioneth	52,038	1
Montgomery	65,718	2
Pembroke	91,824	2
Radnor	23,528	1
	1,360,513	30
England and Wales	25,974,439	490
SCOTLAND.		
Aberdeen	267,990	4
Argyll	76,468	1
Ayr	217,519	4
Banff	62,736	1
Berwick	35,392	1
Bute	17,657	1
Caithness	38,865	2
Clackmannan	25,680	1
Dumbarton	75,333	1
Dumfries	76,140	2
Edinburgh	389,164	6
Elgin	43,788	2
Fife	171,931	4
Forfar	266,360	4
Haddington	38,502	1
Inverness	90,454	2
Kincardine	34,464	1
Kinross	6,697	—
Kirkcudbright	42,127	1
Lanark	904,412	13
Linlithgow	43,510	1
Nairn	10,455	—
Orkney and Shetland	61,749	1
Peebles	13,822	1
Perth	129,007	3
Renfrew	263,374	4
Ross and Cromarty	78,547	1
Roxburgh	53,442	2
Selkirk	25,564	—
Stirling	112,443	3
Sutherland	23,370	1
Wigtown	38,611	1
	3,735,573	70
IRELAND.		
Antrim	421,943	8
Armagh	163,177	3
Carlow	46,568	1
Cavan	129,476	2
Clare	141,457	2
Cork	495,607	9
Donegal	206,035	4
Down	272,107	5
Dublin	418,910	6
Fermanagh	84,879	2
Galway	242,005	4
Kerry	201,039	4
Kildare	75,804	2
Kilkenny	99,531	3
King's	72,852	2
Leitrim	90,372	2
Limerick	180,632	3
Londonderry	164,991	3
Longford	61,009	2
Louth	77,684	2
Mayo	245,212	4
Meath	87,469	2
Monaghan	102,748	2
Queen's	73,124	2
Roscommon	132,490	2
Sligo	111,578	2
Tipperary	199,612	4
Tyrone	197,719	4
Waterford	112,768	3
Westmeath	71,798	2
Wexford	123,854	2
Wicklow	70,386	2
	5,174,836	101
UNITED KINGDOM	34,884,848	661

UNITED PRESBYTERIAN CHURCH, THE, in point of numbers the third of the Presbyterian organizations of Scotland, was formed in 1847 by the union of the United Secession and Relief Churches (see below). The doctrinal standards are those of the other Presbyterian churches of Scotland, and the formula employed at the ordination of ministers is similar to that of the Established and Free Churches; but adherence to the doctrinal standards is professed in view of the Declaratory Act of 1879, according to which signatories "are not required to approve of anything in the standards of the church which teaches or is supposed to teach compulsory or persecuting and intolerant principles in religion," and are allowed freedom of opinion on all points which, in the judgment of the church, do not enter into the substance of the faith. The denomination in 1887 consisted of 32 presbyteries and 564 congregations (518 in 1847), with a total membership of 182,063 (175,066 in 1878; 178,195 in 1883), thus representing about 14 per cent. of the population of Scotland. The number of baptisms in 1886 was 9894; there were 887 Sunday schools, with 11,994 teachers and 97,535 scholars, besides 788 advanced Bible classes, with 30,535 scholars. The total income of the church in 1886 was £373,545 (average for ten years from 1877 to 1886, £375,660); of this total £237,300 was ordinary congregational income, and £136,245 missionary and benevolent income. The average stipend paid to each minister was £259, 16s. 10d. There is a divinity hall in Edinburgh with 4 professors and (session 1887–88) 114 students. The term of study is three years. The United Presbyterian Church has missions in Jamaica (a synod with four presbyteries), Trinidad, Kaffraria, Old Calabar, India, China, Japan, and Spain. The mission staff consists of 60 ordained Europeans, 22 ordained natives, 8 medical missionaries, 3 European evangelists, and 19 female missionaries. Under these are 502 native evangelists, teachers, and other helpers. In 1886 the membership of the native congregations was 13,214 (10,215 in 1881). In Jamaica there is a theological institution. At the end of 1875 the denomination had 620 congregations, with 190,242 members, but in June 1876 98 of its congregations in England, with 20,207 members, were incorporated with the English Presbyterian Church.

HISTORY.—(1) *United Secession Church.*—The general causes which led to the first great secession from the Church of Scotland as by law established in 1688 have already been briefly indicated under PRESBYTERIANISM (see vol. xix. p. 685; compare also SCOTLAND, CHURCH OF, vol. xxi. p. 536 *sq.*). Its immediate occasion rose out of an Act of Assembly of 1732 which abolished the last remnant of popular election by enacting that, in cases where patrons might neglect or decline to exercise their right of presentation, the minister was to be chosen, not by the congregation, but only by the elders and Protestant heritors. The Act itself had been passed by the Assembly, although the presbyteries to which it had been previously submitted as an overture had disapproved of it by a large majority; and in accordance with a previous Act (1730), which had taken away even the right of complaint, the protests of the dissentient majority were refused. In the following October Ebenezer ERSKINE (*q.v.*), minister of Stirling, who happened to be moderator of the synod of Perth and Stirling, preached a synod sermon, in the course of which he took occasion to refer to the Act in question as in his opinion unscriptural and unconstitutional.[1] Some of his expressions were objected to by members of synod because "tending to disquiet the peace of the church and impugning several Acts of Assembly and proceedings of church judicatories," and after long and keen debate it was resolved that he should be censured for them. This judgment, on appeal, was affirmed by the Assembly in May 1733, whereupon Erskine protested to the effect that he held himself still at liberty to teach the same truths and to testify against the same or similar evils on every proper occasion. This protest, in which he was joined by William Wilson, Alexander Moncrieff, and James Fisher, ministers at Perth, Abernethy, and Kinclaven respectively, was regarded by the Assembly as contumacious, and the commission of Assembly was ordered to procure its retractation or to proceed to higher censures. In November accordingly the protesting ministers were severed from their charges, their churches declared vacant, and all ministers of the church prohibited from employing them in any ministerial function. They replied by protesting that they still adhered to the principles of the church, though now obliged to "make a secession from the prevailing party in ecclesiastical courts," maintaining their continued right to discharge all the duties of the ministerial and pastoral office "according to the word of God, the Confession of Faith, and the constitution of the church," and appealing to the "first free, faithful, and reforming General Assembly of the Church of Scotland." In December 1733 they formally constituted themselves into a presbytery, but for some time their meetings were devoted almost entirely to prayer and religious conference. In 1734 they published their first "testimony," with a statement of the grounds of their secession, which made prominent reference to the doctrinal laxity of previous General Assemblies. In 1736 they proceeded to exercise "judicial powers" as a church court, published a "judicial testimony," and began to organize churches in various parts of the country. Having been joined by four other ministers, including the well-known Ralph Erskine, they appointed Mr Wilson professor of divinity. For these acts proceedings were again instituted against them in the Assembly, with the result that, having disowned the authority of that body in an "act of declinature," they were in 1740 all deposed and ordered to be ejected from their churches. Meanwhile the members of the "Associate Presbytery" and its adherents steadily increased, until in 1745 there were forty-five congregations under its jurisdiction, and it was reconstituted into an "Associate Synod." A violent controversy arose the same year respecting the religious clause of the oath taken by burgesses in Edinburgh, Glasgow, and Perth ("I profess and allow with my heart the true religion presently professed within this realm and authorized by the laws thereof"), and resulted in April 1747 in a "breach," when two bodies were formed, each claiming to be the "Associate Synod"; those who condemned the swearing of the burgess oath as sinful came to be popularly known as "Antiburghers," while the other party, who contended that abstinence from it should not be made a term of communion, were designated "Burghers." The Antiburghers not only refused to hold further friendly conference with the others, but ultimately went so far as to pass sentences of deposition and the greater excommunication on the Erskines and other ministers who held the opposing view.

The Associate (Antiburgher) Synod held its first meeting in Edinburgh in the house of Adam GIB (*q.v.*) on April 10, 1747. It grew with considerable rapidity, and in 1788 had ninety-four settled charges in Great Britain and nineteen in Ireland, besides a presbytery in America. For purposes of organization it was formed in that year into four provincial synods, and took the name of "The General Associate Synod." The "new light" controversies as to the province of the civil magistrate in matters of religion led to the publication of a revised testimony in the "voluntary" sense in 1804, and in consequence M'Crie, the historian of Knox, with three other brethren, withdrew to form the Constitutional Associate Presbytery.

The Associate (Burgher) Synod held its first meeting at Stirling on June 16, 1747. The number of congregations under its charge rapidly increased, and within thirty years there were presbyteries in connexion with it in Ireland and North America, as well as throughout Scotland. In 1782 the American presbyteries took the designation of the Associate Reformed Church in America. About the year 1795 the "voluntary" controversy respecting the power of the civil magistrate in matters of religion arose within this synod also, and a large majority was found to have adopted "new light" views. This led in 1799 to the secession of the "Associate Presbytery," which in 1805 took the designation of the Associate Synod or Original Burgher Synod.[2]

In 1820 the General Associate or Antiburgher Synod (to the number of 129 congregations[3]) united with the 154 congregations of the Associate or Burgher Synod. The body thus constituted, "The United Secession Church," had increased by 1847 to 400 congregations, the whole of which united in that year with the Relief Synod to form the United Presbyterian Church.

(2) *Relief Church.*—The Presbytery of Relief was constituted in 1761 by three ministers of the Church of Scotland, one of whom was Thomas GILLESPIE (*q.v.*), who had been deposed by the Assembly in 1752 for refusing to take part in the intrusion of unacceptable ministers. The number of congregations under its charge increased with considerable rapidity, and a Relief Synod was formed in 1773, which in 1847 had under its jurisdiction 136 congregations; of these 118 united with the United Secession Church in that year. The Relief Church issued no distinctive "testimonies," and a certain breadth of view was shown in the formal declaration of their terms of communion, first made in 1773, which allowed occasional communion with those of the Episcopal and Independent persuasion who are "visible saints." A Relief theological hall was instituted in 1824.

See M'Kerrow, *History of the United Secession Church*, 1841; Struthers, *History of the Relief Church*, 1843; Mackelvie, *Annals and Statistics of the United Presbyterian Church*, 1873.

UNITED PROVINCES. See HOLLAND.

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[1] The passing of the Act was certainly unconstitutional; it was rescinded in 1734. "because not made according to former Acts."

[2] The majority of this synod joined the Church of Scotland in 1839. The small minority which still retained the name joined the Original Seceders (see next note) in 1842, the resultant body assuming the designation of United Original Seceders. A small majority (twenty-seven ministers in all) of the Synod of United Original Seceders joined the Free Church in 1852. A synod of this name still exists, having under its jurisdiction four presbyteries, with twenty-nine charges (of which two are in Ireland).

[3] A dissentient remnant (eight congregations) of the General Associate Synod united with the Constitutional Associate Presbytery in 1827. the resultant body being called the Associate Synod of Original Seceders.

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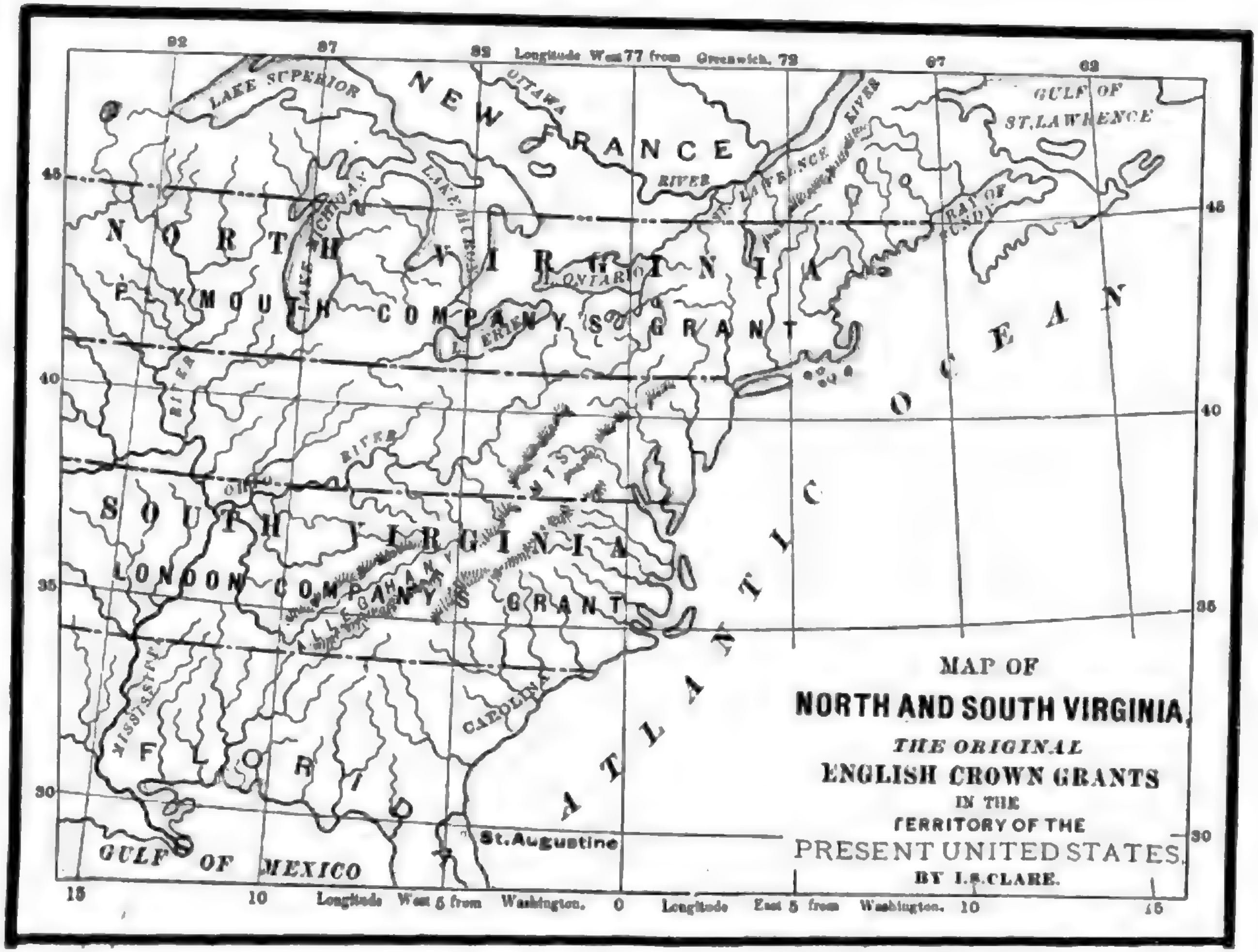
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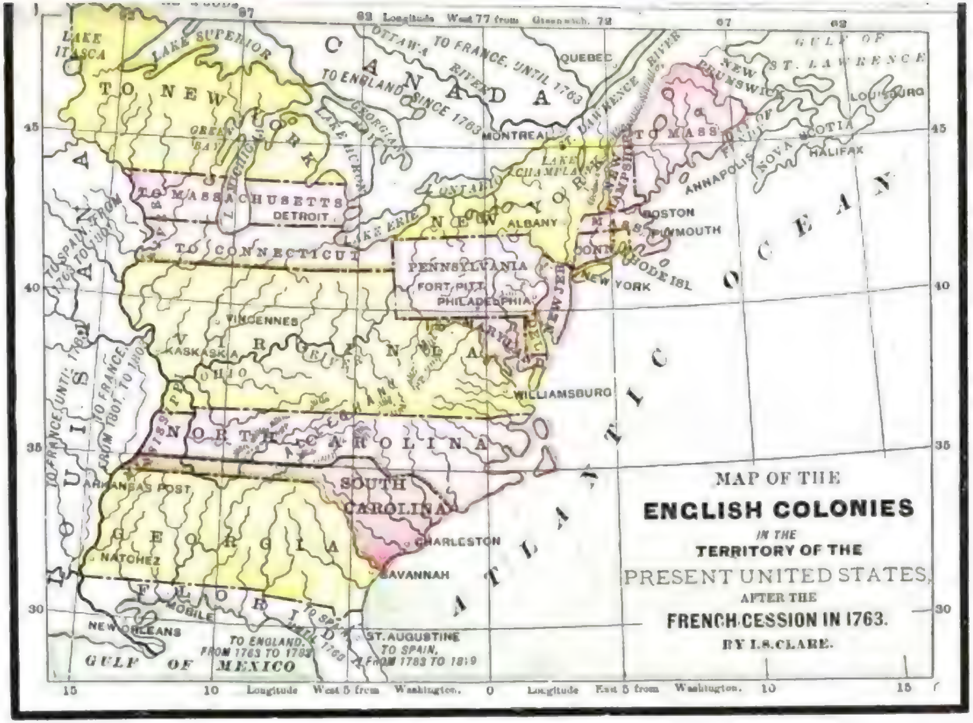
MAP OF
NORTH AND SOUTH VIRGINIA,
THE ORIGINAL
ENGLISH CROWN GRANTS
IN THE
TERRITORY OF THE
PRESENT UNITED STATES.
BY I. S. CLARE.



MAP OF THE

ENGLISH COLONIES

IN THE

TERRITORY OF THE

PRESENT UNITED STATES,

AFTER THE

FRENCH CESSION IN 1763.

BY I. S. CLARE.

Longitude West 77 from Greenwich
Longitude West 5 from Washington.
Longitude East 5 from Washington.
45
40
35
30
15
10
0
87
82
72
67
62
CANADA
OTTAWA RIVER
TO FRANCE, UNTIL 1763
TO ENGLAND SINCE 1763
QUEBEC
MONTREAL
ST. LAWRENCE RIVER
GULF OF ST. LAWRENCE
NEW BRUNSWICK
LOUISBURG
NOVA SCOTIA
HALIFAX
ANNAPOLIS
TO MASS.
LAKE SUPERIOR
LAKE ITASCA
TO NEW YORK
GREEN BAY
L. MICHIGAN
LAKE HURON
GEORGIAN BAY
TO MASSACHUSETTS
DETROIT
TO CONNECTICUT
LAKE ERIE
ONTARIO
LAKE CHAMPLAIN
NEW YORK
ALBANY
NEW HAMPSHIRE
MASS.
BOSTON
PLYMOUTH
CONN.
RHODE ISL.
NEW YORK
NEW JER.
PENNSYLVANIA
FORT PITT
PHILADELPHIA
MARYLAND
DEL.
VIRGINIA
VINCENNES
KASKASKIA
OHIO
WILLIAMSBURG
NORTH CAROLINA
SOUTH CAROLINA
CHARLESTON
SAVANNAH
GEORGIA
ARKANSAS POST
NATCHEZ
FLORIDA
MOBILE
NEW ORLEANS
TO ENGLAND, FROM 1763 TO 1783
TO SPAIN, UNTIL 1763
ST. AUGUSTINE
TO SPAIN, FROM 1783 TO 1819
GULF OF MEXICO
ATLANTIC OCEAN
LOUISIANA
TO FRANCE, UNTIL 1762
TO SPAIN, FROM 1763 TO 1801
TO FRANCE, FROM 1801, TO 1803

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UNITED STATES.

PART I.—HISTORY AND COLONIZATION.

I. DISCOVERY AND SETTLEMENT OF AMERICA.

1. THE date on which America was first discovered by Europeans is a matter of uncertainty. The legends respecting the early voyages hither are numerous, but the most ancient of them are doubtless fictions. No account of the discoveries, previous to the time of Columbus, can be relied upon, excepting those made by the Icelanders, who, about the year 1000, attempted to colonize the country, but without any permanent success. It was not until the coming of Columbus, in 1492, that any benefit was derived by the old world from the discovery of the great continent of America.

The success of Columbus aroused the spirit of enterprise, and other voyages were made, notably those of the Cabots in 1497-98, Ponce de Leon in 1512, and Verrazzano in 1523, under the auspices of the English, Spanish and French governments, respectively. The Spaniards gave the name of "Florida" to North America, while the French called it "Canada or New France," and these two nations in some way conceived the idea that the whole country belonged to them.

2. But the English had not forgotten that the Cabots, with English ships, had first reached the mainland of North America and from this fact they laid claim to the northern part of that continent. Many unsuccessful attempts were made by Englishmen to found colonies. The first of these was Sir Humphrey Gilbert who made two efforts, one in 1578, and the other in 1583, without success, and lost his life in a storm while returning home. Sir Walter Raleigh, Gilbert's half-brother, obtained a patent from Queen Elizabeth, and in 1584 sent out two ships, commanded by Amidas and Barlow, to fix upon a place for a settlement. They explored the coast of what is now North Carolina. Struck with the beauty and fertility of the country, they gave a most flattering account of it on their return home, and Raleigh named it Virginia, in honor of the "virgin queen" Elizabeth. In the spring of 1585 he sent out a colony which settled on Roanoke Island, but it was starved out in the same year. Again, in 1587, Raleigh sent out another colony under White to the same place, but it entirely disappeared, and no trace of it could be found when White came back three years later. In 1602, Gosnola, with twenty colonists, took a short and direct route, and came upon the coast of Massachusetts. He wintered upon an island in the vicinity and then went back, taking the colonists, who refused to stay any longer, with him.

3. In 1606, James I granted a charter to two companies formed in England. This charter gave them the whole continent of North America, from the thirty-fourth to the forty-fifth parallel of latitude. The one called the Plymouth Company was to take the northern half, and the other the London company, the southern half, and their nearest settlements must be a hundred miles apart. Moreover, each colony was to be governed by a resident council appointed by the king, with power to choose one of their own number for president.

4. The earliest attempts at colonization under the new English patent were made by the Plymouth company, but the expeditions which they sent out in 1606, 1607 and 1608, were unsuccessful, and it was left for the London company to found the first permanent English settlement in the new world. In 1606 this company sent out about a hundred men, mostly adventurers, in a fleet of three vessels commanded by Christopher Newport. Being driven by a storm into Chesapeake Bay, he found there a fine river which he named the James river, after the king, and choosing a low peninsula, he there planted the colony of Jamestown on May 13, 1607. But very soon the colonists became dissatisfied. Dissensions arose and Wingfield, president of the council, was deposed. They suffered from starvation, and had it not been for the indefatigable exertions of Captain John Smith, the settlement would have entirely broken up. The colonists experienced many vicissitudes, but after a few years they became prosperous and the permanent settlement of Virginia was established. In the meantime, the policy of the London company toward the settlers became more liberal, and a representative government was granted them in 1619, which was the beginning in America of government by the people. In 1619 a Dutch vessel brought in some negroes purchased by the planters, and thus slavery was introduced into the English colonies.

Plymouth colony.

5. The first settlers of Massachusetts were a band of Puritans, or Separatists, as they were called, because they had separated from the Church of England. Being driven from England, they sought refuge in Holland; but wishing to find a home in the new world for themselves and their children, they returned to England again, and from thence a band of 102 set sail in the Mayflower, and landed at Plymouth, in America, December 21, 1620. The little colony survived the rigors of a northern winter, the burden of poverty, and the lack of food, and became permanently established.

Massachusetts Bay colony.

6. In 1628 John Endicott, with a company, made a settlement at Salem; other towns, also, sprang up around it, and these were all united under a charter obtained from Charles I, with the name of the Massachusetts Bay colony. These two colonies, Plymouth and Massachusetts Bay, were for many years independent of one another; but were at last united in 1692, under the name of Massachusetts.

Maryland

Carolina

Georgia.

7. In 1624, the London company surrendered its charter to the king, who made a disposition of the territory which they had controlled, as he thought fit. A part of it was granted to Lord Baltimore in 1632, and received the name of Maryland. All the country between the English settlements of Virginia and the Spanish posts in Florida was called Carolina. This territory comprised the present states of North Carolina, South Carolina, Georgia, Alabama and part of Florida. In 1729 North and South Carolina were organized, and in 1732 Georgia was colonized by James Oglethorpe, and Savannah founded. Thus, out of the territory, originally granted to the London company, five colonies had been formed.

The other New England colonies

8. To the territory granted to the Plymouth company, the name New England had been given by Captain John Smith in 1614. The founding of the Plymouth and Massachusetts Bay colonies has already been mentioned. The greater number of the people who came from England in the great Puritan migration, settled in the latter colony. At the same time many found it expedient to seek other parts of New England. Now only did new-comers thus try new places, but the older settlements began to send out companies. In 1623 New Hampshire was first colonized under a grant to Captain John Mason and Sir Ferdinand Gorges. Connecticut and Rhode Island also became colonies, and were afterward chartered by the crown in 1662 and 1663. Thus, out of that part of the country originally granted to the Plymouth company, were formed the colonies of Massachusetts, Connecticut, New Hampshire and Rhode Island. Maine was considered a part of Massachusetts and was not counted as

a separate colony among those that finally combined to form the original thirteen states. The territory now occupied by Vermont was claimed in part by New York, in part by New Hampshire, and she did not become a separate state until after the revolutionary war.

9. As has been said, the charter granted to the London and Plymouth companies provided that their nearest settlements should be one hundred miles apart, thus leaving a strip of territory between the two main grants which was really neutral ground, and was never appropriated by either company. The Spaniards had confined their explorations to the south and made settlements there, but they claimed the whole continent north of them. The French had established themselves in the north, and held Canada and part of the northern states; they claimed everything south of them and called the whole New France. The English settlements were midway between the French and Spanish, and the English claimed everything from New England and Carolina westward to the Pacific, naming it all Virginia. Thus, so far, North America was divided between the three European powers, England, France and Spain.

The rise of the Dutch power.

10. A fourth power now appeared. In 1609, the Dutch East India company sent out Henry Hudson, an Englishman in their employ, in the ship named the "Half Moon" to make discoveries in America. He reached the continent and explored the coast as far south as Virginia, then turning to the north he entered the mouth of the river which bears his name, and sailed up the stream as far as the present city of Albany. Having completed his discovery he returned home. Upon the strength of Hudson's explorations, Holland laid claim to all the land along the great river, and called the whole territory New Netherlands. In 1621, the Dutch West India company was formed, and immediately received large grants of land on both sides of the Hudson extending from the Connecticut river on the north to the Delaware river on the south. Previous to this, however, a Dutch settlement had been founded in 1614, on Manhattan Island, the present site of New York City, which was afterwards called New Amsterdam.

The Swedish colony.

The Dutch now began to establish settlements and trading posts in their possessions, which included that neutral territory lying between the original grants to the London and Plymouth companies. In 1638, Delaware was colonized by the Swedes, who founded a settlement on Delaware Bay, which was called New Sweden. But disputes about a territory arose between the Swedish and Dutch colonists, which led to a war between them, ending in the final surrender of New Sweden to the New Netherlands in 1655.

End of the Dutch power.

11. But New Netherlands was soon destined to change hands. The introduction of a foreign element between the northern and southern portions of the English colonies had always been recognized as a source of trouble and danger, and in fact the Dutch settlers, occupying territory claimed by the English on both sides of them, were continually involved in disputes with their neighbors, especially with those of Connecticut. War having arisen between England & Holland, the English king, Charles II, determined to seize the Dutch possessions in North America; so in 1664 he granted the whole of their territory to his brother, the Duke of York. In the same year the duke sent out three vessels under the command of Colonel Nichols, who, upon arriving in the harbor of New Amsterdam, demanded a surrender of the territory to his English majesty. Governor Stuyvesant, being unprepared for defense, complied with the demand, and the whole country passed into the hands of the English. In honor of the duke, the name New Amsterdam was changed to New York, and the whole territory received the same name.

New York.

12. After the Duke of York had gained possession of the Dutch territory, he in turn sold the southern part of it to two English noblemen, Lord Berkely and Sir George Carteret. This tract, in compliment to Sir George, who had been governor of the island of Jersey, was called New Jersey. A liberal constitution was formed by the proprietors, and Philip Carteret appointed governor. The Dutch had several small trading stations in this territory at an earlier date, and the Quakers, having bought the rights of Lord Berkely, came soon afterwards. In 1676 a division was made, the Quakers taking West Jersey and Carteret retaining East Jersey, which became Puritan. In 1702 the colony was given up by the proprietors to Queen Anne in order that a royal governor might be appointed, and the two provinces were then made into one.

Pennsy-vania.

13. The territory comprised within the limits of the state of Pennsylvania was granted in 1681, by Charles II to William Penn, son of Admiral Penn, in payment of an old debt due from the crown to the Penn family. In 1682, the present state of Delaware, then known as the "Territories," was added to his domain, and regarded as a part of Pennsylvania, but in 1703 it became a separate colony. Thus, the formation of the original thirteen colonies has been described. The London Company's territory furnished five, viz: Virginia, Maryland, North Carolina, South Carolina and Georgia. The Plymouth Company's grant, comprising New England, gave four, viz: Massachusetts, Connecticut, Rhode Island and New Hampshire. The neutral territory included between the original grants to the two companies furnished four, viz: New York, New Jersey, Pennsylvania and Delaware.

Delaw

The original thirtee colonies

The con tutions the colo

14. It is in vain to look for well balanced constitutions in the earlier periods of colonial history. England herself can scarcely boast of having a fixed constitution previous to the revolution in the year 1688, a period subsequent to the settlement of the colonies. The legal and constitutional history of the colonies, therefore, affords but little instruction. As has been shown, in less than eighty years from the first permanent English settlement in North America, the two original patents granted to the Plymouth and London companies were divided and subdivided into twelve distinct and unconnected provinces, and in fifty years more a thirteenth, Georgia, was added to the southern extreme of the previous establishments. To each of these, after various changes, there was ultimately granted a form of government resembling in its most essential parts, as far as local circumstances would permit, that which was established in the parent state. Without entering into details, it may be observed, in general, that agreeably to the spirit of the British constitution, ample provision was made for the liberty of the colonists. The colonial forms of government were, in the main, unhampered by the royal prerogatives. In some of the provinces the inhabitants chose their own governors and all other public officers, and their legislators were under little or no outside control. In others, the crown delegated most of its powers to particular persons, who were also invested with the property of the soil. To those colonies which were most immediately dependent upon the king were granted the same rights and privileges as their fellow subjects in the mother country.

Forms gover-ment

15. During the period of colonization, three forms of government were observable—proprietary, charter and royal. The proprietors of land grants offered liberal governmental privileges to those who were willing to settle on their lands, and thus several of the colonies became proprietary. These were Maryland, Carolina, Georgia, New York, New Hampshire, Pennsylvania (also including Delaware) and New Jersey. Some of the proprietors becoming tired of their grants, surrendered them to the crown, and the colonies, established in such territory, became royal provinces, over which the king appointed governors with the power of absolute veto on legislation. The colonies thus coming under the royal authority were, North Carolina, South

Colonies under a charter government.

Carolina, Georgia, New York, New Hampshire and New Jersey. Virginia became a royal province about 1630. Three colonies, only, remained proprietary down to the Revolution; these were Pennsylvania, Delaware (now a separate colony) and New Jersey. The colonies organized under a charter government were Massachusetts, Connecticut and Rhode Island. These charters were granted by royal authority, and gave the colonists the right of choosing their own officers, and making and enforcing their own laws as they thought best. Upon the accession of James II to the throne, he held that all the colonial lands in New England belonged to the crown. Accordingly he sent over Sir Edmund Andros, who was to revoke all the charters, and assume the governorship of the province of New England and New York. The charter of Massachusetts was annulled in 1684, but Connecticut and Rhode Island retained theirs in spite of the royal authority. In 1692, a new charter was granted to Massachusetts, but under its conditions she partly became a royal province.

English policy toward the colonists.

Growth and prosperity of the colonies.

Causes of increase in population.

16. For the first century and a half after the settlement of the colonies, England, in the main, exercised a wise and liberal policy toward them. She allowed them to govern themselves by such laws as their local legislatures thought necessary, and left their trade open to every individual in her dominions. She also gave them full permission to pursue their respective interests in such a manner as they thought proper, and reserved little for herself but the benefit of their trade, and that of a political union under the same head. This indulgence had a very marked effect upon the growth and prosperity of the colonies. They increased in wealth, numbers and resources with a rapidity never before equalled in ancient or modern history. They extended their settlements 1,500 miles along the sea coast, and 300 miles to the westward. In the short space of 150 years their numbers increased to three millions, and their commerce to such a degree as to be more than a third of that of Great Britain, although much restricted by the navigation laws imposed upon them by the mother country. The rapid increase in the population of the colonies was principally owing to internal causes. Though somewhat accelerated by the influx of strangers previous to 1630, yet, after that time, immigration formed but a small feature in peopling the country. The hardships of colonial life, which came to be better understood, and the constant struggles between the people and the home government respecting rights and privileges, served as a check to the advent of new comers. Hence the population of the colonies arose mainly from natural increase. In consequence of the equality of fortune and simplicity of manners which prevailed among them, their inhabitants multiplied far beyond the proportion of old nations, corrupted and weakened by the vices of wealth, above all, of vanity, than which, perhaps, there is no greater enemy to the increase of the human species.

Social life and customs of New England.

17. In the settlement of a new country, many hardships and privations must of necessity be endured, and the American colonists experienced their share of them, more especially those of New England. In that section the climate was more rigorous than in the other parts of the country, and the cultivation of the soil more difficult. The habitations outside of the regular settlements were often far apart, so that intercommunication was infrequent. The dwellings of the settlers were of the ruder sort, being composed of logs, and so imperfectly constructed that they afforded a poor protection against the cold of a New England winter. While the colonists were poor there was necessarily great plainness of living among them. Luxuries were unknown to them, but there was an abundance of the coarser kinds of food. Pork and beans, boiled corn meal and milk, or pork and peas, formed the staple articles of diet. Bread was commonly made of "rye and Indian," and seldom of flour. Tea and coffee were not yet introduced but home-made beer and cider were largely used. Being principally of Puritan stock, there were but few secular amusements among them. Dancing, and the theater, or anything approaching it, were forbidden; musical instruments were rare, and no one was allowed to own a set of dice or a pack of cards. In their desire to promote virtue, the Puritans, no doubt, were too austere in their mode of living, yet the standard of morality among them was certainly very high. In the southern colonies life was more easy, as a general thing. A large proportion of the settlers there were men of good family, attracted to the new world by a desire to make money and to enjoy personal freedom. Many of them secured patents for plantations of their own, instead of attempting to improve the lands in common, and brought out laborers to work them at their private expense. The soil was very productive, and the growth of tobacco, rice and indigo formed a great source of wealth, so that luxury abounded in that part of the country to a much greater extent than in any other. The existence of slavery among them caused a great deal of ignorance and idleness, as the wisest of them admitted; but there grew up an aristocratic class, among whom there were many men of high character and energy. The settlers in the region which now forms the middle states principally followed the occupation of farming, the soil and climate being well adapted for the growth of cereals.

The religious condition.

Religious freedom.

18. The religion of the colonists was chiefly Protestant. A majority of them, especially in the north, were of that class of men who, in England, were called dissenters. In New England they were largely Congregational. All the other leading denominations also had their representatives in different parts of the country. In the royal colonies there was a strong tendency towards the Church of England, which became the prevailing religion among them. In Virginia it was established by law. In fact nearly every colony at the outset attempted to establish some form of religious belief on a governmental foundation, and on account of this, as is well known, persecutions at the first arose. But the spirit of religious freedom predominated, and in general, men were left at liberty to worship God according to the dictates of their own consciences.

The spirit of liberty.

Rights of English subjects.

19. The English colonists were, from their first settlement in America, devoted to liberty, according to English ideas and English principles. After a long struggle between the king and his parliament culminating in the English revolution, the following fundamental principles were settled: "That it was the undoubted right of English subjects, being freemen or freeholders, to give their property only by their own consent. That the House of Commons exercised the sole right of granting the money of the people of England, because that house alone represented them. That taxes were the free gifts of the people to their rulers. That the authority of sovereigns was to be exercised only for the good of their subjects. That it was the right of the people to meet together, and peaceably to consider their grievances, to petition for a redress of them, and finally, when intolerable grievances were unredressed, to seek relief, on the failure of petitions and remonstrances, by forcible means." Upon these fundamental principles thus established, the colonists took their stand, and all encroachments on their rights were met with a more determined spirit of opposition than would have been possible, had they emigrated from the mother country in the preceding century, when the doctrines of the divine right of kings and passive obedience to their will were generally accepted.

Causes favorable to liberty

20. There were many causes favorable to liberty among the colonists. Their removal to so great a distance from the parent government greatly weakened their attachment to their sovereign, and with each succeeding generation that affection became still less marked, and at length was almost entirely lost. Their

religion also fostered a love of liberty. They were chiefly Protestants, and all Protestantism is founded on a strong claim to natural liberty and the right of private judgment. The state of society in the colonies was favorable to a spirit of liberty and independence. Their inhabitants, unaccustomed to the distinctions of rank which characterized European nations, were imbued with the idea that all men are by nature equal. All their impressions were calculated to inspire them with a belief that democratic forms of government were by far the best. With rank and titles they had nothing in common; kings, nobles and bishops were unknown to them. They could not easily be persuaded that their grants of land or their civil rights were the gifts of princes. Many of them had never heard of Magna Charta, and those who knew the circumstances of the remarkable period of English history when that great charter was obtained, did not rest their claims to liberty and property on the transactions of that important day. They looked to the Parent of the universe as the source of all their rights. Their political creed was short but sound. They believed that God made all mankind originally equal; that he endowed them with the rights of life, property and as much liberty as was consistent with the rights of others. That all government was a political institution between men naturally equal, not for the aggrandizement of one or a few, but for the general happiness of the whole community. Impressed with sentiments of this nature, they grew up, from the earliest infancy, with that confidence which is well calculated to inspire a love for freedom and a prepossession in favor of independence.

II.—THE CONTEST BETWEEN ENGLAND AND FRANCE.

France in America. 21. While the English were establishing their colonies along the Atlantic coast, and gradually working their way into the interior, the French were penetrating the continent by the way of the St. Lawrence, taking advantage of the discoveries made by Cartier, Champlain and others. The two great pioneers of French occupation were the fur trader and the missionary. It was about the time of the settlement of Massachusetts Bay that the Jesuit Fathers, who had already been laboring for many years among the Algonquins and Hurons of Canada and New York, began to push their explorations westward with renewed zeal and enterprise, accompanying, and often leading the Canadian fur traders on their long journeys. Among the soldiers, also, who came to New France, as the French possessions in America were called, were men who were intent upon enlarging their king's domains. Several of the Jesuits were martyred. Allouez made known the copper mines of Lake Superior. Dablou and Marquette founded Sault Ste. Marie, the first white settlement in the northwestern states. Marquette, accompanied by the trader Joliet, first reached the upper waters of the Mississippi in 1673.

Robert de la Salle. 22. One of the greatest of French explorers was Robert de la Salle, who came out to Canada to seek his fortune. A tract of land was granted him a few miles beyond Montreal, but he was bent upon new discoveries. He secured the aid of some rich men and of Count Frontenac, governor of Canada, and having built some vessels, he explored the upper lakes, made his way to the Illinois river, and erected a fort on the present site of Peoria. At last he made the great journey which he had for some time been planning. He set out from Fort Miami, on Lake Michigan, with a party of Frenchmen and Indians. He dragged his canoes from stream to stream until, after innumerable hardships and dangers, from which he never flinched, he launched them upon the waters of the Mississippi and floated down its current. He explored the great river to its mouth, and in 1682, took possession of the vast territory drained by it and its tributaries in the name of Louis XIV, king of France, and named it Louisiana after him. He then retraced his course and hastened back to France. The king fitted out an expedition for La Salle that he might establish a colony at the mouth of the Mississippi. The naval commander, Beaujeu, landed La Salle and his company at Matagorda bay, in Texas, which La Salle supposed at first was the mouth of the Mississippi. Then Beaujeu sailed back and left the colonists to their fate. They built a fort, and La Salle set out to find the Mississippi, but utterly failed. Dividing his men, he left one party in possession of the fort, and with the other endeavored to force his way to Canada, there to obtain relief. He never reached the end of his journey. After suffering terrible hardships, he was treacherously murdered (1687) by some of his own party when on his way. France sent out another expedition under D'Iberville, who (1702) founded Mobile. In 1718 the city of New Orleans was founded by the French Mississippi Company.

23. The French planted military posts at intervals along the great river, and settlements rose up about them. The French colonies and outposts also extended from New Brunswick and Nova Scotia, up the valley of the St. Lawrence, and through the region of the great lakes. Thus the English settlements became enclosed by a cordon of military posts, and at that time it seemed as though the whole continent were destined to become French rather than English. The French also had an advantage from the fact that they had secured the good will of most of the Indian tribes through their own prudent policy and the influence of their missionaries. The English settlers looked upon their French neighbors with jealousy and alarm, for they interfered with the extension of their settlements, especially in the north. In the southern colonies the inconvenience of the French occupancy was comparatively but little felt. Their social characteristics and the nature of their industry were not favorable to western migration, so, as there was nothing to tempt them away from their plantations into the wild interior they kept close to the seacoast. But in the north it was different. There the constant increase of commerce was followed by the increased wealth of the towns, and consequently the lands about them became more valuable. The great bulk of the emigrants who came over landed at the northern ports since trade was more active in the northern colonies. Many of these, being unable to purchase homes near the great centers of trade and the many flourishing settlements, or being impelled by a spirit of enterprise, went in search of new lands farther from the coast. Thus the northward and westward growth of New England and the English conquest of New Netherlands brought the two great rivals face to face. [illegible] posts

24. The great struggle between France and England began in 1690. King James II had been dethroned (1688), and William of Orange placed upon the English throne. The French king, Louis XIV, espoused the cause of James, and a war followed, known as King William's War, in which the colonies became involved. Both the French and English colonists made use of Indian allies, and the warfare was marked by the most barbarous excesses. The Indians of Maine and New Hampshire were incited by French traders to attack the English towns. In 1689 Dover was burned. Casco was attacked, but the timely arrival of reinforcements from Massachusetts saved it. All the settlements further east were broken up. In 1690 the war became more earnest. Three war parties of French and Indians were sent out by Count Frontenac from Montreal, Three Rivers and Quebec. The first surrounded the settlement of Schenectady in the night, and put it to the sword. The second destroyed Salmon Falls, New Hampshire, and then in conjunction with the third party, captured Casco. [illegible]

The English colonies became aroused and determined to punish the invaders. An expedition fitted out under the united efforts of Massachusetts, Plymouth, Connecticut and New York was sent out under Fitz-John

Winthrop, against Montreal. An attack made on the town was repulsed by Frontenac. In the meantime Sir William Phipps, with a fleet, sent out from Massachusetts, plundered Port Royal and other French settlements. Then, sailing up the St. Lawrence, he attempted to surprise Quebec. But Frontenac, having defeated the attack on Montreal, reached Quebec before him, and the enterprise failed. The war continued until 1697, when a treaty of peace was made between France and England. Both parties had suffered severely, and neither had gained any real advantage.

ueen nne's ar.

25. The truce between the two great rivals lasted about five years, when war again broke out between them (1702). At once the French and English in America fell to fighting, and the war that followed is called Queen Anne's War. During the five years of peace the French had continued to make settlements in the west. They never lost sight of the great idea which inflamed their ambition, which was to establish a great French-American empire. They had founded Detroit, Mobile and numerous villages on the Mississippi. In the east they had recovered all the places taken from them by the English in the last war, inaugurated new missions, and increased their influence over the Indians. At this time Spain was in alliance with France, and the English settlers found themselves opposed not only by the French in the north and west, but by the Spaniards of Florida in the south. The English colonists directed their first operations against the Spaniards. St. Augustine was captured (1702), but had to be abandoned. Three years later the Christian Indian settlements of middle Florida were destroyed by the English, and the missions entirely broken up.

he war at e north.

26. New England suffered greatly in this war. There was an atrocious massacre at Deerfield in 1704. Haverhill, which had not fully recovered from the massacre of 1697, was plundered and burned a second time, and many of the colonists killed (1708), and the whole of that part of the country was harassed by barbarous foes. Receiving but little help from England, the colonists for several years were unable to undertake any important expeditions. An attack on Charleston, S. C. (1706), by the French and Spaniards, was repulsed. Port Royal was again taken from the French (1710), and with it the most of Acadia, which now became known as Nova Scotia.

xpedition gainst anada.

In 1711 an English fleet arrived in Boston to cooperate with the colonists in an attempt to conquer Canada, but all operations in that quarter proved a failure. In 1713 a treaty of peace was signed at Utrecht, by which the English acquired Newfoundland and Acadia. The eastern Indians were also induced to make peace about this time.

27. Many years of peace now followed, during which the colonies increased rapidly in population and advanced in material prosperity. The French still pursued their scheme of building up a great empire in the west. They controlled the valuable fur trade of the whole Mississippi valley. After their expulsion from Acadia they had crossed to the island of Cape Breton, and erected the strong fortress of Louisburg. At Niagara they had a fort commanding the communication between Lakes Erie and Ontario. Natchez was founded in 1716. In 1710 New Orleans was built, and soon became the capital of Louisiana. The French missionaries also continued their conquests in the wilderness of the Mississippi. After several years of peace, France again declared war against England (1744), and immediately began hostilities against the settlements. The campaign which followed is known as King George's war, because it occurred in the reign of George II.

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28. The colonists determined to carry on the war by their own means without waiting the uncertain aid from England. An expedition was planned against Louisburg which was successful, and that strong fortress fell into the hands of the Americans (1745). This achievement of untrained soldiers was received with enthusiasm by the colonies, and with astonishment in Europe. The treaty of Aix-la-Chappelle (1748) put an end to the war; and greatly to the disgust of New England, Louisburg was restored to the French in exchange for Madras, in Hindustan, which France had taken from England.

Declaratio of war.

29. The colonists had but a short time to reap the benefits of peace, after the treaty already referred to, when the sound of approaching war filled the land with anxiety and gloom. After an interval of about eight years, Great Britain formally declared war against France. The causes leading to this war, which was called the French and Indian war, were the alleged encroachments of the French on the frontiers of the colonies in America belonging to England. The French determined to connect their northern and southern possessions by a line of posts extending along the frontiers of the English possessions, from Lake Ontario to the Ohio, and down the Ohio and Mississippi to New Orleans. Up to the middle of the last century the English had not attempted to explore or settle the regions lying beyond the Blue Ridge and Alleghany mountains, but in 1749 a company of traders from London and Virginia, called the Ohio company, obtained a grant from the crown of 600,000 acres of land on the east bank of the Ohio river, in what is now West Virginia and Pennsylvania. In the years immediately following they made surveys and established a few settlements. One of the surveyors was George Washington.

The Ohio Company.

30. The French, regarding these operations of the Ohio Company as an encroachment upon their territory, strengthened the fort at Niagara, built another at Presque Isle (1753), now Erie, established Posts at La Bœuf and Venango (now Waterford and Franklin, in the oil region of northwestern Pennsylvania), seized the English traders, and confiscated their goods. When rumors came of what the French had done, Governor Dinwiddie of Virginia sent Washington, then not yet twenty-two years of age, to look into the matter, and expostulate with the French regarding their encroachments. After an arduous and perilous winter journey Washington brought back such a report of the determination and activity of the French, that the Virginia Assembly at once took measures to build a fort (1754) at the junction of the Monongahela and Alleghany rivers; but while the fort was being erected the French suddenly appeared, drove the English away, and finished for themselves the fort, which they called Fort Du Quesne.

Washington's mission.

31. In the meantime, a body of 400 men had been raised in Virginia and North Carolina, and sent out under Washington into the disputed territory. Meeting at Grand Meadows a French force which had been sent out to intercept him, he attacked and defeated them (1754). Learning of the approach of a greatly superior force of the enemy, he erected Fort Necessity. Here he was attacked by the French, and compelled to surrender, but on honorable terms. During this time, both the rival governments of France and England were making preparations for the coming struggle, though there was no formal declaration of war until 1756.

Washington's first skirmish.

Braddock defeat.

32. In 1755 General Braddock, with a force of English and American troops, marched against Fort Du Quesne, but was defeated with great slaughter, and but for the skill displayed by Washington the whole army would have been annihilated. Braddock himself was mortally wounded, and died shortly afterwards. After his death, General Shirley took command, and made an attempt to reduce Fort Niagara, but accomplished nothing. General William Johnson was appointed to attack Crown Point. He defeated the French General Dieskau in the battle of Lake George (Sept. 5, 1755), but was unable to reach Crown

Point. In the same year all the French inhabitants of Acadia were banished.

French and Indian War.

33. In May, 1756, war was formally declared by Great Britain, and by France in the following month. Lord Loudon was appointed commander-in-chief of all the forces in America, but owing to necessary delay, General Abercrombie preceded him and took the command. The Marquis of Montcalm became the French commander. Abercrombie awaited the arrival of Loudon before attempting anything. Both officers proved inefficient, and by their delays allowed the French not only time to strengthen their posts, but also to attack those of the English.

Campaigns of 1756 and 1757.

34. In August, 1756, Montcalm captured Fort Ontario with a large number of military stores, guns, prisoners and vessels. In June, 1757, Lord Loudon organized an expedition against Louisburg, but abandoned the attempt on learning that the garrison at that place had been strongly reinforced by a French fleet. In the meantime, Montcalm, collecting his forces at Ticonderoga, marched against Fort William Henry, and compelled it to surrender. After the surrender, many of the garrison were massacred by the French Indian allies. Thus after four years' hostilities, the incompetency of the British commanders still gave the French the advantage. But a change in the British home policy changed the aspect of the war. The celebrated William Pitt was called to the ministry, and immediately began to act with vigor. Abler officers were appointed to command, and expeditions organized against different points. Louisburg was captured July 27, 1758. Fort Du Quesne also was taken, and its name changed to Fort Pitt. General Abercrombie's attack on Ticonderoga (July, 1758,) met with a bloody repulse, but Fort Frontenac was taken, with a large quantity of stores and goods.

The Conquest of Canada.

35. Pitt now determined to dispossess the French of the whole of their American territory. Their armies were directed at the same time against three of their strongest posts, Quebec, Ticonderoga and Montreal. General Amherst captured Ticonderoga July, 1759. Fort Niagara surrendered to Sir William Johnson July 25, 1759. But the most important feature of the campaign was the taking of the almost impregnable fortress of Quebec by the gallant Wolfe, who lost his life in the action. Soon after Montreal surrendered to Amherst. In this campaign the French were driven from all the important posts in Canada, and their power in America was broken forever. The war was virtually at an end, though peace was not restored until the signing of the Treaty of Paris, February, 1763. By this agreement, to which Spain and Portugal were also parties, France surrendered everything east of the Mississippi, except New Orleans, to England. New Orleans and that part of Louisiana beyond the Mississippi were ceded to Spain by the French. In exchange for Havana, which had been captured by the British, Spain yielded Florida to England. In 1800 Spain restored Louisiana to France, and Napoleon sold it to the United states in 1803.

The Treaty of Paris

Pontiac's War.

36. When the treaty of peace was signed, it was trusted that there would be an end to those horrid ravages which had desolated the interior of the country. But the month of May, 1763, proved the fallacy of such hopes. The Indians did not wish to see the country transferred by the French to the English. It was one thing to have the French trading among them, another to have the hated English occupying their lands. It was about this time that the famous insurrection of the Indian tribes broke out. The Delawares and Shawnees and other of the tribes of the Ohio were foremost in this conspiracy. Pontiac, an Ottawa chief, was the prime mover and master spirit in this affair, and hence it is called Pontiac's war. Pontiac expected the French to join him, for they were secretly encouraging him. Most of the western tribes were drawn by him into the plot, but Sir William Johnson prevented a greater part of the Iroquois from joining him. Pontiac's plans were deeply laid, and conducted with Indian craft and secrecy. At a concerted time an attack was made upon all the posts from Detroit to Fort Pitt (formerly Fort Du Quesne). The Indians captured and destroyed eight of the twelve forts, but were unable to take the important posts of Detroit and Fort Pitt, though Pontiac besieged the former place for five months. The frontiers of Maryland, Virginia and Pennsylvania were laid waste, and terrible havoc wrought in the frontier settlements. The English, surprised by the first attack, soon roused themselves and met the danger promptly. The power of the tribes became broken, and most of them sued for peace. Pontiac retired to the Illinois country, and made a stand there for some time longer, finally submitting in 1766.

III. CAUSES OF THE AMERICAN REVOLUTION.

37. The addition to the British empire of new provinces, equal in extent to old kingdoms, not only excited the jealousy of European powers, but occasioned doubts in the minds of enlightened British politicians whether or not such immense acquisitions of territory would conduce to the benefit of the parent state. They saw, or thought they saw, the seeds of disunion planted in the too widely extended empire. To combine in one uniform system of government the extensive territory then under British sway, appeared to men of reflection a work of doubtful practicability; nor were their conjectures at fault. The seeds of discord were soon planted, and speedily grew up to the rending of the empire. The high notions of liberty and independence which were nurtured in the colonies by their local situation, and the state of society in the new world, were increased by the removal of hostile neighbors. The events of the war had also given them some experience in military operations, and confidence in their own ability. Foreseeing their future importance from the rapid increase of their numbers and extension of their community, and being extremely jealous of their rights, they readily admitted and indulged in sentiments and ideas which were favorable to independence. While combustible materials were daily collecting in the new world, a spark to kindle the whole was produced in the old.

Origin of the disputes.

38. In the first period of the settlement of English America, the mother country regarded the provinces as instruments of commerce. She contented herself with a monopoly of their trade without taking upon herself the care of their internal policy, or seeking a revenue from them. Previous to the close of the war in 1755, the catalogue of grievances she imposed upon the colonists was undoubtedly small. The following appear to have been the chief: An act of the British parliament forbidding the cutting down of pitch and tar trees, not being within a fence or enclosure, and sundry acts which operated against colonial manufactures. By one of these, it was made illegal after the 24th of June, 1750, to erect in the colonies any mill or other engine for slitting or rolling iron, or any plating forge, to work with a tilt hammer, or any furnace for making steel. By another, hatters were restrained from taking more than two apprentices at a time, or any for less than seven years. The colonists were also prohibited from transporting hats and home manufactured woolens from one province to another. These regulations were, for the most part, evaded; but if carried into execution, would have been but slightly inconvenient, and that only to a few. These restrictions, though seemingly a species of affront, and calculated to keep the colonists in a constant state of inferiority and subjection, would have been overlooked and forgotten had not other grievances been superadded.

39. The sad story of colonial oppression began in the

year 1764. Great Britain then adopted new regulations respecting her colonists, which, after disturbing the ancient harmony of the two countries for about twelve years, terminated in the dismemberment of the empires. These consisted in restricting their former commerce, but more especially in subjecting them to taxation by the British parliament. The imposition of duties, for the purpose of raising a revenue in America, was considered as a dangerous innovation, but the methods adopted for securing their collection were resented as arbitrary and unconstitutional. It was enacted by parliament, that whoever was caught violating the acts, should be tried in the courts of admiralty. Thus the defendant in such a case was deprived of the right of trial by jury, and subjected to the necessity of having his case decided upon by a single man, a creature of the crown, whose salary was to be paid out of forfeitures adjudged by himself. Moreover, the prosecutor was not called upon to prove his accusation, so the defendant was obliged, either to evince his innocence or to suffer. Thus the guards which the British constitution had placed around property and the barriers which the ancestors of both countries had erected against arbitrary power, were thrown down, as far as they concerned the colonists thus charged with violating the laws for raising a revenue in America.

40. After the peace of Paris, 1763, the national debt of Great Britain amounted to nearly 150,000,000 sterling. To aid in diminishing this heavy debt, the British minister conceived the idea of raising a substantial revenue in the British colonies, from taxes imposed by the parliament of the mother country. On the one hand it was urged that the late war had originated on account of the colonies—that it was reasonable, since it had terminated in a manner so favorable to their interests, that they should help to defray the expenses arising from it. Thus far both parties were agreed; but England contended that her parliament, as the supreme power, had the constitutional right to impose them on every part of the empire. This theory, plausible in itself, and in accordance with the letter of the British constitution, when all the dominions were represented in one assembly, was denied by the colonies as contrary to the spirit of the same government, when, on account of the extension of the empire, it was necessary to have many distinct representative assemblies. The colonists believed that the chief excellence of the British constitution consisted in the right of the subject to grant or withhold taxes, and in their having a share in enacting the laws by which they were to be bound. They conceived that the superiority of the British constitution to other forms of government was, not because of the parliament's forming the supreme council of the nation, but because the people had a share in it by appointing members who constituted one of its constituent branches, and without whose concurrence no law, binding on them, could be enacted. In the parent state it was asserted to be essential to the unity of the empire, that the British parliament should have the right of taxation over every part of the royal dominions. In the colonies it was believed that taxation and representation were inseparable, and that they, as colonies, could neither be free nor happy if their property could be taken from them without their consent. The American people reasoned thus: That if the British parliament, in which they had no representation, were able to take any part of their property from them by direct taxation, then they might take as much as they pleased, and there would be no security for anything that remained from further spoliation.

41. The colonists claimed that they had the exclusive right of laying taxes on themselves, free from extraneous influences, just as much as the British Parliament claimed the peculiar privilege of raising money independent of the crown. The parent state appeared to the colonists to stand in the same relation to their local legislators as the monarch of Great Britain to the British Parliament. His perogative is limited by that palladium of the people's liberty, the exclusive privilege of granting their own money. In fact, they claimed that though subjects of the King, they were not under the control of the British Parliament; that if the King required money of the colonies, he must obtain it through colonial legislation, just as in England he would obtain it through the British Parliament.

The dispute about the Charters.

42. The charters, which were supposed to contain the principles on which the colonies were founded, became the subject of serious investigation on both sides. One clause was found to run through the whole of them, except that which had been granted to William Penn. This was a declaration, "that the emigrants to America should enjoy the same privileges as if they had remained, or had been born, within the realm;" but such was the subtility of disputants that both parties construed this general principle so as to favor their respective opinions. The American people contended, that as English freeholders could not be taxed but by representatives, in choosing whom they had a vote, neither could the colonists; but it was answered that if the colonists had remained in England they must have been bound to pay the taxes imposed by Parliament. It was therefore inferred that, though taxed by that authority, they lost none of the rights of native Englishmen residing at home. The advocates of the British policy could see nothing in charters but security against taxes by royal authority. The colonists, adhering to the spirit more than to the letter, looked upon their charters as a protection against all taxes not imposed by representatives of their own choice. The nature and extent of the connection between Great Britain and America was a great constitutional question, involving many interests and the general principles of civil liberty. It was a vain attempt to decide this by any other recourse to parchment authorities, made at a time long past, when neither the grantor nor grantees foresaw anything like the present state of the two countries. It needed great skill and tact to so manage affairs, that everything might redound to the satisfaction and good of all concerned; to strike the middle line which would have secured as much liberty to the colonies, and as great a degree of supremacy to the mother country as their common good required. But this skill was lacking in British statesmanship. On the one hand, the spirit of the British constitution was opposed to the idea that the British Parliament should exercise the same unlimited authority over the unrepresented colonies which it exercised over the inhabitants of Great Britain. The colonists, on the other hand, did not claim a total exemption from its authority, but allowed the mother country a certain undefined prerogative over them; and accepted the idea that Parliament had a right to make any acts binding them in many subjects of internal policy and regulating their trade. That nice point, which marked the end of parliamentary authority and the beginning of the colonial independence, was not ascertained. Had the question never been agitated, or had a satisfactory compromise been effected, the American Revolution, undoubtedly, would never have become a part of our history.

The connection between Great Britain and America.

The Restrictive Policy of England.

43. The great French and Indian war, though crowned with success, had aroused a spirit of discontent in the colonies. From the beginning, as has been shown, the commercial policy of England toward the colonies had been wholly restricted. "It was a system of monopoly." Her navigation laws had closed their ports against foreign vessels; obliged them to export their productions only to countries belonging to the British crown; to import European goods solely from England, and in English ships; and had subjected the trade between the colonies to duties. All manufactures, too, in the

colonies, that might interfere with those of the mother country had been either totally prohibited, or subjected to intolerable restraints. The acts of Parliament, imposing these restrictions and prohibitions, had at various times caused great discontent and opposition on the part of the colonists, especially among those of New England. But nothing so aroused the jealous sensibilities of the colonists as any attempts on the part of the parent state to raise a revenue from them by taxation. They had ever maintained, from the earliest period of their establishment, that they could only be taxed by a legislature in which they were represented.

The Attempt to Collect Duties.

44. While the French war was in progress, many projects were hatched in England with regard to the colonies which were to be put in force when peace was declared. In 1760, an attempt was made in Boston to collect duties on foreign sugar and molasses imported into the colonies. Writs of assistance were applied for by customhouse officers, empowering them to break open stores, ships and private dwellings in search of goods that had paid no duty, and to compel others to assist them in carrying out their odious measures. The merchants opposed the writ on constitutional grounds. The question was brought into the courts, where James Otis argued so eloquently in favor of American rights, that all who heard him were ready to oppose all writs of assistance. John Adams, who was present, said, "Then and there was the first scene of opposition to the arbitrary claims of Great Britain. Then and there American Independence was born." In his speech, Otis used the words, "Taxation without representation is tyranny." This sentence became a watchword in America during the exciting times which followed.

The Stamp Act.

45. In 1765 Lord Grenville, having previously given notice of his intentions to the American agents in London, introduced into Parliament a long cherished scheme for the purpose of raising a revenue from the American colonies by means of a stamp duty. Petitions poured in against it from the Americans, and at first it met with strong opposition in the House of Commons. But the remonstrances of the colonies could not change the avaricious feelings of Parliament, and the bill passed by a large majority. Those short-sighted legislators did not foresee that in the passage of an act so odious to the colonies, they were awakening an opposition and spirit of independence among them which would materially weaken their own power. The night after the bill passed Benjamin Franklin, who was then in London, wrote to Mr. Charles Thomson, "The sun of liberty is set; you must light up the candles of industry and economy." Mr. Thomson answered, "I was apprehensive that other lights would be the consequence, and I foresee the opposition that will be made."

The Provisions of the Stamp Act.

46. By this act, no written instrument, such as commercial transactions, marriage licenses, deeds, suits at law, and the like, could be legal, unless stamped paper was used, which the colonists were compelled to purchase at an exorbitant price of the British agents. Moreover, it contained another startling provision, and that was, that the colonial legislatures were commanded to grant permission to billet the royal troops in America in inns, alehouses, barns, and vacant houses, and to furnish them with bedding, potables, candles, cooking utensils, etc. As soon as it became known that the Stamp Act was passed, the colonies, from one end of the land to the other, were full of indignation. Parliament had turned a deaf ear to their petitions, and showed by the passage of the Act a determination to treat them, not as English citizens, but as servants and slaves. Parliament, they said, might make laws to regulate the commerce of the empire, and so draw a revenue from America, but it had no right to levy a direct tax like this. Only the colonial government, elected by the people, could do such a thing. They must either surrender without a struggle their liberty, or oppose strongly and firmly the grasping avarice of a nation, the most powerful in the world.

The excitement produced by the passage of the Act.

47. They were not long in making up their decision and proclaiming it to the world. The legislature of Virginia was in session when the news arrived. Patrick Henry, then a young man, but possessed of brilliant talents, opposed it with all the energy of his great mind. He brought before the house five resolutions which were adopted, and which closed by declaring, "That any person, who, by speaking or acting, should assert or maintain that any class of men except the general assembly of the province, had a right to impose taxation, he should be considered an enemy to his majesty's colony." In advocating these resolutions, he boldly denounced the policy of the British government, and declared that the king had acted the part of the tyrant. Warming up with his subject, and alluding to the fate of other tyrants, he exclaimed with flashing eyes and in thunder tones, "Cæsar had his Brutus, Charles I his Cromwell, and George III"—"Treason! treason!" arose from every part of the house. Pausing a moment until the tumult had subsided, he added, "may profit by their example. If this is treason make the most of it." Similar sentiments flew like lightning through the other colonies. The tongues and pens of the citizens labored to kindle the latent sparks of patriotism. The press strongly opposed the innovation and called upon the citizens to resist it.

Patrick Henry.

The Con nental Co gress.

48. The expediency of calling a continental congress, to be composed of deputies from each of the provinces, had early occurred to Massachusetts. So the assembly of that province fixed on New York as the place, and the second Tuesday of October, 1765, as the time for holding the congress, and invited all the other colonies to send delegates to the same. Nine colonies took part in it, and sent their most distinguished men. For the first time the whole country had a common cause, and there was need that the people should consult together. This congress drew up a declaration of their rights and a statement of their grievances. They asserted in strong terms their exemption from all taxes not imposed by their own representatives. They also concurred in a petition to the king, a memorial to the House of Lords, and a petition to the House of Commons. The colonies that were prevented from sending their delegates, forwarded petitions, similar to those which were adopted by the deputies who attended.

49. On the 1st of November, the day on which the Stamp Act was to go into operation, the bells were tolled, and the flags hung at half mast, as if for the "funeral of liberty." The courts were closed; business was suspended. The houses of the British officials were attacked by mobs, and the effigies of the planners of the Act were carried about the streets in public derision and then burned, or torn in pieces by the enraged populace. In different parts of the country the stamp-masters were compelled to resign their offices to prevent being mobbed. The Stamp Act was so formed that the penalty of disobedience would be no less than the suspension of the whole machinery of the political and social order, and the creation of a state of anarchy. Neither trade nor navigation could proceed, no contract could be legally made, no process against an offender could be instituted, no student could receive a diploma, nor even could the estates of the dead be legally settled, or the marriage ceremony performed, until the stamp duty was paid. By degrees, however, things began to assume their usual course, and all kinds of business was transacted in open defiance of the Act.

Sons of Liberty.

50. Associations, under the title of the "Sons of Liberty," were formed in every part of the country. They denounced the Stamp Act as being an outrage on

the British constitution, and resolved that they would defend those who fell into the hands of British tyranny, on account of their clinging to their rights as freemen. Merchants resolved to import no more goods from Great Britain until the act was repealed, and the people generally denied themselves the use of foreign luxuries. No one would venture to carry the Stamp Act into execution: in fact, no stamped paper was to be seen; all had been either destroyed or concealed.

The Effect in England.

Repeal of the Stamp Act.

51. The information of the violent proceedings of the colonies was received in England with consternation. A small party in Parliament upheld the colonies. In the House of Commons William Pitt uttered the memorable words: "We are told that America is *obstinate*—America is in open rebellion. *Sir, I rejoice that America has resisted!* Three millions of people so dead to all the feelings of liberty as voluntarily to submit to be slaves would have been fit instruments to make slaves of all the rest." In the meantime Lord Grenville had been dismissed, and the Marquis of Rockingham, a friend of the Americans, appointed in his place. Under his administration the obnoxious Stamp Act was repealed March 18, 1766, for the English government saw that it was impossible to enforce it. At the same time, Parliament took care to say that it "had a right *to bind the colonies in all cases whatever.*"

How the News was Received.

A new Scheme of Taxation.

52. The news of the repeal was received with the liveliest expressions of joy and gratitude. Public thanksgivings were held, English goods imported and a general calm succeeded the storm which had raged so violently. By the people of New England and New York less joy was felt. They feared, from the passage of the declaratory act, that this was only a truce in the war against American rights. In the mirror of the past they saw reflected the future, and trembled at the picture. Nor were their suspicions unfounded. Scarcely had the excitement over the Stamp Act died out, when other causes of complaint arose. In June, 1767, Charles Townsend, chancellor of the exchequer, brought into Parliament a bill imposing duties in the British colonies on glass, paper, painters' colors and tea, which became a law. Another law was also enacted, appointing officers of the navy as custom-house officers, to enforce the act of trade and navigation. Previous to this new act of tyranny, the legislative power of New York had been suspended, until it should furnish the king's troops with certain supplies at the expense of the colony.

The Seizure of Hancock's Sloop

53. Early in 1768 the general court of Massachusetts sent a petition to the king, and addressed circular letters to the colonial assemblies, asking their co-operation in obtaining the redress of their grievances. The British ministry were alarmed and demanded of the court that they should rescind the vote directing circulars to be sent. The assembly refused, and the governor dissolved it. This attempt to intimidate only served to strengthen the opposition. Shortly after this Mr. Hancock's sloop Liberty was seized for not having entered all the wines brought from Madeira. This act of the custom-house officers was resented by the people. The houses of the officials were attacked, and they were compelled to seek safety in flight. The refractory spirit of the citizens of Boston had been displayed on so many occasions that General Gage was directed to station one or more regiments there to overawe the citizens and protect the officers in the discharge of their duties. Two regiments were accordingly ordered from Halifax, who took possession of the state house, and planted two pieces of cannon at the principal entrance. All this only tended to increase the general indignation.

54. Early in the year 1769 Parliament passed resolutions censuring the conduct of the citizens of Massachusetts, and directing the governor to make strict inquiries as to all treasons committed in that province since the year 1767, that the offenders might be sent to England for trial. The legislature of Virginia, on the receipt of that order, passed resolutions denying the right of the king to remove an offender out of the colony—away from his home and friends—for trial. The governor, on hearing of the resolutions, immediately dismissed the assembly. The members met at a private house, and entered into a written agreement not to import any of the taxed articles. Their example was extensively followed. The assemby of Massachusetts convened, but refused to proceed to business while armed troops surrounded the state house. The governor refused to remove them, and the assembly adjourned to Cambridge. Toward the close of the season the governor requested them to provide funds to pay for the quartering of the troops, but they refused, declaring that they would never make any provisions to support a standing army among them in times of peace. The governor, therefore, prorogued the assembly.

The Boston Massacre.

55. The presence of the soldiers in Boston was a constant cause of irritation, and the citizens had many quarrels with them. At length on March 5, 1770, a serious collision occurred between the troops and a mob, and the soldiers fired, killing five of the crowd, and mortally wounding two others. The reports of this Boston massacre, as it was called, were greatly exaggerated, and filled the country with excitement. The citizens assembled in crowds, and could only be dispersed by the governor promising them that justice should be done. The troops were removed from the city, and Captain Preston, who ordered the firing, and his men tried for murder. Although the excitement was intense, yet such was the love of justice that the soldiers, who were defended by John Adams and Josiah Quincy, were all acquitted except two, who were convicted of manslaughter.

Lord North's Bill.

Destruction of Tea at Boston.

56. In England, on the very day of the outrage in Boston, Lord North was called to the British Ministry. He introduced a bill into Parliament which passed on April 12, removing the duties that had been laid in 1767, excepting that on tea, but still declaring their right of taxing the colonies. For a long time no tea had been imported, and the effect had begun to be severely felt by the British merchants. By an act of Parliament, therefore, the East India company were allowed to import their teas into America free of duty in England. The naked question of the principle regarding taxation was thus presented. The scheme was an insidious one, but it failed most completely. Lord North supposed that by reducing the tax on tea to three pence a pound, the Americans would buy largely, thus relieving the East India company, who had large quantities of tea stored up in its English warehouses. Tea was accordingly shipped from England in great quantities to various parts of the colonies. This brought matters to a crisis. One sentiment prevailed throughout the whole continent. Taxation was to receive its final blow. Whoever submitted to it was an enemy to his country. From New York and Philadelphia the ships were sent back, with their cargoes, to London. In Charleston the tea was landed, but not permitted to be sold, and being stored in damp cellars, finally perished. Still more decisive action was taken in Boston. The ships anchored in the harbor. Some small parcels of tea were brought on shore, but the sale of them was prohibited. The captains of the vessels would have made sail back to England, but they could not obtain the consent of the consignees, a clearance at the custom house, or a passport from the Governor to clear the port. To settle the matter completely, a company of men disguised as Indians went on board the ships during the night and threw the cargoes into the water. Three hundred and forty-two chests were thus broken open and the contents thrown into the harbor (December 16, 1773).

57. When the news of this affair reached England,

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Parliament, in order to punish the inhabitants of Boston, passed the Boston Port Bill in 1774, which prevented the lading and unlading of goods, wares and merchandise in that town and harbor on and after June 1, 1774, and the seat of government was to be transferred to Salem. But the people of Salem refused to build their fortunes on the ruins of their countrymen, and the inhabitants of Marblehead generously offered the Boston people the use of their warehouses and harbor. In the following March, two other bills, equally tyrannical, passed both houses of Parliament. One subverted the whole constitution and charter of Massachusetts, taking all power out of the hands of the people and vesting it in the crown. The other authorized the governor to send any person indicted for murder or other capital offence committed in aiding the magistracy, to England or some other colony for trial.

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58. These laws, which were gross violations of the rights and charters of the colonies, excited the deepest indignation everywhere in America. The people of Boston, reduced to distress by the stoppage of their trade, were regarded as martyrs of liberty, and contributions were made for their relief, not only in the thirteen colonies, but even in London and Quebec. In Boston itself, although patriotic meetings were held almost daily in Faneuil Hall and the Old South Church, all disorderly and unconstitutional proceedings were avoided, so that nothing was done for which the British authorities could punish the people. The friends of the crown about this time became known as Tories, and the popular party as Whigs. The Quebec Act, which was passed among the other acts just mentioned, extended the boundaries of Canada over the whole territory situated north of the Ohio, and east of the Mississippi. This was done to prevent Canada from joining the rebellious colonies. The colonies warmly protested against this concession to liberty of conscience, for the Act sanctioned throughout the province the free exercise of the Roman Catholic religion, and confirmed to the clergy of that profession their accustumed dues and rights, thus practically establishing the Roman Catholic system in the new territory. To such freedom the colonists were on principle opposed at the time, though somewhat later they found it expedient to adopt nearly the same policy, and to promote a closer union among themselves by juster treatment of their Roman Catholic brethren.

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59. Committees of correspondence had already been formed at the suggestion of Patrick Henry, Thomas Jefferson, Richard Henry Lee and other Virginians, and by this means the colonies took counsel together for the common defense. In May, 1774, proposals were made by the assemblies of several of the provinces for a general congress of delegates. The scheme was taken up with great enthusiasm, and on September 5, 1774, an assembly of fifty-five delegates, representing all the colonies except Georgia, met in Philadelphia, under the presidency of Peyton Randolph, of Virginia. This was the first or, as it is often called, the "old" continental congress. The action of this body was still mainly deliberative. They passed a resolution highly commending the conduct of Massachusetts in the conflict with the wicked ministers, and exhorted all to press on in the cause of liberty. They drew up a bill of rights, entered into an agreement for themselves and for all their constituents to cease all importations from Great Britain, and adopted measures for organizing committees in every town and city to see that this agreement was enforced by every species of popular nfluence. They also voted an address to the king, one to the people of Great Britain and another to Canada. Their petition to the king entreated him, in eloquence the most affectionate and respectful, to restore to them their violated rights—their rights as English freemen. Provision was then made for another congress to meet in the following May, unless the grievances should meanwhile be redressed. When the proceedings of Congress were published in England, Pitt (now Lord Chatham) said: "For solidity of reason, force of sagacity and wisdom of conclusion under a complication of difficult circumstances no nation or body of men can stand in preference to the general congress at Philadelphia. The histories of Greece and Rome give us nothing equal to it, and all attempts to impose servitude upon such a mighty continental nation must be in vain."

Pitt's
Opinion

The People
Take Arms

60. These resolutions of the Continental Congress aroused the indignation of the British government. America, they said, had long wished to become independent, and to prevent this was the duty of every Englishman, and that it must be done at every hazard. In the meantime, the situation of affairs in Massachusetts became alarming. The people collected arms, enrolled themselves into companies and prepared to turn out at a moment's notice, from which circumstance they were called "minute men." Public speakers and writers boldly defended the right of the people to withstand oppression. Royal officers were forced to resign. General Gage began to fortify Boston Neck, and the powder and other military stores in Cambridge and Charleston were, by his order, removed to Boston. He had about 4,000 troops under him, and sent home a request for 20,000 more. An assembly was called in Massachusetts, but dissolved by the governor. The members then met in Salem, appointed a committee of safety and sent messengers to New Hampshire, Rhode Island and Connecticut, asking for their assistance in raising an army of 20,000 men to act in any emergency. England, although she could distinctly see the upheaving of the violence of colonial indignation, shut her eyes to the sight. Chatham, Burke, Fox, Barré and other enlightened statesmen in Parliament urged the government to recede from its untenable position, but the obstinacy of the king prevented any conciliation; it was resolved that America was in rebellion and must be subdued; and so the revolution began.

Conduct of
the People

61. It was a fortunate circumstance for the colonies that the royal army was posted in New England. The people of that northern country have their passions more under the command of reason and interest than in a southern climate. One rash, offensive action against the royal forces at this early period, though successful, might have worked great mischief to the American cause. It would have lost them European friends and weakened the disposition of the other colonies to assist them. The patient and the politic New England men, fully sensible of their situation, submitted to many insults and restrained their feelings of resentment. In civil wars or revolutions it is a matter of much consequence who strikes the first blow. The compassion of the world is nearly always in favor of the attacked. For the space of nine months after the arrival of General Gage the behavior of the people of Boston is particularly worthy of imitation by those who wish to overturn established governments. They conducted their opposition with exquisite address. They avoided every kind of outrage and violence, preserved peace and good order among themselves, successfully engaged the other colonies to make common cause with them and counteracted General Gage so effectually as to prevent his doing anything for his royal master, while by patience and moderation they protected themselves from just censure. Though resolved to bear as long as prudence and policy dictated, they were all the time preparing for the last extremity by furnishing themselves with arms and training their militia.

The Beginning of the
Struggle.

62. Provisions had also been collected and stored in different places, particularly at Concord, about twenty miles from Boston. General Gage sent out a detachment of 800 men, under the command of Colonel Smith and Major Pitcairn, to destroy these stores. Notwithstanding the precautions taken to prevent the

Lexington and Concord.

spread of the intelligence, the march of the troops had been well made known by expresses and signal guns. Thus, when the British troops, early in the morning of the 14th of April, 1775, reached Lexington, two-thirds of the way to Concord, they found a small body of Americans under Captain Parker, drawn up on the common to dispute the way. Captain Parker had given orders not to fire unless fired upon. The British troops rushed upon them, firing and calling upon them to disperse. Eight of the Americans were killed and and several more wounded. The little band of patriots slowly retreated, returning the fire as they went, and the British kept on to Concord, where they destroyed a few stores. At a bridge near the village they encountered 400 Americans, hastily collected from the neighboring towns, and were so warmly received that they began a hasty retreat. The militia pressed them on all sides; the retreat became a rout, and when the British were at last rescued by the arrival of Lord Percy with reinforcements, they had lost 273 men. They continued their retreat under Percy, bearing their dead and wounded with them. All the way, from behind stone walls, fences and farmhouses, the angry farmers galled them with shot. They did not desist until the troops had crossed Charlestown Neck and were safe under the guns of the British vessels.

63. As arms were to decide the controversy, it was another fortunate circumstance for the Americans that the first blood was drawn in New England. The inhabitants of that country were so connected with each other by descent, manners, religion, politics and a general equality, that the killing of a single individual interested the whole people and made them consider it a common cause. The blood of those who were killed at Lexington and Concord proved to be the firm cement of an extensive union. Intelligence of these events spread like wild fire throughout the country; the torch of war had been lighted, blood had been offered on the altar of liberty, fearfully was the death of those patriots slain at Lexington and Concord to be avenged. Couriers galloped in every direction, beating a drum, and shouting in tones that thrilled every listening ear, "To arms, to arms! liberty or death." The streets of Lexington and Concord had been soaked in blood, and the whole country was in a blaze of wrath. But amidst the intense excitement which prevailed, the still thoroughly English characteristics of the people manifested themselves. The provincial congress of Massachussetts, which was in session at the time of the fight, dispatched an account of it to Great Britain, accompanied with many depositions to prove that the British were the aggressors. They also made an address to the people of Great Britain, in which, after complaining of their sufferings, they said: "These have not yet detached us from our royal sovereign; we profess to be dutiful and loyal subjects, and though hardly dealt with as we have been, are still ready with our lives and fortunes to defend his person, crown and dignity. Nevertheless, to the persecution and tyranny of his evil ministry, we will not tamely submit." From this commencement of hostilities, the dispute between Great Britain and the colonists took a new direction.

The Gathering of Troops.

64. Up to this time no party in America had thought of a separation from the mother country, but now the colonists were aflame with the spirit of independence. Mechanics left their shops, and farmers the plow, and hurried to the scene of conflict. In the course of one or two days the king's army found itself besieged in Boston by an irregular and ill-furnished, but large and determined body of men who marched to the scene of action from all parts of New England. The provincial congress of Massachussetts came together under the presidency of Dr. Joseph Warren, voted to raise 13,000 men, and invited the other New England colonists to make up the army to 30,000. In a few days a line of encampment stretched from Roxbury to the river Mystic, and the British forces in Boston were environed by an army of 20,000 soldiers. Benedict Arnold gathered about him a band of volunteers, and rushed to Boston. Here he formed the bold plan of seizing the important fortresses of Ticonderoga and Crown Point.

Capture of Ticonderoga and Crown Point.

65. Having received instructions from the committee of safety to raise a sufficient number of men for the purpose, he marched to Bennington, where he found that Colonel Ethan Allen had collected a large band for the same object. They marched on together at the head of three hundred men, and reached Ticonderoga on the 10th of May, 1775. Advancing to the gateway, Arnold and Allen entering side by side, Allen rushed to the governor's room and demanded his surrender. "In whose name?" stammered the terrified governor. "In the name," said Allen, "of the Great Jehovah and the Continental Congress." This was high authority, and the governor immediately surrendered. They were equally successful in obtaining Crown Point. By this fortunate expedition they gained possession of two important fortresses, and gave the American troops about Boston a much-needed supply of arms and ammunition.

The Second Continental Congress.

66. The second Continental Congress met at Philadelphia, May 10, the day of the capture of Ticonderoga. Peyton Randolph was at first the president, but John Hancock soon succeeded him in that position. Washington, Jefferson, Franklin, the Adamses, Patrick Henry and R. H. Lee, were members. The Congress was moderate, and asked only for a redress of grievances, not for independence; but it took active measures for carrying on the war. It formed a federal union, assumed the general authority of government, issued bills of credit to the amount of three millions of dollars for defraying the military expenses, and pledged the faith of the United Colonies for their redemption.

IV.—THE WAR FOR INDEPENDENCE, 1775–83.

67. In May, 1775, the British army in Boston received reinforcements from England, under Generals Howe, Clinton and Burgoyne, which, together with the garrison, formed an army of more than twelve thousand men. The Americans comprised a number of independent commands under Generals Artemus Ward, of Massachussetts; Israel Putnam, of Connecticut; Nathanael Green, of Rhode Island, and other states, General Ward being recognized as chief. The whole number of men was about sixteen thousand. Upon the arrival of the English reinforcements, General Gage now proclaimed martial law throughout the state, offering pardon, however, to all rebels who would return to their allegiances, excepting Samuel Adams and John Hancock. The Americans, learning that General Gage was determined to penetrate into the country by the way of Charlestown Neck, issued orders to Colonel Prescott, on the evening of the 16th of June, to take one thousand men and form an intrenchment on Bunker's Hill, an eminence which commanded the neck of the Charlestown peninsula. By some mistake they went further on, and occupied Breed's Hill. At midnight those stern-hearted men stood on the top while Putnam marked out the line of entrenchments. By daylight they had thrown up a redoubt eight rods square, in which they could shelter themselves. In the morning the English officers and the people of Boston could hardly believe their eyes as they saw this redoubt almost over their heads. The patriots on the hill were first seen from the ships, which immediately opened fire. All the artillery of the city and the floating battery were pointed against that single, silent structure. Still those hardy heroes toiled on amid the storm of shot and shell which fell among them, until by noon they had run a trench nearly down to the Mystic river on the north: then laying down their picks and shovels

they took up their muskets, and prepared themselves for the coming attack.

Battle of Bunker Hill

68. The cannonading having failed to dislodge the Americans, about noon Gage sent a body of about three thousand men, under Howe and Pigot to carry the height by assault. Having crossed the Charles river from Boston in boats, they advanced up the hill under cover of fire from the ships and batteries. The provincials stood firm. "Don't one of you fire," was the command of Putnam, "till you see the whites of their eyes. The English advanced, stopping every few yards, to deliver their deep and regular volleys against the intrenchment; but not a shot replied. That silence was more awful than the thunder of cannon. When the hostile columns had almost reached the works, the stern order "*Fire!*" rang with starling clearness on the air. Suddenly a sheet of flame burst from that low, dark wall, and down went the enemy rank by rank. Their lines wavered, then broke, and the troops fell back in disorder to the landing place. There they rallied, and soon moved forward again to the charge, and again were driven back by the steady fire of the colonists. At this critical moment General Clinton arrived with reinforcements. By his exertions the troops were again rallied, and a third time advanced to the charge. Throwing aside their knapsacks and reserving their fire, the soldiers, with fixed bayonets, marched swiftly and steadily over the heaps of their fallen comrades, up to the intrenchments. Only one volley struck them, for the Americans had fired their last rounds of ammunition, and were without bayonets. Clubbing their muskets, they still beat back the enemy, until the order was given to retreat, when they retired slowly and made good their way over Charlestown Neck. At the beginning of the retreat the brave General Warren was killed. The Americans lost 449 in killed, wounded, and prisoners, while the British loss was nearly 1,500. The result of the battle was encouraging to the provincials. It give them confidence in themselves, and consequence in the eyes of their enemies. They had proved to themselves and others that they could measure weapons with the disciplined troops of Europe, and inflict the most harm in the conflict. This dear-bought victory, won only through the exhaustion of the American's powder, was so little satisfactory to the British Government that General Gage was superseded by General Howe. This engagement, known as the battle of Bunker Hill, was the first real battle of the Revolutionary War.

Washington appointed Commander-in-Chief.

69. In the meantime, Congress on the 15th of June, at Philadelphia, elected George Washington, by a unanimous vote, to the high office of commander-in-chief of the united colonies. Washington, who was present, accepted the appointment, expressing a sense of the high honor which he had received, and the vast responsibity of the station. He refused to accept any compensation for his services, merely asking Congress to defray his expenses. Congress also adopted the unorganized force before Boston, naming it the Continental Army. In subordination to the commander-in-chief, Messrs. Ward, Charles Lee, Schuyler, and Putnam were appointed major-generals; Horatio Gates, adjutant-general, and Messrs. Pomeroy, Montgomery and Wooster, Heath, Thomas, Spencer, Sullivan and Greene, brigadier-generals. Soon after his election, General Washington, accompanied by Lee, proceeded to Cambridge to take command of the army, which amounted to about 14 000 men. He found them a crowd of brave, undisciplined soldiers, unprovided with arms, ammunition and provisions. His first business was to organize them into an army, while he kept watch over the British in Boston

Attack on Canada.

70. Meanwhile an expedition was organized for an attack on Canada, under the command of General Schuyler; but Schuyler, falling sick by the way, the command devolved on Richard Montgomery. This officer captured St. John's and Chambly, both on the Sorel river, and then made himself master of Montreal; but in making an assault on Quebec, December 31, 1775, he was repulsed, losing his own life, while Benedict Arnold, another leader, was wounded. Sometime afterward the British army in Canada was reinforced, and the Americans were obliged to abandon all designs in that quarter. While these events were taking place on the northern frontiers, English ships were laying waste towns and cities upon the Atlantic coast Bristol in Rhode Island, and Falmouth in Massachusetts, were burned because they had taken part in the rebellion. Congress thought it time to turn its attention to the construction of armed vessels. Thirteen were accordingly fitted out, a navy established, and a large number of privateers licensed, which scoured the seas and did great injury to the English commerce. General Washington employed in the service several cruisers to intercept the store ships of the enemy Regular courts of admiralty were established for the adjudication of prizes, and by these timely measures much good was accomplished.

Privateers licensed.

In the South.

71. In the summer of 1775, Dunmore, the royal Governor of Virginia, was driven out of Williamsburg, then the capital of the colony, and obliged to seek safety on board a British man-of-war. Collecting some ships and a considerable number of men, partly slaves and indented servants, to whom he promised freedom, he burned Norfolk (January, 1776), which was the largest and richest town in Virginia, and made descents upon various parts of the coast. In North Carolina there was some sharp fighting between the Tory settlers and the patriotic militia, in which the Tories were worsted. In South Carolina, the gallant defense of Charleston (June, 1776,) where a British fleet, under Sir Peter Parker, aided by a large land force, under General Clinton, was beaten off with great loss by a small body of men commanded by Colonel Moultrie, filled the colonists with encouragement.

72. During the year 1775 the royal government was generally terminated throughout the country, the King's governors abdicating their posts and taking refuge on board the English shipping. An act was passed by the English Government prohibiting all trade and commerce with the rebellious provinces, and authorizing the capture of all American and other vessels found trading with the colonies, and the crews of the captured vessels were to be treated, not as prisoners, but as slaves. The colonists had sent over their last petition, styled the *Olive Branch*, to the King, but both houses of Parliament refused to hear it, alleging that they could not receive any proposition coming from an unlawful assembly. Until now they hoped for reconciliation with the mother country, but the rejection of this last petition determined the complete separation of Great Britain and the colonies.

Events of 1776

73. At the beginning of 1776 Washington, by the help of Congress, had succeeded in getting into military order the army, which now ceased to be a collection of little colonial militia organizations. On the 2d of January he hoisted the Union flag in compliment of the United Colonies. This flag bore the strips which are found in the flag of today, but the crosses of St. George and St. Andrew were retained on a blue ground in the corner, blending the ideas of a new nationality and English supremacy. The present flag was adopted June, 14, 1777. Early in March, Washington was ready to drive the British out of Boston. On the night of the 4th he occupied and fortified Dorchester Heights, overlooking the harbor. General Howe, who succeeded George, saw that he must fight at a great disadvantage, or abandon the town. Thinking "discretion the better part of valor," he gathered together his forces, took to the fleet and sailed away. With him went those families which had remained loyal to the king. Thus Boston was relieved of the

Evacuation of Boston.

presence of the British, to the great joy of the inhabitants. There was now open war between the two countries. But after this New England scarcely knew the presence of soldiers, as it became the policy of England to strike at the heart of the colonies. Putting Boston in a state of defense, Washington now hastened to New York, where he was certain the next blow would be struck, and Lee was ordered to take command of the troops in the South. The fortifications which Lee had begun were hastily completed. Greene was placed in command of a division on Long Island. Measures were taken to disarm the Tory inhabitants, and the royal governor, Tryon, was driven to seek refuge on board a British man-of-war in the lower bay.

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74. Even after the war had fairly begun, the colonies still looked forward to a reconciliation with the mother country and the first proposals of a separation were received with general disapproval. But the conflict of arms, and the obstinate refusals of all overtures on the part of Parliament, gave impulse to a bolder policy. All this time the Second Continental Congress was in session at Philadelphia, and it agreed to consider definitely the question of independence. Then it took a recess of four weeks, to give the delegates an opportunity to go back to the people and learn what was the general judgment. When the members returned to their seats there was no longer any doubt what course should be pursued. A committee had been appointed to propose a full declaration. The committee was elected by ballot, and consisted of Thomas Jefferson, John Adams, Benjamin Franklin, Roger Sherman, and Robert R. Livingston. Mr. Jefferson and Mr. Adams acted as a sub-committee to prepare the draft, and Mr. Jefferson drew up the paper. The chief merit of the document is his. Some changes were made in it, on the suggestion of other members of the committee, and by others in Congress while it was under discussion. On July 2, 1776, Congress adopted the resolution, "That these United Colonies are, and of right ought to be, free and independent states; that they are absolved from all allegiance to the British crown, and that all political connection between them and the State of Great Britain is, and ought to be, totally dissolved." Two days latter Congress adopted the declaration written by Jefferson. It declared what were the natural rights of all men; it recited the acts of George III, King of Great Britain, by which he had abused his authority over the colonies, and deprived them of their rights and liberties. It reminded the world how patiently the colonies had born their injuries; of the petitions they had addressed to the King, which had been disregarded; how the colonies had appealed, not to the King only, but to their brethren, the people of England, but that all had been in vain. Therefore, as the representatives of the *United States of America*, in general Congress assembled, the delegates published this declaration of the independence of the States. The declaration was received by the people with demonstrations of joy. Washington caused it to be read to his soldiers in New York on the 9th of July. On the same evening the excited inhabitants pulled down a leaden statue of George III on horseback, which stood on the Bowling Green, and it was melted into bullets for the use of the patriot army. In all the other parts of the country the joy was intense.

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75. The British ministry were confounded at what they called the daring enormity of the colonists, in spurning the royal power and authority. They were surprised that rebels dared to show such temper and spirit. Forthwith they determined by augmented forces to crush them at a blow, and to coerce them into a sense of duty and submission to their king. Doubting the competency of their own power to subjugate the colonies, the English Parliament, at an immense expense, resorted to the aid of foreign mercenaries to carry on their bloody work. 17,000 troops, hired from the German States, were conveyed hither to aid in the subjugation of the colonies.

The Attack on New York.

76. When the British had failed to get possession of South Carolina in the early summer of 1776, they turned their attention to New York. The American army was intrenched on Long Island and the heights overlooking New York when the British fleet entered the harbor and landed some of their troops on Staten Island. General Howe and his brother, Admiral Howe, had been appointed commissioners to receive the submission of any rebels who might throw themselves on the king's mercy. They had been instructed to propose conditions of peace, but they had no authority to grant independence, and Washington refused any other terms. On the 22d of August the British forces under Generals Clinton, Cornwallis, Porter and Grant, landed on the southern shore of Long Island. The larger part of the American army was posted in what is now the heart of Brooklyn. General Putnam was in command of Long Island, but his army was greatly inferior in numbers and equipments to the enemy. On the morning on August 27, Putnam was attacked by the British and compelled to retreat to Brooklyn. Had the British general followed up his advantage, he might have slain or captured all of Putnam's force. But at nightfall, under cover of the fog, Washington skillfully withdrew all the forces on the Brooklyn side and united them with the rest of his army in New York. He had completely foiled the enemy.

Evacuation of New York.

77. It was impossible to hold New York, because it could be shelled from Brooklyn Heights and attacked on both sides by the English fleet, so Washington withdrew his forces to Harlem Heights, and fortified himself there. The British then entered New York, and it remained in their hands until the close of the war.

The condition of the patriots was now deplorable. The army, greatly reduced by losses in battle, was still further weakened by desertions and insubordination. Thousands of disheartened soldiers went home. But Washington succeeded in partly establishing discipline, and opposed so bold a front to the enemy that Howe did not venture to attack him directly. Lord Cornwallis, however, succeeded in gaining a position on the opposite side of the Hudson. Washington was compelled to withdraw across the river, knowing that the enemy would aim for Philadelphia. The two armies crossed New Jersey in hot haste, Washington maneuvering so as to defeat the British design of cutting him off from that city. The armies, while in motion, were often in sight of each other. Washington continued his retreat slowly, followed by the enemy, until early in December he crossed the Delaware river near Trenton. Howe now thought the campaign over, and went into winter quarters.

Operations in New Jersey

78. The succession of disasters, beginning with the battle of Long Island, greatly discouraged the Americans. The legislatures of New Jersey and Pennsylvania adjourned and left the states almost without a government. Congress, fearing for its safety in Philadelphia, removed to Baltimore, leaving Washington with almost dictatorial powers. Apathy and disorder prevailed among the troops, many of whom had to march with bare, bleeding feet along the frozen roads. A great number of prominent persons, believing that the cause of independence was lost, hastened to make their peace with the British authorities. It was truly a time which "tried men's souls." Amidst the prevailing gloom, Washington stood firm. Strengthened by the arrival of Lee's division, now under command of Sullivan, since the capture of Lee by the British, Washington determined to strike a blow that would revive the drooping courage of the people. He resolved to fall upon a detachment of Hessian troops, stationed at Trenton under Rhal, and chose Christmas night for the attack. Recrossing the Delaware with 2,400 men, he attacked the town while the Hessians were carous-

The Battle of Trenton

ing, and completely routed them, taking one thousand prisoners.

The Battle of Princeton.

79. This brilliant exploit had a wonderful effect upon the people. The soldiers who were about to return home consented to serve six months longer; Congress, which had exhibited great firmness during these times of trial, put forth fresh efforts to strengthen the army, and Washington, invested for six months with the authority of a dictator, crossed the Delaware again and occupied Trenton. Cornwallis now advanced toward that place with all his available forces, and Washington's danger was greater than before. But again his masterly genius prevailed. Leaving his camp fires burning, he abandoned his position, passed silently around the enemy, and at sunrise (January 3, 1777), fell upon the British reserves at Princeton, just as they were starting out to take part in the expected battle at Trenton, and routed them. Thus Howe, instead of occupying all New Jersey, was cooped up at Brunswick and Amboy, and Philadelphia was relieved of further danger from Cornwallis. After these splendid successes Washington retired with his army toward Morristown, which he made his headquarters, and arranged his troops in safe positions between that place and the highlands of the Hudson. Here he passed the winter, frequently making sudden and daring exploits, without risking a general engagement. By this means the enemy was compelled to abandon every post in New Jersey, except New Brunswick and Perth Amboy. Philadelphia being now in no danger from the British, Congress returned to that place.

Commissioners sent to France.

80. Aware of the importance of inducing the French to espouse the American cause, and relying on the enmity of France against Great Britain, Congress appointed as commissioners to the court of France, Benjamin Franklin, Silas Deane and Arthur Lee. They were instructed to procure arms and ammunition, and to obtain permission to fit out American vessels in the French ports, to annoy the commerce of England. They also directed them to solicit a loan of 10,000,000 francs, and to endeavor, by every means in their power to prevail on the French government to recognize the independence of the United States. The commissioners were kindly received and obtained the aid they requested, although the French government was not willing, as yet, to recognize the United States as an independent nation.

Foreign Officers.

81. Commissions were offered to French and other foreign officers who wished to serve in the American army, and a large number of ambitious soldiers consequently embarked for America. Washington was embarassed by the arrival of such a large number, not all of whom were men of merit. Among the foreigners, however, who thus gave their services to the American cause were several distinguished officers; Baron de Kalb, an Alsatian; Kosciusko and Pulaski, the famous Polish patriots; Baron Steuben, an experienced and accomplished Prussian soldier, and the young French Marquis de La Fayette, who purchased a ship with his own means and sailed for America to offer his sword, without pay, to the cause of independence.

Campaign of 1777.

82. Near the end of May, 1777, the American army, numbering about 18,000 men, moved from its winter quarters at Morristown and took a position at Middlebrook, on which the British left their encampment, and General Howe endeavored to induce General Washington to meet him on equal ground. But Washington chose to continue his defensive warfare, and not to risk an open battle. Finding various feints and attempts ineffectual, Howe ordered a hasty retreat to Staten Island. He then embarked 16,000 troops, and leaving Sir Henry Clinton in command at New York, put to sea, keeping his destination secret. On the 20th of August, the fleet entered Chesapeake Bay, intending an attack on Philadelphia. Washington hurried to Philadelphia by forced marches, and on September 11, engaged Howe at Brandywine creek. After a hard-fought battle the Americans were forced to retreat. After some days occupied in maneuvering and skirmishing, on the morning of October 4 Washington made a sudden attack on Howe's position at Germantown. For a while the victory seemed in favor of the Americans, but, owing to a heavy fog, they became confused, and the British troops rallied and drove them back with heavy loss. After these battles the British became masters of Philadelphia, and Washington took up his winter quarters at Valley Forge, about twenty miles distant from that city.

The Battl of the Brandywine.

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Surren of Burgoyne.

83. While these events were occurring in the middle states, in July, 1777, Burgoyne, with an army of British, Hessians and Indians, entered the states from Canada, intending to seize the whole line of the Hudson river. While on his route he sent out detachments on both sides, one under St. Leger against Fort Schuyler, and another under Colonel Baum, to seize the American stores collected at Bennington. St. Leger's enterprise failed, and Baum was completely routed by the Green Mountain boys at Bennington (August 16). October 7, Burgoyne was defeated by the Americans under Gates, at Bemis Heights, and October 17 was compelled to surrender at Saratoga. The surrender of Burgoyne proved to be the turning point of the war. It gave artillery and arms to the American army, it encouraged the soldiers, and made a great impression in Europe.

Operat of 1778

84. In the meantime the winter was passing and bringing with it severe trials to the American army at Valley Forge. The men were without shoes, and the snow was stained with the marks of their bleeding feet. There was no money to pay them. The bills issued by Congress had become so depreciated as to be almost worthless. Food was so scarce that Washington was authorized to seize provisions wherever he could find them. About this time there was a plot to compel Washington to resign, and to have Lee or Gates put in his place. But the scheme failed, and Washington became more popular than ever. In the spring of 1778 the condition of affairs improved. Robert Morris, of Philadelphia, afforded relief to the treasury by raising large sums of money for the government, on his personal credit, and continued to serve the country in this way until the end of the war. When the news of Burgoyne's capture reached France, she instantly made a treaty of alliance with America (February 6, 1778), and sent out a fleet under Count d'Estaing to aid the colonies. The news of the treaty was received by the Americans with great joy. The British Government now sent over commissioners to offer terms of peace, giving the Americans all they asked for, except independence, but all propositions short of that were refused.

The Prospect Brightens.

Treaty Allianc with France

Battle of Monmouth.

85. General Howe was now instructed to concentrate all his forces in New York Consequently the British suddenly left Philadelphia, and set out on their march. Washington instantly left Valley Forge, and pursued the enemy with 12,000 men. He came up with them at Monmouth where a hotly contested, but indecisive, battle was fought. The enemy continued their retreat, and were enabled to gain New York. Having failed in their designs against New England and the Middle States, the British now transferred their operations to the South. An expedition was sent by sea and Savannah, Georgia, was taken at the end of the year 1778. Augusta was then occupied, and Georgia was practically in the hands of the British. Thus ended the campaign of 1778. General Lincoln received orders from Congress to take command of the southern forces, and the army under Washington retired to winter quarters near Middle Brook, New Jersey.

The War in the South.

Campaign of 1779.

86. There were no great movements during 1779. Washington resolved to make the campaign a defensive one. General Clinton, who commanded at New York,

Mad Anthony Wayne.

sent out an expedition which captured the half finished fort at Stony Point, situated on the west bank of the Hudson river. Washington determined upon its recapture, and upon the night of July 16, it was carried at the point of the bayonet by the troops under the gallant General Wayne, or "Mad Anthony Wayne" as he was called. In October, the Americans, aided by the French, made an attack on Savannah in order to wrest it from the British. At the end of five hours' hard fighting, in which the brave Pulaski was mortally wounded, the French refused to continue the attack longer, and sailed for the West Indies, whereupon the Americans retired to Charleston. This brought the southern campaign of 1779 to an end. This year was signalized by the victories achieved by the infant navy of America, under the command of the intrepid Paul Jones, who fought with the "Serapis" one of the most desperate naval battles on record (September 23).

Operations in the South

Battle of Camden.

The Battle of Cowpens.

87. The seat of the war was now mainly in the South. The people there were nearly equally divided in allegiance. Savannah, the chief town of Georgia, was already in possession of the British, and in May Charleston was captured by them. The enemy had now a large army in the field in that quarter. At first it was opposed by no united American army. The patriotic planters gathered in companies, and rode here and there under the leadership of daring men like Marion and Sumter. They harassed the British wherever they could find convenient points of attack. Clinton, having gained possession of South Carolina, returned to New York, leaving Cornwallis in command. Meantime an American force under Baron De Kalb, had been sent by Washington to the South; but Congress interfered and put Gates in De Kalb's place. Gates, whose military capacity was much overrated, collected together about six thousand men, and marched hastily toward Camden, in the interior of South Carolina. Here he was met by the British under Cornwallis, who inflicted a disgraceful and disastrous defeat upon him (August 16, 1780). During the fight the heroic De Kalb lost his life. Gates fled to North Carolina, leaving his fugitive soldiers to take care of themselves. Soon afterward he was removed from command, and Greene appointed in his place. In September, 1780, Arnold's treachery against the government was discovered, and he was compelled to flee to the British lines. Major Andre, who had been arranging terms with Arnold, was captured on his return, tried as a spy, condemned, and executed October 2, 1780. Greene being now in command of the American troops in the South, showed at once the qualities of a good general. He secured additions to the weakened southern army, and began operations against Cornwallis. In December, 1780, Greene was at Charlotte, North Carolina, and Cornwallis was in South Carolina, moving northward. Greene divided his forces in two bodies. His plan was to get on each side of the British army, and while avoiding a general battle, to annoy the enemy continually. Although General Greene's men were scantily clad, half starved, and dispirited, destitute of arms and ammunition, the officers under his command were as brave men as ever followed a leader. Morgan, Lee, Marion, Sumter and Colonel Washington formed a group to which the British army could furnish no parallel. In the course of his movements, Cornwallis dispatched Tarleton against Morgan, who commanded one of the divisions of Greene's army. They met at Cowpens (January 17), and after one of the severest conflicts of the war, Tarleton was completely defeated, with the loss of the greater part of his force, and all his artillery and baggage.

Guilford Court House.

88. Morgan now hastened his march eastward to join Greene, and Cornwallis followed in hot pursuit. In order to move faster the British burned their stores and superfluous baggage, but Morgan succeeded in effecting a junction with Greene. Now followed a series of masterly movements by Greene, lasting through the winter, the spring, and the following summer. The hostile forces met at Guilford Court House (March 15, 1781). The battle was fought desperately for two hours, and all the advantages of a victory were on the side of the Americans. Notwithstanding Cornwallis claimed the victory, he retreated, closely pursued by Greene. Cornwallis avoided a battle and retreated to Wilmington, and from there proceeded to Petersburg, Virginia. Greene moved to South Carolina, where he had a fight at Hobkirk's Hill (April 25), with a force under Lord Rawdon, whom Cornwallis had left in command. Here Greene was compelled to retreat, but Rawdon's loss was so great that he soon after evacuated his main position at Camden. During April and May Greene swept through the country, carrying the British posts in succession, until the enemy were confined to three points, Ninety-six, Eutaw Springs and Charleston.

89. Having rested his army, Greene marched against Eutaw Springs, where he found the British forces under Colonel Stuart (Rawdon having resigned and sailed for England) drawn up to receive him. A severe engagement took place (September 8, 1781), both sides claiming the victory. This was the last general action in South Carolina; the British, abandoning the open country, retired to Charleston. Cornwallis arrived in Virginia in May, 1781. Having received reinforcements, he fortified himself at Yorktown, on the south side of York river. Tarleton occupied Glouster Point, opposite Yorktown. The British force in Virginia at this time was about 8,000 men.

Siege of Yorktown.

90. Meanwhile Washington, having been reinforced by a lately arrived body of 6,000 French troops, under Rochambeau, was threatening New York. About this time the French admiral, De Grasse, who had been engaged against the English in the West Indies, came north to co-operate a little while with Washington, and it was resolved, instead of carrying out on an attack upon New York, which had been planned, to strike a hard blow at Cornwallis in Virginia. The army of Rochambeau marched from Newport to meet Washington in the highlands. Their destination was kept secret, and the movements of both so artfully contrived that Clinton supposed they were going to attack New York. He did not discover their object until they had reached the Delaware. Sir Henry then sent out an expedition under Benedict Arnold to ravage Connecticut, hoping thereby to cause Washington to return, but this maneuver did not effect its object. Washington and Rochambeau pressed forward with the utmost alacrity. They received the gratifying intelligence that De Grasse had already arrived with his fleet and had blockaded the Chesapeake, thus cutting off the escape of the British by water. On September 30, 1781, the allies invested Yorktown and Glouster. After a siege of nearly three weeks, Cornwallis, finding it no longer possible to hold Yorktown, surrendered his whole army of nearly 8,000 men to Washington (October 19, 1781). On that day Clinton left New York to join Cornwallis. A week later, when off the Virginia capes, he heard of the news of the surrender. It was too late for him to be of any service, and he returned to New York.

91. The surrender of Cornwallis sent a thrill of joy through the country, and was the most decisive event of the war. The territory of the thirteen states was now restored to the jurisdiction of Congress, and the contest decided in favor of America. The surrender of Cornwallis was accepted both by the Americans and the English in America as the end of the war. Congress recommended the states to observe a day of thanksgiving to God for the signal success of the American arms. The people waited impatiently for the two governments to agree upon terms of peace. There were after this a few encounters between the two armies, but

there was no general battle. The British still had possession of New York harbor and the surrounding country. General Washington went into camp with his army at Newburgh, on the Hudson. There he could keep open communication betweeen New England and the rest of the country. The French allies remained in Virginia. Generals Wayne and Greene drove such portions of the British forces as remained in the Carolinas and Georgia down to the sea-coast, and shut them up in Savannah and Charleston. There they were protected by their vessels. The people of Great Britain became clamorous for peace. The obstinate king was still resolved "never to consent to a peace at the expense of a separation from America, but a resolution in favor of peace, supported by the leading members, passed the House of Commons February 27, 1782. The king was compelled to dismiss Lord North and accept a ministry headed by the Marquis of Rockingham, who was committed to the policy of peace, and commissioners were appointed on both sides to negotiate a treaty, hostilities being stopped in the interval.

The Treaty of Peace.

92. Much firmness and wisdom were shown by Messrs. Jay, Franklin, Adams and Laurens, the American commissioners. Many questions were raised, an important one of which was that of boundary, England wishing to keep the Ohio valley and part of Maine. The property of the Tories had been confiscated; the English wished it restored. England tried to exclude New England from the right to fish off the banks of Newfoundland. These and other questions caused delay. The delay was increased by the efforts of France and Spain to postpone the final settlement until they should get all which they demanded as nations from Great Britain. The preliminary articles of peace were settled at Paris on the 30th of November, 1782, and in September, 1783, a formal treaty was signed. By this treaty Great Britain acknowledged the independence and sovereignty of the United States, and a new nation took its place among the governments of the earth.

The Army disbanded.

93. The American army was now disbanded. During the progress of negotiations the temper of the officers and soldiers was far from satisfactory. They had received but a small portion of their pay, had often suffered from absolute hunger, and were becoming restless under their wrongs and neglect. Some of them so far forgot themselves as to desire the establishment of a military despotism, and Washington received a letter in which he was advised to declare himself king—a proposition which he indignantly refused to entertain for a single moment. Then anonymous letters were circulated among the troops in March, 1783, tending to inflame their minds and advising them to organize for the purpose of enforcing Congress to grant their demands. To counteract this movement Washington called all the officers together, and in his subsequent farewell address soothed them by kind words and promises, and appealed to the nobler sentiments of the heart. Thus the danger was dispelled, and on November 3, still glowing with patriotism, the soldiers separated, resolved to endure all necessary privations. The army certainly had been treated badly by both Congress and the States, but there was some excuse for their conduct in that the country was very poor, and that, after spending nearly $100,000,000 during the war, the treasury found itself at the end about $40,000,000 in debt. This was exclusive of the outlay of the separate states, which amounted to $60,000,000 or $70,000,000 more.

Evacuation of New York.

On November 25 the British evacuated New York, and Washington's troops marched in by the way of King's Bridge. On November 2 Washington issued his farewell address to the army; on December 4, with a heart full of love and gratitude, he bade his officers adieu. It was a deeply affecting scene, and men, who had braved the horrors of many a battle, now, as they approached their beloved commander-in-chief, were melted to tears and incapable of utterance. Washington then proceeded to Annapolis, at that time the seat of Congress, and tendered his resignation as commander-in-chief of the armies of the United States, and immediately retired as a private citizen to his home at Mount Vernon, on the Potomac, in Virginia.

Washington's Resignation.

V.—THE FORMATION OF THE FEDERAL CONSTITUTION.

94. The States were governed during the latter part of the war by "Articles of Confederation," proposed by Congress at the time of the Declaration of Independence, but not adopted until several years later. Nearly all power was vested in the separate states; Congress had but little authority; there was no president or other executive chief. During the war for independence the army, which was called the Continental army, was under the authority of the Continental Congress, and it received its pay, when paid at all, in Continental currency. These two words "Continental Currency," were placed at the head of the paper-money which Congress began to issue at the beginning of the war. No other way of raising money to meet the military expenses seemed clear to Congress than to issue this currency, since there would be no revenue from duties, as resolutions had been passed to have no trade with Great Britain. All the colonies represented in Congress agreed to redeem the bills which should be issued, just as each colony had been accustomed to redeem its own bills. At first the money was found to be very useful, and its value was not questioned, as nearly everyone thought that the war would soon be over. But the war dragged along; Congress had been obliged to issue bills to the amount of $20,000,000; whether or not the colonies would be able to win independence was a matter of doubt; the country was poor, and it was not certain that the Confederation would last. Under these circumstances people began to refuse to take the money at the value printed upon it.

Powers of Congress.

95. Under the "Articles of Confederation," adopted in 1777, the powers of Congress were but small. The colonies were jealous of each other, and especially the smaller of the larger, and so they all wished to give the "Confederation," as it was called, just as little power as they could. The new government was to be merely a "firm league of friendship" between sovereign states, which were to retain every power not "expressly" delegated to Congress. At this time Congress consisted of but one house, in which each state had an equal vote. There was no national executive head. Congress retained the power to borrow money, but was not authorized to raise money by taxes, or to fix the rate of duties on foreign goods imported, or compel obedience to any law. In fact, the provincial spirit which manifested itself in the several colonies, so prevailed over the spirit of nationality, as to completely take from it all power of action, even in the most violent emergencies, without the express consent of the several provinces. This was done by the celebrated "Articles of Confederation," by which Congress was reduced from a prompt and energetic exercise of power, assumed and used for the general good, to a mere advisory body, which, strictly speaking, had no authority at all: for the very first article, after that giving title to the instrument, made the following declaration: "Each state *retains* its sovereignty, freedom and independance, and every power, jurisdiction, and right which is not by this confederation *expressly delegated to the United States in Congress assembled.*" Thus Congress was bound, hand and foot, by the narrow-minded jealousy of the several states. Important measures required the votes of nine of the 13 states, and amendments the votes of all. Congress alone could decide upon the needed amount of money, but the power of collecting the taxes was vested in the states, only. Congress could decide disputes between the states, but it had no power to compel respect or obedience to its

decisions. It alone could make treaties with foreign nations, but no individual state was bound to respect those treaties, so far as Congress was concerned. Every state had the power of regulating its own commerce, both foreign and domestic. In truth, all the acts of Congress were simply recommendations to the state assemblies; and these recommendations were always largely debated, oftentimes rejected, and never assented to in season to have their best effect. Washington and the army and the Revolutionary cause were thus nearly sacrificed by a states-right prejudice, as bad in principle as it was slow and injurious in fact.

Robert Morris.

96. When Congress tried to borrow money in Europe, it succeeded in getting some at high rates of interest. But in the present state of the country foreigners were slow to lend; they were not sure of getting their money back again. They knew they would not if the states failed in establishing their independence. And even if they did, the question was, would they pay if peace came? Under the then existing form of government it seemed doubtful. The several states could raise money to meet their obligations by taxing their citizens; they could also impose duties on articles of trade. The government, as vested in Congress, could do neither of these things; it could only apportion to the several states their share of the public expenses. If the states refused to pay, Congress had no power to compel them. Foreign countries, also, did not like to make treaties with such a loose and feeble government. Washington said: "We are one nation to-day, and 13 to-morrow: who will treat with us on these terms?" Thus, both Congress and the states struggled on, making more paper money and borrowing at high rates of interest. Laws were passed requiring the people to take the paper money in payment of debts. But the currency became more and more worthless, so that about the middle of the war, 16 hundred dollars of it was asked for a suit of clothes. After the alliance with France, the prospect brightened. People had more confidence in the success of the United States, and it became easier to borrow money in Europe. About this time, also, Robert Morris, of Philadelphia, who thoroughly understood the mistakes which had been made, was offered the position of superintendent of finance. He accepted the office only on condition that Congress should abandon the attempt to compel the people by law to take the paper money in payment of debts. In 1781 Congress passed a resolution that it would pay all its debts in solid coin, and recommended the states to do the same. It chartered the Bank of North America, and this bank lent money both to the government and to the people. At the close of the war the government found itself deeply in debt. Part of this money was due to foreigners, and part to the people of the country. How this debt was to be paid, was the question to be settled by the Confederation.

The Sale of Unoccupied Lands.

97. One way was through the sale of unoccupied lands. When the Confederation was forming there was much dispute and uncertainty about the western boundaries of the different colonies. Virginia, for example, claimed the country now occupied by Kentucky, Indiana, Ohio and Illinois. It was proposed that the states should give up their western lands to the United States. Virginia was the first to do this, and other states followed her example (1784). Congress used this property to pay the debts of the government. It gave lands to officers and soldiers in payment of their claims. Many of these moved out on their lands, and companies were formed for colonizing, especially in the Ohio valley. Congress could not go much farther. It could say what taxes ought to be laid, and could recommend a uniform rate of duties throughout the country; but it was obliged to ask the state to lay the taxes, to levy the duties, and then to pay the money raised into the treasury of Congress.

Shays' Rebellion.

Ordinance of 1787.

98. It perceived that this would never do—that a stronger form of government was necessary for the welfare and prosperity of the country. Disorders arose within the separate states, and a state of anarchy in general prevailed. The western counties of North Carolina undertook to form a state of their own, called Frankland. The part of Virginia which afterward became Kentucky, made a similar attempt. An extensive rebellion in Massachussetts, led by an ex-captain in the Continental army, named Daniel Shays (December, 1786), and directed against the collection of taxes, etc., for six months resisted the authority of the state. It was finally put down by a military force under General Lincoln. The one act of authority which Congress could exercise was in providing for the government of the country which had been ceded to it by the states. This led to the passage of the important ordinance in 1787. By this ordinance all the district northwest of the Ohio was formed into one territory. Congress appointed a governor, a council and judges. The people of the territory were allowed to choose their own assembly and make their own laws. The most important provision of the ordinance was that by which slavery was forever excluded from the northwest territory.

Difficulties of the Country.

99. It was impossible for the country to go on as it was. The states were separating from one another, and from Congress. Congress could with difficulty bring enough members together to form a quorum. Scarcely any one outside paid attention to what it did. Least of all was it respected by foreign governments. John Adams, who had been sent as minister to England, could hardly get a hearing there. Many of the states refused or neglected to pay even their allotted shares of interest on the public debt, and Congress had not the power to compel payment. The national credit became worthless. Foreign nations refused to make commercial treaties with the United States, preferring rather to take advantage of the impotency of Congress, and lay any burden upon American commerce that they thought fit. In 1785, Algeria declared war against the United States. Having no efficient navy, Congress recommended the building of five ships of war, but as it had the power to recommend only, the ships were not built, and American commerce was left a prey to the Algerine pirates. Great Britain still refused to carry out the treaty of 1783, or send a minister to the United States. The federal government was despised abroad, and disobeyed at home.

Convention of 1787.

100. Amidst this discouraging and confused state of affairs, the more thoughtful of the people saw that some change in the form of government was necessary and so a convention of delegates was called to meet in Independence hall, Philadelphia, May 14, 1787, in order to decide upon a new constitution, and make, if possible, a stronger government, without doing harm to the liberties of the people. The states sent their ablest men to represent them. Many of the delegates had been members of the first Congress. Among others, Virginia sent Washington, Edmund Randolph, George Mason, Madison and George Wythe; New York, Hamilton; Massachusetts, Rufus King, Strong and Gerry; Pennsylvania, Franklin, Robert Morris, Gouverneur Morris and James Wilson; New Jersey, Paterson; Connecticut, Sherman, William S. Johnson and Ellsworth; and South Carolina, Rutledge and the two Pinckneys. Washington was appointed president of the convention.

The Constitution.

101. There was great difference of opinion among the delegates regarding the question at issue, but all agreed that it was necessary to give the government greater authority. After a long discussion, lasting many weeks, the convention drew up a constitution of the United States (September 17, 1787) which was to take the place of the articles of confederation. The convention reported its work to Congress, and Congress submitted it to the several states. By the terms of the constitution, it must be ratified by nine states before it could become the law of the land. Much opposition

was manifested toward its adoption. It was discussed everywhere, and its every article was earnestly debated. Hamilton, Madison and John Jay of New York published a celebrated series of papers called The Federalist, in which they went over all its features with great thoroughness, showing the reasons for the action of the convention. By this means they did much to convince the people of the importance of the work done. Delaware was the first to ratify the constitution, which it did unanimously. Pennsylvania followed, ten days afterward, with a two-thirds vote in favor. Eight other states also ratified it, so that it went into effect in 1788. Of the three states which remained, New York accepted the constitution in time to take part in the first presidential election that same year. North Carolina accepted it during the year following; and Rhode Island, last of all, in the year after that (1790). Thus the old "Confederation" came to an end and the new "Union" began.

The Union.

The Preamble.

102. The opening words of the constitution are as follows: "We, the people of the United States, in order to form a more perfect union, established justice, insure domestic tranquility, provide for the common defense, promote the general welfare, and secure the blessings of liberty to ourselves and our posterity, do ordain and establish this constitution for the United States of America." This first sentence of the constitution is often called the preamble, but no such term was applied to it by the framers of the constitution, neither is it found in the original manuscript. It is not a preamble in any sense, but is the enacting clause—an integral part of the constitution, stating that it was the people of the whole United States who established it. A preamble gives reasons why a resolution should be adopted or enacted, but it is no part of the resolution or enactment. The enacting clause, on the contrary, is mandatory. No other part of a statute is more important. Thus, this introductory sentence gives the authority and the ends for which the constitution was made. It was ordained by the people of the United States as a nation, and for the purposes so admirably set forth in its opening clause; and wherever in the constitution the words "United States" occur they signify the nation as a whole; wherever the word "States" occurs, it denotes the states considered separately, or as distinguished from the nation.

Articles of the Constitution.

103. The constitution contains seven articles, which are subdivided into sections. Besides these seven articles, fifteen amendments have been made to the constitution, which are as binding as the original articles. By the first article all legislative power is vested in the Congress of the United States, which consists of a senate and house of representatives. Under the confederation the whole governmental authority was vested in Congress. There was no executive department and no judicial. The first resolution adopted in the constitutional convention stated that a national government ought to be formed, consisting of supreme legislative, executive and judicial departments. Most legislative bodies have two houses. This is true of all the existing state governments, and was true of all the states at the time the constitution was framed, except Pennsylvania and Georgia, which had but one each. The Continental Congress had but one house. While there is a general distribution of powers among the three great departments of government, the exercise of these powers is not absolutely exclusive.

The House of Representatives.

104. The federal house of representatives is descended, through the state houses of representatives, from the colonial assemblies. It is an assembly representing the whole population of the country as if the people were all in one great state. It is composed of members chosen every year by the people of the states. A candidate for election to the house must be at least twenty-five years old, must have been seven years a citizen of the United States, and must be an inhabitant of the state in which he is chosen. As the federal Congress is a taxing body, representatives and taxes are apportioned among the several states according to the same rule, that is, according to population. At this point a difficulty arose in the convention as to whether slaves should be counted as population. If they were to be counted, the power of the slave states in all matters of national legislation would be greatly increased. The difficulty was adjusted by a compromise measure according to which five slaves were to be reckoned as three persons. Since the abolition of slavery this provision has become obsolete, but until 1860 it was a very important factor in American history.

The Three-Fifths Compromise.

The Connecticut Compromise.

105. In the federal house of representatives the great states, of course, have much more weight than the smaller ones. In 1790 the four largest states had 82 representatives, while the other nine had only 33. The largest state, Virginia, had ten representatives, to one from Delaware. These disparities have increased. In 1880, out of thirty-eight states, the nine largest had a majority of the house, and the largest state, New York, had 34 representatives to one from Delaware. This feature in the house of representatives caused the smaller states in the convention to oppose the whole scheme of constructing a new government. They were determined that all the states, both great and small, should have equal representation in Congress. Their prolonged opposition threatened to ruin the whole plan, when a method of compromise was fortunately discovered. It was intended that the national legislature, in imitation of the state legislatures, should have an upper house or senate, and at first the advocates of a strong national government proposed that the senate also should represent population. But it happened that in the state of Connecticut a unique governmental method had been adopted. There it had always been the custom to elect the governor and upper house by a majority vote of the whole people, while for each township there was an equality of representation in the lower house. The Connecticut delegates in the convention, therefore, being familiar with a legislature in which the two houses were elected on different principles, suggested a compromise. Let the house of representatives, they said, represent the people, and let the senate represent the states; let all the states, great and small, be equally represented in the senate. Such was the famous "Connecticut Compromise." Had this not been adopted the convention would doubtless have broken up without accomplishing its purpose. After it was accepted, and the jealous fears of the smaller states allayed, the work, yet to be accomplished, was comparatively easy.

The Senate

106. Thus it came about that the upper house of the national legislature is composed of two senators from each state. As they represent the state, they are chosen by its legislature and not by the people. They are chosen for a term of six years, and one-third of the number of terms expire every second year, so that, while the whole senate may be renewed by the lapse of six years, there is never a "new senate." The senate has thus a continuous existence and a permanent organization, whereas each house of representatives expires at the end of a two-years' term, which is usually known as a "congress," and is succeeded by a "new house." A candidate for the senatorship must be at least thirty years of age, must have been nine years a citizen of the United States and must be an inhabitant of the state which he represents.

Time of Assembling

107. Congress must assemble at least once in every year, and the constitution appoints the first Monday in December for the time of meeting; but Congress can if necessary, enact a law changing the time. The established custom is to hold the election for representatives upon the same day as the election for president - the Tuesday after the first Monday in November. As the period of the new administration does not begin until the fourth day of the following March, the new

house of representatives does not assemble until the December following that date, unless the new president should think it necessary to call an extra session of Congress at an earlier date. Each house is judge of the elections, qualifications and returns of its own members, determines its own rules of procedure and may punish its members for disorderly behavior, or by a two-thirds vote expel a member. Absent members may be compelled under penalties to attend. Each house is required to keep a journal of its proceedings, and at proper intervals to publish it, except such parts as for reasons of public policy should be kept secret.

Privileges of members.

108. Senators and representatives receive a fixed salary by law, which is paid out of the public treasury. In all cases, except treason or felony or breach of the peace they are privileged from arrest during their attendance in Congress, as also while on their way to it and while returning home; "and for any speech or debate in either house they shall not be questioned in any other place." During the session of Congress neither house may, without the consent of the other, adjourn for more than three days, or to any other place than that in which Congress is sitting. No person can at the same time hold any civil office under the United States government and be a member of either house of Congress.

Presiding officers.

109. The vice-president is the presiding officer in the senate, with power to vote only in case of a tie. The house of representatives elects its presiding officer, who is called the Speaker. In the early history of the House of Commons, in England, its presiding officer was naturally enough its *spokesman*. He could speak for it in addressing the crown. Instances of this kind occurred during the fourteenth century, until in 1376 the title of Speaker was definitely given to Sir Thomas Hungerford, and from that date the title has always held. The same title was given to the presiding officers of the American colonial assemblies, and thence it passed on to the state and federal legislatures. The Speaker presides over the debates, puts the questions and decides points of order. He also appoints the committees of the house of representatives.

Power of impeachment.

110. The house of representatives has the sole power of impeachment, and the senate has the sole power to try all impeachments. When the president of the United States is tried, the chief justice of the supreme court must preside. As a precaution against the use of impeachment for party purposes, a two-thirds vote is required for conviction. In case of conviction the judgment cannot extend further than "to removal from office, and disqualification to hold or enjoy any office of honor, trust or profit under the United States;" but the person convicted is liable afterward to be tried and punished by the ordinary process of law.

The president's veto power.

111. The constitutional provisions for legislation are admirably simple. All bills for raising revenue must originate in the lower house, but the upper house may propose or concur with amendments as in the case of other bills. After a bill has passed both houses, it must go to the president for his approval. If he approves it, he signs it, and it becomes a law. If he disapproves it, he returns it to the house in which it originated, with a written statement of his objections, which must be entered in full upon the journal of the house. The bill is then reconsidered, and if it obtains a two-thirds vote it is sent, together with the objections, to the other house. If it passes there by a two-thirds vote, it becomes a law. Otherwise it fails. If the president keeps a bill longer than ten days (Sundays excepted) without signing it, it becomes a law without his signature, unless Congress adjourns before the expiration of the ten days, in which case it fails to become a law, just as if it had been vetoed. This method of vetoing bills just before the expiration of Congress, by keeping it in one's pocket, so to speak, was styled a "pocket veto," and was first employed by President Jackson in 1829.

Powers granted to Congress.

112. By the constitution, Congress has the power "to lay and collect taxes, duties, imposts and excises, to pay the debts and provide for the common defense and general welfare of the United States," but all duties, etc., were to be uniform throughout the United States. Other powers are naturally attached to this—such as the power to borrow money on the credit of the United States; to regulate foreign and domestic commerce; to coin money and fix the standard of weights and measures; to provide for the punishment of counterfeiters; to establish post-offices and post-roads; to issue copyrights and patents; to establish courts inferior to the supreme court; to punish offenses committed on the high seas, or against the law of nations; to declare war, grant letters of marque and reprisal, and make rules concerning captures on land and water; to raise and support an army and navy (no appropriation to be for more than two years), and to make rules for the regulation of the land and naval forces; to provide for calling out the militia to suppress insurrections and repel invasions, and to command the militia while actually employed in the service of the United States. The several states, however, were to train their own militia and appoint the officers. Congress may also establish a uniform rule of naturalization, and uniform laws on the subject of bankruptcies, but it has not yet done so. It was also empowered to establish a national capital or federal district (which is the District of Columbia, containing the city of Washington), to exercise exclusive control over it, and over forts, magazines, arsenals, dockyards and other needful buildings, which it erects within the several states upon lands purchased for such purposes with the consent of the state legislature; and finally, "to make all laws which shall be necessary and proper for carrying into execution the foregoing powers and all other powers vested by this constitution in the government of the United States, or in any department or office thereof." This last clause may be called the elastic clause of the constitution. It has been the subject of continued debate, and has undergone a great deal of stretching for one purpose and another. It was a profound disagreement in the interpretation of this clause which, after 1789, divided the American people into two great political parties.

The "Elastic Clause."

Powers denied to the States.

113. The national authority of Congress is further sharply defined by the express denial of sundry powers to the several states. The states are expressly forbidden to impose any duties on imports or exports, except for inspection charges, which must be passed over to the treasury of the United States; to make treaties of any kind; to lay any duty on tonnage; to keep troops or ships of war in time of peace; to engage in war unless actually invaded, or in such imminent danger as will admit of no delay; to grant letters of marque and reprisal; to coin money; to emit bills of credit; to make anything but silver a legal tender; to pass any bill of attainder, *ex post facto* law, or law impairing the obligation of contracts, or to grant any title of nobility.

Prohibitions laid upon Congress.

114. Some express prohibitions were laid upon the National Government. Duties may be laid upon imports, but not upon exports. Duties and excises must be uniform throughout the country, and no commercial preference can be shown one state over another. The privilege of the writ of *habeas corpus* cannot be suspended except "when, in cases of rebellion or invasion, the public safety may require it." A census must be taken every 10 years in order to adjust representation, and no direct tax can be imposed except according to the census. No bill of attainder, or *ex post facto* law can be passed. A bill of attainder is a special legislative act by which a person may be condemned to death, or to outlawry and banishment, without the opportunity of defending himself, to which he is entitled in a court of law.

Congress can grant no title of nobility, and no federal officer can accept a present, office, or title from a foreign state without the consent of Congress. "No religious test shall ever be required as a qualification to any office or public trust under the United States." Money is to be taken from the treasury only in consequence of appropriations made by law.

Qualifications for the presidency.

115. No one is eligible to the office of president unless he is a native born citizen. The candidate must be at least 35 years old, and must have been 14 years a resident of the United States. The president's term of office is four years. The constitution says nothing about his re-election, and there is no written law forbidding his being re-elected many times. Some of the presidents have served two consecutive terms, and it seems to have become the established custom not to go beyond that. The president is solemnly sworn to execute his office faithfully, and "to preserve, protect, and defend the Constitution of the United States" to the best of his ability. In case of his death, resignation, or inability to perform the duties of his office, the vice-president takes his place; and, in the case of the inability of both, the members of the cabinet succeed in the order prescribed in the Presidential Succession Act of 1886. The president is commander-in-chief of the military and naval forces of the United States, and of the militia in the several states actually engaged in the service of the United States: and he has the prerogative of granting reprieves and pardons for offences against the United States, except in cases of impeachment. He can make treaties with foreign powers; but no treaty is valid unless confirmed by a two-thirds vote of the senate. He appoints ministers to foreign countries, consuls, and the greater officers, such as the heads of executive departments and judges of the supreme court, and all other officers whose appointment Congress has not vested in other officers; but all presidental appointments are to be confirmed by the senate. When vacancies occur during the recess of the senate, he may fill them by granting commissions to expire at the end of the next session. He commissions all federal officers. He receives all foreign ministers. He may summon either or both houses of Congress to an extra session, and if the two houses disagree in regard to the time of adjournment, he may adjourn them to such a time as he thinks best, but of course, not beyond the time fixed for the beginning of the next regular session. The president must from time to time make a report to Congress on the state of affairs in the country, and suggest such a line of policy or such special measures as may seem proper to him. This report has taken the form of an annual written message. He may also call upon the heads of departments for an opinion, in writing, on any subject relating to such department. The president is paid by the United States, and his salary is not to be increased or diminished by Congress during his term of office. The act authorizing any increase must apply only to the successors of the president who signs the act.

Powers and duties of the president.

The President's message

Executive departments.

116. The constitution made no express provision for the creation of executive departments, but left the matter to Congress. At the beginning of Washington's administration three departments were created—those of state, treasury and war, and an attorney general was appointed. Since then the number of departments has been increased, until now (1890) there are eight: those of state, of the treasury, of war, of the navy, of the post-office, of the interior, of justice, and of agriculture. The chief officer of each department is called its secretary. The secretaries of these departments are the president's advisers, and constitute his cabinet. They are selected by the president and are confirmed by the senate, but are responsible to no one but the president.

117. The secretary of state ranks first among the cabinet officers. He is the minister of foreign affairs, and is the only officer who is authorized to communicate with other governments in the name of the president. He is at the head of the diplomatic and consular service, issuing instructions to the United States ministers abroad, and taking a leading part in the negotiation of treaties. He keeps the national archives, and superintends the publication of laws, treaties and proclamations, and he is the keeper of the great seal of the United States. The cabinet officer next in rank is the secretary of the treasury. He conducts the financial business of the country, superintends the collection of revenue, and gives warrants for the payment of moneys out of the treasury. He also superintends the coinage, the national banks, the custom-houses, the coast-survey and lighthouse system, the marine hospitals, and life-saving service. He sends reports to Congress, and suggests such measures as seem good to him. He is aided by two assistant secretaries, six auditors, a register, a comptroller, a solicitor, a director of the mint, commissioner of internal revenue, chiefs of the bureau of statistics and bureau of printing and engraving, etc.

Secretary of the Treasury.

War and navy.

118. The war and navy departments need no special description here. The war department is divided into ten bureaus, among which is the weather bureau, presided over by the chief signal officer. The navy department consists of eight bureaus, and among its many duties it has charge of the naval observatory at Washington, and publishes the nautical almanac. The department of the interior is divided into eight bureaus. It deals with public lands, pensions, patents, Indian affairs, education, public documents, and the census. The postmaster-general's department has to do with the postal affairs of the country. The attorney-general's department was organized in 1870 into the department of justice. The attorney-general is the president's legal adviser, and represents the United States in all law suits to which the United States is a party. The agricultural department, which was created in 1889, superintends the agricultural interests of the country.

Department of the Interior

Postmaster General and Attorney-General

Agricultural Department.

119. The best method of electing the president was a question which perplexed the constitutional convention as much as any other. To submit the election of an officer so exalted to the popular vote, was regarded with general distrust. At one time the convention decided to have the president elected by Congress, but there was a grave objection to this; it would be likely to destroy his independence and make him the mere creature of Congress. At last the plan of an electoral college was devised. Each state is entitled to a number of electors equal to the number of its representatives and senators together; and the electors choose the president and vice-president, meeting at their state capitals for that purpose, and sending separate certificates of their choice of president and vice-president to the presiding officer of the Senate at Washington. No federal senator or representative, or any person holding civil office under the United States, can serve as an elector. Each state may appoint or choose its electors in such a manner as it sees fit; at first, they were more often than otherwise chosen by the legislatures; now they are always elected by the people. The day of election must be the same in all the states. By act of Congress the electors are to be chosen on the Tuesday after the first Monday in November.

The Electoral College

Powers of electors.

120. It was the original intention that the electors should be left free to make their own choice, and there are instances in early years of electors of one party voting for personal friends of the opposite party. At first the electoral votes did not state whether the candidates named in them were candidates for the presidency or vice presidency. Each elector simply wrote down two names, only one of which could be the name of a citizen of his own state. In the official count, the candidate who had the highest number of votes, provided they were a majority of the whole number, was declared president, and the next highest became vice-president. The natural result of this was seen in the

first contested election in 1796, which gave the presidency to John Adams, while his antagonist, Thomas Jefferson, became vice-president. In 1800, Jefferson and his colleague Burr received exactly the same number of electoral votes. This threw the election into the house of representatives, and such intrigues followed for the purpose of defeating Jefferson that the country was threatened with civil war. This necessitated a change in the method of election. In 1804, the twelfth amendment was adopted. The method by this amendment was changed so that the electors make separate ballots for president and vice-president. In the official count the votes for the president are first counted. If no candidate has a majority then the house of representatives must immediately choose the president from the three names highest on the list. In this choice the house votes by states, each state having one vote; a quorum for this purpose must consist of at least one member from two-thirds of the states, and a majority of all the states is necessary for a choice. Then if no candidate for the vice-presidency has a majority, the senate makes its choice from the two names highest on the list. A quorum for the purpose consists of two-thirds of the whole number of senators, and a majority of the whole number is necessary to a choice.

lfth end- nt.

121. In 1877 an unforeseen difficulty arose, and one for which no provision had been made. During the presidential contest between Tilden and Hayes, South Carolina, Florida and Louisiana had each set up rival governments. Ballots for Tilden and ballots for Hayes were sent in at the same time by the two hostile sets of electors in each of these states, each list being certified by one of the two rival governors in the same state. In the absence of any recognized means of deciding which ballots to count, the two parties in Congress submitted the result to arbitration. An "electoral commission" was created for the occasion, consisting of five senators, five representatives and five judges of the supreme court. By this expedient, a clumsy one perhaps, the difficulty was tided over. The question of conflicting returns has at length been set at rest by the act of 1887, which provides that no electoral votes can be rejected in counting, except by the joint action of both houses of Congress.

toral mis- n.

122. The judiciary is the third of the three great departments of the general government. The constitution itself provides for one supreme court, but leaves to Congress to determine how many inferior courts should be established. The organization of the supreme court is also left to Congress. The chief reason why a national judiciary is necessary in addition to the state systems is that the state judges might be biased in favor of their own state. Laws of Congress often bear with greater hardship on some states than others, and public opinion in those states upon whom the burden lay, might be so strong in opposition, that no judge elected and supported by those people would sustain it. But if the judge belonged to a national system, and thus represented and was supported by the whole nation, he would have nothing to fear, and thus his decision would be more impartial. The experience of the confederation taught this. The national judiciary consists of three grades of courts: The supreme court, the circuit courts and the district courts. The supreme court is the highest in the land, and was established by the constitution itself. The others were established by Congress. The supreme court consists at present of a chief justice and eight associate justices, and its jurisdiction is almost wholly appellate; that is, cases are not tried in it, but it only hears appeals from other courts, and that only in the most important cases. It has original jurisdiction in a few cases. Of the circuit courts there are nine in the country. Each of the nine judges of the supreme court is also presiding judge of a circuit court. The area of the United States, not including the territories, is divided into nine circuits, and in each circuit the presiding judge is assisted by special circuit judges. The circuits are divided into fifty-six districts and in each of these there is a special district judge. The districts never cross state lines. They cover each a state or a part of a state.

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rts.

Tenure of office.

123. By the constitution, the judges hold office during good behavior. In no other department of the general government are offices held for so long a term. The purpose is to insure a correct and impartial administration of justice by making the judges independent of conflicting parties. The object of the framers of the constitution was to remove them as far as possible from undue political influences. As with the president, so in this case. Congress, though it fixes the salaries of the judges, cannot diminish them while in office. The jurisdiction of the federal courts does not extend to all kinds of cases, but only to such as the constitution specifies. The cases enumerated in the constitution in which the national courts have jurisdiction may be divided into three general classes, (1) those arising under the constitution, the laws of Congress and treaties, (2) those affecting foreigners, and (3) those between different states or the citizens of different states. Cases which arise under the constitution, laws or treaties of the United States may be those where a person is given a right by the constitution, etc., which he does not have by the laws of his state, as for instance a right to sue an infringer of a patent granted to him, or where he violates a law of Congress or treaty, as counterfeiting coin, or doing anything forbidden by a treaty, or where any question arises as to the meaning of the constitution, laws or treaties of the United States, or as to whether a law of Congress is constitutional or not. In these cases it makes no difference whether the parties are citizens of the same state or not. The jurisdiction is given to the national judiciary for two reasons: First, in order that in the interpretation and enforcement of its own laws, it may not be dependent on the states; and second, in order that the interpretation may be uniform throughout the country.

Salary.

Federal jurisdiction.

Cases unde United States law

Cases affecting foreigners.

124. In cases affecting foreigners the decision properly belongs to the federal courts, for the reason that if a foreigner is injured here, the nation, and not the state, is responsible to the foreigner's government; therefore the nation, and not the state, should make redress for the injury And where the foreigner is an ambassador, or other minister, the supreme court has original jurisdiction in the case. Admiralty jurisdiction is also given to the federal courts, for the reason that many admiralty cases affect foreigners. Another reason is, that admiralty is a part of the regulation of commerce, which is a subject taken away from the states and given entirely to the United States.

Cases affecting different States or their citizens.

125. The third class of cases in which the federal courts have jurisdiction, is where the parties on the two sides, plaintiff and defendant, are either two different states, or citizens of different states. The federal courts are to decide controversies between two or more states; because, domestic tranquility requires that the contention of states should be peacefully terminated by a common judicatory, and because, in a free country, justice ought not to depend on the will of either of the litigants. They are to decide controversies between a state and the citizens of another state; because, in case a state (which comprehends all its citizens) has demands against some citizens of another state, it is better that she should prosecute their demands in a federal court than in a court of the state to which those citizens belong, the danger of irritation and criminations arising from apprehensions and suspicions of partiality being thereby obviated. They are to decide controversies between citizens of the same state claiming lands under grants of different states; because, as the rights of the two states to grant the land are drawn into question, neither of the two states ought to decide the controversy.

Original and appellate jurisdiction.

126. The judicial power of the United States extends to all cases of law and equity arising under the constitution and laws thereof, and to treaties made under their authority. But there are two kinds of jurisdiction, original and appellate. Original jurisdiction is jurisdiction of a cause from its beginning. If a party can *begin* his suit in the circuit court, for instance, then that court has original jurisdiction in the case. If he cannot bring his case into the circuit court until it has been tried in some lower court, then the circuit court is said to have appellate jurisdiction. Appeal lies from the district court to the circuit court when the matter involved is of a value greater than $500, and from the circuit court to the supreme court when $5,000 or more is involved.

Court of claims.

127. No direct suit can be brought against the United States either by a citizen or a state, without the authority of an act of Congress. But in 1855 Congress established a court, called the court of claims, in which those having claims against the United States, may bring a suit in the ordinary way. The demand is presented to the court by petition, setting forth specifically its origin and nature, and the party is allowed to prove it by the same rules of evidence which are usually adopted in a court of justice. If a claim is established Congress makes provision for its payment. An attorney, called the solicitor of the United States, appears before this court in behalf of the government.

Treason.

128. In the constitution, treason is made to consist only in levying war against the nation, or in adhering to its enemies, giving them aid and comfort. The purpose was to make the meaning as definite as possible, so that all opportunity for constructive treason might be removed. It has been decided by the court that there must be an actual levying of war; that a conspiracy to subvert the government by force is not treason. But if war be actually levied, that is, if a body of men be actually assembled for the purpose of effecting by force a treasonable purpose, all those who perform any part, however minute, or however remote from the scene of action, and who are actually leagued in the general conspiracy, are to be considered as traitors. Conviction of treason requires the testimony of two witnesses to the same overt act of treason, or a confession in open court. A private confession passes for nothing. To Congress is given the power to declare the punishment of treason, "but no attainder of treason is to work corruption of blood, or forfeiture, except during the life of the person attainted." The *attainder* spoken of in this clause must be that connected with the judgment pronounced by a court, and not a legislative attainder, for we have already seen that Congress is forbidden, as also the states, from passing any bill of attainder. Congress might provide for a judicial attainder in the case of treason, but the the effects of this attainder must be limited to the life of the offender.

As treason is a crime against sovereignty, a violation of one's allegiance, there can be no treason against a particular state. The states, however, have always asserted their power to punish for treason against them individually. It has never been fully maintained in practice; but the theory had its effect in the secession period. If a state, by its courts, punishes treason, it must not be as treason against itself, but as treason against the union; and in this view, the propriety of that state legislation which affixes to it particular penalties, is doubtful.

Relations of States.

Privileges of citizens.

Fugitive criminals.

Fugitive slaves.

129. Article IV of the constitution contains a number of important provisions, most of which affect the relations of the states to each other, and to the general government. The first one is in regard to the effect which the laws, records and judgments of our state shall have in another, and the provision is that they shall have full effect everywhere. No state can grant privileges to its own citizens, from which the citizens of other states are excluded. There must be an equality of citizenship everywhere. Without such a provision, any state might deny to citizens of other states the right to buy and hold real estate, or to become voters after living in the state the prescribed time, or to enjoy equal privileges in trade or business. The subject of delivering up fugitives from justice, is one which among different nations, has involved some doubts. The constitution of the United States, however, provides that they shall always be given up to those who, in the states, have a right to require it. By the common law, a slave escaping into a non-slaveholding state became free. But the constitution provided that fugitive slaves were to be surrendered to their owners. Escaped slaves were, under this provision, returned to the south up to 1861. The clause is of course obsolete now.

New States.

The Northwest Territory.

130. The constitution provides for the admission of new states to the union, but it does not allow a state to be formed within another state. A state cannot "be formed by the junction of two or more states, or parts of states, without the consent of the legislatures of the states concerned, as well as of the Congress." Shortly before the making of the constitution, the United States had been endowed for the first time with a public domain. The territory northwest of the Ohio river had been claimed, on the strength of old grants and charters, by Massachusetts, Connecticut, New York and Virginia. In 1777 Maryland refused to sign the Articles of Confederation until these states should agree to cede their claims to the United States, and thus, in 1784, the Federal government came into possession of a magnificent territory, out of which five great states—Ohio, Indiana, Illinois, Michigan and Wisconsin—have since been made. While the Federal convention was sitting at Philadelphia the Continental Congress at New York was doing almost its last, and one of its greatest pieces of, work in framing the ordinance of 1787 for the organization and government of this newly acquired territory.

Other territories and their governments

131. In 1803 the vast territory of Louisiana, comprising everything (except Texas) between the Mississippi river and the crest of the Rocky Mountains, was purchased from France. A claim upon the Oregon territory was soon afterward made by discovery and exploration, and finally settled in 1846 by treaty with Great Britain. In 1848 by conquest, and in 1853 by purchase, the remaining Pacific lands were acquired from Mexico. All of this vast region has been at some time under territorial government. As for Texas, on the other hand, it has never been a territory. Texas revolted from Mexico in 1836 and remained an independent state until 1845 when she was admitted to the union. Territorial government has generally passed through three stages: First, there are governors and judges appointed by the president; then, as population increases, there is added a legislature chosen by the people, and empowered to make laws subject to confirmation by Congress; finally, entire legislative independence is granted. The state is then ripe for admission to the union as a state.

Guarantee clause.

132. The national government was to guarantee to each of the states a republican form of government, and to protect each of them against invasion or, on application of the legislature or governor, against domestic violence. This clause makes a republican government necessary in every state. It is equivalent to saying that no other shall be permitted to be established. This is the only instance in the constitution where the government has a duty enjoined upon it, while the particular department is not mentioned. Here the obligation is from the United States to the states; but whether to be exercised by the president or by Congress is one of the questions that has grown out of the reconstruction measures. In the case of Rhode Island the supreme court held "It rests with Con-

gress to decide what government is the established one in a state. For, as the United States guarantee to each state a republican government, Congress must necessarily decide what government is established before it can determine whether it is republican or not. And when the senators and representatives of a state are admitted to the councils of the union, the authority of the government under which they are appointed, as well as its republican character, is recognized by the proper authority."

Republican government.

133. The constitution does not define a *republican* government. The national government may be assumed to be republican in form, and thus a model for the states. Mr. Madison says: "We may define a republic to be a government which derives all its powers directly or indirectly from the great body of the people, and is administered by persons holding their offices during pleasure, for a limited period, or during good behavior." Farrar says: "The principle of republicanism is the equal right of the people, the citizens, all the members of the body politic. In theory it is the government of public opinion. The fundamental principles of right and justice for the government, the representative character of the governors, and their practical responsibility to the governed, are the essentials of republicanism."

State governments.

134. The constitution indirectly requires various provisions in the state governments by enjoining duties. The senators of the United States are to be elected by the state legislatures. Members of the house of representatives are to be elected by the same electors as vote for the members of the most numerous branches of the state legislature. The executive of the states is often referred to. The judges are to take oath to obey the constitution of the United States. Thus the states must have three great departments, the legislative, executive and judicial. The legislature must be in two branches, and the most numerous branch must be elected by the people. The states are supposed to have written constitutions.

The first ten amendments.

135. One of the strongest objections urged by its opponents against the adoption of the constitution as it came from the hands of the convention, was the want of a recognition of certain rights of citizens. To meet this objection, in September, 1789, the first ten amendments were proposed by Congress, and in December, 1791, they were declared in force. These ten amendments, which are called a "Bill of Rights," because they contain a list of the rights deemed most important to the liberty of the people, do not change any original provision of the constitution. They act merely as restrictions and limitations upon the powers of Congress, and were deemed unnecessary by those who framed the constitution for the reason that these rights were so generally acknowledged, and that the powers of Congress were limited to those expressly granted to it. But as several of the state conventions had, at the time of adopting the constitution, expressed a desire that declarations and guarantees of certain rights should be added in order to prevent misconstruction and abuse, the first Congress, at its first session, proposed twelve amendments, ten of which were ratified by the requisite number of states. These amendments forbade the establishment of any religion by Congress, or any abridgment of freedom of worship, of speech, or of the press, or of the popular right to assemble and petitition the government for redress of grievances, the billeting of soldiers, unreasonable searches or seizures, or general warrants, trials for infamous crimes except through the action of a grand jury, subjecting a person for the same offence to be twice put in jeopardy of life or limb, compelling him to witness against himself in criminal cases, the taking of life, liberty, or property without due process of law or without compensation for property, and the demand of excessive bail, or the imposition of excessive or of cruel or unusual punishments. They confirmed the right of the people to keep and bear arms, to a jury trial from the vicinage in criminal cases or in cases involving more than twenty dollars, to a copy of the indictment, to the testimony against the prisoner, to compulsory process in his half, and to counsel for him. Finally, it is declared that "the enumeration of certain rights shall not be construed to deny or disparage others retained by the people," and that "the powers not granted to the United States by the constitution, nor prohibited by it to the states, are reserved to the states respectively, or to the people."

136. All the debts of the federation, and its engagements, were made binding on the new government; and the constitution, and the laws and treaties to be made under it were declared to be "the supreme law of the land;" the judges in every state were to be bound thereby, "anything in the constitution or laws of any state to the contrary notwithstanding." The language of this clause is clear and explicit. The people of the United States established this constitution for the United States. It was the work of the nation itself, and was binding in every part of the republic. This clause was intended to affirm the supremacy of the national government over the state governments. If the constitution was not the supreme law of the land it would not be a consitution, it would be a nullity. Its supremacy is necessarily involved in the instrument itself, yet it was necessary to declare it, in order that all might understand it and no room be left for controversy.

Supreme law of the land.

VI. THE GOVERNMENT UNDER THE CONSTITUTION.

137. As soon as the constitution had been ratified by the requisite number of states, Congress named the first Wednesday in January, 1789, as the day for the choice of electors, the first Wednesday in February for the choice of president and vice-president, and the first Wednesday in March for the inauguration of the new government at New York city. The last date fell on the 4th of March, and this has been the limit of each president's term since that time. The election took place at the appointed time, and when the votes of the electors were counted before Congress it was found that George Washington had been unanimously elected president, and that John Adams, standing next on the list, was vice-president. Before the inauguration, the old Confederate Congress had "given up the ghost." On October, 1788, its record ceased, and for nearly six months the United States were without any national government. The contest for nationality had been successful, and the old order of things passed away for ever.

Inauguration of president.

Washington the first president.

The condition of the country.

138. The nation over which George Washington was called to preside in 1789 was a third-rate power, inferior in population and wealth to Holland, for example, and about on a level with Portugal or Denmark. The first census was taken in 1790, and the population was then four millions. The people were thinly scattered through the thirteen states between the Atlantic and the Alleghanies, beyond which mountainous barrier a few hardy pioneers were making the beginnings of Tennessee, Kentucky, and Ohio. Roads were few and bad, none of the great rivers were bridged, mails were irregular. There were few manufactures. There were many traders and merchant seamen in the coast towns of the north, but the great majority of the people were farmers, who lived on the produce of their own lands, and seldom undertook long journeys. Hence the different parts of the country knew very little about each other, and entertained absurd prejudices, and the sentiment of union between the states was extremely weak. East of the Alleghanies the red man had ceased to be dangerous, but tales of Indian massacre still came from regions no more remote than Ohio and Georgia. Spain still held vast possessions west of the Mississippi.

The first census.

The only other power which had possessions in North America was England. The feeling entertained toward the states in England was one of mortification and chagrin, accompanied by the hope that the half-formed union would fall to pieces, and its separate states be driven by disaster to beg to be taken back into the British empire. The rest of Europe knew little about the United States, and cared less.

The beginning of the government.

139. It was under these circumstances that the young government began its career, and it was fortunate for it that it began under the auspices of such an administration as Washington's. Congress met in New York, March 4, 1789. It adopted twelve amendments to the constitution, ten of which, as has been shown, were ratified by the states. But the most pressing business before Congress was to obtain money to pay the debt of the confederation. This difficult work was so successfully accomplished that little change has been found necessary in financial methods from that day to this. Washington's cabinet consisted of Thomas Jefferson, as secretary of state; Alexander Hamilton, as secretary of the treasury; and Henry Knox, as secretary of war. John Jay was appointed chief justice, and Edmund Randolph attorney-general. The financial success of the government was mainly due to the organizing genius of Hamilton, assisted by the skill and tact of Madison, as leading member of the house of representatives. Hamilton saw in the payment of the national debt an opportunity to give strength to the United States in the eyes of foreign nations. He saw also that it gave an opportunity to bind the states in a more perfect union. He proposed three measures: First, that the government should assume the foreign debt of the Confederation, and pay it in full: secondly, that the domestic debt, which seemed to have been virtually repudiated, should likewise be assumed and paid; thirdly, that the debts of the separate states should also be assumed and paid by the federal government. The first proposition was adopted unanimously. The second was opposed on the ground that it would only benefit speculators, who had bought up United States securities at a discount; but by dint of forcible reasoning the measure was carried. The third measure caused great debate, and met with violent opposition. There was a fierce and bitter fight over it, which at last was only settled by great political manipulation.

Hamilton's measures

Federalists and anti-Federalists

140. There were already two parties in the country, the Federalists, who desired a strong general government, and who had urged the people to accept the constitution, and the anti-Federalists, who wished to give more power to the state government, and less to the general government. Hamilton was the leader of the Federal party, and the anti-Federalists united to defeat his last measure. At this time the site of a Federal capital was to be selected. The northern people generally wished to have it not further south than the Delaware river, while the southerners were determined to have it no further north than the Potomac. Hamilton was bent on carrying his point, and took advantage of this dispute. He persuaded two Virginia congressmen to change their votes and support his measure. In return he promised to use his influence to have the capital located upon the banks of the Potomac, instead of at some northern point. This change of votes gave him the requisite majority. The assumption of state debts was a master stroke of policy. All those persons to whom any state owed money were at once won over to the support of the Federal government. Many of these persons were powerful and wealthy; and all now felt a common interest in upholding the national credit, which, through these wise and vigorous measures of Hamilton, was soon completely restored.

Revenue.

141. The next step was to raise a revenue for the carrying on of the government, and this must be raised by Federal taxation. There were two ways in which this could be done—by imposing duties on goods imported into the country, or by levying internal taxes. By the first method, the United States would declare its right to tax foreigners; by the second, to tax its own citizens. The former method was mainly resorted to, because it was more indirect, and because the people, as yet, did not like the idea of being directly taxed to support the general government, even though it had been established by themselves. However, a tax was laid upon the manufacture of spirituous liquors in 1794, and this caused serious trouble. The settlers in the mountains of Pennsylvania and Virginia had long since found out that it cost more to carry their corn and wheat to market than they could sell it for, and accordingly they distilled it into whisky. When Congress laid a tax on whisky, they bitterly opposed it, and when the revenue officers came to collect the tax, the settlers refused to pay it, and threatened to take up arms. But Washington instantly sent an army of sixteen thousand men into the disaffected region, and the insurrection was summarily suppressed.

Whisky insurrection.

Indian war

142. The Indian tribes on the Ohio became very troublesome to the settlers who now began to pour into the west. General Harmer, who was sent against the savages in 1790, was defeated near the present site of Fort Wayne, Indiana, and General St. Clair met with a similar disaster the next year. General Wayne ("Mad Anthony") was then despatched to the Indian country. He devastated their villages, sweeping everything before him, till he reached the Maumee river, in the northwest corner of Ohio. There he won a great victory near the site of Maumee City, August 20, 1794, and obliged the Indians to sue for terms. By a treaty concluded in the following year, the United States acquired from the savages a large tract for settlement in the present states of Ohio and Indiana.

Origin of political parties.

143. About this time the divisions between political parties become strongly marked. The occasional irritation shown in the debates in Congress is an evidence that the first ill-defined estimate of the new scheme of government was giving way to positive and settled opinions of its powers, and of the policy which should be followed in managing it. As we have seen, people were first divided into two great national parties in the autumn of 1787, when the question at issue was whether the Federal constitution should be ratified by the states. It is probable that a majority of the American people were anti-Federalists in 1789, although the Federalists, by the active assistance of many of their natural opponents, had gained the executive, the house, the judiciary and most of the state legislatures, and were able to defeat the disagreeing factions known collectively as anti-Federalists. Hamilton's measures as secretary of the treasury embodied an entire system of public policy, and the opposition to them made the differences between the two parties still more prominent. Hamilton's opponents, led by Jefferson, made the objection to his principal measures that they assumed powers in the national government which were not granted to it by the constitution. Hamilton then fell back upon the elastic clause of the constitution, and maintained that these powers were implied in it. Jefferson held that this doctrine of "implied powers" stretched the elastic clause* too far. He claimed that this clause ought to be construed strictly and narrowly. Hamilton contended that it ought to be construed loosely and liberally. Hence the names "strict-constructionist" and "loose-constructionist," which mark, perhaps, the most profound and abiding antagonism in the history of American politics.

144. During the year 1792, the various anti-Federalist factions had become cemented into one party through their efforts in resisting the Federalists, but the party still lacked a name. That of anti-Federalist was no longer applicable, for its opposition to the Federal

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* Article I., Section VIII., Clause 18.

union had entirely ceased, and the parties had become divided in the only sound and healthy way possible in a free country, namely, into those who wished to extend and those who wished to limit, the powers of government. Neither party had been consistent in applying its principles, but in the main, Hamilton can be called the founder of the Federalist party, which had for its successors the National Republicans of 1828, the Whigs of 1833 to 1852, and the Republicans of 1854 to the present time; while Jefferson may be regarded as the founder of the party which, after discarding the old name of anti-Federalist, adopted that of Democratic-Republican. This always was the *official* party title. They preferred to be called Republicans, while their enemies tried to call them Democrats, an epithet which was then supposed to convey a stigma. However, the correct name for this party was Republican from about 1792 to about 1828, and since then it has been known as the Democratic party.

145. At the request of both Federalists and Republicans, Washington consented to serve as president a second time, so that the party contest was narrowed down to the vice-presidency. For this office the anti-Federalists, or Republicans, as they were now called, supported George Clinton, of New York, while the Federalists presented the name of John Adams. Jefferson would doubtless have been put forward, but that would have cost Virginia her vote, for her electors could not have voted for Washington and Jefferson, both being from Virginia. The presidential election took place November 6, 1792, and resulted in a Federalist success and the re-election of John Adams. During Washington's first term, Vermont, by consent of Congress, was admitted into the Union (February 18, 1791,) and Kentucky became a state on the 1st of June, 1792. In the year 1791 a bill for the establishment of a national bank was introduced into Congress, which passed after a strong debate.

National bank.

Washington's second term.

146. During the first years of the American Republic, the terrible scenes of the French Revolution were enacted. Jefferson and the anti-Federalists sympathized strongly with the French Revolutionists, and wished to aid them in their struggle against the European powers. This party specially affected the leveling principles avowed by the French Republicans, and the opposite party did not object to these principles to a limited degree. Early in April, 1793, news was received that the French Republic had declared war against Great Britain and Holland. It excited the sympathies of the American people for their sister republic, even though that republic was the aggressor; and it needed a firm hand and indomitable will like Washington's at this time to control public affairs, for the country was in a position to drift easily into war as an ally of France. Washington consulted his cabinet, and by their unanimous advice determined to regard the former treaty as nullified by the change of government in France, and to issue his proclamation of neutrality between the French Republic and her enemies. The proclamation at once called down a storm of rage and invective against the president. He was assailed by the press and extreme republicans, and accused of being an enemy to France and republican institutions, of disregarding a solemn treaty, and of usurping the functions of Congress in regard to the announcement of peace or war.

Proclamation of neutrality.

Citizen Genet

147. The French expected the Americans to help them in their war with England; and in 1793 they sent over a minister to the United States to induce them to do so. This man was called Citizen Genet. He arrived at Charleston, South Carolina, in April, and was received with the most extravagant marks of public attachment. Misled by the warmth of his reception, he entered on and persisted in a course which would only have been pardonable if he had been still on French soil. He fitted out privateers from American ports to cruise against the enemies of France, and sought to embark the American people in the cause of his country whatever might be the determination of the government. Many Republicans were disposed to uphold him in all his acts, but his insolence presently disgusted his own supporters. He violently assailed President Washington and the government, and otherwise misbehaved himself, until Washington sternly checked his proceedings, and at length complained of him to the French government, which thought best to recall him.

Threatened war with England.

148. About this time war was apprehended between the United States and England. England had never accredited a minister resident to the United States, and had refused to carry out those articles of the Treaty of 1783, which bound her to surrender her military posts on United States soil, and to pay for the slaves carried away by her armies. She had also issued orders which bore hard upon American merchants and sailors. She claimed the right to lay hold of any provision for the enemy which she might find in a neutral vessel, to seize the product of French colonies wherever found; and to board any vessel to make search for seamen of British birth, and carry them off for her own service. It was also believed that her agents had interfered to prevent treaties of peace with the savages of the northwest, and had incited them to renewed attacks upon the frontier settlements. Her refusal to evacuate the western posts was grounded on the alleged unjustifiable neglect of the United States to enforce that article of the treaty of 1783 which provided for the payment of debts due to British subjects. For her further offensive measures no justification was offered, except her sovereign will. Out of these circumstances war might easily have grown, and it required all the wisdom of Washington and his advisers to prevent it. So bitter was the feeling against England held by men of both parties, that Congress began at once to take measures to raise an army, equip a navy and to stop all commerce with her. War was imminent, and Washington determined to avert it.

Jay's treaty.

149. He appointed John Jay, who was then chief justice, to be envoy extraordinary to England, for the purpose of preserving peace by a new treaty, in which the points in dispute between the two countries should be settled. Jay concluded a treaty with England which did not satisfy him, but which was the best he could secure. It reached America March 7, 1795, and was sent to the senate in special session, June 8. The treaty provided that the western posts be surrendered to the United States, that compensation be made for illegal captures of American property, and British creditors be secured the means of collecting debts, contracted prior to the Revolution. But England still retained the right of impressing American seamen of English birth, and of shutting off American commerce from the West Indian trade. When the conditions of the treaty became known there was great excitement in all portions of the country, and the wrath of the Republicans rose to fever heat. Hamilton was stoned on the street, and scurrilous newspapers railed against Washington, calling him the "step-father of his country." But the senate ratified the treaty, and Washington signed it, because imperfect though it was, it was better than none, and would avert war. It was the first substantial recognition which England had made of the sovereign rights of the United States, and the result proved Washington's wisdom, for peace prevailed, commerce revived, and many who had at first denounced the treaty, became its friends.

Party contests

150. During Washington's second term, party contests had become numerous in the sessions of Congress. After much opposition on the part of the Republicans, the Federalists succeeded in passing a system of indirect taxation to provide for the increased expenses of the government. A Federalist bill to prevent such practices as Genet's was opposed by the Republicans.

The XIth amendment.

but was passed with some modifications. An attempt was made by some of the Republicans to secure the passage of resolutions censuring Hamilton's management of the treasury, but it met with no success. The supreme court had decided that an action brought by a citizen of the United States would lie against a state, just as against any other corporation. This alarmed the Republicans. An amendment to the constitution was therefore adopted by Congress, securing states against suits in the United States courts. It was afterward ratified by the required number of states, and became the XIth Amendment, which has enabled so many states to repudiate debt with impunity. In June, 1796, Tennessee, formerly a part of North Carolina, became a state of the union.

Washington's farewell address.

151. The time for a new election of president was now at hand. Washington was importuned to accept a third term of office. Electors nominated by both parties were called upon to promise that, if elected, they would give their first votes to Washington, but he refused to accept. When he retired from the presidency he made a farewell address to the people of the United States. In that address, which is weighty with words of wisdom, he urged the people to prize the Union which they had formed; to remember that each part of the country had free intercourse with all other parts, and that each could help the other. He begged them to suffer no parties to gain ascendancy in the Union which should weaken its strength, and bade them to glory in the name of America. He reminded them that Europe had interests in which America had little concern, warned them against the admission of any European or other foreign influence into American councils, and urged them to make religion, education and public good faith the basis of government.

The principles of the two parties

152. As Washington refused to be a candidate for a third term, the election of 1796 was warmly contested by the two parties. No formal nominations were made but it was understood that the Republican electors would cast their votes for Thomas Jefferson, of Virginia, and Aaron Burr, of New York, and the Federalist electors for John Adams, of Massachusetts, and Thomas Pinckney, of Maryland. Hamilton, having made so many enemies by his political zeal, was not considered a suitable candidate. The principles of the two parties were distinctly understood. The Republicans claimed to be the friends of liberty and the rights of man, the advocates of economy and of the rights of the states. The Federalists claimed support as the authors of the Government, the friends of neutrality, peace and prosperity, and the direct inheritors of Washington's policy. In February, 1797, the electrical votes were counted, and John Adams, the Federalist candidate, was found to be elected president, and Jefferson, according to the rule at the time, as second on the list, became vice-president. This was an unwise rule, since under it the death of the president might reverse the result of the election.

Difficulties with France.

153. On March 4, 1797, Adams and Jefferson were sworn into office. Shortly after the commencement of President Adams' administration the French Directory, displeased with the strict neutrality which the United States had observed during its war with England, and also on account of the treaty of peace which had been recently entered into between England and the United States, adopted resolutions highly injurious to American commerce, and refused to receive Mr. Pinckney, the American minister, until the United States had complied with their demands. The first act of Mr. Adams was to call an extra session of Congress, to determine how a war with France was to be avoided. A special commission of three envoys was sent to France, John Marshall, afterward chief justice, Charles Pickney and Elbridge Gerry, but the French government refused to receive them. Prince Talleyrand had the impudence to send secret agents to deal with the envoys. These agents demanded that a large sum of money be paid the government before the envoys could be received at all. After that the United States must lend money to France to enable her to carry on her war. When this was done France would repeal some of the acts which injured American commerce.

X. Y. Z. dispatche

154. The envoys indignantly refused to accept such terms and sent home to America an account of this infamous proposal, and Mr. Adams laid the dispatches before Congress, substituting the letters X. Y. Z. for Talleyrand's emissaries. Hence, these papers have ever since been known as the "X. Y. Z. dispatches." April 8 the senate voted to publish the X. Y. Z. letters and the dispatches of the envoys. To England they seemed of such importance that they were sent to every part of Europe to excite feeling against France. One burst of indignation arose in America, and for the moment the Republican party seemed overwhelmed. Pinckney had declared, "Millions for defence, but not one cent for tribute," and the words were taken up as a popular cry. The United States prepared for war. A few excellent frigates were built, an army was raised, and Washington was placed in command with the rank of lieutenant-general. It was during this excitement that the song of "Hail Columbia" was published. American men-of-war were ordered to seize any French vessels which should commit depredations on American commerce, and some naval engagements took place with success on the American side. Intercourse with France was suspended. The treaties with France were no longer binding upon the United States, and authority was given to the president to issue letters of marque and reprisal.

Alien and sedition laws.

155. The country was now on the side of the government. The Federalists, who had been losing ground, were now stronger than before. They attempted to strengthen the government still further by passing in Congress two acts called the alien and sedition laws. The first of these acts, passed June 25, 1798, authorized the president to order out of the country any alien whom he might regard as dangerous to the peace and liberty of America, and made provisions for the fining and imprisonment of such aliens as refused to obey the president's order. July 14 the sedition law was passed. By this act a heavy fine and imprisonment were imposed upon such as should combine or conspire together to oppose any measure of the government, and upon such as should utter any false, scandalous or malicious writing against the government, Congress or president of the United States. This act was to remain in force until March 3, 1801. These laws placed a power in the hands of the government which alarmed the Republicans. They claimed that the laws were aimed against them. They opposed the action of Congress, not as friends of France but as Americans. They believed that less power should be given to the federal government, and more to the separate states. This belief, which so nearly prevented the adoption of the constitution, had never disappeared. It showed itself on every occasion, and helped to shape the course of the Democratic-Republican party. This party came to be called the Statesright party, because it was jealous lest the states should not have all their rights under the constitution.

156. Thus, when the Federalists forced through Congress the alien and sedition laws, they called forth a vigorous remonstrance from the southern Republicans. A series of resolutions, drawn up by Jefferson, was adopted by the legislature of Kentucky (1798), and a similar series, drawn up by Madison, was adopted in the same year by the legislature of Virginia. These are known as the Kentucky and the Virginia Resolutions of 1798. The Virginia Resolutions asserted that in adopting the constitution the states had surrendered only a limited portion of their powers; that whenever

the Federal government should exceed its delegated authority, it was the right and duty of the states to interpose and pronounce such acts unconstitutional. Accordingly, by these resolutions, Virginia declared the alien and sedition laws to be a usurpation by the Federal government of powers not granted to it, and were thereby unconstitutional, and she appealed to the other states to join in that declaration. The response from other states being unfavorable, Virginia repealed those resolutions the next year, 1799.

157 The attitude assumed by Virginia in these resolutions was certainly uncalled for, either on her part or that of any other state, inasmuch as the constitutionality of the acts of Congress could be decided by a competent tribunal only—the federal supreme court.

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The Kentucky Resolutions were to the same general effect as those of Virginia, but with the additional declaration that the federal constitution was merely a compact, to which the several states were the one party and the federal government the other, and that each party must decide for itself as to the infractions of the compact, and as to the proper remedy to be adopted. These resolutions received as little attention as those of Virginia. In the following year (1799) Kentucky repealed the resolutions, but with the additional clause that a state might rightfully nullify and declare void any act of Congress which it might consider unconstitutional. This was a dangerous assumption, for it verged upon the right of secession, and these resolutions were used by the south as a partial precedent for nullification in 1832, and for secession in 1860

158. Meanwhile, though there was open hostility between France and the United States, war was not actually declared The French, seeing the warlike attitude of the United States, became more civil. Talleyrand tried to disavow the X Y Z. affair, and made conciliatory proposals to Vans Murray, the American minister at the Hague. The president had expressed his determination to send no more ministers to France until assured of a friendly reception, but he suddenly appointed three envoys to that country against the protest of two of his cabinet. Their protest was sustained by the leading Federalists throughout the country, and by this act the president lost, in some degree, the support of his party For some time also there had been intense jealousy and dislike between Adams and Hamilton, the other great Federalist leader, and this increased the difficulties of the Federalist party When the new embassy reached Paris, they found the government in the hands of Napoleon Bonaparte, who gave them a cordial welcome, and they soon succeeded in settling the matters in dispute in an amicable manner The policy of John Adams in making peace with France, contrary to the popular sentiment, demands the highest commendation, but it lost him the presidency for a second term.

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159. On the 14th of December, 1799, George Washington died at Mount Vernon after only one day's illness. The event was mourned all over the United States with sincere sorrow, and was appropriately observed by Congress and other public bodies. Bonaparte ordered the standards of the French army to be shrouded in crape for ten days, and in England a fleet of sixty British men-of-war lowered their flags to half mast.

oval of apital.

In the following year the national capital was removed from Philadelphia to the site chosen on the banks of the Potomac. The city there laid out received the name of of Washington.

fourth den-

160. By the spring of 1800 it became manifest that the Federalist party was losing ground. In April the New York state election went against them. Soon after this, the dismissal by the president of some of the the cabinet officers who were too friendly with Hamilton, caused an irreparable break in the party. Hamilton printed a severe attack on the president, and endeavored to make arrangements for giving Pinckney a majority of Federalist electors that he might be chosen president and Adams vice-president, as these two were the nominees of the Federalist party. The Republican candidates were Thomas Jefferson, of Virginia, and Aaron Burr, of New York. The fourth presidential election took place in November, 1800. The election was very close. In February, 1801, the electoral votes were counted, of which 73 were for Jefferson, 73 for Burr, 65 for Adams, 64 for Pinckney, and 1 for Jay There was no highest name on the list, and it was left for the house of representatives to choose between the two highest candidates. The house was Federalist, but was restricted to a choice between two Republicans. Some of the Federalists wished to elect Burr instead of their great opponent, Jefferson, but Hamilton used all his influence against such a scheme, and at last, on February 17, 1801, Jefferson was elected by the house, and Burr became vice-president

Fourth administration.

161 The inauguration of Jefferson was the first that took place in the city of Washington. The new president's first inaugural message announced the future policy of the Republican party to be careful fostering of the state governments, the restriction of the powers of the Federal government to their lowest constitutional limit, the immediate payment of the national debt and the reduction of the army, the navy, the taxes, and the duties on imports, to the lowest available point. Many of the Federalists believed that speedy ruin to the country would follow the advent of Jefferson to the presidency. He was "an atheist in religion and a fanatic in politics," and the vice-president was only more tolerable because less known. The party which supported them, it was claimed, was composed of revolutionists, disorganizers and Jacobins. The Federalist party, which contained the larger portion of the intellect, wealth and culture of the country, honestly believed, no doubt, that the government had fallen into bad hands But their fears were groundless. The president's first administration was marked by national prosperity The principal offices of government were transferred to the Republican party, and executive pardons were issued to those persons who had been imprisoned under the alien and sedition laws. The supreme court, under the lead of Chief Justice Marshall, remained Federalist in complexion, and did a grand work for several years in interpreting and strengthening the constitution. President Jefferson instituted the custom of sending a written message to both houses of Congress as more befitting Republican simplicity, instead of giving the address in person, which had hitherto been the rule.

The Louisiana purchase.

162 The population of the United States was rapidly increasing, and was beginning to press forward into the Mississippi valley. In 1802 Ohio was admitted into the union, Mississippi and Indiana were already organized as territories, and a growing interest was felt in the western country. By a secret treaty with Spain in 1800, France had recovered the territory of Louisiana, the Spanish civil officers, however, were left in command, and in 1802 the Spanish intendant at New Orleans issued a proclamation closing the Mississippi to American commerce. This action threatened to result in war. Jefferson had opened negotiations with Napoleon for the purchase of the territory. The French emperor had at first refused to treat on the subject. He had acquired this territory with the vague intention of regaining the French ascendancy in America, which had been lost in the seven years' war. Knowing that whoever controlled the mouth of the Mississippi must become master of the whole valley, Jefferson proposed to buy New Orleans. Napoleon had refused this, also, but in 1803 the prospect of a renewed war with Great Britain made him change his mind He knew that in case of war an English fleet would be sent to take possession of Louisiana, and that it would be impossible for the French to hold the port of New Orleans. He was determined that the place should not fall into the

hands of his powerful enemy, so he offered to sell it to the United States for fifteen million dollars. The president at once agreed to the proposition, though he believed that the constitution gave the Federal government no power to purchase foreign territory and make it a part of the union. In this instance, an article for the ratification of the purchase was prepared as an amendment to the constitution, but was never offered, as the president's action met with a general acquiescence and has since been imitated in similar instances without question. The Louisiana purchase included everything west of the Mississippi not already occupied by Spain, and comprised the whole or part of the present states of Arkansas, Colorado, Iowa, Kansas, Louisiana, Minnesota, Missouri, Nebraska, Oregon, the two Dakotas, Montana, Washington, Wyoming, Idaho, and the Indian territory. The effect of this great acquisition of territory, by such an active and prosperous people as the Americans, was to insure them the ultimate control of the continent without incurring any foreign warfare worth historic mention. It set the nation free for an indefinite length of time from European complications, but, on the other hand, it was the means of creating some new and formidable features in the rivalry between the free states and slave states.

The Tripolitan war

163. The Barbary states on the southern shores of the Mediterranean were in the habit of sending out piratical vessels to prey upon the commerce of other nations and reduce their sailors to slavery. All the great powers of Europe, as well as the United States, had adopted the custom of paying tribute to these petty governments, in order to secure immunity for their trade. But these pirates grew increasingly insolent, so that the patience of the American government became entirely exhausted. A small fleet was sent out to the Mediterranean, which bombarded Tripoli. After a desultory warfare extending over two years, the Tripolitans sued for peace. The English government then followed the example of the United States, and in a few years more this abominable nuisance was suppressed.

The XIIth amendment

In the latter part of 1803, during the first session of the VIII Congress, the manner of the presidential election was amended to the form which it has at present. The amendment having been ratified by the necessary number of states, this became the XII amendment to the constitution. Articles of impeachment were voted by the house against a federalist judge, Chase of Maryland, for arbitrary and oppressive conduct in trying cases under the alien and sedition laws. At the next session of Congress in 1804, Chase was tried and acquitted.

Hamilton and Burr.

164. In 1804 Jefferson was re-elected president, with George Clinton for vice president, in place of Aaron Burr, who had separated from his party. The federalists then made Burr a candidate for the governorship of New York, but here, as in 1801, Hamilton used his influence against him, and Burr was defeated. Resenting this opposition, Burr contrived to force Hamilton into the acceptance of a challenge. They met on July 11, 1804, and Hamilton was killed. The mourning of the country over the loss of this distinguished man was intense, and the wretched Burr found that his public career was at an end. Bankrupt in fortune, and a fugitive from home, he visited New Orleans and other parts of the south and west (1805) for the purpose of arranging an enterprise whose exact object has never been positively discovered. He planned either the seizure of Mexico, or the establishment of a monarchy west of the Alleghanies. He was arrested by the federal government on a charge of treason, and was tried before Chief Justice Marshall in September, 1807, but after a long investigation he was acquitted in consequence of a defect in the chain of evidence. Afterward he became an outcast from society and died in obscurity.

Burr's conspiracy.

Jefferson's second administration.

165. On the 4th of March, 1805, Jefferson and Clinton were sworn into office. Jefferson's second administration was the beginning of a stormy period which ended in war. The wars of Napoleon still continued, and France and Great Britain were using every expedient to cripple each other without regard to the rights of neutral nations. In the beginning of these wars the United States, being a neutral power, had acquired a valuable foreign commerce, but this was speedily destroyed by the arbitrary measures of the belligerents. With his famous Berlin and Milan decrees, Napoleon sought to prevent neutral vessels from entering British harbors, and claimed the right to seize all vessels trading with England or her colonies (1806). England replied with her orders of council issued by the king, which forbade all commerce with the ports of Europe that were within the French dominion or in countries allied with France. If an American vessel touched at almost any port of continental Europe, the first British cruiser that came along deemed her its lawful prey; if she touched at a British port, she was liable to capture by the first French craft that she should meet. Jefferson had abandoned the policy which Adams had adopted of building a strong navy. He imagined it possible to defend American harbors by means of gunboats carrying each one gun, and had recommended this plan, which Congress adopted. This "Gunboat System" was always hateful to the navy, and was a constant object of federalist ridicule and attack.

The right of search.

166. While the offensive measures of England and France made American merchantmen a prey to both parties, England, in another respect, possessed a peculiar power of annoying the United States. She still claimed and exercised the right of stopping American vessels and seizing all sailors, even naturalized citizens, who were supposed to be British subjects. In June, 1807, the insolence of this claim was carried so far that the British man-of-war, Leopard, stopped the United States frigate, Chesapeake, off the entrance of Chesapeake Bay, fired into her, killing or wounding twenty-one of the crew, and took off four men, three of whom were Americans. President Jefferson demanded reparation for this outrage, and issued a proclamation ordering all British war vessels out of American waters. The British government was ready to disavow the act of the Leopard, but there was no willingness shown to make reparation. Feeling unprepared for war, the United States government had recourse to an exceedingly stupid and dangerous measure. The president recommended a bill by which American vessels should be prohibited from leaving foreign ports, and foreign vessels from taking cargoes from the United States, and all coasting vessels should be required to give bonds to land their cargoes in the United States. This was the celebrated Embargo Bill, which did more harm to American commerce than all the cruisers of France and England were able to do. It also intensified party feeling and even threatened the existence of the union.

Embargo bill

167. As time went on the Embargo Act became so unpopular that before the close of Jefferson's second term many of his friends forsook him. A great pressure was brought to bear upon Congress to repeal the act. It passed in its place the Non-intercourse Act. This act prohibited trade with England and France so long as their obnoxious measures should be kept in force, but it allowed free trade with other countries. Among the other important events of Mr. Jefferson's administration were the passing of an act of Congress prohibiting the slave trade after January 1, 1808; the beginning of the United States coast survey, a valuable work which is still continued to the great credit of American science, and the application of steam to navigation by Robert Fulton. Jefferson refused to be a candidate for a third term, and at the election in 1808, James Madison, of Virginia, was chosen president

Non-intercourse act.

Other events.

by the Republican, or, as it now began to be called, the Democratic party. Clinton was re-elected vice-president. The candidates of the Federalists were C. C. Pinckney and Rufus King.

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168. The Non-intercourse Act went into force March 4, 1809, when Mr. Madison succeeded to the presidency. He belonged to Jefferson's party and continued his policy. Party feeling had grown very bitter. New England, which suffered the greatest from the breaking up of trade, was the stronghold of the Federalists. They complained loudly that if it were not for the Embargo and Non-intercourse Acts there would be no trouble. The southern and western people, who were principally Democratic Republicans, retorted that they had evidence of negotiations between the New England Federalists and England; that the Federalists were planning for a separation of New England from the union. This charge was indignantly denied, but it helped increase political hostilities. In 1810 Congress repealed the Non-intercourse Act, which had accomplished nothing in the way of intimidation. Congress then informed England and France that if either nation would repeal its obnoxious measures the Non-intercourse Act would be revived against the other. Napoleon was studying how he might get the advantage of England, and he withdrew, or pretended to withdraw, his decrees prohibiting commerce with England so far as the United States were concerned, but at the same time gave secret orders by which the decrees were to be practically enforced as harshly as ever. Congress at once revived the Non-intercourse Act against Great Britain alone.

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169. England and the United States grew more irritated with each other, and in 1811 hostilities actually began on sea and land. In May the United States frigate *President* hailed the British man-of-war *Little Belt* and was answered by a shot. The *President* then replied with a shot in turn, and a sharp action ensued in which the *Little Belt* was badly crippled, and lost thirty-one killed and wounded. Tecumseh, the famous Shawnee chief, had gathered a large number of warriors, and at the instigation of the British they were attacking the northwestern settlements. General Harrison marched against them, and on November 7 he defeated them at Tippecanoe. The English continued to seize vessels and men. More than nine hundred American vessels had been seized since 1803, and several thousand American seamen had been impressed into the British service. The people of the United States were exasperated at their losses and their inability to protect themselves. Madison wished to continue the general peace policy of Jefferson, but new leaders had sprung up in the Republican party who were in favor of war. Chief among these were Henry Clay, of Kentucky, speaker of the house, William H. Crawford, in the senate, and John C. Calhoun, of South Carolina, in the house. These became the recognized congressional leaders of the party. The economical and retrenching policy of Jefferson was abandoned, and preparations were begun for hostilities. Bills were passed to enlist men, to organize the militia and to enlarge and equip the army.

170. President Madison was given to understand that his nomination for a second term of office depended upon his adoption of the war policy, otherwise De Witt Clinton, of New York, would be nominated in his stead. The president accepted the conditions and on June 18, 1812, war against Great Britain was formally declared. It was soon learned that the British government had revoked the orders in council five days after the declaration of war, but this concession came too late. Even if it had come in time probably nothing short of an abandoment of the right of search and impressment on Great Britain's part would have proved satisfactory. The war feeling was by no means unanimous. The New England Federalists bitterly opposed it. The chief support came from the south and west, which felt less keenly the effect upon their prosperity, caused by the breaking up of commerce. Immediately after the declaration of war the Federalist members of Congress had published their protest against it in an address to their constituents. When requisitions were made by the president upon the governors of the different states for their respective quotas of troops, according to the act passed by Congress to embody the militia, the governors of Massachusetts and Connecticut refused to allow their militia to leave their states on the ground that it was unconstitutional for the Federal government to call out the militia except in case of an invasion or resistance to the laws of the United States, and neither of these had taken place. April 30, 1812, Louisiana was admitted into the union of states.

war

The war of 1812.

171. The war opened by the invasion of Canada by General Hull, who was ordered to cross at Detroit and attack Fort Malden a few miles distant, but he was compelled to fall back again to Detroit. Here he was attacked by a large force of British and Indians under General Brock and Tecumseh. Believing he was not strong enough to defend the place he surrendered (August 16, 1812), not only Detroit, with its garrison and stores, but the whole territory of Michigan. Being exchanged, after some time he was tried by a court-martial on charges of treason and cowardice. He was acquited of treason and was sentenced to be shot for cowardice, but was pardoned by the president on account of his past good services. In October another attempt was made upon Canada near Niagara. A small force crossed the river and attacked the British in a strong position on Queenstown Heights. At first the Americans were successful but were at last defeated with heavy loss.

Surrender of Detroit.

Queenstown Heights.

Naval exploits.

172. To compensate for these disasters on land the little American navy won imperishable glory on the ocean. The United States frigate *Essex*, Captain Porter, captured the British sloop-of-war *Alert* after a fight of eight minutes, without losing a man. The *Constitution*, Captain Hull commanding, fought a famous action with the British frigate *Guerrière* near the Gulf of St. Lawrence (August 19), and in less than an hour completely destroyed her. This victory dispelled the belief that the British navy was invincible, and the whole country was filled with transports of delight. On the 18th of October the sloop-of-war *Wasp*, commanded by Captain Jones, captured the British brig-of-war *Frolic* off the coast of North Carolina, but the same day the British ship *Poictiers* took both the captor and her prize. On October 25 the frigate *United States*, under Commodore Decatur, fought a memorable action with the British ship *Macedonian*, which surrendered to Decatur after being nearly cut to pieces. This engagement took place off the Island of Madeira, but Decatur succeeded in carrying his prize to America. The *Constitution*, commanded by Captain Bambridge, in a two hours' fight off the coast of Brazil, knocked to pieces the British frigate *Java* (December 29), which lost 230 men and had to be burned, while the *Constitution* lost but twelve men and not a single spar.

173. During the first six months of the war the despised American navy, of which even the Americans expected but little, became the admiration of the world. Privateers also were very active, and before the end of the year the captures from the British numbered about fifty vessels of war, two hundred and fifty merchant vessels, and three thousand men. Under the impulse of these successes the Federalists, who had been opposed to the war, were beaten in the autumn elections, and Madison was re-elected president, with Eldridge Gerry for vice-president. The American disasters on land had led the government to collect a large army, which was placed under the command of General Har-

The re-election of Mad

The war in the northwest.

rison. He first made an attempt (January, 1813,) to recover Detroit and the territory of Michigan, but was driven back to Fort Meigs by Proctor, who besieged him there, but unsuccessfully. So much of the frontier was occupied by the great lakes that it was of the greatest importance to get control of these, and for this purpose, both British and Americans were busily engaged during the summer of 1813 in building fleets. Captain Oliver H. Perry directed the building of the fleet on Lake Erie, and sailors were sent forward from the seacoast. He had just completed nine vessels, which were at anchor in Put-In-Bay, when he saw the British approaching. He at once moved out to meet the enemy (September 10) and in a little more than two hours was able to send this dispatch to General Harrison, who was in command on the Sandusky: "We have met the enemy and they are ours; two ships, two brigs, one schooner, and one sloop." This victory turned the scale of war in the northwest. Harrison shipped his army across the lake in Perry's fleet, and attacking Proctor at the River Thames (October 5), inflicted a crushing defeat upon him. This was a severe blow to the Indians also, for their great leader, Tecumseh, was killed. The American success restored the northwestern territory to the country.

Battle of Lake Erie.

174. In the spring of 1813 Tecumseh had visited and roused the Creek Indians of the southwest, and in August they took occasion to attack the frontier settlements, beginning with the terrible massacre at Fort Mimms, near Mobile. General Andrew Jackson, with the formidable Tennessee militia, marched into the Creek country, and won a series of telling victories, by which they were entirely subdued, and purchased peace by the surrender of two-thirds of their hunting grounds. In the meantime the British, after the defeat which they had suffered from the American navy in 1812, strengthened their Atlantic squadron. During the summer of 1813 they attempted to blockade the coast from Maine to Georgia. Congress, in turn, hastened to build new ships; and the courageous privateers continued to fight pluckily, and to bring prizes into the United States ports. In February, 1813, the American sloop *Hornet*, Captain Lawrence commanding, destroyed the British brig *Peacock*, which sank before all of her crew could be removed. On his return to the United States, Lawrence was promoted to the frigate *Chesapeake*, with which, on June 1, he had a severe engagement with the British frigate *Shannon* near Boston. Lawrence was mortally wounded at the beginning of the action. As he was carried below, he exclaimed: "Don't give up the ship!" The *Chesapeake*, however, was captured by boarding, after she had lost a large proportion of her officers and men. The *Argus*, Captain Allen, was captured by the British man-of-war *Pelican* (August 14), after a gallant fight in which Captain Allen received his death wound. Lieutenant Burrows, in the brig *Enterprise*, captured the British brig *Boxer* (September 5), after a short action. The frigate *Essex*, Captain Porter, made a brilliant and successful cruise during the year 1813, and did great damage to the British commerce. At length, however, she was attacked in March, 1814, by the British ships *Phoebe* and *Cherub*, and after the bloodiest fight of the war, the *Essex* was compelled to surrender. The sloop *Peacock* captured the British brig *Epervier* off the coast of Florida (April, 1814). The *Wasp* made a brilliant cruise, taking a number of British vessels. The old *Constitution*, Captain Stewart, engaged singly the British sloops-of-war *Cyane* and *Levant* off the coast of Portugal, and captured both in a remarkable night engagement, February 20. The *Hornet* captured the British brig *Penguin* in March, off the Cape of Good Hope, and in June, the *Peacock* closed the long record of victories by taking the British ship *Nautilus*. These last three actions took place after peace had been concluded.

Events on the sea.

On the Niagara frontier.

175. In the summer of 1814, the Americans made a fresh attempt to invade Canada under General Brown, with whom served Brigadier-General Winfield Scott. They crossed the Niagara river and in four hard-fought battles defeated the British at Chippewa (July 5), Lundy's Lane (July 25), and Fort Erie (August 15 and September 17), but in spite of these successes, they could not establish themselves in Canada, and retired across the line before cold weather came. In March, 1814, Napoleon was dethroned and sent to Elba, and the European war being over, England was enabled to spare more men for the war in America. Her policy was to march two armies into the United States. One was to descend from Canada by the route which Carleton and Burgoyne had followed, and the other was to land at New Orleans and move northward. To divert attention a fleet under Admiral Cockburn sailed up the Potomac and attacked the capital. There was scarcely any resistance, and the British wantonly destroyed public buildings, books and papers (August, 1814). Nothing was spared except the patent office and the jail. The British them moved upon Baltimore. General Ross and his troops were landed a few miles below the town, but the Americans gallantly repulsed them. Then the fleets bombarded the forts which protected Baltimore (September 12 and 13). Fort McHenry received the hottest fire from the fleet. It was upon seeing the flag still flying from the fort, when the smoke cleared away, that Francis S. Key wrote the national song, "The Star-Spangled Banner." The fleet finally abandoned the attempt and sailed away.

Capture of Washington.

176. The British in Canada, having been reinforced by the arrival of fresh troops from England, advanced with an army of fourteen thousand men under Prevost, to attack Plattsburg, on Lake Champlain, while a British squadron, under Captain Downie, sailed up the lake to co-operate with him. The Americans, under General Macomb, being only fifteen hundred strong, fell back behind the Saranac, and there made a vigorous defense. They had also a squadron of small vessels under Commodore Macdonough, and this was stationed at the entrance of Plattsburg bay. Captain Downie attacked Macdonough (September 11, 1814), at the same time that General Prevost attempted to force the passage of the Saranac, but the British fleet was annihilated by Macdonough and Prevost, beaten at every point by Macomb, retreated in disaster to Canada. But while this attempt on New York proved a failure, the British succeeded in seizing the unoccupied wilds of Maine east of the Penobscot river, and thus created a panic in New England.

Battle of Plattsburg.

The war in the south.

177. The expedition against Washington was designed chiefly as an insult; the expedition against New Orleans was for conquest. If the British could gain this important position they would control the Mississippi and the western country. In December, a British army of 12,000 men under General Parkenham, landed below New Orleans. General Jackson hastened to that city with 6,000 militia to oppose him, and fortified the town as best he could. After a fortnight's siege the British determined to assault the American works. Early on the morning of January 8, 1815, they made the attack. Jackson's men, trained to rifle shooting and aided by artillery, met them with great coolness, and in less than half an hour the British were in full retreat, leaving Pakenham and 2,600 men behind them, killed or wounded, while the American loss was but 8 killed and 13 wounded. This battle also occured after peace was declared.

178. Negotiations for peace had been begun in August, 1814. The American government was anxious for almost any honorable peace in preference to continuing the war with England. The latter country had revoked the orders in council long before, but still England's demands were such that they could not be accepted with honor by the Federal government. The war feeling was thus continued among the republicans,

and some of their leaders began to meditate measures which the strict constructionist principles of the party would not justify. Propositions were made to introduce the English system of impressment of seamen, and of allowing officers of the army to enlist minors over eighteen years of age without the consent of their parents or guardians. The Connecticut legislature ordered the governor to resist the execution of these and similar measures if they should become laws. In view of these things, and provoked by the British invasion of Maine, the legislature of Massachusetts had invited the other New England states to send delegates to Hartford, Connecticut, "to confer upon the subject of their public grievances." Delegates from Massachusetts, Connecticut and Rhode Island, and from parts of Vermont and New Hampshire, met at Hartford in December, 1814, to discuss the situation of affairs and decide upon the proper course to be pursued. Among other measures they recommended the adoption of several amendments to the constitution, chiefly with intent to restrict the powers of Congress over commerce, and to prevent naturalized citizens from holding office. As there was much secrecy in its proceedings a popular suspicion was aroused that a dissolution of the union had been proposed, perhaps resolved upon, in its meetings. This suspicion completed the ruin of the Federalist party. Some years afterward the journal of the convention was published in order to justify its members, and to show that no treasonable designs were officially proposed. It was then, however, too late to be of benefit to the party, for the popular opinion had become fixed.

179. The final negotiations for peace took place at Ghent, in Belgium, the commissioners on the part of the United States being John Quincy Adams, James A. Bayard, Henry Clay, Jonathan Russell and Albert Gallatin. The treaty was signed December 24, 1814, and promptly ratified by both governments. It was welcome to the administration, whose want of experience in the conduct of the war had involved the country in great financial straits. The treaty left things apparently just as they had been before the war. Nothing was said about the right of search and impressment of seamen, out of which the war arose, but the United States had shown to the European nations that she would not be insulted with impunity. The British ceased to enforce their claims, and hence the United States may be said to have succeeded in the object of the contest. England withdrew her claims to sovereignty. The nation was not only established in its own domain, but it had equal rights with Europe on the broad seas. The last vestige of subjection to the Old World disappeared when Decatur sailed into the harbor of Algiers in June, 1815. That country had again declared war on the United States. Decatur compelled the Dey to come on board his flag ship and sign a treaty renouncing forever all demands against Americans. The other Barbary States signed similar treaties, and from that time on American commerce became completely free.

180. The close of the war marks the final downfall of the federal party. From this period the few remaining Federalists ceased from any united party action. There was but one party, whose principles consisted of a combination of those which had characterized the original Federal and Republican parties. The leading principle of the Federal party, the establishment and continuance of the Federal government, had been quietly adopted by the Republicans, while the Republican principle of limiting the duties and powers of the government had been as quietly accepted by the Federalists after the Republican party had come into power. In the presidential election of 1816, the Federalist candidate, Rufus King, received only 34 electoral votes against 187 for the Republican candidate, James Monroe. His administration lasted from 1817 to 1825, for in 1820 the Federalists put no candidate in the field, and Monroe, being nominated for a second term, his election was practically unanimous. His administration has been called the "Era of good feeling." People forgot the old quarrels in their joy at the end of the war and the revival of business. For a time the violent party feeling, which had flamed so high during the European strife, had quieted down. New occasions for political contest had not yet come. Congress occupied itself chiefly in the regulation of internal affairs. Taxes were reduced, and a slight increase was made in the tariff. The feeling was growing among the Republicans that the tariff ought to be so arranged as to afford protection to those manufactures which had been developed in the United States during the war, but were now suffering from a competition with the cheaper goods which were imported from England. But no action was taken on the subject.

The era of good feeling

The national bank.

181. As has been stated, the charter of the national bank which had been granted during Washington's first administration, had expired in 1811, and the Republicans, then in power, had refused to re-charter it. The attempt to carry on the war by loans had resulted in almost a state of bankruptcy. In April, 1816, a bill was passed, granting a charter for a national bank to expire in 1836. It was modeled upon the one which the Republicans had formerly opposed. The Republican newspapers warmly advocated the scheme, and republished Hamilton's argument in favor of such a bank, thus showing how far loose constructionist ideas had spread in the Republican party. The bank was organized with a capital of $35,000,000, four-fifths of which might be in government stock. It was to have custody of the government revenues, but the secretary of the treasury was empowered to divert the revenues to other custodians, giving his reasons for such actions to Congress.

Trouble in Florida.

182. In 1817 hostilities broke out with the Seminole and Creek Indians of Spanish Florida, Georgia, and Alabama; General Jackson, being sent to the scene of disturbance, chastised the savages and destroyed their villages. Jackson, with all his admirable qualities, was not a cautious man. Satisfied that the Spaniards had incited the Indians to make war, he invaded Florida (April, 1818), and took possession of Spanish forts and built a fort of his own. Then he seized Pensacola and sent the Spanish troops and civil authorities to Havana. Though Jackson's high-handed measures were not fully sustained by Congress, yet, so popular was he, that instead of being reproved by Congress, he was regarded as a great hero worthy of warmest praise. Spain vigorously protested against these proceedings as a gross violation of neutrality, but she was too weak to offer any effectual resistance. The matter was finally arranged by the purchase of Florida by the United States for $5,000,000 (1819).

Growth of the nation.

183. The growth of the nation was so rapid that for six years after the close of the war of 1812 a new state was added each year. Indiana was added in 1816, Mississippi in 1817, Illinois in 1818, Alabama in 1819, Maine in 1820, and Missouri in 1821. The population now numbered nearly ten millions; the public revenue had increased from five million dollars during the time of Washington to twenty-five million dollars. Since 1790 the government had granted patents to its inventors. A few had been granted prior to 1812, but after that the number increased rapidly. In 1836 the patent office was made a distinct bureau under the secretary of state, and a commissioner of patents was appointed at its head. The great coal and iron regions lying in the Appalachian range were now yielding their riches. Charcoal was formerly used in smelting iron, but in 1820 the ironworkers of Pennsylvania began to make experiments in mixing anthracite coal with charcoal. When it was found that anthracite coal could be used alone, the manufacture of iron received a new impetus

and increased rapidly. With a country so large, and with a population spreading in every direction, the urgent demand of western settlers for some quicker and easier mode of inter-communication and transportation led to a variety of plans to accomplish the end. Private companies and sometimes the state built roads and canals. The greatest of these public works was the Erie canal, which owed its execution chiefly to the energetic governor of New York, De Witt Clinton. It was begun in 1817, and opened for traffic in 1825. It extended across the state from Lake Erie to the Hudson, and was the largest canal in the world. When the enterprise was first undertaken, and until its completion, it was called "Clinton's big ditch," but it was one of the principal means by which the city of New York became the chief commercial city of the new world. This was before the locomotive had been perfected, so that steam railroads were not yet in operation.

Erie canal.

Steamboats

184. In 1807, Robert Fulton had invented the steamboat. In 1811 a steamboat was launched on the Ohio river at Pittsburg, and presently many like craft were traveling the western rivers, thus opening an easy means of communication between distant points. Just after the Erie canal was begun, a steamboat was built, which was the first to navigate Lake Erie. The next year the steamer *Savannah* crossed the Atlantic, went as far as St. Petersburg and returned. Six years later, when the Erie canal was finished, the steamer *Enterprise* went from America to India by way of the Cape of Good Hope. In 1826 the first railroad in the United States was opened from Milton to Quincy, in Massachusetts. It was only two miles long, and was used for hauling granite, the cars being drawn by horses. In 1830 the first passenger railroad in America was opened, the Baltimore and Ohio Railroad, which was fifteen miles in length. The cars were at first drawn by horses, but with next year a locomotive was used. The construction of railroads now began in all directions, and during the next twenty years nearly ten thousand of miles were built. By the application of steam to industry, the discovery of large tracts of coal and iron ore, the invention of labor-saving machines, the communication by steam and railroad, the means were given to an energetic people for transforming the wilderness of the southern half of North America into a rich and prosperous country.

Railroads.

185. In its international relations the action of the government had become strong, quiet, and self-respecting. Mexico and the Spanish colonies of South America had revolted against Spain and established republics, and in 1822 President Monroe acknowledged them as independent nations. During the revolt it seemed likely that the "Holy Alliance" of Austria, Prussia, and Russia meant to assist Spain in bringing her revolted colonies to obedience. Great Britain had been gradually withdrawing her support from the alliance, and Canning, the new British secretary, determined to impress a check upon it by calling in the weight of the American government. A hint was given to the American minister, and in his annual message to Congress, in 1823, Mr. Monroe declared that "We could not view an interposition for oppressing them (the South American states), or in controlling in any other manner their destiny by any European power, in any other light than as a manifestation of an unfriendly disposition towards the United States." This statement announced the great fact that "the American continents are not to be considered as subjects for future colonization by any European power." This principle, so boldly declared, became known as the "Monroe doctrine," and, having the full sympathy of England, it proved effectual. The attitude of the national mind implied in such a declaration showed that our period of national weakness had come to an end.

Monroe doctrine

The slave system.

186. Before the Revolution all the colonies held negro slaves, but north of Maryland these slaves were few in number, and were soon emancipated in all the northern states except Delaware. In the early years of the Republic many of the wisest men in the south were desirous of getting rid of slavery. All but three of the United States which made the confederation forbade the importation of slaves. These three were North Carolina, South Carolina, and Georgia; and they insisted, when the consitution was formed, that the right to import slaves should continue until 1808. At the close of the eighteenth century there was a strong anti-slavery feeling even in Virginia and North Carolina, and the supposition generally prevailed that the slavery system would gradually die out without causing any serious political trouble. In two states only, South Carolina and Georgia, was slavery looked upon with any marked degree of favor, and this was owing to the fact that these two states were mostly given to the cultivation of rice and indigo, which seemed to make slave labor indispensable. In 1783, the famous cotton-gin was invented by Eli Whitney, a Connecticut schoolmaster living in Georgia. The construction of this machine was so simple that the slaves could use it, and cotton could be cleaned and prepared for market with great rapidity. Hitherto very little cotton had been raised in South Carolina and Georgia, but with the advent of the cotton-gin, cotton-growing became a profitable industry, and in consequence there was an increasing demand for slaves. As the importation of slaves had been prohibited by the constitution after 1808, the cotton-planters could henceforth obtain slaves only by purchasing them in such border states as Kentucky and Virginia. To the tobacco-planters of these states, this seemed to promise a source of great profit, and many of them gave their attention to the raising of slaves for the southern markets. Hence anti-slavery sentiments were soon extinguished among them. There was no likelihood now that slavery would die a natural death. The interests of the south seemed to be bound up in the slavery system, and the way was prepared for uniting all the slave states into a solid south, as opposed to a solid north. The greatest danger to slavery had been the growing conviction that it was wrong in principle and that the nation ought not to permit it. But slavery existed under the laws, and the states where it did not exist were not at first disposed to interfere. They held that slavery was purely an affair of the states in which it was found. Besides, the northern States were now engaged in a variety of enterprises, while the southern States were still chiefly employed in the few agricultural industries of tobacco, cotton, rice, and sugar. The south thus looked to the north for clothing, tools, much of their food, and all the luxuries of life. The merchants of the north found a great market for their goods in the south; their manufacturers, also, needed cotton to keep their mills in motion. For these reasons, chiefly, the relations between the two great sections in regard to slavery had not been disturbed; but the time was at hand when this question of slavery was to be the paramount one in the whole republic.

The cotton-gin.

The slavery struggle.

187. In the northwest territory slavery was prohibited by law; in all territories south of that domain it was permitted. There soon grew up a contest between the free and the slave states for control of the government, the south wishing to extend the area of slavery by the admission of new slave states, the north seeking to confine the institution to the localities where it already existed, while the abolitionists of the North wished to put a stop to it altogether. Thus began the "irrepressible conflict" between free and slave labor which ended, after more than forty years, in the great civil war. It was not until the Mississippi was crossed, and settlements began to be made in the great territory originally called Louisiana, which Jefferson had added to the national domain, that the question

arose whether the states made from it were to be slave states or free. The first discussion was over the admission of the territory of Missouri as a state. A kind of compromise had been kept up from the beginning by admitting a slave state and a free state by turns, so as to counterbalance each other in Congress. Thus Vermont had been counterbalanced by Kentucky, Tennessee by Ohio, Louisiana by Indiana, Mississippi by Illinois. In the same manner, the admission of Alabama, in 1819, should have counterbalanced the admission of Maine in the following year; but, as Missouri was also knocking at the door of Congress, the southern members refused to admit Maine until it should be agreed to admit Missouri as a slave state.

The Missouri compromise.

188. When Missouri applied for permission to enter the sisterhood of states, and a bill was brought before Congress to that effect (1819), an amendment was offered to the bill, forbidding slavery or involuntary servitude in Missouri, except as a punishment for crime. At once party lines were broken. The members from the free states voted for the amendment, and the members from the slave states against it. It was carried in the house, but rejected by the senate, and the bill was lost. At the next session of Congress, Missouri again presented her plea for admission as a state, and Maine made her first application for the same privilege. The Maine bill passed without opposition in the house, but by a sectional vote of that body slavery was again prohibited in Missouri. In the senate, the Maine bill and a Missouri bill permitting slavery were united, and then passed by a sectional vote. As the case now stood, both bills were compelled to stand or fall together, and the responsibility of their acceptance or rejection was thrown upon the house. The house held to its first action, and rejected the combined bills as passed by the senate. The difficulty was at length settled by the famous Missouri Compromise of 1820, in which each section gave up some of its demands, the house by permitting slavery in Missouri, and the senate by permitting Maine and Missouri to be voted upon separately. Thus Maine and Missouri were admitted into the union, the latter as a slave state; but it was agreed by both branches of Congress that slavery should be prohibited forever in all other territories north of the parallel of 36° 30', which was the southern boundary of Missouri.

isit of
a Fayette.

189. In 1824, Congress requested President Monroe to invite La Fayette to visit the United States as a guest of the nation. The marquis, then sixty-seven years of age, spent eleven months in a tour of the states, receiving everywhere the highes honors. His great fortune had been lost during the French Revolution, and Congress voted him a present of a township of land and two hundred thousand dollars in money. On the 17th of June, 1825, the fiftieth anniversary of the battle of Bunker Hill, General La Fayette laid the corner-stone of the Bunker Hill monument. There were present on the occasion about forty of the survivors of the battle and two hundred soldiers of the Revolution. A memorable oration was delivered by Daniel Webster.

190. In the presidential election of 1824, there were no recognized parties, and political issues were so obscure that the contest turned chiefly upon the personal merits of the candidates. The leading candidates were John Quincy Adams, of Massachusetts, secretary of state, William H. Crawford, of Georgia, secretary of the treasury, Henry Clay, of Kentucky, speaker of the house, and Andrew Jackson, a private citizen of Tennessee. On account of the number of the candidates and the character of the contest, the presidental campaign of 1824 has been humorously styled the "Scrub race for the Presidency". All the candidates claimed to be Republicans. Crawford and Jackson were representatives of the strict constructionist principles, but Jackson was not in favor with the Crawford faction on account of his leaning toward a protective tariff. Adams and Clay were loose constructionists. The personal nature of the canvass is shown in the tendency of the supporters of the different contestants to designate themselves as "Jackson men" or "Adams men" rather than by any real party title. John B. Calhoun, of South Carolina, was generally supported for the vice-presidency by the friends of all the other candidates. In February, 1825, the electoral votes were counted, and were found to be, for president, 99 for Andrew Jackson, 84 for John Quincy Adams, 41 for William H. Crawford, and 37 for Henry Clay, and for vice-president, 182 for John C. Calhoun, and 78 for various other persons. Calhoun was therefore declared elected vice-president. Jackson had received the greatest number of electoral votes for president, but no one had a majority; and so the election went to the house of representatives. As Clay stood fourth on the list he was not eligible, and only three names were open to choice in the house. The friends of Clay therefore—unable to vote for him—united with the friends of Adams and thus secured the election of the latter. The feeling excited by this result had a tendency to widen the breach between the two divisions of the Republican party, and before long they became openly opposing parties.

The scrub race for the presidency.

The Adam administration.

191. From the beginning of Mr. Adam's administration, both factions of the defeated party united in an opposition to the president, which continued through his whole term of office. Adams appointed Clay to the leading position in his cabinet, and at once the charge was made that Adams and Clay had formed a corrupt bargain, in which the latter had agreed to cast his influence in favor of Adams, in return for which Clay should receive the position of secretary of state, which was then usually considered as the stepping-stone to the presidency. This imputation was indignantly denied by Clay, but the cry of "bargain and intrigue" was kept up until Adams retired from the presidency at the end of his four years of office. In the first year of his administration, the South American states, which had now become independent, proposed to hold a congress at Panama, to consult upon matters of interest common to the whole of America. They invited the United States to send delegates. President Adams accepted the invitation in behalf of the union. Congress, however, after a stormy debate, refused to send delegates. It was claimed that these South American states had abolished slavery, that they were near neighbors to the south, that they might include Cuba, which was still a part of Spain, make the island independent, and free the slaves there. The whole scheme was fraught therefore with danger to the slave states, and was rejected. The slave states were strong supporters of the doctrine of state sovereignty. They held that the states were independent of one another and of the federal government, a doctrine which had been held from the beginning of the union. The independent power of the state was a safeguard against too great a power in the central government.

The proposed congress

Protective tariffs.

192. The first tariff act of 1789 involved the idea of protection to home manufactures. The duties, however, ranged only from 7½ to 10 per cent., averaging about 8½ per cent. The system, too, which was introduced by Hamilton, seemed to be rather for political than economic purposes. Up to the passage of the tariff act, the laying of duties had been controlled by the states. The possibility of secession among the states in which the state-rights feeling was strong, was a feature that every statesman had to take into account. Hamilton wished to establish the new Federal government as firmly as possible, and his object in the tariff system seems to have been to create a class of manufacturers, running through all the states, but dependent for prosperity on the Federal government and its tariff. This would be a strong factor in support of the government against any attempt at secession, or any tendency

Tariff of 1816.

to return to the old system of control by State legislature. The war of 1812 had made it difficult to obtain manufactured goods from abroad, and many needed articles had begun to be made in the United States. After the war was over, American manufacturers wished to continue their business, but as they could not compete successfully with English manufactured goods, a higher protective tariff was thought necessary. In 1816 a tariff was instituted which imposed a duty of about twenty-five per cent. on imported cotton and woolen goods, and specific duties on iron imports. The English manufacturers made far more cloth than could could be used in England alone, and they sold it to other countries. They could make the cloth better and more cheaply than it could be made in the United States. The people of the United States, therefore, would prefer to buy it of England rather than of the American manufacturers. Now England had established herself in India, and received at first most of her cotton from that country. She wished to favor her own merchants, who brought the cotton from India, and therefore she laid a tax upon the cotton from the southern states. Then the south began to send her cotton to the north, where they could sell it without paying duties, and favored a heavy duty on all cotton goods brought from England. By this means they thought, that Northern manufacturers could make up their cotton into goods which would cost the buyers less than English goods of the same kind. They reasoned thus: If the cotton has to travel across the Atlantic, pay a tax there, be made into cloth, cross the Atlantic again, and then pay a heavy duty at the custom-house, it will cost the merchant who buys it so much that he when he sells it he must ask a higher price than for the cloth made perhaps in the next town to him. So the customer will buy the native cloth. This tariff on European goods, therefore, was called a protective tariff, because it was intended to protect the American planter and manufacturer. At first the northern people did not favor it. Their business was much more in ships than in mills; and if the tariff prevented the importation of European goods, their vessels would not be of much use.

Tariff of 1824.

193. There was nothing new in the principle of the protective tariff. As has been shown, Hamilton had urged it at the beginning of the government, and it was the method used by many countries for the protection of their own industries. But the tariff of 1816 in the United States came at a time when it had a marked effect in the history of the people. If the United States could manufacture its own goods from its own products, and sell them to its own citizens, then one part of the country would help another, and the whole union would prosper together. Thus the tariff fell into its place as one of the plans adopted by the country when it settled down to the work of possessing the land and improving it. But as time went on, the south, which had at first favored a protected tariff to ensure the sale of her cotton, now began to oppose any further increase of duties on foreign goods. Thus in 1822, a proposition for making the tariff more protective was defeated by the southern section in Congress. The tariff of 1824 was adopted by very small majorities. It was an advance on all preceding tariffs in its consistent design of excluding foreign competing goods from American markets. It was passed by the northern members, except those from the northeast, against the almost unanimous vote of the southern members, who considered it unconstitutional, sectional, and unjust. In 1828, the Protectionists, as those who favored a high protective tariff were now called, succeeded, after a debate of six weeks, in passing another tariff bill which was so protective as to be satisfactory to manufacturers but very objectional to the southern states, where it was pronounced a legalized robbery. From this time, the nullification doctrines of the Kentucky resolutions of 1799 began to gain strength rapidly in the south.

Whigs and Democrats.

The "American System."

194. In the presidential canvass of 1828, the two factions of the great Republican party now assumed the character of two distinct and opposite parties. The supporters of Jackson assumed the name of Democrats, while the opposition, which favored the re-election of Adams, were known at first as National Republicans. But in the course of Jackson's administration, as they saw fit to represent him as a kind of a tyrant like George III, they assumed the name of Whigs; and henceforth, until 1854, Whig and Democrat were the names of the two great political parties in the United States. Without entering into a detailed history of these parties and their principles, it may be said in general that the questions which have divided them have been concerned with the powers of the national government. The Whigs wished to give the Federal government the power to use the public money in the making of roads, improving rivers and harbors, etc., under the general head of *Internal Improvements;* the Democrats claimed that these things ought to be done by the states or by private enterprise. The Whigs espoused the policy of laying duties on imports as high as revenue results would approve; within this limit the duties were to be defined for purposes of protection; and the superabundant revenues were to be expended on internal improvements. This was known as the "American system." This policy was opposed by the Democrats, but not always intelligently. The Whigs also favored the continuance of the national bank which had been chartered in 1816. The Democrats strongly opposed it, and on the question they achieved a complete and decisive victory under President Tyler. On the question of internal improvements, however, the opposite still holds the ground, but most of its details have been settled by the great development of the powers of private enterprise during the past sixty years, and it is not at present a leading question. The question of the tariff, however, remains to-day as a "burning question," but it is no longer argued on grounds of constitutional law, but on grounds of political economy.

Andrew Jackson president.

Origin of the "spoils system."

"Rotation in office."

195. In the presidential canvass of 1828 Jackson was elected president, with John C. Calhoun as vice-president, and on March 4 they were sworn into office. The eight following years have been called "the reign of Andrew Jackson," from the arbitrary methods which he seemed to assume in regard to money affairs in his administration. One of the greatest mistakes of the president was the use of government offices as rewards for his friends and adherents. As early as the beginning of the present century a vicious system was growing up in New York and Pennsylvania. In those states the appointive offices came to be used as bribes or as rewards for partisan services. By securing votes for a successful candidate, a man with little in his pocket and nothing particular to do, could obtain some office with a comfortable salary. It would be given him as a reward for political services, and some other man, more competent than himself, would have to be turned out in order to make room for him. A more effective method of driving "good citizens" out of politics could hardly have been devised. The result was that the civil service of those states was seriously damaged in quality, politics degenerated into a wild scramble for office, salaries were paid to men who did little or no public service in return, and thus the line which separates taxation from robbery was often crossed. About the same time the idea obtained that there is something especially democratic, and therefore meritorious, about "rotation in office." Government offices were regarded as plums at which everyone ought to be allowed a chance to bite. The way was prepared in 1820 by W. H. Crawford, of Georgia, who succeeded in getting the law enacted which limits the

The "spoils system" made national.

terms of office for postmasters, revenue collectors and other servants of the Federal government to four years. The importance of this measure was not understood, and it excited very little discussion at the time. After Jackson obtained the presidency the methods of New York and Pennsylvania were applied on a national scale. Jackson cherished the absurd belief that the administration of his predecessor Adams had been corrupt, and he accordingly turned men out of office with a keen zest. During the forty years between Washington's first inauguration and Jackson's the total number of removals from office was seventy-four, and out of this number five were defaulters. During the first year of Jackson's administration the number of changes made in the civil service was said to be 2,000. Such was the abrupt inauguration upon the broadest scale of the so-called "spoils system." The phrase originated with W. L. Marcy, of New York, who in a speech in the senate in 1831 declared that "to the victors belong the spoils." The author of the phrase did not of course realize that he was making one of the most infamous remarks recorded in history, and Jackson doubtless would have been greatly surprised could he have foreseen that he was introducing a gigantic system of political knavery and corruption, which would help sustain all manner of abominations, from grasping monopolies and civic jobbery down to political rum shops.

The United States Bank.

196. Jackson made another mistake which, however, was trivial compared with the adoption of the spoils system. He was bitterly opposed to the United States bank because he believed that it was unauthorized by the constitution and a means of political corruption. As the charter was about to expire in 1836 he urged Congress not to renew it. An angry controversy followed. A bill renewing the charter passed in 1832, but Jackson vetoed it. Subsequently he recommended that the public money should be removed from the bank, and when Congress refused to consent to this measure he took the responsibility of ordering the secretary of the treasury to remove it (1833), a measure which, at first, was followed by great distress among merchants. It was in this quarrel that the supporters of the bank became known as Whigs, while the partisans of the president kept the old name of Democrats. The bank was finally closed in 1836 when its charter expired.

Indian troubles.

197. In 1832 hostilities with the Sac and Fox tribes of Indians broke out in what is now Wisconsin. Their chief, Black Hawk, was captured, and the Indians were removed beyond the Mississippi. Georgia wished to get rid of the Creeks and Cherokees remaining within the state; but they refused to go. The United States had made treaties with them and these treaties acknowledged the right of the Indians to the land which they held. They were more civilized than the Indians in general and had farms which they cultivated. A few of their chiefs were persuaded to sign a new treaty with Georgia, giving up their lands. The other Indians at once put them to death; they declared that these chiefs had no authority to sign for the tribes, and that in consequence there was no treaty. Georgia would not wait for the Indians to yield but ordered a survey of their lands to be made for settlement by the whites. It must be remembered that although the territory was within the boundaries of Georgia it was yet distinctly under the control of the Indians by agreement with the United States. The federal government was very desirous of getting the Indians out of Georgia, and tried every means to persuade them to leave, and accordingly in a tacit manner suffered the state to crowd the Indians out. It was no less true that the state was taking to itself a power which belonged to the union. The wrangle over the Indians began in the administration of John Quincy Adams, and continued after Andrew Jackson was chosen president. Jackson had no love for the Indians, having fought them all his life, and he did not now interfere. Georgia had her own way, and the doctrine of state sovereignty was more firmly held than ever.

Nullification.

198. At this time the southern people felt themselves to be Virginians, Carolinians, Georgians, rather than American citizens. They were brought up through this feeling of undue loyalty to their native states to have a secondary regard for the national union, and because possessed of an institution which they were anxious to maintain, they were necessarily fearful of the influence of an entirely free government. Since slavery could be sustained only by state law, in opposition to the spirit of the age, the state must be made so sovereign as to be able to withstand all national interference. To make sure of this result at the time now before us, some of the prominent southerners met on a certain occasion to try the temper of President Jackson by an attempted defiance of the national authority. But the indignant and determined response of the president checked for a moment their designs, few men daring any longer to follow to their ultimate conclusions the teachings of the great southern leader, John C. Calhoun; and so, for nearly two years, but little opposition was openly undertaken. Calhoun, however, never ceased his plotting; and in 1832, such had been the progress of his plans, that he deemed himself strong enough to carry his state-rights doctrine triumphantly through, in spite of the known hostility of the patriotic Jackson. Congress, as will be remembered, had enacted a tariff of a mixed character, mainly for revenue, but incidentally protecting some of the manufacturing interests of the northern states; and among the articles thus protected were coarse woolen goods, which were used in the south as clothing for its slaves. The price of those articles was thus made a trifle higher than it would have been without this protection; and the slave holders, always a unit for the state-rights doctrine, had to pay this higher price. The north was all the while under the same tariff, paying an increased price for cotton on every yard of imported cloth. This was not considered by the south, and so in 1832, a state convention in South Carolina declared the tariff acts unconstitutional, and therefore null and void, and resolved that any attempt to collect the duties at any port in that state should be resisted by force of arms. Preparations were also made to take South Carolina out of the union. "Nullification" was the name given to this act by which the state declared certain laws of the general government to have no force in her territory

Webster and Hay

199. The 1st of February, 1833, in case Congress did not repeal its protective system prior to that date, was fixed upon as the limit of the state's forbearance; for after that day, South Carolina, in the event of the non-compliance of the United States with her sovereign pleasure, was to consider herself as forming no part of the Federal union. All she desired, she said, if her demands were refused, was "to be let alone," when she would proceed to govern herself, according to the alleged Jeffersonian doctrine, as an independent state. The excitement was intense all over the union. Webster was in the senate and General Jackson in the presidential chair, and they worked together, though opposite in their party connections, like twin brothers, for the salvation of their common country. Webster pleaded for the union, claiming that the constitution was not a "compact of states," but a "nation," created by the whole people for their collective government and benefit. In the course of controversy in the senate, he held his famous debate with Mr. Hayne, lasting for several days, and presented the arguments against the right of secession with an eloquence and force never equalled in any discussion on that question. President Jackson firmly believed that the states should manage their own affairs but he also held that when laws were passed in Congress for the whole country,

no one state had a right to refuse obedience to such laws. He declared that "the Federal union must and shall be preserved." and sent an armed fleet to Charleston harbor, warning South Carolina at once that, if she resisted, the whole force of the union would be used against her. For a while it looked as if there would be a resort to arms, but Clay, who was the leader of the Protectionists, came forward and proposed a compromise by which the tariff was modified. South Carolina had won her point. The doctrine of nullification had not been put to the test of arms; but the doctrine of state sovereignty had established itself more firmly at the south.

Specie circular.

Martin Van Buren president.

The panic of 1837.

200. After the fall of the United States bank many state banks had been formed, often with little capital, to supply the expected need of paper money. These banks issued notes which were largely used in the purchase of public lands from the United States, and the treasury was accumulating paper currency of doubtful value. Soon after Congress had adjourned, the president directed the secretary of the treasury to issue the so-called specie circular, ordering the United States agents to receive in future only gold and silver in payment for lands. The demand for specie at once became pressing, and could only be met by the banks in which the revenue was deposited. Other banks fell into difficulties which culminated in the great "panic of 1837," which took place under Martin Van Buren's administration. General Jackson having served two terms, was succeeded by Mr. Van Buren, who became president on March 4, 1837. The administration of Mr. Van Buren (1837–41) was occupied chiefly with efforts to remedy the commercial disasters of the nation. The new president had taken Jackson's cabinet, and had declared his purpose "to follow in the footsteps of his illustrious predecessor." He, therefore, caught the first full effects of the storm produced by Jackson's financial policy, from which even Jackson's popularity and admitted honesty would hardly have saved him. A spirit of reckless speculation had been excited by the excessive amount of paper money in circulation, and property had acquired a fictitious value. Most of the banks which were not lucky enough to have government deposits at command went down under the specie circular of 1836. The "pet banks" which had received the deposits of the public money, had used them as loans to business men, and now, when a sudden demand for those deposits was made, many of these banks also were involved in the general ruin. The sudden calling in of these loans was the beginning of this famous panic of 1837, the counterpart of which had never before been seen in the United States. Early in May the banks of New York city refused to pay gold or silver for their notes, and the New York legislature authorized a suspension of specie payments throughout the state for one year. This was followed at once by the suspension of banks in other cities. The president by proclamation (May 15) called an extra session of Congress, to met September 4, and consider and secure the financial interests of the government. Meanwhile the panic continued during the summer of 1837, causing widespread ruin among banks, corporations and business men, and violently reducing nominal fortunes to far less than their real value.

The sub-treasury system.

201. Finally, after some vicissitudes, the financial difficulties of the nation were satisfactorily adjusted by the adoption of one phase of the National Bank question, that of the so-called sub-treasury system which was ultimately established in 1846, and has been in force ever since. By this system the public revenue are not deposited in any bank, but are paid over on demand to the treasury department by the collectors, who are required to give bonds for the proper discharge of their duty. The establishment of this system was creditable to Van Buren's administration, but the country was not prosperous during his term of office, and he was defeated as a candidate for re-election (1840) after a remarkably exciting canvas. The Whigs relying upon the same kind of popular feeling which had elected Jackson, again put in nomination the plain soldier, Harrison, who had been Van Buren's opponent in the preceding canvas, and who had lived in a log cabin and had hard cider on his table. In the famous "hard cider campaign" of 1840, Harrison won a sweeping victory, obtaining 234 electoral votes to Van Buren's 60. John Tyler, of Virginia, a Democrat in politics, was elected vice-president. The election of Tyler was a political mistake on the part of the Whigs, for in one month after his inauguration, President Harrison died, and Tyler succeded to the presidency. Thus the government had a Democratic head, and the Whigs lost, in the main, the fruits of their victory.

The "hard cider" campaign

Tyler's administration.

202. Mr Tyler retained Harrison's cabinet, and promised to carry out his policy. In an extra session of Congress beginning May 31, a bill to abolish the sub-treasury of the previous administration was passed by both houses, which now had a Whig majority, and was signed by the president. Both houses then passed a bill to incorporate the fiscal bank of the United States. Many of the objectionable features of the old United States bank had been discarded; but the measure still met with great disfavor among the Democrats. The bill was vetoed by the president. He stated as his objection, that the powers given to the bank were such as he and the majority of the people believed to be unwise and unconstitutional to grant. An effort was made to pass the bill over the veto by a two-thirds vote, but it failed. The Whig leaders then requested the president to present them with an outline of a bill which he would be willing to sign. After consultation with the cabinet it was given, and passed by both houses. The president vetoed this bill also. A two-thirds vote could not be obtained to pass it over the veto. This action of the president in vetoing a bill which had been drawn according to his own suggestions, roused the indignation of of the Whigs who had elected him, and all his cabinet resigned. Daniel Webster, however, the secretary of state, retained office long enough to finish a negotiation with Great Britain for the settlement of a dispute regarding the northwestern boundary.

Oregon.

203. The northwestern corner of North America down to the parallel of 54° 40′, now known as the territory of Alaska, then belonged to Russia. The region known as Oregon, which lay between Russian America and California, was claimed by the United States on the ground of the discoveries of Lewis and Clarke. After the second war with England, when both countries claimed this region, it was agreed in 1818 that they should hold it jointly for ten years. The Hudson Bay Company, which was fully equipped for the fur trade, increased its stations. At the end of ten years it seemed to have almost entire possession. In 1828 it was agreed to continue the joint occupation until notice of its termination should be given by one nation or the other. When this agreement was renewed St. Louis was the great center of the fur trade of the west. Expeditions from that point into the disputed territory soon became common. The hunters brought back word of the fine farming and grazing lands which they had seen, and parties of emigrants began to make settlements in that direction. The Hudson Bay Company put every possible obstacle in the way of immigration, as they had wished to keep the country for hunting and trapping. They managed to create the impression in the United States that the Rocky Mountains could not be crossed by wagons, and that the country on the other side was a barren wilderness. In 1836, Dr. Marcus Whitman was sent out with a company of missionaries to the Oregon Indians. He was a man of energy and foresight. He saw that it was practicable for emigrant trains to cross the mountains by good passes, and he

knew that if he could make this generally known the people of the United States would soon occupy the country.

204. When Lord Ashburton came in 1842 to settle with Mr. Webster the boundry line between the British possessions and the United States, the Hudson Bay Company had succeeded in keeping out almost all American emigrants. They had laid their plans also to bring in English settlers from the Red river country, so as to strengthen the British claim to all Oregon. As soon as Dr. Whitman learned this, he set out in October of that year, and made his way across the entire continent to Washington. There he found that a treaty had been signed, but that Oregon had beed left out of consideration altogether. Dr. Whitman's errand was to make known to the administration at Washington the value of Oregon, and then to organize companies of emigrants to settle within its bounds. He did both. In the following summer he had a great body of settlers over the mountains, and at the close of 1844 there were three thousand Americans in Oregon. The people were fast deciding the question of ownership. Congress now took up the matter in earnest. The American people claimed the whole western territory, and the Democrats went into the next presidential campaign with the alternative war-cry "Fifty-four, forty, or fight," meaning that the parallel of 54° 40′ must be made the northern boundary. But the wiser men were ready to compromise, and a treaty was made with Great Britain in 1846, by which the forty-ninth parallel was made the dividing line west of the Rocky Mountains.

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205. In 1842 an affair known as "Dorr's Rebellion" occurred in Rhode Island. The state was still governed under the old colonial charter, and a party led by Thomas Dorr was anxious to exchange it for a new constitution giving greater power to the people. Dorr assumed to be governor by the votes of his partisans; the lawful governor, under the charter, called for the assistance of the United States, and civil war was imminent, when President Tyler sent troops into the state to uphold the old government. Dorr was convicted of treason and sentenced to imprisonment for life, but he was soon pardoned, and a more liberal constitution was afterward adopted.

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very.

206. Calhoun was steadily teaching the southern states that their safety lay in the doctrine of state sovereignty, and the slaveholders were beginning to think that the union was not worth much to them unless it protected the slave system. Meanwhile, a very different belief was becoming common in the north, which was largely due to the influence of William Lloyd Garrison, of Massachusetts. He had established a weekly paper in 1831, called *The Liberator*, which was devoted to the entire and immediate abolition of African slavery in America. Many others, men and women, came forward to support him, and in 1833 the National Anti-Slavery Society had been formed, and its branches had multiplied rapidly. The renewal of the slavery question alarmed the southern people and also many of the northern people, who considered any attack upon slavery dangerous to the peace of the union. From this time dates the existence of the party opposed to slavery in the United States, at first known as abolitionists. They did not, however, constitute a political party, but as individuals kept up an incessant attack upon the evil of slavery. They were persecuted in every way possible, but every attempt to intimidate them only gave a new opportunity for the discussion of the rights and wrongs of the slave. The slaveholders and their friends at the north declared that the abolitionists were destroying the peace of the country, and charged them with inciting the slaves to insurrection. Hence they called upon all friends of the union to put them down. Finally mob violence was resorted to in Boston and other northern cities to destroy abolition printing presses, break up abolition meetings and silence abolition orators.

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Petitions to Congress.

207. These lawless outrages only served to fire the zeal of the abolitionists, and they began to offer petitions to Congress to abolish slavery in the District of Columbia, while the dissemination of abolitionist books and papers was greatly increased in every part of the country. Congress in 1835 had resolved to lay all future petitions on the subject of slavery upon the table. In 1836 the president's message to Congress made indignant reference to the practice of sending abolition documents through the United States mail. He recommended a bill to prohibit the practice in future. Accordingly, a bill was introduced in Congress, prohibiting any postmaster from knowingly putting any abolition documents or newspapers into the mails. The bill was rejected. The right of petition has been a right always held sacred by the people, and a champion for this right appeared in John Quincy Adams, who had been sent back to Washington as a representative from his district in Massachusetts. He presented these petitions again and again. The slavery party refused to admit them, and in consequence multitudes of people at the north were gained over to the anti-slavery side.

Arkansas and Michigan.

208. The political parties had not yet openly divided on the question of slavery, but the opposition to the Democratic party had become firmer, which resulted, as has been shown, in the formation of the Whig party (1836). Since Missouri had been admitted into the union two other states had been formed, Arkansas in 1836 and Michigan in 1837. Half of the states were now free states and half slave. But in population the free states were rapidly gaining on the slave states. In 1830 they exceeded them by over a million; in 1840 the excess was nearly two and a half millions. Moreover, after the admission of Arkansas, Florida was the only territory which could be admitted as a slave state, whereas the north had still a vast space westward at its command. To southern statesmen it seemed likely that the north would presently far exceed the south in territory, population, wealth and political power and would steadily gain a majority in the senate and the house. It was, therefore, probable that before long the north would come to control the action of Congress, and might then try to abolish slavery. This the south naturally dreaded, and this feeling of dread was intensified and exasperated by the abolitionist agitation. The only safeguard for the south seemed to be the acquisition of fresh territory, and southern statesmen looked for this to the great country of Texas, which lay south of 36° 30′, was suited to the institution of slavery and was already occupied by many southerners.

Annexation of Texas.

209. Texas was originally a part of the Spanish province of Mexico. In 1821 Mexico revolted from Spain, and formed a republic moulded after the United States. Like other Spanish states in America it abolished slavery. The south thus had for its neighbor a free country hemming it in on the south and southwest. Presidents John Quincy Adams and Jackson each had made the attempt to buy Texas from Mexico, but she had refused to sell. Meanwhile emigration had set in from the southwestern states, and many Americans had made their home in Texas. The most noted of these was General Sam Houston, the leader of an adventurous set of men. At his instigation Texas rebelled against Mexican rule, and, in the decisive battle of San Jacinto (1836), won her independence and set up a government of her own with Houston at the head. Texas then applied for admission to the union. The importance of such an addition was seen at once. Out of this vast territory five states could be formed. If slave states they would greatly strenghen the slavery party. The whigs, under Webster and Clay, opposed annexation on the ground that it would bring on a war with Mexico, which had not acknowledged the independence of Texas. The ques-

tion of annexation was hotly discussed in the presidential election of 1844. Van Buren, who had opposed annexation, was rejected by the democratic party, and James K. Polk, of Tennessee, who favored annexation, was nominated. The whig candidate was Henry Clay; and there was a third candidate, which decided the result of the election. The abolitionists had put forward James Birney as a presidential candidate in 1840, who had received very few votes. They now nominated him again. A close and bitter contest followed. The democratic party was committed to the annexation of Texas, although the demand for the tariff of 1842, and for "the whole of Oregon or none, with or without war with England" helped to gain votes. Nevertheless the success of the Whigs seemed probable, until the weakness of Clay's moral fibre ruined it. He wrote a letter in which he tried to conciliate southern Democrats by saying that he would be "glad to see" the annexation take place at some future time. By this device he won no democratic votes, for Polk was a warm advocate of annexation, but angered a great many anti-slavery Whigs, who purposely threw away on Birney their votes, by which means New York was carried for Polk, and he was elected president. It was the most closely contested election in the history of the United States, except those of 1800, 1876 and 1884. The result in fourteen of the twenty-six states was doubtful for some days, and most of these chose Polk electors by very slender majorities. In several of them the small abolition vote would have turned the scale and chosen Clay electors. Thus Polk was elected, and, in December, 1845, Texas was annexed by resolution of Congress, and admitted into the union (December, 1845) with the understanding that it might be hereafter divided, so as to make several slave states. Florida had already been admitted as a state in March of the same year. In spite of the strong opposition to the annexation by the anti-slavery party there was a general feeling of pride that the country had acquired so large an addition to its domain. Politicians in favor of annexation did their best to draw the popular mind away from the question of slavery, and to hold out splendid prospects of the rapidly increasing United States. They began to aver that it was the "manifest destiny" of the nation to possess the whole continent. But the slavery question could not be held in abeyance. With the election of Polk the north and south were finally arrayed in opposition to each other. The policy of the Democratic party now began to be shaped chiefly by the adherents of Calhoun, the representatives of slavery and nullification, though the latter political heresy was not likely to be pushed to the front so long as the control of the federal government was in their hands; but the slavery question became the "burning question" from that time on until it was decided by the civil war.

The Mexican war.

210. When Texas was annexed to the United States, Mexico was so occupied with intestine dissensions and revolution that her exhibition of resentment was at first confined to a formal protest, and the withdrawal of her minister from Washington. No aggressive movement was made by her even when the United States troops under General Taylor occupied the east bank of the Nueces river, a part of the state which Mexico insisted had never belonged to Texas. In the meantime, in anticipation of trouble, a naval expedition had been sent by the American government to the gulf December 31, 1845, and an act passed extending the United States revenue system over the doubtful territory beyond the Nueces river to carry out which a revenue officer was appointed to reside in the new district. Even then Mexico did not institute hostilities, but expressed her willingness to negotiate concerning the disputed territory between the Nueces and the Rio Grande In March, 1846, General Taylor was ordered by the president to advance from the Nueces to the Rio Grande, and occupy the debatable district. These measures, adopted by the president, by which our troops crossed the boundary claimed by Mexico, were considered by a large portion of the people of the United States as impolitic, if not unjust, and the occupation of a territory by our troops, which at least was a subject of dispute, was deemed by many a belligerent act. General Ampudia so considered it, and notified the American general to retire beyond the Nueces within twenty-four hours. In April General Arista superseded Ampudia in command, and communicated to Taylor that he considered hostilities commenced. Early in May Arista, with 6,000 Mexicans, crossed the Rio Grande, attacked General Taylor with his force of 2,300 at Palo Alto, and was badly defeated. The next day Taylor assumed the offensive, attacked Arista at Resaca de la Palma, and compelled him to retreat in haste across the Rio Grande.

War declared.

211. The United States government, before it could hear of these actions, declared war against Mexico (May 13, 1846), and called for 50,000 volunteers. Mexico likewise declared war against the United States for interfering in her affairs with Texas. Soon after the declaration of war, Colonel Stephen W. Kearney was ordered to lead an expedition into New Mexico for the purpose of separating that province from Mexico. Leaving Bent's Fort, he followed what was known as the Santa Fe trail, along the Arkansas river, across the Colorado mountains to the Rio Grande, and down that river to Santa Fe. Here he took possession of the country in the name of the United States, declaring New Mexico a territory of the Union, and left a governor and some troops. Then he set off for California, to carry out the same design of separating a Mexican province from the Republic of Mexico and attaching it to the United States. Before war was declared Captain John C. Fremont was sent on an exploring expedition to California. Some vessels of the navy also were sent to the Pacific coast to be in readiness. The United States had reason to think that England would make an excuse of the Mexican troubles to set up a claim to California. Fremont and his men, aided by officers of the navy with marines, made no delay when they learned that war was in progress. They easily took possession of one village after another. They expelled the Mexican soldiers, and finally seized Monterey, the capital of the province. There were a number of American settlers there, who proceeded to declare the independence of California and organize a government.

Expedition into New Mexico.

Fremont in California.

Doniphan's expedition.

212. When Colonel Kearney left Santa Fe, he ordered Colonel Doniphan, with about a thousand volunteers, to chastise the Navajo Indians. Having performed this duty and compelled the savages to make a treaty of peace, Doniphan marched a thousand miles to join the army in Mexico. At Bracito, December 25, 1846, he defeated a large force of Mexicans, and near Chihuahua, Feburary 28, gained a decided victory over an army four times as large as his own. Finally he reached General Wool, at Saltillo, May 22, after a march which is considered as one of the most brilliant exploits of the war.

213. In the meantime Taylor had conquered the northern portion of Mexico; while Scott, landing at Vera Cruz, advanced and captured the City of Mexico. The United States soldiers were victorious over the Mexicans wherever they came into conflict, and whatsoever the disparity of numbers, as instanced in Doniphan's victory; while at Buena Vista, February 22, 1847, Taylor routed a Mexican army more than four times greater than his own. To the student of history the Mexican war will have great interest, as having been the school in which most of our great generals, who made their mark in the civil war, received their practical training. The capture of the City of Mexico (September 14 1847), put an end to the war. A treaty was entered into with Mexico, by which the Rio Grande was made the southwestern boundary of the United

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States, and the Gila river the northern boundary of Mexico. The United States paid Mexico $15,000,000 for the territory which was thus added to its domain, exclusive of Texas. Five years later, the United States bought the Mesilla valley, south of the Gila river, for $10,000 000. General James Gadsden was the agent in this purchase. By these two cessions Mexico transferred to the United States the country now comprised in California, Arizona, Nevada, Utah, and parts of Wyoming, Colorado, Kansas, and New Mexico.

Big-
Papers

not
viso.

214. This immense acquisiition of territory, though a fortunate one in many respects, had an immediate effect upon American politics far more disturbing than anything which had occurred since 1820. The general sentiments of the anti-slavery party had been opposed to the war, and these sentiments had been fully set forth in a series of remarkable political poems entitled, "The Biglow Papers," by James Russell Lowell. The sectional strife which had been allayed for the time being by the Missouri Compromise, now began to be renewed. In the new territory acquired from Mexico, slavery had been forbidden by the Mexican law, and the north desired this prohibition kept in force, but the south opposed the idea. It was proposed by some, as the simplest solution of the difficulty, to prolong the Missouri Compromise line from the Rocky mountains to the Pacific, but neither party was willing to give up so much to the other. The increased opposition to slavery in the north had created an increased obstinacy in the south, so it was rapidly becoming a difficult thing to effect compromises between the two sections. In 1846, David Wilmot, a Democratic member of the house, from Pennsylvania, offered an addition to a bill, making appropriations for the purchase of the Mexican territory. This addition was the celebrated "Wilmot Proviso," applying to any newly acquired territory the provision of the ordinance of 1787, "that neither slavery nor involuntary servitude shall ever exist in any part of said territory, except for crime, whereof the party shall be first duly convicted." The Whigs and northern Democrats united in favor of the proviso, and it passed the house, but was sent to the senate too late to be acted upon.

Soil

215. In the same year that peace was made with Mexico (1848) came the presidential election. Several efforts had been made to pass the Wilmot Proviso, but without success, but it called into existence the Free Soil party, formed by the union of anti-slavery Democrats and Whigs with the Abolitionists. As a compromise between the advocates and opponents of the extension of slavery, a bill had been passed by the senate establishing territorial governments in Oregon, New Mexico and California, with a provision that all questions concerning slavery in those territories should be referred to the United States supreme court for decision. It was voted for by members from the slave states, but lost in the house. A bill was then passed in the house, by a sectional vote, to organize the territory of Oregon, without slavery. This was passed by the senate with an amendment declaring that the Missouri Compromise Line extended to the Pacific ocean. The amendment was rejected by the house, again by a sectional vote, and, the senate withdrawing, the bill passed.

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216. The Whig National Convention met at Philadelphia, June 7, 1848, and nominated Zachary Taylor, of Louisiana, and Millard Fillmore, of New York. No platform was adopted, and resolutions affirming the Wilmot Proviso as a party principle were repeatedly voted down. The Democratic National Convention met at Baltimore, May 22. It revived the strict constructionist platform of 1840 and 1844, and nominated Lewis Cass, of Michigan, and William O. Butler, of Kentucky. The National Convention of Free Soilers met at Buffalo, August 9. It adopted a platform declaring that Congress had no more power to make a slave than to make a king, and that there should be no more slave states and no more slave territories. It nominated Martin Van Buren, of New York, and Charles Francis Adams, of Massachusetts. The Free Soilers decided the election by drawing the Democratic vote from New York, and so Taylor became president. He was brave, honest and shrewd, and by far the ablest president between Jackson and Lincoln. Though a Louisiana slaveholder, he was unflinching in his devotion to the union.

California

217. The leading political struggle during Taylor's administration related chiefly to the admission of California as a state in the union. Texas was the last slave state. The tide of emigration was moving steadily westward and northwestward. In 1846 Iowa was admitted into the union, and in 1848 Wisconsin. While the representatives of the people in Congress were struggling with the question of free or slave territory, the people themselves were rapidly increasing the influence of the free states. In the year that California became the property of the United States (1848) gold was discovered in the valley of the Sacramento, and a very hasty exploration showed that there was an immense deposit of the precious metal in the newly acquired territory. The news spread all over the world and immediately there followed a great rush to the gold region. In a little over a year the population had become large enough to entitle it to admission to the union, and there was need of a strong government to keep in check the numerous hordes of ruffians who had flocked in along with honest people. President Taylor was eager to bring California into the union before the question of slavery in that territory should be discussed in Congress. He urged the people to call a convention and organize a state. They did this (1849), and since they were almost wholly from the north, they framed a constitution prohibiting slavery, and applied for admission. The south earnestly opposed the admission of California as a free state, and the extreme southern party even took some steps toward secession. The debates were conducted on both sides with great bitterness.

Clay's compromises.

The fugitive slave law

218. The controversy went on for a year, until it was settled by a group of compromise measures devised by Clay, who thirty years before had succeeded so well with his Missouri Compromise. He proposed that California should be admitted as a free state; that any new states properly formed from Texas should also be admitted; that the territories of New Mexico and Utah should be organized without the Wilmot Proviso (*i. e.*, with squatter sovereignty, by which the people of each territory were left free to settle the question of the existence of slavery for themselves); that the slave trade should be abolished in the District of Columbia, and especially that a more rigid fugitive slave law should be enacted. The constitution expressly gave to slave-holders the right to recover their slaves if they escaped into another state, but the increasing hostility of the people in the free states to the slavery system made it extremely difficult for slave-holders to find and recover runaway slaves when they had escaped into the northern states. This matter was one of great irritation to the southerners. They complained that they were deprived of their rights in direct opposition to the constitution. The new fugitive slave law was therefore so drawn as to require the arrest, by United States officers, of fugitive slaves in the northern states, and it also gave the officers the right to call upon any citizen to help them in their search and capture. The law also imposed penalties on all rescuers and denied them a jury trial.

Effects of the compromises.

219. Webster gave his support to the Compromise of 1850. Like many others, he viewed with alarm the growing dissensions between the two sections of the country. He worked with all his might to preserve the Union against the attacks of the extreme pro

slavery men on the one hand and of the Abolitionists on the other. California was admitted to the union, and the fugitive slave law was passed. Instead of bringing quiet, as the Missouri Compromise had done, the Compromise of 1850 was the beginning of a more bitter and deadly strife. Perhaps the most important feature of the Compromise, in its bearing upon future events, was the fugitive slave law. The cruelties attending its execution aroused the fierce indignation of the north. The disgust and horror felt toward it caused the passage, by some northern legislatures, of "personal liberty laws," intended to protect free negroes falsely alleged to be fugitive slaves. During the discussion of Clay's Compromise Bill of 1850, President Taylor died after a very short illness (July 9, 1850), and Vice-President Fillmore succeeded to the vacant office. He enforced the Compromise Act impartially, but the fugitive slave law was often evaded and sometimes forcibly resisted. It strengthened the anti-slavery party in the free states, while the agitation of the question of the morality and wisdom of slavery was hotly resented at the south.

Personal liberty laws.

Fillmore president.

Development of the country.

220. It was now the middle of the century, and the union seemed full of prosperity. So various had the interests of the people become that a new department in the administration had been created (1849) called the department of the interior, and comprised a number of offices like the census office, patent office, land office, and bureau of Indian affairs, all of which had formerly been scattered among the other departments. The secretary of this department was made a member of the cabinet. During Mr. Fillmore's administration postage was reduced, so that an ordinary letter could be sent to any place in the country for three cents. Before that it had cost ten cents to send a letter from Philadelphia to Boston. At once the number of letters transmitted through the mails was wonderfully increased. The extinction of Indian titles in northern Michigan brought about the discovery of the great copper mines of that region, whose existence had long been suspected before it could be proved. Railroads in the east were beginning to show something of a connected system, and the increase of railways in the west made it possible for the great farms to send grain and other provisions to the city very cheaply. Railroads in the south had hardly changed since 1840. In 1840 Samuel F. B. Morse, an American artist, had received a patent for an electric telegraph apparatus, and four years later he sent his first dispatch over the wires from Baltimore to Washington. This practical proof of the power of the telegraph was followed by a rapid extension of lines in every direction.

The telegraph.

Government expeditions.

221. Several expeditions were ordered by government to gain a better knowledge of the national domain. In 1848, and again in 1852 and 1853, Captain John C. Fremont was sent out with exploring parties to the Rocky Mountains. The discoveries which he made, and the new importance of California since the discovery of gold there, induced the government to make more careful surveys. The war department undertook one to determine the most practicable and economical route for a railroad from the Mississippi river to the Pacific ocean. Captain Wilkes was sent to the Pacific Ocean, where he explored the Antarctic continent; an expedition under Lieutenant Lynch explored the valley of the Jordan and the Dead Sea; and Commodore Perry was sent with a fleet to Japan, a country which had heretofore been almost unknown to Europe and to America.

222. Between the east and the west railroads were growing busier. Towns and cities sprang up along their routes, and where a new and fertile district was found the settlers did not rest until they had a railway for the transportation of their produce; and very often the railroad itself was the pioneer of a new territory, being followed by the people who made claims along its route. Ships and steamers were constantly crossing the Atlantic. Improvements were made by American shipbuilders in the construction of sailing vessels and the clippers, as they were called, were built, which were able to sail with a good wind almost as swiftly as steamers. The increased development of wealth in the country gave a fresh impetus to the spirit of invention. McCormick invented his reaping machine, and obtained a patent for it in 1834. Its results have been hardly less in importance to the United States than the invention of the locomotive. Since then agricultural machines and implements have rapidly increased. It was agricultural machines that made the western farms profitable, and enabled the railroads to fill the west so rapidly with population. Friction matches had come into use, and anthracite coal was now extensively used both in manufactures and locomotion. In 1839 Goodyear had devised his method of vulcanizing india-rubber. In 1846 came the sewing machine, the power-loom, and the use of anæsthetics in surgical practice. The rotary printing press was invented in 1847.

The Mormons

223. During this rapid change in all the conditions of life, it was not strange that there should be a corresponding change in the minds of men, and that their ideas should become somewhat unsettled. Hence transcendentalism in religion, literature and politics began to flourish; visionary proposals of every kind were made; new communities were established, and new sects sprang up. In 1830 Joseph Smith had declared that he had received a revelation from God which was contained in a book called The Book of Mormon. He formed a society of men and women who were his disciples, and called themselves Mormons, and they made a settlement in Missouri. In 1838, Smith, with his followers, was driven away to Nauvoo, in Illinois. Ten years later, Smith was killed, and the Mormons, under Brigham Young, removed beyond the western frontier, and settled on the broad plain about Great Salt Lake, in the new Territory of Utah. Their missionaries traveled in the older states and in Europe, making converts, and bringing them to the new Mormon home. They offered to people who were discontented, and to the hard-worked poor, a land of promise and plenty. They appealed to religious people, and declared that God was with them, as He had been with the Jews of old. Salt Lake City was founded, and became their capital. Since then, having rapidly increased in wealth and population, they have now become a dangerous factor in the American system. Their peculiar tenets, which consist mainly in their polygamy and submission to their sacred hierarchy, have rendered it impossible to admit them as a State into the Union, while their numbers are so great that it is contrary to American instincts to deprive them of the right of self-government, and keep them under the power of Congress. A solution of the vexing question may soon be reached by the increasing enforcement of the United States laws against polygamy.

Education and literature

224. About the middle of the century, the American methods of education were greatly improved, and American literature began to attract the world's attention. There were publication societies formed by the churches, which multiplied books, papers and tracts without number, and these found their way to remote villages and homes. Educational societies helped establish schools and colleges in the thinly settled parts of the country. There was a Colonization Society, which tried to answer some of the difficult questions of slavery by sending free blacks to Liberia, in Africa. This was the time when the lyceum system became popular. In the cities and towns courses of lectures were instituted, and the latest thoughts in science, art, literature, politics and philosophy, were given to the people. The newspaper had become a national institution, and was a familiar visitor to the great majority of families of the republic. There were daily papers

Newspapers.

in all the cities and towns, and in many papers the contents of books were published, aside from the general news and topics which interested the country. American authors were taking their place among the great men of the ages in the realm of letters. Before 1830, Bryant, Irving and Cooper, had become distinguished. In 1847, Edgar Allan Poe, the most imaginative of American poets, had died. In 1850, Washington Irving had written all his works except his Life of Washington. The poems by which William Cullen Bryant is best known had been written and given to the world. James Fenimore Cooper died the next year, leaving behind him a long list of novels, the best of which were descriptive of American life. Then came Longfellow, Whittier, Hawthorne, Holmes, Bancroft, Prescott and Emerson. The Scarlet Letter had been given to the public, which made Hawthorne famous. Longfellow had published Evangeline, and many of his most popular poems. Whittier had become celebrated as a poet; Oliver Wendell Holmes, as a poet and wit, William Gilmore Simms, as a novelist; Ralph Waldo Emerson had become known by his essays as one of the great masters of English prose; James Russell Lowell, poet and satirist, had issued his Biglow Papers, which helped people to understand the meaning of the Mexican war, while they laughed over the verses. And besides these, there were many others who assisted in raising the standard of American literature, and making it a distinct voice of the nation.

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225. All these things—churches, lyceums, public meetings, societies, newspapers and books, had their influence in shaping public opinion; and as they increased, more earnest grew the discussion of the slavery question. About this time, when the administration of Fillmore was coming to an end, a book was brought out which had an enormous sale, and was translated into all the literary languages of the world. This book was "Uncle Tom's Cabin," written by Mrs. Harriet Beecher Stowe, and it was for the time more widely read throughout the world than any other book. It was a story claiming to show what negro slavery really was, and what it meant in the lives of men and women, white and black, in the Southern States of the Union. The book was candidly written, and in a wonderful spirit of fairness, rather understating than exaggerating the evils of slavery, and its truths were all the more convincing for that reason. Its influence was doubtless very great in strengthening the anti-slavery feeling at the north, and in finally extinguishing the disturbing evil of the country.

VII.—THE APPROACHING CONFLICT.

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226. June 1, 1852, the Democratic National Conventional met at Baltimore. Its platform included the strict constructionist platforms of former conventions, endorsed the Virginia and Kentucky resolutions of 1798, and pledged the Democratic party to a faithful observance of the compromise of 1850, including the Fugitive Slave Law, and denounced all agitatation of the slavery question. It nominated Franklin Pierce, of New Hampshire, and William R. King, of Alabama. The Whig National Convention met June 16 at Baltimore. In its platform it adopted its usual loose constructionist principles, though somewhat more cautiously worded than formerly, and endorsed the compromise of 1850 and the Fugitive Slave Law. It nominated Winfield Scott, of Virginia, and William A. Graham, of North Carolina. The Free Soil Democratic Convention convened at Pittsburgh August 11. In its platform it declared slavery to be a sin against God and a crime against man, and denounced the compromise of 1850, and the two parties who supported it. It nominated John P. Hale, of New Hampshire, and George W. Julian, of Indiana. Some of the Whigs, dissatisfied with General Scott, wished to bring forward Daniel Webster as an independent candidate, but Mr. Webster died in October of that year. Henry Clay had also died in June of the same year. These two great leaders of the Whig party were succeeded by such men as Sumner, Seward and Chase, avowed enemies of slavery. John C. Calhoun was also dead, and Jefferson Davis, afterwards to play such an important part in the nation's history, acquired the leadership of the slave-holders of the south.

227. The slavery question was the principal issue in the presidential election in November, 1852, and in the contest the Whigs met with a crushing defeat, which put an end to their party When the electoral votes were counted in February, 1853, it was found that Pierce and King had received 254, and Scott and Graham only 42. Mr. Pierce's administration (1853-57) was chiefly occupied with the slavery dispute, in which he represented the policy of the southern party. He chose William L. Marcy for secretary of state, James Guthrie for secretary of the treasury, Jefferson Davis for secretary of war, and Caleb Cushing for attorney-general.

Pierce's administration.

228. The slave power was now at a loss what to do for new territory in which to extend itself. The north had already a preponderance in the senate, consequent upon the admission of California, and, from the rapid growth of the northwestern states, in which New England ideas and sentiments were becoming predominant, the southern leaders recognized the fact that ere long the north would hold the power in the house. Webster had shown, in his memorable speech of March 7, 1850, that there was no more territory for slavery within the limits of the union. What, then, were the southern states to do? It seemed absolutely necessary at once to get a new slave state to balance California, but the available land south of 36° 30' was already occupied. New Mexico and the Indian Territory south of Arkansas presented themselves, but the westward movement of population along these lines would be far too slow for their purpose.

The slave power.

229. Seeing no legitimate method to acquire territory, their former plan was repeated, if not by the southern states themselves, certainly under the instigation of many of their citizens, and by members of the state rights party of the south, and for their advantage; for it was precisely at this period that William Walker, of Tennessee, the notorious filibuster, undertook to snatch Sonora for the south from Mexico, exactly as his predecessors had done with Texas. But he failed. In 1855, he and his band made the same experiment in Nicaragua. Here, for a time, he was successful. He overturned the lawful government, made himself president, and almost made the state in readiness for slavery and annexation to the federal government. But he was subsequently driven out, after which he returned home greatly disappointed and mortified. After two more unsuccessful attempts on Nicaragua, he planned his fifth and last expedition against Honduras. He was encouraged and assisted by his southern friends; mass meetings of his supporters were held even in New York, and in many other northern cities; and the state sovereignty party everywhere applauded his efforts to revolutionize and wrong a state. But Walker failed more fatally this time. He was defeated, captured and shot.

Filibustering.

230. Having been foiled in the attempt to gain a foothold in Central America, the slave power now turned to another state as offering a solution of their difficulties. The southern states wished to annex Cuba. Mr. Pierce proposed to buy it, and at his suggestion a conference was held at Ostend, in Belgium (1854) between the American ministers to Spain, England and France, Messrs. Pierre Soulé, James Buchanan and John Y. Mason to consider the question. A memorandum drawn up by these gentlemen and submitted to the president, is known as the Ostend Manifesto. It declared that Cuba was necessary to the United States; that it was the duty of this country to prevent the

Cuba.

Ostend manifesto.

emancipation of slaves in the island; and that if Spain refused to sell Cuba, the United States would be justified in taking it from her by force. This declaration caused great indignation in the north. Nothing, however, came of it.

Tendencies to disunion

231. Meanwhile, the tendencies to disunion were becoming stronger. Texas, the last slave State ever admitted, had refused to be divided, hence the South could hope for no further increase of numbers. After 1850, the political power had passed out of the hands of the south. The free states now, by uniting, could control both houses of Congress, elect the president and vice-president, dictate the appointment of judges and other federal officers, and make what laws they pleased. Thus the interests of the south depended upon the one question whether the free states would thus unite or not. Under circumstances so critical it were better for the slave power that all questions calling public attention to the question of slavery should be avoided; this, however, was simply impossible. The numbers interested in its solution had become too great to be silenced. It was the question of the hour, discussed in all ranks of society, breaking up party lines, and even disorganizing ecclesiastical institutions. The Protestant church organizations of the United States had been greatly agitated by the irrepressible question, and some of them became divided. In 1845, the Baptist church separated into a northern and southern branch, and the Methodist church shared the same fate the following year. The Presbyterian church managed to maintain its integrity until 1861, when it also yielded to the pressure; and the only churches retaining their national character were the Episcopal and Roman Catholic.

Kansas-Nebraska bill.

232. The southern leaders, strongly desirous of acquiring more territory in which to extend slavery, now concocted a seemingly practicable scheme to get control of that part of the country lying west of Missouri and Iowa. This land lay to the north of 36° 30', and according to the terms of the Missouri compromise, was forever to be free soil. A plan was devised to obtain if possible, the repeal of that celebrated compact. With the aid of some of the northern members of Congress this might be done. The scheme proved successful so far as legislation could go. In December, 1853, a bill was introduced in the senate to organize the territory of Nebraska. A southern senator at once arose and demanded that the Missouri compromise should not be so construed as to prohibit slavery within the new territory. The bill was at once dropped. But a sufficient number of free state Democrats soon acquiesced in the southern demand to make it a success. One week later a new bill was brought in, known as the Kansas-Nebraska bill. It divided the region covered by the previous Nebraska bill into two territories, one directly west of Missouri, and between the parallels of 37° and 40°, to be called Kansas, and the other north of this and between the parallels 40° and 43°, to be called Nebraska. Thus two states were opened to the southern institution, instead of one, for this new bill distinctly declared that the Missouri Compromise had been swept away by the later compromise of 1850. President Pierce had pledged himself to the south, in his letter accepting his nomination, to acknowledge and execute this latest bargain with slavery, in case he should be elected.

Squatter sovereignty.

233. The bill was enacted, but the position was now assumed, that Congress had no authority to vote slavery *in*, or to vote it *out* of either of these territories, since it belonged of natural right to their respective populations to decide for themselves the character of their own institutions. This idea was known as that of squatter sovereignty, and it was proclaimed in order to open Kansas to an immediate slave immigration from Missouri, while Nebraska might afterward be captured in the same way from slaveholding Kansas. It was a plausible doctrine, because it appealed to that strong love of local self-government which has always been one of the soundest political instincts of the American people. The plan was an astute one. It originated with Stephen A. Douglass, a northern Democrat, and laid bare the finest region of country which opened up for settlement, as a battle-ground between the slave-labor and the free-labor systems.

234. This act was the most palpable blunder ever known in the history of American politics. Its practical result was to create a furious rivalry between north and south, as to which should first get settlers enough in Kansas to secure a majority of the popular vote. The issue, thus clearly defined, wrought a new division between political parties. The southern Democrats and southern Whigs united in favor of the Kansas-Nebraska bill, while the northern Whigs and Free-Soilers united against it. The division between the northern and southern Whigs was final. The northern section at once repudiated their old party name, and combining with all the northern men who were opposed to the extension of slavery took the name of anti-Nebraska men, and succeeded in electing a majority of the house of representatives. A new party had arisen in 1852, which was now an important factor in American politics. It assumed the form of a secret oath-bound organization, of whose name, nature and objects, nothing was told, even to its members until they had reached its higher degrees. Their consequent declaration that they knew nothing about it gave the society its popular name of "Know-Nothings," but it assumed the name of the "American party." Its design was to oppose the influence of the Roman Catholic church, the easy naturalization of foreigners, and to aid the election of native-born citizens to office. Its nominations were made by secret conventions of delegates from the various lodges, and its nominees were to be voted for by all its members under penalty of expulsion in case of refusal. For a time it was quite successful in state elections, and was now aiming at a greater extension of its influence. At first it had intended to ignore the slavery question, but after a few years of existence the complications arising from the discussion of this subject affected its organization and resulted in its division.

Anti-Nebraska me

The Ameri-can party.

235. The old Whig party disappeared about this time. Some of its members joined the American party, and the majority, including the old anti-slavery men and Free Soilers, with many others, united under the name of the Republican party. The name was at once recognized by the Democrats, who, in contempt, called them "Black Republicans," because of their alleged fondness for negroes. The Democratic party, which had been practically the only party since 1852, had now to contend with a political organization which adopted broad constructionist principles, declared itself in favor of protective tariff, internal improvements and a national system of bank currency, and added to them the further principle that the Federal government has the power to control slavery in the territories. It affirmed, at first, that it had no design to interfere with the institution of slavery in the states where it belonged, but simply intended to exclude it from the territories. But with the enunciation of its fundamental principles it was at once recognized as an anti-slavery party and the only one to which the southern slave could look with the faintest hope of aid in throwing off the chains of bondage. The Democratic party had quite thrown aside its original title—that of Republican—but the name was still popular, and the new party, by a skillful stroke of policy, took advantage of this feeling and assumed the old name. Thus, in 1856, the two great parties, which were to figure so largely for the next thirty years in the history of the country, were arrayed against each other.

The Republican party

The strug-gle for Kans

236. The attention of the whole country had now been turned to the struggle provoked by the Kansas-

Nebraska bill, and the repeal of the Missouri Compromise. Kansas had been offered as a prize to be contended for by free and slave states, and both had accepted the contest. As in the case of California, it was found a slow work to colonize the new territory, even from Missouri, by permanent settlers, for the people of that state had land enough of their own, still unoccupied, to absorb for years their surplus population. The only recourse, therefore, was to send their worst inhabitants across the border, not to settle, but to vote and fight for slavery. Consequently gangs of "border ruffians" poured into Kansas from Missouri and Arkansas. But the free states were not behind in a struggle. Anti-slavery societies subscribed money to hasten immigration into the contested territory, and people from the free states migrated thither in such numbers that in a few months they constituted a decided and lawful majority of the actual settlers. The administration took alarm at the ill success of its own plans. Many of the inhabitants of Missouri undertook to impede the passage of northern emigrants through their state, but the immigrants circumvented them by winding their way around through the free state of Iowa. In the meantime the government sent an army to Kansas, professedly to keep the peace, but it would seem in reality to compel the acceptance and establishment of slavery. The first election of a delegate to Congress took place November 29, 1854, and was carried by organized bands from Missouri, who crossed the border on election day, voted, and returned at once. In the spring of 1855, the ruffians in this way voted to organize a territorial legislature, and this measure was carried in the same lawless manner. In July, 1855, this legislature, all pro-slavery, met at Pawnee, and adopted a state constitution. To save trouble, as well as to secure at once the establishment of slavery, they took a summary vote, adopting in their entirety the laws of slaveholding Missouri. At the same time they enacted a set of original statutes, which denounced the penalty of death for nearly 50 different offences against the institution of human bondage.

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237. To defend themselves against these illegal proceedings, the actual settlers held a free-state convention at Topeka, September 5, 1855, repudiating the work of the pro-slavery party: and on January 15, 1856, they elected state officers under the lawful constitution. Nine days afterwards, the state-rights president, in a special message to Congress, endorsed the pro-slavery legislature, and pronounced the attempt to form a free-state government, without the approval of the Federal authorities in the territory, to be an act of rebellion. He then issued a proclamation warning all persons against such acts of resistance to the lawful government, and despatched another body of troops to enforce the constitution of the border ruffians. The struggle continued unabated. In the senate-chamber Charles Sumner had been stricken to the floor with a bludgeon and nearly murdered by Brooks, in the presence of several southern and unresisting senators, for daring to criticise these unjust and one-sided proceedings. Brooks was expelled by northern votes, but was immediately returned by his southern constituents. In Kansas, the free-state settlers refuse to recognize the territorial government of the slave party, and as the pro-slavery settlers and their allies would not render obedience to the other government, the contest passed into a real civil war, the two sides mustering considerable armies, fighting battles, capturing towns, and paroling prisoners. Two free-state towns, Lawrence and Ossawattomie, were sacked. The free-state legislature peaceably assembled at Topeka, and was dispersed by order of the president. Many of its members were arrested and imprisoned. Every free-state citizen's dwelling had to be guarded and defended by armed force, and no free-state man could plow or plant or gather in his crops without fighting for his life.

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238. The free settlers still continued to maintain their position, in spite of the persistence of slave party, with the whole force of the administration at its back. Several pro-slavery governors — Shannon, Geary and Walker—were sent to represent the southern party, and subdue the citizens to its purpose and control. A second slave constitution, made at Lecompton, was offered to the people in a tricky and nefarious manner. It was to be voted for "with" or "without" slavery, but in either case there would be an affirmation of the doctrine of states-rights. The free settlers accordingly refused to vote. The constitution of necessity was adopted and the new document sent to Washington, was accepted by the president and State-rights party. But the measure failed to carry through the house. Another territorial legislature was elected, and this body sent the Lecompton constitution to the polls to be voted for, or against, as a whole. It was defeated by a majority of six thousand. In spite of this, however, the president, in a special message, urged upon Congress the Lecompton constitution *with* its slavery features, declaring that the new legislature had no right to submit it to a second vote. But he was not sustained. In July, 1859, the citizens of Kansas met again in convention at Wyandotte, and adopted a resolution forever excluding slavery. It received a majority of four thousand at the polls.

Lecompton constitution

Presidential campaign of 1856.

239. In the heat of the Kansas struggle came the presidential election of 1856. The Democrats nominated James Buchanan and John C. Breckenridge, adopted the strict constructionist platform of former conventions, and added to it an endorsement of the Kansas-Nebraska bill and the principle of squatter sovereignty. The Republicans nominated the western explorer, John C. Fremont, and declared the right and duty of Congress to prohibit slavery in the territories, thus planting themselves upon the ground of the Wilmot Proviso. The small remnant of Whigs, including the Know-Nothings of the north and those southern men who wished no further discussion of slavery, nominated Fillmore, and tried to turn attention away from the great question at issue by protesting against the too hasty naturalization of foreign-born citizens. Buchanan received 174 electoral votes, Fremont 114 and Fillmore 8. The large Republican vote showed that the northern people were at length awakened to the situation, and the south in consequence was both astonished and alarmed. For the first time in the history of the country a distinctively anti-slavery candidate had obtained an electoral vote, and had nearly gained the presidency. Though the Democratic party had been successful in this election, its triumph was seen to be far less complete than when it come out of the election of 1852. It no longer controlled twenty-seven of the thirty-one states; all the free states but five had cast their votes against it, and its candidate no longer had a majority of the popular vote, but was simply chosen by a majority of the electoral vote.

The strongest section of the Union was in the hands of its political opponent, through whose ranks a spirit of earnest enthusiasm was being increasingly diffused.

African slave-trade.

240. The strength of the opposition manifested against the Democratic party in this election, more than ever convinced the south that the time was fast approaching when political power would pass from those who defended slavery to those who opposed it. Hence the slave power gathered up its forces for the great struggle which must inevitably ensue. It became more aggressive than ever. It demanded a renewal of the African slave trade, which had been forbidden since 1808, and without waiting for the question to be settled, the nefarious traffic was opened on an extensive scale, with but little attempt at concealment. During the year 1857, twenty-two vessels engaged in this business were captured by the British fleet watching the African coast and every vessel but one of these was American. By 1860 the trade had assumed large proportions, and was

openly advertised in the southern newspapers. But this was not deemed sufficient. To insure the perpetuation of the "peculiar institution," it was necessary to enlist the active protection of the Federal government in its favor. Squatter sovereignty had not served the purpose, for in the Kansas struggle, despite all the efforts made, slavery had been worsted. Squatter sovereignty was accordingly thrown aside, and a demand made that the Federal government should protect slavery in all the territories.

The Dred Scott decision.

241. Up to this time the constitutionality of the Missouri Compromise had never been considered in the supreme court. The question was brought to test in a case which was decided in 1857, two days after Buchanan's inauguration. One Dred Scott, a slave who had been taken by his owner from Missouri into free territory, and had therefore sued for his freedom, was sold to a citizen of another state. Scott then transferred his suit to the Federal courts, under the power given them to try suits between citizens of different states, and the case came by appeal to the supreme court. The decision was startling to the north. It declared, in substance, that according to the constitution, no slave, or the descendant of slaves, could be a citizen of the United States; that slaves were not persons, but property, and that slave-owners could migrate from one part of the union to another and take their negroes with them, just as they could take their horses or any other property. It, moreover, pronounced the Missouri Compromise Act unconstitutional and void, slaves being private property, with which Congress had no right to interfere And it further declared that it was the duty of Congress, not to prohibit, but to protect, slavery in the territories. The mass of the northern people held the opposite of Chief Justice Taney's decision. They claimed that slaves were regarded by the constitution, not as property, but as "persons held to service or labor" by State laws; that Congress was constitutionally bound to protect liberty as well as property; and that its duty was to prohibit, not to protect, slavery in the territories. It was plain that the decision of the supreme court would never be received as the law by the free states. A storm of angry dissent arose, of which the slave-holders hastened to take advantage. They maintained that the duty of Congress to protect slavery in the territories had been confirmed by the highest judicial authority in the land, and that the Republicans had refused to accept its rulings; therefore, whatever the result might be, the Republican party must accept the responsibility. At this time, as will be seen, the northern, or Douglas Democrats as they were called, who had heretofore supported the south, now refused to follow the southern lead any further, but chose rather to divide the party.

Slave states and free states.

242. In 1860 the slave states were fifteen in number, namely, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Alabama, Kentucky, Tennessee, Louisiana, Mississippi, Arkansas (admitted 1836), Florida (1845), and Texas (1845). The free states were eighteen, namely, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Michigan (admitted 1837), Iowa (1846), Wisconsin (1848), California, Minnesota (1858), and Oregon (1859). Kansas had adopted a free state constitution, but was not admitted until 1861. At this period the population of the United States was more than 31,000,000, an increase of over 8,000,000 in ten years. The population of the slave states was 12,000,000, including 4,000,000 slaves and 250,000 free blacks; but the colored element in the southern population could hardly be regarded as a factor of strength, but rather as a possible source of danger. No serious slave uprising had ever threatened the south, but John Brown's raid and the alarm which it produced in the southern states betokened a danger which added a new terror to the chances of a civil war. Brown, a Connecticut man of the old Puritan type, had been an anti-slavery leader in the Kansas fights. His plan was to raise an insurrection among the slaves of Virginia, and arm them to liberate their people by force. In October, 1859, he and his men surprised and seized Harper's Ferry, where there was a large store of muskets and ammunition; but the negroes did not rise, and Brown was overpowered by national and state troops, and hanged (December 2) by the authorities of Virginia.

John Brown's raid.

The split of the Democratic part

The Republican convention

Constitutional Union party

243 The next election for the presidency was looked forward to as a critical time. Many persons of influence in the south declared that if the election should strengthen the preponderance of the north, the slave states would break up the union and form a confederacy of their own. The Democratic national convention, which met at Charleston, S. C., April 23, 1860, was characterized by its stormy session. The demands of the southern extremists produced a political schism, and the convention with the party was split into two distinct portions. The Douglas Democrats refused to yield to the wishes of the slave power, and still maintained the principle that the question of slavery in each territory should be decided by its settlers; but they made a concession by offering a resolution that the party would abide by the decisions of the supreme court. The southern delegates offered resolutions affirming the doctrine of the Dred Scott decision, that neither congress nor the territorial legislatures had a right to prohibit slavery in the territories. The convention adopted the Douglas platform, whereupon the delegates from many southern states, successively protested and withdrew, and at once organized a new convention in Charleston, adopted their platform, and adjourned to meet again in Richmond, June 11. The original convention, after balloting fifty-seven times for candidates without a choice, adjourned to meet again at Baltimore, June 18. Upon reassembling at the appointed time, it seated some new delegates friendly to Douglas, whereupon the remaining southern delegates, who chiefly belonged to the border states, also withdrew, and joined their brethren at Richmond. Here they nominated John C. Breckenridge and Joseph Lane for president and vice-president. The remainder of the Baltimore convention nominated Stephen A. Douglas and Herschel V. Johnson. The Republican convention assembled at Chicago, May 16. It adopted a somewhat broad constructionist platform; advocated the exclusion of slavery from the territories by congressional measure; declared in favor of a protective tariff, the homestead bill, internal improvements, and a Pacific railway. It nominated Abraham Lincoln and Hannibal Hamlin. There was a fourth organization called "The Constitutional Union Party," composed of the fragments of the old Whig and Know-Nothing parties. It declared as its political principles, "The constitution of the country, the union of the states, and the enforcement of the laws." Its candidates were John Bell and Edward Everett. Four parties were now in the field, and only two had the courage of their convictions, the southern Democrats and Republicans. The Bell party had adopted a "take it as you please" platform; it simply evaded the slavery question altogether; while the Douglas platform sought to throw the responsibility of a decision concerning the question upon any shoulders except those of the Douglas Democrats.

Election of 1860

244. An exciting canvass now followed. The Republican party had been gaining confidence and enthusiasm, and the discordant efforts of the three parties opposed to it, only made Lincoln's election more certain. In the electoral college Lincoln obtained 180 votes, Breckinridge 72, Bell 39, and Douglas 12. No candidate received a majority of the popular vote, Lincoln standing first and Douglas second. The popular vote for Douglas, though large, was not so distributed

as to gain a majority in any state except Missouri; beside the nine electoral votes in that state, he obtained three in New Jersey. Thus the election resulted in a decisive victory for the Republicans. Its significance was far reaching. The interests of the south and even of slavery there would be safe enough under Lincoln, but the overthrow of the Dred Scott and squatter sovereignty doctrines was certain, and an immediate stop would be put to the extension of slavery in the territories. In such circumstances the course of events was evident. Nullification was no longer feared by the nation. Secession on the part of a single state even, was now almost out of the question. No one of the southern states would agree to secede unless assured of support by the others; a combined action was necessary to assure the success of any secession plans.

245. During the discussion which preceded the election, the north heard repeated threats from the south, that if the Republican party were successful, the slaveholding states would leave the union; but these threats were looked upon as merely the angry declarations of a few heated politicians. Yet these disunion expressions were sincere. The southern people had learned to look upon the north as thoroughly hostile to the south. They made little distinction between the Republican party and the Abolitionists, and they felt instinctively that a government elected in a spirit of opposition to slavery would find many ways to injure it. The political habits, and the way of life at the south, made it easy for southern voters to believe in disunion as a cure for the evils with which they felt they were threatened. The doctrine of state independence had become familiar to them; it had been laid down in the Kentucky and Virginia resolutions of 1798, and had been maintained by Georgia in the difficulty with the Indians, and by South Carolina in her Nullification Act. They had remained "Planting States;" they still had their own social life; the same families lived upon the same estates. There was no such constant movement from one state to another as at the north, nor any such introduction of immigrants from Europe. They were, as they have always had been, Carolinians or Virginians, rather than Americans. South Carolina took the lead in fulfilling the promise of secession. As soon as it was announced that Mr. Lincoln was elected, her legislature ordered (November 10, 1860,) the assembling of a convention in December following. The senators from the state, and all office holders in South Carolina under the Federal government at once resigned. The convention met at the appointed time, and on December 20, unanimously passed an ordinance of secession declaring "that the union now subsisting between South Carolina and the other states under the name of the United States of America is hereby dissolved." As reasons for this course, the convention referred to the nullification of the Fugitive Slave Law by the personal-liberty bills, and the election of a president, "whose opinions and purposes were hostile to slavery." The convention then took all the necessary steps to put the state in readiness for war, and adjourned. A copy of the ordinance was sent to each of the slave states, and several of them now rapidly followed this bold lead. Similar ordinances were passed by Mississippi, January 9, 1861; Florida, January 10; Alabama, January 11; Georgia, January 19; Louisiana, January 26, and Texas, February 1. Tennessee, North Carolina, Arkansas and the border states still refused to join their more southern neighbors. One force, however, might be exerted which would compel them to a decision. Should the Federal government attempt to coerce the seceding states, a state which did not wish to secede, but maintained the doctrine of state sovereignty and the right of secession, would be inclined to take up arms in its defence. Thus, in the following spring, four more of the slave states reinforced the original seven seceding states, making their final number eleven.

246. The act of secession, at first, met with opposition in the south, not from any sentiment that the act was wrong, but from the expediency of its exercise. Delegates had been elected to the state conventions who were to vote against secession, but they were defeated through the idea which had obtained that the state "could make better terms out of the union than in it." It was held that it would be more advantageous to their rights and interests to withdraw temporarily from the Federal government until proper guaranties for the observance of these should be given; and if all conditions were satisfactory, then they might deem it best to return. In planning secession, the southern leaders recognized many things in favor of independence on which they supposed they might reasonably count.

Plans of the South.

To gain success, it was not necessary for them to conquer the north, or any part of it, but only to hold their own frontier; whereas, should the north attempt coercion, it would necessitate the military occupation, by its armies, of the whole vast area of the southern country, which would be a tremenduous undertaking never attempted before on a corresponding scale by any civilized government. They did not believe the United States authorities would really attempt such a measure. In this they fatally erred. They believed that all the slave states would join in the secession movement. This, however, was not done. Then they hoped that the action of the Republican administration would be so paralyzed by Democratic opposition in the north, that its efforts at coercion would be rendered futile. In this they were doomed to disappointment; for when war came, the great majority of the northern Democrats loyally supported the government; while those, nicknamed "Copperheads," who endeavored to impede its efforts, were too small in number to do any serious harm. Finally, they thought they might look for aid from England and France. "Cotton is king," was the cry, and while the English manufacturers were dependent for their cotton from the south, it would scarcely be possible that the English government would allow the southern coasts to be blockaded. But the sentiment of the great majority of England's working people was found to be in favor of the north. The great mass of the English people, in spite of many aristocratic sympathizers with the south, felt that the action of Great Britain in the African slave trade question, would not permit her, without the most glaring inconsistency, to give support to the principal slave power in the world. With respect to France the case was just as hopeless. Napoleon III, it is true, was desirous of recognizing the independence of the south, for he had designs upon Mexico incompatible with the Monroe doctrine, but he was unwilling to make the move without the concurrence of England, and this he could not obtain. Thus the southern leaders failed in their expectations, and were thrown upon their own resources.

Organization of the Confederacy.

247. In February, 1861, a convention of delegates from the seceding states met at Montgomery, the capital of Alabama, and formed a government under the name of the Confederate States of America. The title thus declared that the states formed a confederacy and not a union The government was a provisional one for a year, since only seven of the southern states were represented. Jefferson Davis, of Mississippi, was chosen president and Alexander H. Stevens, of Georgia, vice-president. A provisional constitution was formed, and an army, treasury, and other executive departments established. The permanent constitution, adopted in March, was copied from that of the United States, except that it made careful provision for slavery, and forbade a protective tariff or the maintenance of internal improvements at general expense. The seceding states at once took measures to take possession of the arsenals, forts and other property of the United States within their borders. Mr. Buchanan's secretary of war was John B. Floyd, of Virginia, a zealous secessionist, and

by his orders an immense quantity of muskets, cannon, ammunition, and other warlike stores had been transferred from northern to southern arsenals. All this fell into the hands of the secession party. The army was scattered at remote posts where it could be of no use, and most of the navy was at foreign stations. General Scott urged President Buchanan to strengthen the garrisons of the southern forts, but Mr. Floyd protested, and nothing in that direction was done.

Star of the West.

248. The forts throughout the south were mainly in the hands of southern men, who delivered them to the new authorities. The commanders of Fort Pickens, at Pensacola, and of the forts at Key West and Tortugas refused to give them up. The greatest interest, however, attached to the forts within the borders of South Carolina. The harbor of Charleston was commanded by Forts Sumter and Moultrie and Castle Pinckney. Fort Sumter was not yet finished, and the garrison, under Major Anderson, was occupying Fort Moultrie, a weaker work. This officer secretly transferred his men and supplies to Fort Sumter during the night of December 26, 1860. South Carolina demanded the evacuation of the fort. President Buchanan refused the demand, and sent the steamer *Star of the West* with supplies and reinforcements for the fort. He intended the expedition to be a secret one, but it was known at once in Charleston, and when the steamer appeared it was fired upon and driven back (January 9, 1861). The South Carolinians had taken possession of the other forts in Charleston harbor, and now erected additional works. General P. G. T. Beauregard was placed in command of the harbor defences. President Buchanan was filled with perplexity. In his message to Congress he stated his inability to execute the laws in the seceding states, but Congress gave him no help. He condemned the doctrine of secession, and denied the right of the states to secede; he also denied the right of the government to coerce them when they did secede. His cabinet was divided. The southern members dropped out as their states seceded, and General Cass, of Michigan, secretary of state, resigned in displeasure at Mr. Buchanan's inaction.

Kansas admitted.

The popular feeling.

Peace Congress.

249. The resignation of the southern senators and representatives gave the Republicans a majority in Congress. That body now proceeded to admit Kansas as a state, and passed a protective tariff designed to encourage manufactures. Otherwise Congress did nothing but pass resolutions intended to pacify the south. Time which should have been spent in concentrating the energies of the Federal government, and preparing it to assert its supremacy, was frittered away in vain discussions about measures proposed to avert the disaster. Mr. Seward, senator from New York, and one of the most conspicuous of the Republicans, was willing to give up congressional prohibition of slavery in the territories, to enforce the fugitive slave law, and to perpetuate slavery by a constitutional amendment. The people throughout the country were in a state of bewilderment. The government authorities seemed to have no power to direct affairs. Great meetings were held in the principal cities of the north denouncing abolitionism and urging extreme concessions. Prominent journals of both parties declared that armed coercion was madness and never would be permitted. At the suggestion of the Virginia legislature, a peace congress, composed of delegates from thirteen free states and seven border states, met at Washington (February 4, 1861), and tried to bring about harmony between the sections, by proposing a number of amendments to the constitution. Nothing came, however, of any of these schemes. Disunion was now an assured fact, and was soon to pass into open hostility. It was during this state of affairs that the new administration of Abraham Lincoln entered upon its perplexing duties.

VIII.—THE CIVIL WAR.

Lincoln's inauguration.

250. Mr. Lincoln was inaugurated March 4, 1861. In his address he declared that he had neither the right nor the desire to interfere with slavery where it already existed; that no state could lawfully go out of the union; and that he should maintain the laws and constitution of the United States to the best of his ability. The new administration was beset with difficulties on every side, and the condition of affairs seemed almost desperate. Many of those who for years had guided the "ship of state," and who understood its workings, were now foremost in advocating secession. Mr. Lincoln's officers were new to the business of the Federal government. The treasury, by defalcation, was nearly bankrupt. Few troops were within call; and the army had been almost broken up by the surrender of detached forces in the Confederate states, and the capture of munitions of war. The vessels of the navy were sailing or at anchor in distant waters, and numerous officers of both the army and the navy were resigning their commissions on the ground that they owed allegiance first to the states from which they came. Seven states had already revolted, and others were ready to swell the number upon the first attempt to enforce the Federal authority. The public officers were largely occupied by persons in sympathy with the secession movement, and every step taken by the new government was known at once to the leaders of the Confederacy, and to crown all, Mr. Lincoln was beset by a vast horde of office-seekers eager to take advantage of the change of administration.

Fort Sumte

Effect in the north

251. The president waited a month and then notified Governor Pickens, of South Carolina, that he should send supplies to Fort Sumter at all hazards. This announcement precipitated an attack upon the fort. Major Anderson was first summoned to surrender, but he refused. At daybreak on the morning of April 12, 1861, the Confederacy began its open conflict with the United States. All the batteries around the fort opened fire upon it; the fort replied, and the bombardment continued for thirty-six hours without loss of life on either side. The ammunition in the fort was then exhausted, and the works inside were on fire. Thereupon the United States flag, for the first time in its history, was lowered to insurgent citizens, and the garrison capitulated. This event aroused the north as if from a trance. Until now, the mass of the people had refused to believe in real danger; but the first shock of arms thoroughly convinced them that the south was ready to fight, and could not be curbed without war. It did more than this. In the northern states party distinctions were for a time swept aside; there was but one party worth the name—the party for the union. The southern states were no longer "erring sisters" to be coaxed by concessions. The whole north called loudly for the full exercise of the Federal power to compel the south to obedience at the point of the bayonet.

First cal for volun teers.

The feel in the south.

252. The day after the evacuation of Fort Sumter President Lincoln called for 75,000 volunteers for three months (April 15). The response was so promptly made that the first Massachusetts troops began their march on the same day, and in a surprisingly short time the quota was full; nay, it could have been filled three or four times over, and the many who were refused felt a keen disappointment at not being allowed to bear arms in defense of the union. In the south, also, the effect of the first conflict was correspondingly great. To the ignorant masses it did not seem possible that any other power could be superior to that of their own state; while the more intelligent classes had, from their childhood, imbibed the doctrine that state sovereignty was the foundation of civil liberty. Hence all felt bound to follow the lead of their state; and when

the president of the new Confederacy issued his call for men, it was answered, as in the north, by overflowing numbers.

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253. Those southern states which had wavered were now compelled to make their choice. When Mr. Lincoln called for troops the Governors of Arkansas, Virginia, North Carolina and Tennessee refused to obey. North Carolina and Arkansas then seceded, and joined the Confederacy. In Tennessee and Virginia "military leagues" were formed with the Confederate states, by which Confederate troops were allowed to take possession of their territory, and by their aid the question of secession was submitted to popular vote. Thus the secession of these two states was accomplished in part, but not wholly. The people of the Alleghany mountains were loyal to the union; in eastern Tennessee they aided the Federals as much as possible; the opposition to secession was so strong in the western counties of Virginia that the inhabitants refused to obey the convention which passed the ordinance; they chose a legislature which claimed to be the true government, and at last formed a new state which was admitted into the union in 1863 under the name of West Virginia. Even thus curtailed, Virginia was a most important accession to the confederacy: it increased its military strength greatly, and at once became the chief battle-ground of the war. The confederate government was moved from Montgomery to Richmond; and since Washington was separated only by the Potomac from the confederacy, it was clear that the great contest would be fought in the country which lay between the two capitals. Moreover, Virginia was the richest and greatest of the slave states, and furnished the southern army with its ablest leaders, many of whom—such as Lee, Jackson, Johnston, and Ewell—were opposed to secession, but thought it right to shape their own course by that of their state.

254. There was a strong anti-union element in Missouri, Kentucky, Maryland, and Delaware, and the most momentous results—involving, doubtless, the success of the union cause—were involved in the action they would now take. Aside from Virginia, Missouri was the most powerful slave state, and her geographical position, with that of Kentucky and Maryland, was of incalculable military importance. Had these three states united with the confederacy it might have won the prize for which it was contending—independence. Missouri, however, did not break away, though the issue was for some time doubtful with her. Delaware cast her lot with the union. In Maryland and Kentucky efforts were made to maintain neutrality, but they were soon induced to declare in favor of the Federal government. Kentucky, however, had some of her sons in the southern ranks, among whom was John C. Breckinridge, a former vice-president of the United states, who became an officer in the confederate army.

255. The Federal government was in no want of men, but the action of Secretary Floyd had almost stripped it of arms to equip them. Agents were sent abroad to purchase guns, private manufactories were worked day and night to produce them, and in a short time the administration was able to call more men into the field. The northern people were unmilitary in their habits and thoughts. They had a militia, but it was poorly organized. The Mexican war had drawn few volunteers from this section, and the United States army was very small and imperfectly equipped. The early action of the Confederates also had weakened it. There was, however, a greater population to draw from than at the south. There was also a wider range of industry to supply the necessary funds to carry on the war. The agricultural products of the United States far exceeded in volume those of any other country, and in merchant shipping it was only second to Great Britain. Between 1830 and 1860 American civilization had shown a wonderful growth in all directions—in facilities of travel and exchange, in home comforts, in manufactures, in literature and art, and especially in the development and building up of that moral sense which enabled the country to pass so successfully through the trying times of the next four years.

Of the south.

256. But this material and moral progress was mostly confined to the north. The south was far from possessing an equal share in it. Her case was one of arrested developement, not from any natural inferiority in the people, but simply because their moral sense and spirit of enterprise had been blighted by the curse of slavery. Labor was held to be degrading, and those who carried on the few branches of industry were considered an inferior caste; railroads, commerce and manufactures could not thrive, and hence there was but little immigration; the progressive ideas from the modern world outside were opposed from the fear that they might prove injurious to the pet institution of slavery. Thus the advance of civilization was checked, and whatever might have conduced to the material welfare of the south was kept away as far as possible. In the north the rising man was marked by the extent of his business relations; in the south by his ability to buy slaves, which assured him nearly always an entrance into the the ranks of the dominant class. This class furnished the representatives and senators in Congress, the governors, and all the officeholders over which the slave power had control. Thus its ablest and best men combined to defend certain tendencies which were foreign and hostile to those of the rest of the country, and of the world in general. With such odds against it, the struggle of the south during the four years of war showed of what heroic stuff its people were made.

First bloo of the war.

257. The first blood of the war was shed in the streets of Baltimore. Massachusetts and Pennsylvania troops on their way to Washington were attacked by a Baltimore mob (April 19, 1861,) and some of the soldiers killed. The populace, which sympathized with the south, declared that no northern troops should pass through the city. The railroad was blocked up, bridges were burned, telegraph wires were cut, and all direct communication with the north was stopped, until the president sent a military force from Annapolis to occupy Baltimore and keep the road open. In a short time the active hostility of the people was overcome, and the national capitol made secure. By July 4 the confederates had pushed their forces as far as Manassas Junction, about thirty miles from Washington. Their line of defence was already marked out, and its length has been estimated at eleven thousand miles, including the Atlantic and gulf coasts. It comprised the left bank of the Potomac from Fortress Monroe nearly to Washington; from thence it extended to Harper's Ferry, on through the mountains of western Virginia and the southern part of Kentucky, crossing the Mississippi a short distance below Cairo. From this point its direction was through southern Missouri to the eastern border of Kansas; then southwest, through the Indian territory, and along the northern boundary of Texas to the Rio Grande. The area contained within this interior line and the sea-coast was about 800,000 square miles, with a population of over 9,000,000. It comprised, also, the territory devoted to the raising of cotton, an article necessary to the manufacturing interests of the world. It was upon this production that the south relied largely for aid; all the munitions of war could be procured in exchange for it; and she believed it would be a powerful factor in preventing the blockading of her ports.

The blockade.

258. In consideration of this fact, and also that the confederate line of sea-coast was over three thousand miles in length, with but one port of refuge for a blockading fleet about the middle of the line, it scarcely seemed possible that a blockade could be maintained with any marked degree of success. Nevertheless,

the president issued a proclamation (April 19, 1861) declaring a blockade of all the southern ports, and the Federal government proceeded to purchase and arm a large number of merchant vessels. But it could not at once bring together a navy powerful enough to keep vessels from entering or leaving the blockaded ports. The south not only sent out vessels laden with cotton to the West Indies and to Europe, but received in return military supplies of all kinds. Upon the appearance of Mr. Lincoln's blockade proclamation, Mr. Davis issued one also, granting letters of marque and reprisal to private vessels, against the commerce of the United States. The governments of Great Britain and France now issued proclamations of neutrality, thus making the contest between the north and the south a civil war, according to subseqent decisions of the supreme court.

Congress.

Battle of Bull Run.

259. At the meeting of Congress (July 4, 1861) the Republicans had a majority in both branches, the free states and border states only, being represented. The house voted to devote its time solely to the business connected with the war. It supported the president's proclamation closing the southern ports against commerce. Bills were passed to define and punish conspiracy against the United States, and to confiscate all private property, including slaves, employed against the Federal government; to authorize a loan; to call out 500,000 volunteers, and to appropriate money for the army and navy. During this session occurred the first battle of Bull Run (July 21, 1861). General Scott had been appointed commander-in-chief of the union forces. The first military movements were in the mountains of western Virginia, and the success of the union army there led many people to suppose that in a short time the rebellious states would be compelled to obedience. Mr. Seward, who was secretary of state, was especially cheerful, and promised that the war should be over in ninety days. The newspapers and people generally urged an immediate movement upon Richmond. Very few had any knowledge of the difficulties before them, and General Scott, pressed by public opinion, gave the order to advance. This resulted in the first serious battle of the war. The union forces were defeated, and retreated in a panic upon Washington. Both armies were yet so new in military training that the confederates gained nothing from their success.

Effect of the defeat.

McClellan in command

Confederate army.

260. This disaster opened the eyes of the north, and the country settled down into a more serious temper. Congress was, more than ever, stimulated to increased energy, and pledged itself to vote any amount of money and any number of men necessary to maintain the union. Propositions to consider negotiations for peace were constantly offered by extreme Democrats, and as constantly rejected by large majorities, on the ground that negotiation with armed rebellion was unconstitutional. General Scott, having resigned the command of the northern armies on account of his age and infirmity, was succeeded by General George B. McClellan, whose successful campaign in western Virginia had given him a high reputation throughout the army. He had a genius for organization, and possessed the unbounded confidence of the people. He immediately set about forming the first great army of the war—the Army of the Potomac—at Alexandria, in preparation for a second advance. But the advance was delayed much too long to suit the impatience of the people and the administration; and as the winter of 1861-62 passed away without any forward movement, the expressions of dissatisfaction became louder and more general. The confederacy also spent the summer and autumn of 1861 in organizing its northern Army of Virginia, under General Beauregard.

Ball's Bluff.

The neutral states

Wilson's Creek.

Lexington.

Kentucky.

261. In the autumn of 1861 a portion of General Stone's command on the Upper Potomac was sent on a reconnoissance into Virginia, under Colonel Baker, and, being attacked by the confederate general, Evans, at Ball's Bluff, was disastrously defeated. Colonel Baker was among the killed. Although Missouri had not seceded, a strong party, with which the governor was acting, wished to carry it over to the confederacy. A confederate camp near St. Louis was broken up by Captain Lyon, of the regulars, and the St. Louis arsenal was saved to the government. The state was afterward invaded by confederates from Arkansas, who were defeated by Lyon (now a general) at Booneville, June 17, and by Sigel at Carthage, July 5. A large force of confederates under McCullough and Price attacked Lyon at Wilson's Creek (August 10). Lyon was killed, and his command fell back toward the center of the state. Price with 20,000 men then attacked Lexington, which was garrisoned by 2,000 federal troops under Colonel Mulligan. After an heroic defense of three days the little garrison was compelled to surrender (September 20) after their water supply had been cut off for forty-eight hours. General Fremont was now appointed to the command of the western department. He drove Price into the southwest corner of the state, and was about to give battle when he was superseded by General Hunter (November 2). Hunter retreated to St. Louis, with Price in pursuit; but in a fortnight Hunter was replaced by Halleck, and Price was driven into Arkansas. Kentucky, like Missouri, was distracted by dissensions among its own people, and by armies on both sides. General Polk of the confederate army occupied Hickman and Columbus, towns on the Mississippi. There was also a confederate force at Belmont, Missouri, opposite Columbus. Ulysses S. Grant, recently appointed a brigadier-general of volunteers, now first came into notice. He drove the confederates out of Belmont (November 7), but was unable to hold the town because it was commanded by the fortifications of Columbus.

Fugitive slaves.

262. From the beginning of the war, the federal government was embarrassed by the question of fugitive slaves. Congress had passed the act confiscating slaves employed in service hostile to the United States. While General Fremont was in command of the forces of the west, he had issued a proclamation declaring the slaves of Missouri confederates free men, but this was countermanded by President Lincoln, who did not wish to estrange those slave-holders, especially in Kentucky, who were still loyal to the union. In Virginia, General Benjamin F. Butler had declared that slaves were "contraband of war," and therefore liable to confiscation by military law. But as yet the disposition of the north was to subdue the south without interfering with slavery; and some union commanders restored to their masters the slaves who had escaped into the federal lines.

Operations on the coast.

Blockade runnin

263. Formidable expeditions were fitted out to recapture southern harbors. A combined land and naval force, under General Butler and Commodore Stringham reduced and occupied two forts at Hatteras Inlet, North Carolina, at the entrance to Albemarle and Pamlico Sounds (August 29), and Port Royal harbor, near Beaufort, South Carolina, was secured through the reduction of Forts Walker and Beauregard by the fleet under Commodore Dupont (November 7), and a land force under General Thomas W. Sherman. These successes were of great value to the Federal government. They not only closed important southern ports, but they furnished convenient stations for the blockading fleet. The "paper blockade," as it had been called, was soon made a very effective one along the whole length of the southern coast from the Potomac to the Rio Grande, an achievement which by many had been deemed impossible. Still, in spite of the watchfulness of the federal navy, several confederate men-of-war and privateers sailed out of port, and did much damage to merchant ships. The practice of "running the blockade" became a very profitable

business; and notwithstanding the danger of capture, which was the case in many instances, the profits on a single successful voyage were so great that adventurers found they could afford to take the risk.

tions.

264. As has been stated, the south depended largely upon assistance from abroad, and the southern leaders still clung to the hope that they could prevail upon Great Britain and France to recognize the independence of the confederacy. Two commissioners, therefore, Messrs. Mason and Slidell, were sent by the confederate government to London and Paris. They ran the blockade, made their way to Havana, and then embarked for England in the British mail-steamer Trent. Some distance out, the Trent was overhauled by an American man-of-war under Captain Wilkes, the two commissioners were taken off (November, 1861), and carried to Boston harbor, where they were imprisoned in Fort Warren. This action, which was illegal and unauthorized, caused great excitement in England, and came very near causing a collision between the two countries. Lord Palmerston made a peremptory demand for the surrender of the prisoners. The American government had already disavowed the act of Captain Wilkes, which, though it was justified by the British claim of the "right of search," was contrary to American principles. The confederate envoys were therefore promptly released and sent to England. Just before this occurrence President Lincoln requested two confidential agents to visit France and England in order to help the federal cause and avert the danger of foreign war by their influence with the governments and with persons of distinction. The persons selected for this delicate and important trust were Archbishop Hughes, of New York, and Mr. Thurlow Weed. They sailed in November and rendered very valuable service, Mr. Weed in England, and the archbishop in France.

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265. At the beginning of 1862 the war had assumed vast proportions. The number of men under arms on both sides was nearly a million. The confederates held possession of the Mississippi river from the gulf of Mexico to the southern boundary of Kentucky, and occupied a chain of strong positions extending thence through Tennessee and Kentucky to the southwestern corner of Virginia. Between the Alleghanies and the Blue Ridge was the fertile Shenandoah valley, often disputed by both armies. At the east the confederates were posted in great force between the Potomac and the Rappahannock. Now that Delaware, Maryland, Kentucky and Missouri had been saved to the union, it was certain that the battle would be fought out in the territory to the south of them. The plan of the Federal authorities was to open the Mississippi and penetrate the confederate line at the west, while at the same time McClellan attacked Richmond, and a land and naval force continued the process of capturing the southern ports on the Atlantic coast. Simon Cameron, who had been secretary of war, resigned January 20, 1862, and was succeeded by Edwin M. Stanton. All the Federal armies were to move simultaneously on the 22d of February, Washington's birthday, but this order could not be strictly carried out.

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266. The first advance was made in the west. General Grant had entered Kentucky from Illinois, and succeeded in securing the mouths of the Tennessee and Cumberland rivers, two streams which were to serve as military highways by which the Federal armies were to penetrate into the heart of the confederacy. The chief confederate positions between the Mississippi river and the Alleghany mountains were Fort Henry on the Tennessee Fort Donelson on the Cumberland (both in Tennessee), and Bowling Green and Mill Spring in southern Kentucky. This line of defense was in command of General Sidney Johnston, with headquarters at Bowling Green. Here he was confronted by General Buell's army, the middle one of the three great Federal armies, which came to be known as the Army of the Cumberland. Forts Henry and Donelson formed the center of the confederate line, and was confronted by Grant, whose troops afterwards formed the army of the Tennessee. In January, 1862, General Thomas with the left of Buell's force thoroughly defeated the confederate right at Mill Spring. General Grant, aided by the river fleet under Commodore Foote, now assailed the center. Fort Henry was first attacked and reduced by the gunboats before Grant had time to invest it. The combined forces then assaulted Fort Donelson, which after a brave resistance was captured (February 16) with 15,000 prisoners. The center of the confederate line was now pierced, and Johnston and Polk were compelled to retreat for fear of being cut off. Columbus, Bowling Green and Nashville were evacuated, and the whole of Kentucky and most of Tennessee was in the hands of the Federals. General Buell occupied Nashville; a strong union party showed itself in Tennessee, and Senator Andrew Johnson was appointed military governor of the state.

Forts H. and Don- son.

267. The confederates formed their second line of defense along the railroad from Memphis to Chattanooga, and began massing their forces at Corinth. The armies of Grant and Buell were to unite and attack the enemy in his new position. Grant moved up the Tennessee river and halted at Pittsburg Landing, or Shiloh, about twenty miles from Corinth, there to await the arrival of Buell. Here Johnston made a brilliant attack upon him with the intention of crushing him before Buell could come up. A terrible battle was fought (April 6 and 7,) in which the confederate leader, who was one of the slain, came very near effecting his purpose. But the federal forces, though driven back at nearly every point, stubbornly resisted, and at the close of the first day, Buell's advance guard came upon the scene. The next morning, Grant, now reinforced, assumed the offensive; and after a fight of several hours, the confederates were driven back to Corinth.

Pittsburg Landing.

268. While these operations were taking place in Tennessee, Commodore Foote with his gun-boats entered the Mississippi with a small army under Pope, and captured Island Number Ten on the day of Grant's victory at Shiloh. Two months later Fort Pillow was abandoned by the confederates, and Memphis at once fell into the hands of the union army. The victory at Shiloh decided the fate of Corinth, an important railroad center, though it was not captured for several weeks afterward on account of the slow advances of General Halleck, who had assumed command of the federal forces at that point. Meanwhile a fleet under Farragut and Porter, with a land force under Butler, had been sent to attack New Orleans. Farragut ran past the batteries and forts at the entrance of the river, attacked and destroyed the ironclads which met him, and captured New Orleans, which was occupied by the army under Butler. Farragut with a part of his fleet then pushed up the river, clearing away all obstacles, passed the batteries at Vicksburg, and met the federal gunboats under Captain Davis, above. Thus the war in the west had been, so far, marked by an almost unbroken series of victories for the federal armies. At the northern boundary of the state of Mississippi the union advance stopped for a time, but all was held that had been won. To gain control of the great river, it was necessary to take Vicksburg, with its outpost, Port Hudson, which, between them, commanded the entrance to the Red river, and thus kept open the communications of the eastern part of the confederacy with its states of Texas, Louisiana and Arkansas. To capture Vicksburg would cut off these states, and greatly cripple the fighting power of the confederate government. The occupation of Chattanooga was also necessary to the success of the union arms. It would open the way into Georgia, and prevent the confederates from recovering any of the lost ground in Tennessee.

On the Mississippi

New Orleans taken

The Mon- tor and the Merrimac

269. While the south had met with defeat in the west,

it was encouraged by a success in Hampton Roads. The confederates had taken the Merrimac, a former frigate of the United States navy, and transformed her into an ironclad ram, with sloping sides and huge iron beak. On March 8, 1862, this strange-looking craft entered Hampton Roads and attacked the federal fleet lying there, which consisted of five wooden ships of war. The Merrimac destroyed the Cumberland, and also compelled the frigate Congress to surrender. At night she went back to Norfolk. The next morning she was seen coming out again to complete the work of destruction. Suddenly the Monitor, a turreted ironclad vessel, advanced to meet her, and after an obstinate engagement of several hours the Merrimac was compelled to retire. These encounters were remarkable as the first engagements between ironclads and wooden vessels and between two ironclads. The result caused a revolution in the navies of the world; the day of wooden war-vessels was seen to be over, and all the great powers began at once the construction of iron and steel vessels.

Virginia campaign.

270. The military operations in Virginia during the year 1862 offered a strong contrast to the course of events in the west. This was owing partly, no doubt, to the superior ability of the confederate commanders, as compared with their antagonists, partly because on the union side military affairs were too much intermingled with politics. While General McClellan was organizing a splendid army of 200,000 men near Washington, General Banks was ordered to occupy the Shenandoah valley. He began his advance in February, and having, as he supposed, cleared the valley of the enemy, set out with his own corps proper to join McClellan. As soon as he was gone, General Jackson, popularly known as "Stonewall Jackson," hastened to attack the division of Shields which remained in the valley. After a desperate battle at Kearnstown (March 23), Jackson was compelled to retire. Banks returned to the valley and Shields was sent to join McDowell at Fredericksburg. General Fremont now approached from the west, in order to unite with Banks near Stanton. To prevent this Jackson formed the plan of attacking the Federal forces in detail. He nearly succeeded in getting into the rear of the main body with a much larger army than Banks could muster. By a hurried retreat Banks reached and crossed the Potomac, with the confederate cavalry in close pursuit. Shields hastened back to the valley, but his advance guard was defeated at Port Republic (June 8) by Jackson, who, the same day, had checked Fremont at Cross Keys. Having thus saved the valley to the confederates, and obliged the government at Washington to detain for the defense of the capital a large body of troops which McClellan greatly needed for other duty, Jackson joined the confederate army in front of Richmond.

The Shenandoah valley.

The Army of the Potomac.

271. General McClellan concentrated the Army of the Potomac between Washington and Manasses, as if intending to advance against Richmond by that route. He then withdrew his forces and went by water to Fortress Monroe in order to advance up the peninsula between the James and York rivers. Here he was held in check for a month by Johnston at Yorktown, and when McClellan was ready to take the place, the confederates retreated toward Richmond. The union forces followed, and both armies concentrated around Richmond. McClellan gained the battles of Williamsburg (May 5), and West Point (May 9), and advanced within seven miles of the city. A panic broke out in the southern capital, and the confederate Congress adjourned in haste. It was just at this time that Stonewall Jackson, by his brilliant and daring exploits in the Shenandoah valley, obliged the federal government to keep in front of Washington a corps under McDowell which was about to co-operate with McClellan by way of Fredericksburg. The movements of McClellan involved the separation of the two wings of his army by the little river Chickahominy, which by a sudden rise was changed into a wide stream. The confederates under Johnston at once attacked the union left wing at Fair Oaks and Seven Pines. A fierce battle ensued, lasting two days; the result, however, was a union victory. Johnston was wounded, and was succeeded by Robert E. Lee, who retained command of the army of Virginia during the rest of the war.

Fair Oaks and Seven Pines.

272. The absence of McDowell, who was expected to support McClellan's right, compelled a change in the whole plan of operations. Although Lee had been repulsed in an attack on the Federal lines at Mechanicsville (June 26), he fell upon them again at Gaines Mill, the day following, in overwhelming force, and drove them across the Chickahominy with severe loss. Jackson had now reinforced Lee, and McClellan was cut off from his base of supplies on York river. Unable to reunite his wings and regain his base, the union general decided upon the difficult manœuver of establishing another base on the James river. While effecting this change, the union troops were hard pressed by Lee and and Jackson, who, during the period from June 26 to July 1, attacked them at Golding's Farm, Savage's Station, White Oak Swamp, Glendale, etc., and finally at Malvern Hill, where the confederates were signally repulsed. This was the last of a series of engagements known as the "Seven Days' Battles," in the course of which McClellan lost over 15,000 men. Lee suffered almost as much. The union army had now reached the James river, and established itself in a position from which it could not be driven.

The "Seven Days' Battles."

273. Lee and Jackson then turned their attention toward Washington, which was defended by an army under General Pope. Pope's forces stretched along the Rappahannock and Rapidan to the Shenandoah valley. General Banks held a position at the western end of the line, and was attacked by Jackson at Cedar Mountain. Lee followed close behind, and the two generals forced Banks back and then attacked Pope. McClellan received orders from Washington to join Pope, and a portion of his forces came up in time to take part in the second battle of Bull Run, August 29. Pope's army was put to rout, Washington was threatened and the whole country was wild with excitement. Lee now led his victorious army across the upper Potomac and entered Maryland. McClellan, gathering up the remants of the two defeated armies, followed and confronted the confederates at Antietam creek. A desperate struggle took place (September 17). It left each army exhausted, but the victory remained with the union forces. The confederates recrossed the Potomac and retired up the Shenandoah valley. The administration was dissatisfied with McClellan's course, and his command was given to General Burnside. The new commander at once moved toward Richmond, proposing to cross the Rappahannock at Fredericksburg. Here he found Lee posted upon the hills behind the town. Burnside crossed the river, and, forming his army in three divisions, attempted to storm the heights (December 13). It was a day of terrible slaughter for the federal troops. They were repulsed with the loss of twelve thousand men, the army was demoralized and retreated to the north side of the river. Burnside was then superseded by General Hooker. The close of 1862 thus found the opposing armies in nearly the same positions as at the beginning of the war. At the north gloom and discouragement prevailed. At the state elections held in the autumn there was a majority against the administration in several of the northern states, and the result of the campaigns on the Potomac gave great strength to the peace party, which believed that the attempt to subjugate the south ought to be abandoned.

The seco battle of Bull Run.

Battle of Antietam.

Fredericksburg.

274. In June 1862 the great union force at Corinth was divided, Buell's army marching eastward to seize

Chattanooga, while Grant's remained at Corinth till it should be ready to start for Vicksburg. The campaign was so badly managed by Halleck that the confederates, under Bragg, seized Chattanooga before Buell's arrival. They were thus enabled to press him so vigorously that he had to be largely reinforced from Grant's army. Thus weakened, Grant was unable to advance for several months. During the summer of 1862 the confederates made a great effort to repair the disasters they had suffered on the Tennessee and Mississippi rivers by an invasion of Kentucky. An army under Kirby Smith moved from Knoxville, East Tennessee, while another, under Bragg, marched from Chattanooga. The confederate general, Smith, defeated General Nelson near Richmond, Kentucky, August 30, and advanced toward the Ohio, threatening Cincinnati. General Lew Wallace, however, compelled him to fall back to Frankfort. Bragg in the meantime hastened toward the city of Louisville. Buell, leaving Nashville, by forced marches reached the place one day ahead of Bragg. Being reinforced he slowly pushed the confederates back. Bragg formed a junction with Smith at Frankfort, and four days later a severe but indecisive battle was fought at Perryville (October 8). The confederates then retreated through Cumberland Gap.

Operations in Kentucky

Iuka and Corinth.

275. During Bragg's campaign, the confederate army in Mississippi under General Van Dorn made an attempt to turn Grant's left wing at Corinth, and thus force him back down the Tennessee river. This wing was commaded by General Rosecrans, who defeated Price at Iuka, a few miles from Corinth, September 19. On October 4, Van Dorn and Price together attacked Corinth, but were repulsed by Rosecrans with a loss of five thousand men, and pursued forty miles. Soon after this Rosecrans superseded Buell in command of the army of the Cumberland. Bragg had advanced to Murfreesborough, in central Tennessee. There Rosecrans attacked him (December 31), and a bloody battle was fought, in which 40,000 men were engaged on each side, and each lost more than 10,000. This engagement is generally known as the battle of Stone river. It was indecisive. On January 2, 1863 Bragg renewed the attack with great vigor, but this time he was signally defeated and compelled to retire to Chattanooga.

Stone river.

276. While these battles were being fought, Grant had begun his first movement against the strong and important post of Vicksburg, on the Mississippi. His plan was to march from Jackson, Mississippi, while Sherman, with his 40,000 men, and Porter with a fleet of gunboats, descended the river from Memphis. The movements were made according to this arrangement, but Van Dorn's cavalry succeeded in getting in Grant's rear and cutting off his supplies. This compelled Grant to abandon his march to Jackson. Sherman and Porter attacked the bluffs north of Vicksburg, but were repulsed with heavy loss (December 29). Hearing of Grant's misfortune they returned to Memphis.

Affairs on the coast.

277. After Hatteras Inlet to Pamlico Sound had been captured, it was next resolved to attack the confederate position on Roanoake Island, which commands the passage between Pamlico and Albemarle Sounds. A land and naval expedition under General Burnside and Commodore Goldsborough took the forts and batteries of the island (February 8, 1862), captured a confederate flotilla, occupied Newbern, North Carolina (March 14), and reduced Fort Macon, at Beaufort, April 25. Expeditions from Port Royal under Commodore Dupont took possession of Darien and Brunswick, Georgia, and of Jacksonville, Fernandina, and Saint Augustine, Florida. April 11, 1862, General Gilmore captured Fort Pulaski on the Savannah river. Thus the port of Savannah was completely closed, although no effort was made for some time to occupy the city.

Congress.

278. During the movements of the armies in 1862, Congress had not been idle. It was chiefly occupied in measures connected with the prosecution of the war. Its most far-reaching action was in the provision for a uniform national currency. At the beginning of the war the government had borrowed large sums of money to defray expenses, and it continued to borrow, as new demands arose. The result was similar to that which occurred in the Revolutionary war. The promises to pay became less valuable as compared with gold, which was the standard of value throughout the civilized world. The banks in the several states could no longer obtain gold without paying a high price for it; and at the end of 1861 they suspended specie payments. In order to provide a currency for the people, a bill was passed by congress, early in 1863, authorizing the issue of notes by the United States treasury. These notes received the popular name of "greenbacks," from the color of the paper on which they were printed; and to insure their success they were declared by Congress to be "legal tender" (February 25, 1863). Early in 1863, Congress passed an act establishing national banks. Heretofore the states had incorporated all banks, and the bills of each bank were seldom current except in its own neighborhood. By the national banking system, the banks were to be organized and United States bonds deposited at Washington. The banks were then permitted to issue notes up to ninety per cent. of the value of the bonds deposited, and the notes, being thus secured, became current in every part of the country. The national banks are still in operation. A homestead bill was passed, which assigned public lands to actual settlers at reduced rates. Congress also prohibited slavery in the District of Columbia; slaves of insurgent were ordered to be confiscated; and the army was forbidden to surrender fugitive slaves to their masters. It provided for the construction of a Pacific railroad and telegraph, and began a further development of the system of granting public lands to railway corporations.

Paper currency

National banks

Emancipation.

279. Since the south had brought on the war in defense of slavery, the abolition sentiment had spread very rapidly in the north, and it had now become supported by the military needs of the hour. At the beginning of the conflict the union leaders and people generally had not favored any interference with slavery, but circumstances had proved their position to be untenable. President Lincoln, who watched anxiously every movement, was convinced that the time had come when the federal government could no longer attempt to carry on the war successfully and spare the system of slavery, which was perceived by every discerning man to be at the foundation of the confederacy. He therefore announced (September, 1862,) that unless the revolting states should return to their allegiance by January 1, 1863, he should declare the slaves in these states to be free. It was a formal notice given out of respect to law; no one seriously expected that it would be regarded by the confederate states. And it was not. They only grew more firm in consequence of the action taken. On the first day of January, 1863, in accordance with his notice, the president issued his celebrated Proclamation of Emancipation. This act caused much discussion. Mr. Lincoln could not, legally, issue such a declaration, for the constitution gave him no authority to abolish slavery. But he acted on the principle of military necessity, advocated by John Quincy Adams in his speech of April 14, 1842, in which he said: "Whether the war be civil, servile, or foreign, I lay this down as the law of nations: I say that the military authority takes for the time the place of all municipal institutions, slavery among the rest. Under that state of things, so far from its being true that the states where slavery exists have the exclusive management of the subject, not only the president of the United States, but the commander of the army, has power to order the universal emancipation of slaves." However the case may be, the president's course was dictated by clear common sense and wise statesmanship. The events of the pre-

Proclamation.

ceding summer had shown that the war was far from being at an end. The cutting off of the cotton supply had been a general calamity, and the distress produced in consequence created a fear lest England and France should unite in an attempt to put an end to the contest. But the proclamation changed all this. By it the struggle was converted into a crusade against slavery, and in this light foreign intervention was now simply impossible, owing to Great Britain's attitude toward slavery. Moreover, should the federal government be successful, the question of slavery would practically be settled forever, for its abolition would be certain when the union was re-established. One of the first results of the act was the formation of regiments of negro soldiers. An attack made by one of these regiments, under Colonel Shaw, upon Fort Wagner, in Charleston harbor, though unsuccessful, showed so much bravery that the prejudice against negro soldiers disappeared, and great numbers were enrolled.

Negro soldiers.

280. General Hooker spent three months in reorganizing and strengthening the Army of the Potomac. At the end of April, 1863, he began his march toward Richmond with 120,000 men. Sending the sixth corps, under Sedgwick, to cross the Rappahannock below Fredericksburg, he threw his main body across the river a few miles higher up, and before Lee understood his purpose he had advanced to Chancellorsville. Here Lee won one of the most marked of his victories (May 1 to 4), with only one-half as many men as Hooker commanded. Jackson made a magnificent attack upon the union right, taking it by surprise, and drove it back in confusion. Sedgwick, on the left, had carried the heights of Fredericksburg and was pushing on toward Chancellorsville, when the disaster on the right enabled Lee to face him with the main confederate force. Sedgwick was compelled to retire during the night which followed the 4th of May, and Hooker recrossed the Rappahannock the next night. Hooker's loss was 16,000; Lee's was 12,000; but the confederates further sustained a severe disaster in the death of Stonewall Jackson.

Battle of Chancellorsville.

Invasion of Pennsylvania.

281. Lee now repeated the maneuver he had practiced after defeating General Pope. Turning Hooker's right flank, he pushed on through the western part of Maryland into Pennsylvania, so as to threaten Philadelphia, Baltimore, and Washington. There was intense alarm at the north, and reinforcements were hurried into Pennsylvania from all quarters. In consequence of a disagreement with General Halleck, Hooker resigned the command of the Army of the Potomac, and it was given to General George G. Meade. The two hostile armies, each 100,000 strong, were now moving in parallel lines, with the Blue Ridge and South Mountain range between them. On the 1st of July they came into collision at Gettysburg. A tremendous battle was fought, lasting until the close of July 3. It resulted in the defeat of Lee, with a loss of nearly 40,000 men; Meade's loss was 24,000. This battle was one of the greatest of modern times, the loss on both sides being more than one-third of the whole number engaged. It was also the turning point of the civil war. The south was never able to collect so fine an army again, and never recovered from the exhaustion of the Gettysburg campaign. Lee moved slowly back to his old position on the Rapidan, where he and Meade held each other in check until the following spring. Many in the north were inclined to believe that Lee's former successes had been due to Stonewall Jackson's ability, and that he had lost his prestige upon the death of that brave commander. But the campaign of 1864 was to prove the contrary.

Battle of Gettysburg

The Vicksburg campaign.

282. On the next day after the battle of Gettysburg, General Grant gained a decisive victory on the Mississippi. Having failed in several attempts to take Vicksburg from the north, he now determined to transfer his army to the south side of this strongly fortified place. To do this it was necessary to cross the river, march down its west bank, cross again below Vicksburg, and march up the east bank, while the fleet, which had run past the batteries of Vicksburg after the capture of New Orleans, would have to pass them again in order to transport the army over the river and protect the crossing. This plan was carried out in April. Commodore Porter performed his task successfully under a heavy fire, and on the 29th of April opened a cannonade upon Grand Gulf, at the mouth of the Big Black river, where it had been determined to attempt a crossing. The confederate batteries here proving too strong, the fleet ran past them, also, and the crossing was made at Bruinsburg, a few miles below. Grant now pushed rapidly forward. The confederates were beaten at Port Gibson, and compelled to evacuate Grand Gulf. McPherson and Sherman captured Jackson, the capital of Mississippi, and a place of great military importance on account of its railway connections. The union army then turned, fell upon the confederate general, Pemberton, who had marched out of Vicksburg to unite with Johnston, defeated him at Champion Hills (May 16), and at the crossing of the Black river (May 17), and at last shut him up in Vicksburg. After a siege of forty-five days Pemberton surrendered, and the great confederate stronghold of the west, with 27,000 prisoners, fell into the hands of the victorious Federals. Port Hudson, under siege at the same time, could no longer hold out, and the Mississippi, as President Lincoln said, "ran unvexed to the sea." This was the heaviest blow that the confederacy had as yet received; its whole western zone was now virtually conquered, and it became possible to concentrate greater union forces against its middle and eastern zones. The news of Gettysburg and Vicksburg made the Fourth of July, 1863, a day of rejoicing in the north, and of mourning in thousands of bereaved homes.

Jackson.

Champion Hills and Black River

Capture of Vicksburg

283. The Vicksburg campaign marked the decline of the confederate fortunes in the west, as the Gettysburg campaign did in the east. In the meantime the people had learned to give a more careful attention to the welfare of the soldiers who were bearing the brunt of the conflict. The Sanitary Commission, the Christian Commission, and other voluntary associations, had been organized, and were doing a grand work for the moral and physical needs of the men in the field; and this care was not confined solely to northern troops, but was often extended to the confederates as well. The expenses of the National government for prosecuting the war now amounted to $2,000,000 per day on an average, and notwithstanding the heavy taxation imposed upon the country the debt had increased to $500,000,000 by June, 1862; during 1863 it was double that amount; by June, 1864, it had grown to $1,700,000,000; and at the end of August, 1865, it attained its maximum, $2,845,907,626. But the best of care and judgment was exercised in the use of these vast expenditures. The army was constantly supplied with improved weapons and munitions of war; the blockading fleets were kept in perfect order, and everything was done to insure the success of the union arms.

The Sanitary and Christian Commissions.

Government expenses.

Conscription

284. As early as April, 1862, the confederate Congress had passed a conscription act, enrolling in the army all adult white males below a certain age, but as the war went on the demand for men became continually greater and the conscription was made more sweeping. Toward the end of the war every white man between the ages of seventeen and fifty-five was held liable to military service, and in practice the only limit was physical incapacity. The federal government also was compelled to take almost a similar course. In March, 1863, Congress passed an act for the enrollment of all able-bodied male citizens between the ages of eighteen and forty-five, and the president was authorized to make drafts for military service,

Draft riots.

those between twenty and thirty-five to be first called upon. Under this law a call for 300,000 troops was made in May. As the full number was not made up by volunteering a draft was ordered to supply the deficiency. The first attempts to carry it out resulted in forcible resistance in many places, the most notable being the "draft riots" in New York city in July, just after the battle of Gettysburg. These riots lasted four days in that city. During this time New York was in the hands of a lawless mob, many shocking murders were committed and $2,000,000 worth of property was destroyed. All opposition was at length put down, but exemptions and substitute purchases were freely permitted, and the states endeavored to fill their respective quotas as far as possible by offering bounties as a stimulus to volunteering.

Chattanooga.

285. After his renowned victory near Murfreesboro, Rosecrans remained quiet for a period, preparing for a new campaign. Late in June he began a series of skillful movements against Bragg which compelled the confederate general to fall back upon Chattanooga. Early in September Rosecrans forced him to evacuate the place by threatening his communications. The union general followed him across the Tennessee river and was thus beyond the strong position of Chattanooga.

Chickamauga.

General Bragg, having been heavily reinforced from Virginia, turned at Chickamauga creek to give battle. A severe engagement was fought (September 17-20, 1863) in which Longstreet routed the right of the union forces, but the wonderful skill and bravery of General Thomas, who commanded the left wing, saved the federal army and secured its retreat to Chattanooga. Bragg having gained possession of the mountains around the place cut off almost all avenues of further retreat and laid siege to Chattanooga. The government at Washington had committed the mistake of dividing the union forces, for while Rosecrans was left to face an army greatly superior in numbers, under General Bragg, General Burnside was sent into east Tennessee with an independent command. Bragg was now so sure of Rosecrans' defeat that he dispatched Longstreet with a part of his army to attack Burnside at Knoxville. In October Rosecrans was superseded by Thomas, and Grant was put in command of all the western armies. He was joined at Chattanooga by two corps under Hooker from the Potomac. General Sherman came up from Vicksburg with a greater part of the army of the Tennessee.

Lookout Mountain and Missionary Ridge.

Bragg's positions on Lookout Mountain and Missionary Ridge were now assaulted. The former was successfully stormed by Hooker (November 24), part of the fighting taking place amidst a thick mist which covered the summit, hence this has been called the "battle above the clouds." On the next day Missionary Ridge was carried by the main army, Hooker on the right, Thomas in the center and Sherman on the left. Bragg was driven from all his positions back to Dalton and was soon afterward superseded by General J. E. Johnston. Longstreet raised the siege of Knoxville and retreated across the mountains into Virginia to join Lee.

Charleston.

286. Many attempts had been made to reduce Charleston, South Carolina, the strongest, as well as the most important of the southern seaports, but without success. At length Fort Wagner was taken (September 7) after a tremendous bombardment by the Federal fleet and Gillmore's batteries; Fort Sumter, also, was reduced to ruins. The blockading vessels were thus enabled to enter the harbor, and the port of Charleston was entirely closed.

Confederate cruisers.

Taking advantage of every loophole in the British foreign enlistment act, the confederate authorities had succeeded in fitting out several formidable cruisers, which, in the course of the year 1863, did immense damage to American commerce. Whenever they were closely pursued by United States vessels they took refuge in neutral ports, and then put out to sea again upon the first favorable opportunity. The most active ones were the *Florida*, the *Alabama* and the *Georgia*. The *Florida*, built at Liverpool, after having captured twenty-one vessels, was seized in the harbor of Bobia, Brazil (October, 1864). The *Georgia*, built at Glasgow, put to sea in April, but was captured after a short cruise by the United States frigate *Niagara*. The most important of the confederate cruisers was the *Alabama*. She was built at Liverpool for the confederate captain, Semmes. The British government was urged by the American minister, Mr. Adams, to enforce its own laws, and prevent her going to sea; yet she was allowed to set sail in July.

The Kearsage and Alabama.

After destroying more than sixty vessels, she was met by the United States steamer *Kearsage*, commanded by Captain Winslow, off Cherbourg (June 19, 1864), and after an hour's action the *Alabama* was sunk.

Minor operations.

287. At the beginning of 1864, several detached operations were carried on which, though attracting much attention at the time, had but little direct bearing upon the closing campaigns of the war. General Sherman made his raid nearly across the state of Mississippi, destroying railroads, bridges and supplies. General Seymour, leading a union expedition into Florida, was defeated. General Banks was sent up the Red river to attack Shreveport, and bring away cotton. The expedition ended in failure and disaster. General Rosecrans was appointed to command in Missouri. He succeeded in repelling an invasion by Price, who was finally driven from the state. General Forrest, with a confederate force made a raid into Tennessee and Kentucky, and captured Fort Pillow (April 12), where a number of negro troops were massacred.

Grant in the east.

288. The success of Grant in the west had made him the chief figure in the war. In March, 1864, he superseded Halleck as commander-in-chief, with the rank of lieutenant-general. He at once took personal direction of the campaign against Richmond, while retaining Meade in immediate command. The army of the Potomac was re-organized in three crops, under Hancock, Warren and Sedgwick, to which was soon added another under Burnside, while General Philip Sheridan was called from the west, and appointed to the command of all the cavalry in the eastern army. Lee's forces, which comprised the flower of the southern troops, had otherwise been divided into three corps, under Generals A. P. Hill, Ewell and Longstreet.

Sherman.

Sherman had been left in command of the three western armies of the Ohio, the Cumberland, and the Tennessee, and he was to oppose Johnston at Dalton. According to arrangement, a simultaneous advance was made in Georgia and Virginia, early in May. The army of the Potomac, numbering about 125,000 men (nearly twice as many as Lee's), crossed the Rapidan and entered the "Wilderness" on the other side.

The Wilderness

It was Grant's object to push through this difficult country as rapidly as possible and get between Lee's army and Richmond. In pursuing the direct route through Fredericksburg to Richmond, the union army encountered a series of strong defensive positions, of which Lee availed himself with consummate skill. The battles began on the 5th, and continued until the 12th without interruption, both sides fighting with the utmost bravery and suffering severely. Lee was steadily forced back, and on the 9th Grant was clear of the Wilderness with his forces concentrated near Spottsylvania court-house. Here there was furious and obstinate fighting for ten days, with scarcely any intermission. Then followed the battles of North Anna and Cold Harbor in which the union losses were terrible. Having now reached the Chickahominy, and finding it impossible to break through Lee's lines of defense, Grant crossed the river, and moving far to the right of his adversary, transferred his army beyond the James to assail Richmond from the south.

Petersburg.

This involved the reduction of the strongly-fortified town of Petersburg, on the Appomattox, practically a part of the defenses of Richmond, from which it was twenty miles distant. It also brought the Federal lines into dangerous proximity to Lee's railroad communications with the south. At this point, therefore, the confederate commander stationed the best part of his troops, and stubbornly resisted all Grant's efforts to extend his lines further to the southwest or to reach the railroads.

Cedar Creek.

289. A long siege of Richmond and Petersburg was now begun early in June, but neither army remained inactive. In July, Lee sent Early into the Shenandoah valley, with a corps strong enough to menace Washington, hoping that Grant might be induced to call off troops from Petersburg. The chief result of Early's movement was the burning of Chambersburg, and the capture of a quantity of supplies. Grant put Sheridan in command of the valley, who defeated Gen. Early at Winchester (September 19), and at Fisher's Hill two days later, after which he destroyed all the rich crops in the valley and carried off the cattle, so that the confederates might not be tempted to repeat the raid. But Early, having obtained fresh troops, suddenly fell upon the federals at Cedar Creek (October 19), driving them back in great confusion. Sheridan was absent when the battle was fought, but, getting intelligence of it, he rode rapidly up the valley, rallied his men, who were, however, being enheartened by their respective commanders, and scattered Early's forces, which never met Sheridan again as a compact army during the remainder of the war.

Meanwhile, Grant had succeeded in getting possession of a few miles of the Weldon railroad, upon which Lee depended for transportation, but the confederate general brought his supplies in wagons round that portion held by the federals. The two armies now remained in comparatively the same position until the following spring.

The Atlanta campaign.

Operations at Atlanta.

290. The western campaign in 1864 began at the same time as Grant's movement in Virginia. Sherman advanced from Chattanooga with 100,000 men under Thomas, McPherson, and Schofield, against Johnston's force of 75,000. The objective point of the campaign was the capture of Atlanta, Georgia, a very strongly fortified place about one hundred miles south of Chattanooga, and the chief manufactory of the confederate military supplies. Johnston, with his weaker force, dared not risk a regular battle, but he made the best use of the various defensive positions which the rough and mountainous country afforded. By a series of masterly flank movements Sherman compelled him to evacuate one position after another. Severe battles were fought at Resaca (May 15), Dallas (May 25), Lost Mountain (June 14), and Kenesaw Mountain (June 27). By the 10th of July Johnston was intrenched behind the defenses of Atlanta, and the two armies were facing each other with the Chattahoochee river between them. Johnston's retreat had been conducted with great skill, but he was now superseded by Hood (July 17), who was known as a "fighting general." Hood at once proceeded to carry out the active policy of the confederate government, and assumed the offensive. Before the end of the month he had made three furious assaults on the union lines and was repulsed in every one of them. The federals, however, sustained a heavy loss in the death of General McPherson. At length, by fine maneuvering, Sherman succeeded in gaining the rear of Atlanta, and cutting the supply railroads. This obliged the confederates to retreat in all haste, and on the 2d of September, Sherman was able to telegraph to Washington that Atlanta was won.

Hood in Tennessee.

Nashville.

291. Hood, by the direct command of Davis, now made a fatal mistake, which materially hastened the downfall of the confederacy. He moved northwestward by Tuscumbia and Florence into middle Tennessee, thinking that Sherman would follow him in order to defend that state. But Sherman was no more to be controlled by this device than Grant had been by Early's raid into the Shenandoah. He divided his army, sending back part of it under Thomas to take care of Hood, while he himself prepared to continue his advance through Georgia. Hood, moving northward toward Nashville, was met and defeated at Franklin (November 30), with heavy loss, by Schofield. The confederate general arrived at Nashville with about 44,000 men The union forces awaited him there behind the fortifications. Thomas, having completed his preparations, suddenly moved out of his works and fell upon the confederate lines (December 15). The battle lasted two days and ended in the utter rout and demoralization of Hood's forces. Thus one of the two great armies of the confederacy was scattered, never again to be united. Of all the battles fought in the course of the war, this was the most complete victory.

Presidential election of 1864.

292. While these things were going on, the presidential election of 1864 took place. Some of the more radical men, dissatisfied with what they called Mr. Lincoln's timid and irresolute policy, met in convention (May 31) at Cleveland, Ohio, and nominated John C. Fremont for the presidency. Mr. Lincoln and Andrew Johnson were nominated (June 7) for president and vice-president by the Republican National Convention at Baltimore. The Democratic National Convention declared in its platform that the inability of the federal government to restore the union by war was demonstrated by four years of failure; that the constitution had been violated in all its parts under the plea of military necessity; and that a cessation of hostilities ought to be obtained. It nominated George B. McClellan and George H. Pendleton as president and vice-president. This declaration of the peace Democracy that the war was a failure, when all things were now pointing toward the final success of the north, caused many doubtful votes to be cast for the Republican candidates, and assured their election. When the electoral votes were counted, Lincoln and Johnson had received 212, McClellan and Pendleton 21.

Sherman's march to the sea.

Savannah.

293. Sherman had burned Atlanta, destroyed the railroads and telegraphs in his rear, sent back the sick and wounded, and much of the baggage, and set out (November 14) on his "famous march through Georgia." His army, 65,000 strong, was spread out over a breadth of forty miles, subsisting mainly on the produce of the country. For a month scarcely anything was heard of him at the north, when he suddenly turned up at Savannah, Ga. He had met with but little opposition on his route. The confederates had numerous bodies of troops which might have been concentrated to oppose his march, but he had threatened so many points and kept the enemy in so much doubt as to his objects that they could not tell for which point he was making. On December 13 Fort McAllister was taken by assault, and on the 20th Savannah was evacuated by the confederates, Sherman sending the news of the capture to president Lincoln as a "Christmas gift." He also sent word that the confederacy was nothing but a shell, and that he was ready with his victorious army to march northward.

Mobile and Wilmington.

Sherman's march to the north.

294. The only important ports, except Galveston, which remained open to the confederacy in the summer of 1864, were Mobile in Alabama, and Wilmington, in North Carolina. The forts commanding the entrance to Mobile Bay were captured (August 5) and the port was closed. On January 16, 1865, Wilmington, North Carolina, was taken by a combined land and naval force, under General Terry and Commodore Porter. On the day before this event, Sherman had begun his northward march, passing through Columbia, to Fayetteville, North Carolina. This movement had forced the evacuation of Charleston and other coast cities, and their garrisons had been concentrated under Johnston as a last hope. The military support of the confederacy now rested on the army which Lee commanded within the intrenchments of Richmond and Petersburg, and on the remnant of the western forces with which

Johnston was trying to check Sherman's advance. Some sharp fighting took place north of Fayetteville, but Goldsborough was reached March 21, and Johnston retreated to Raleigh. Sherman pushed on after him. but events in Virginia were fast rendering a contest in North Carolina unnecessary. While the union army occupied Goldsborough, Sherman took a steamer on the coast and hurriedly visited the James river, where he met the president, General Grant and General Meade, and arranged with them the plan of operations for the future. During Sherman's march through North Carolina, Sheridan had led a column of cavalry up the Shenandoah valley to destroy Lee's communications in the rear of Richmond. He passed along the James river, doing great damage to the canal and railroads, and joined the main army in front of Petersburg just as Sherman arrived there for his conference with the president and Grant.

Fall of the confederacy

295. The situation of Lee was now becoming desperate. He determined to abandon Petersburg and Richmond, move by way of Danville, and effect a junction with Johnston. With this purpose he made one desperate attempt to break the center of the union lines at Fort Steadman, intending under cover of the attack to withdraw his force. The effort failed, and Lee was repulsed with heavy loss. Grant resumed his attempts to push his lines further round to the south of Petersburg. Sheridan was put in command of the extreme left. Here he attacked Lee's right at Five Forks (April 1), destroyed the Southside railroad, and maintained his position. To avoid being outflanked Lee was compelled to lengthen out his line, already too thin. The next morning (April 2) Grant made a general assault, and carried his army within the lines of the Petersburg defences. Lee retreated, with the intention of bringing his forces and Johnston's together for a final stand, while the advance guard of the union army entered Richmond. The confederate authorities hastened to escape to Danville, having first set fire to the shipping, tobacco warehouses, etc., at Richmond. No time was lost in celebrations of the victory. Grant pressed on in the pursuit of Lee with all vigor. He had so disposed the federal army that the escape of the confederates was almost impossible. The confederate forces were headed off at Appomattox Court House, where Lee surrendered (April 9, 1865). The terms of surrender offered by Grant were very generous; all private property belonging to officers and soldiers was to be retained, the men were even allowed to keep their horses, "because," Grant said, "they would need them for the work on their farms." Officers and men were at once set free on parole, with the understanding that so long as they did not violate their parole, nor break the laws, they would not be disturbed by the federal government.

Five Forks

Richmond.

Surrender of Lee.

Surrender of Johnston.

296. Sherman had begun his final operations against Johnston when the news arrived of the surrender of Lee. Johnston thereupon capitulated (April 26) on much the same terms that had been accorded to the confederate army in Virginia, after an unsuccessful effort at a more favorable settlement. All the other confederate forces in the field also surrendered, and the great civil war came to an end. The news was received with an outburst of joy at the north. Mr. Lincoln had begun his second term on March 4, 1865. At that time the end of the struggle was plainly near, and the president in his inaugural address had already expressed the hope that there would be a reconciliation between the two sections. He said: "With malice toward none, with charity for all, with firmness in the right as God gives us to see the right, let us strive to finish the work we are in, to bind up the nation's wounds, to care for him who shall have borne the battle, and for his widow and for his orphans; to do all which may achieve and cherish a just and a lasting peace among ourselves and with all nations."

297. The public rejoicings over the capture of Richmond were clouded by the death of the wise and noble Lincoln. He had gone to Ford's theater on the evening of April 14, and was sitting in his box, when an actor named J. Wilkes Booth entered unperceived and shot the president through the head, crying: "The south is avenged. *Sic semper tyrannis.*" Almost at the same time one of Booth's accomplices named Payne attempted to assassinate Secretary Seward, who was ill at home, and wounded him seriously but not fatally. There had been a plot on the part of some desperate characters when the confederacy fell, to destroy the leaders of the federal government, but their plans were accomplished in part only. The chief parties implicated perished miserably. Booth and Payne escaped for a time, but were soon caught. Booth was killed while resisting arrest. Payne and three others were hanged, and several persons concerned in the plot were sentenced to imprisonment. The president lingered a few hours, and died without giving any sign of consciousness. His death caused the deepest sorrow, not only in the north, but in the south as well, and throughout all the civilized world. He had won the abiding love and trust of the people, and his name will forever be linked with that of Washington; for he was in many ways the second founder of his country.

Seward.

298. Jefferson Davis, while trying to escape, was captured by a detachment of General J. H. Wilson's cavalry at Irwinsville, Georgia, and was sent to Fortress Monroe. Here he was confined a close prisoner for a long time on charge of treason. He was at last liberated on bail furnished by Horace Greeley and others, and all proceedings against him were finally abandoned. In fact, the glorious triumph of the government of the United States was in no wise sullied by any dismal executions for treason. The assassination of Lincoln checked for a time the movement which had already begun for the restoration of the seceding states. People who had been ready in their joy to make peace with those who had been leaders in the confederacy now were ready to believe that the spirit which had brought on the war was unchanged. There was a demand that the laws against treason, passed by Congress during the heat of the war, in 1862, should be rigidly enforced. These laws prescribed that the punishment of treason and rebellion should be death, or fine and imprisonment. But a wiser judgment prevailed. There was no hanging for treason. The leaders of the confederacy were never brought to trial. The president of the confederate states was suffered to go free; and the vice-president, before his death, became an efficient and respected member in the Congress of the United States. For a long time, however, all persons who had previously taken oath of allegiance to the federal government, and then had broken it by joining the confederacy, were debarred from holding any office under the government of the United States.

299. At the close of the war the federal armies numbered about 1,000,000 men, of whom nearly 600,000 were present in the field. The number of confederate soldiers surrendered and paroled was, 174,000, besides whom there were 63,000 prisoners in the hands of the Federals. The whole number of men who served on the union side during the war was about 1,500,000. Of these, 96,000 were killed, 184,000 died of disease while in the service; many thousands more died of wounds or sickness after being discharged. The armies of the confederacy are supposed to have reached their strongest point at the beginning of 1863, when they numbered about 700,000. There was great dissatisfaction among the southern people at the manner in which Jefferson Davis conducted the war; and the arbitrary attempts of the confederate government to force men into the ranks, aroused, at last, a spirit of opposition. During the latter part of the war desertions had become very frequent; and this fact, taken in connection with the losses

in battle, and from disease, caused a great reduction in the numerical force, so that at the end of the struggle, it is doubtful whether the confederate armies contained more than 200,000 men. As soon as possible after organized resistance had ceased, the Federal armies began to be disbanded. The men were discharged at the rate of about 300.000 a month, 50,000 being retained in service as a standing army.

300. The expenses of the Federal government amounted at one time to three and a half million dollars a day. By August 31, 1865, the whole debt had reached its maximum, amounting to about $2.845,907,626. Some $800,000,000 of revenue had also been spent mainly on the war. Beside the regular outlay by the government enormous sums were spent by states, cities, counties and towns, in bounties to volunteers, and by the sanitary commissions and other societies for the comfort of sick and wounded soldiers, and for the whole army in general. The expenses of the confederate government can never be known. Its debt was estimated at about $2,000,000,000, but this was wiped out by the failure of the confederacy, all its bonds and notes becoming worthless. The amount of property destroyed by the union and confederate armies can scarcely be estimated, and the money value ($2,000,000,000,) of the slaves in the south fell a sacrifice to the war. In the United States funds were raised by the sale of bonds, the issue of paper money, of "greenbacks," and the imposition of heavy taxes, including for some years a tax on incomes. The notes became greatly depreciated, so that in July, 1864, the price of gold in paper currency was nearly three dollars. Gold and silver almost disappeared from circulation.

Confederate finances.

301. The finances of the confederacy were in a ruinous condition long before the end of the war. It could make no drafts on the future, by bond issues, and it was a very difficult matter to find purchasers for southern bonds. As expenses increased, they had to be met by paper issues, and each issue was accompanied by a corresponding decline in value, until a dollar in coin was worth fifty dollars in paper. Large sums were required to buy even the most necessary articles. Boots were worth two hundred dollars; shoes, one hundred and twenty-five dollars; coats, three hundred and fifty dollars; pantaloons, more than one hundred dollars; flour, two hundred and seventy dollars per barrel; potatoes, twenty to twenty-five dollars per bushel; bacon, ten dollars per pound; meal, sixty-five to seventy-five dollars per bushel; butter, sixteen dollars per pound. Other things were proportionately high in price; luxuries of all kinds had disappeared, and almost the entire population was reduced to extreme poverty

VIII.—THE RESTORATION OF THE UNION.

The 13th amendment.

302. At the beginning of the war the greater part of the northern people was opposed to any interference with slavery, and the federal government announced its determination not to meddle with the question. But the progress of the war compelled it to a different course. Hence, first came the Proclamation of Emancipation; then in February, 1865, congress passed the thirteenth amendment to the constitution, abolishing slavery in the United States forever. After the war was over the first wish of those who had been most prominent in putting down the confederacy was that the union should be restored as quickly as possible to its former state, with the exception of slavery. It was to be many years, however, before the warring sections of the union could be transformed into a harmonious nation. The war had devastated the country in which it had been engaged. The people on each side had suffered in the loss of friends, home and property, and could not at once be reconciled. The great change which had taken place in the abolition of slavery reached to the very foundations of southern society and industry.

Johnson president.

303. Upon the death of Mr. Lincoln, Vice-President Johnson succeeded to the office of president, and to the difficult task of the reconstruction of the rebellious states. He had been selected by the republican party as representing the union men of the south. He was not, however, in full sympathy with the Republicans, and it soon became evident that there was a breach between the president and Congress, which constantly widened. The first business engaging the attention of the government after the restoration of peace was the establishments of regular governments in the southern states. The president issued various proclamations, in which he declared all southern ports open to commerce except four in Texas, and granted amnesty and pardon to all persons engaged in the rebellion, except fourteen specific classes of leaders, who were to make special applications for pardon. About the manner of restoring the state governments, however, a serious quarrel arose between the president and Congress. The constitution made no provision for the readmission of a state which had withdrawn from the union, and Mr. Johnson, as a former states-right Democrat, held that the southern states had never been out of the union; that the leaders were solely responsible; that as soon as the seceded states applied for readmission under such a form of government as the constitution required, the federal government was bound to admit them without imposing conditions upon subjects over which the constitution had not expressly given Congress jurisdiction. The Republican leaders held that the action of the seceded states had deprived them of their rights as members of the union; that in the relation they now occupied they were in the category of territories seeking admission to the union, in which case Congress could admit or reject them at will. The particular question which brought on the controversy was the civil status of the negro. The Republicans held that slavery had been the cause of the war; that it was now abolished; and that only by giving the freedman the right to vote could he be protected, and the results of the war secured. They also claimed that no state should be admitted until it had granted the right of suffrage to the negroes within its borders. Johnson held this to be a matter of internal regulation beyond the control of Congress.

Quarrel between the president and Congress.

304. When Johnson succeeded to the presidency in April, 1865, he had a clear field before him, for congress was not to meet until December. From May 9 to July 13 he appointed provisional governors for seven states, whose duties were to reorganize the governments. The state governments were organized, but passed such stringent laws in reference to the negroes that the Republicans declared it was a worse form of slavery than the old. When Congress met in December, 1865, it was very largely Republican and firmly determined to protect the negro against outrage and oppression. The first breach between the president and the party in power was the veto of the first Freedmen's Bureau bill in February, 1866, which was designed for the welfare of the colored people. President Johnson objected that it had been passed by a congress in which the southern states had no representatives. The bill failed to pass by a two-thirds vote. Congress then passed a civil right's bill in March, 1866, by which freedmen were made citizens of the United States, and United States officers were instructed to protect these rights in the courts. The president vetoed this bill also, the objection being that it interfered with the rights of the states. This bill was passed over the veto. To make the bill stronger, Congress adopted the Fourteenth Amendment to the constitution (June 16), and submitted it to the states, the necessary majority of which ratified it. Both houses then passed a joint resolution that no delegation from any of the states

Freedmen's Bureau bill.

Civil rights bill.

The Fourteenth amendment.

lately in rebellion should be received by either the senate or the house until both united in declaring said state a member of the union.

305. The president disapproved of these measures, and there was now open hostility between the executive and congress. In February, 1867, a bill was passed admitting Nebraska as a state, with the provision that it should never enact any law denying the right of suffrage to any person because of his color or race. This was vetoed, and passed over the veto. On March 2, 1867, the "bill to provide efficient governments for the insurrectionary states," which embodied the congressional plan of reconstruction, was passed over the president's veto. This bill divided the southern states into military districts, each under a brigadier-general, who was to preserve order and exercise all the functions of government until the citizens had formed a state government, ratified the amendments, and been admitted to the union. On the same day the Tenure of Office bill was passed over the veto. This provided that civil officers should remain in office until the confirmation of their successors; that the members of the cabinet should be removed only with the consent of the senate; that, while Congress was not in session the president might *suspend* (not remove) any official; and in case the senate at the next session should not ratify the suspension, the suspended official should resume his office.

306. On August 5, 1867, the president had requested Edwin M. Stanton to resign his office as secretary of war. Mr. Stanton refused, was suspended, and General Grant was appointed to his place. When congress met, the senate refused to agree to Stanton's removal. General Grant then resigned the office, and Stanton again took possession. The president removed him a second time, and appointed General Lorenzo Thomas to the place. Stanton held to his office, and sent notice to the speaker of the house; thereupon the house passed a resolution (February 24, 1868), for the impeachment of the president. The articles of impeachment accused him of disobeying the tenure of office law, and of various other offences. The trial took place according to the constitution, members of the house appearing as accusers, and the senate acting as judges, with Chief Justice Chase, of the supreme court, in the chair. After the trial began the president made a tour of the north and west, and delivered many violent and passionate speeches to the crowds which assembled to meet him, and denounced the congress then sitting as "no congress," because of its refusal to admit delegations from the southern states. On these speeches the house based additional articles of impeachment. The exciting trial lasted two months, and ended in May with a vote of thirty-five for conviction, and nineteen for acquittal. Thus there was not a two-thirds majority for conviction. The senate adjourned *sine die*, and a verdict of acquittal was entered.

307. The Russian possessions in North America, comprising a large and thinly populated territory at the northwest corner of the continent, were purchased of the Russian government by the United States in 1867 for the sum of $7,200,000. This territory is known as Alaska. Nevada, the thirty-sixth state, was admitted during Mr. Lincoln's administration (1864); Nebraska, the thirty-seventh, was admitted in 1867. In 1868 General Grant was elected president, as the candidate of the Republican party, thus sealing the process of the reconstruction; Schuyler Colfax became vice-president. The Democratic candidates were Horatio Seymour, of New York, and Frank P. Blair, of Missouri. Virginia, Mississippi and Texas were the only states of the late confederacy which were excluded from this election; all the rest had been reconstructed and admitted by Congress in June, 1868. The Republican candidates carried twenty-six of the thirty-four voting states. In his inaugural address. General Grant declared that the government bonds ought to be paid in gold, advocated a speedy return to specie payments, and made many important recommendations in reference to public affairs. Regarding the good faith of the nation, he said: "To protect the national honor, every dollar of the government's indebtedness should be paid in gold, unless otherwise expressly stipulated in the contract." Congress acted promptly upon his recommendation, and on March 18, 1869, an act was passed, entitled "An Act to strengthen the public credit." Its language gave a pledge to the world that the debts of the country would be paid in coin, unless there were in the obligations express stipulations to the contrary.

Act to strengthen the public credit.

The XVth amendment

308. On February 26, 1869, the Fifteenth Amendment to the constitution was passed by Congress. Its adoption had been previously recommended by Grant. It guaranteed the right of suffrage without regard to race, color, or previous condition of servitude. It was ratified by the requisite three-fourths of the states, and declared in force March 30, 1870. In the meantime the foreign affairs of the country had been favorably established. Its promptness in disarming at the end of the war had put it under no disadvantage in dealing with other nations. The successful completion of the Atlantic cable (1866) gave a promptness and dispatch to diplomacy which was well suited to American methods. The most important measure of foreign policy during President Grant's administration was the treaty with Great Britain (May 8, 1871), known as the Treaty of Washington. Soon after entering upon his office, the president had begun negotiations, looking to a settlement of the claims made by the United States against Great Britain, arising from the depredations upon American commerce by confederate cruisers fitted out in British ports, the questions growing out of the Canadian fishery disputes, and the location of our northern boundary line at its junction with the Pacific ocean, which the jurisdiction of the island of San Juan in controversy.

Treaty of Washington.

The Alabama claims.

309. A high joint commission had assembled at Washington, composed of American and English statesmen, which formulated the Treaty of Washington, and by its terms the claims against Great Britain, commonly known as the "Alabama claims," were referred to a court of arbitration, which held its session at Geneva, Switzerland. In September, 1872, it awarded the United States the sum of $15,500,000, which was subsequently paid by the British government. The fishery question was referred to arbitration by three commissioners, one to be chosen by the United States, one by Great Britain, and the third by the other two, provided they should make a choice within a stated time, otherwise the selection to be made by the Emperor of Austria. The two commissioners having failed to agree, the third was named by the Emperor of Austria. The award was unsatisfactory to the United States. The decision of the commission was severely criticised by the people and the press, and the dispute has been reopened since from time to time, to the detriment of both countries. The San Juan question was referred to the Emperor of Germany as arbitrator with sole power. His award fully sustained the claim of the United States.

The fishery question.

San Juan.

310. President Grant's first administration had been vigorous and progressive, but a number of Republicans had become estranged, feeling that they were being ignored by the executive. These persons formed themselves into an organization under the name of Liberal Republicans. This opposition resulted in the nomination of Horace Greeley for president, and B. Gratz Brown for vice-president, by the Liberal party (1872). These nominations were afterwards adopted by the Democratic party. The republican convention renominated President Grant, with Henry Wilson as nominee for vice-president. When the election took place Grant carried thirty-one states with a popular vote of 3,597,070, the largest that had ever been given for any

Liberal Republicans

president. He received 286 electoral votes, against 66 which would have been cast for Mr. Greeley had he lived. The noted journalist, however, died soon after the election. The canvass had been one of the most exciting and aggressive in the history of the country, and abounded in personal attacks on the candidates. During President Grant's first term of office the work of reconstruction according to the plan settled by Congress had been steadily carried out, and by July, 1870, the work had been accomplished, and all the states were again members of the Union, although the votes of Arkansas and Louisiana were not received by Congress in 1872, because of fraud and illegality in the election.

Case of the "Virginius."

Political troubles in the South.

311. The relations between the United States and Spain were frequently disturbed by incidents growing out of an insurrection in Cuba, which had lasted for a number of years. Several American citizens had been arrested by the Spanish authorities, under the pretense that they had been furnishing aid to the insurgents, and American vessels plying in Cuban waters had been subjected to much inconvenience. Matters at length culminated in the seizure by Spain (October, 1873), without justification, of the American steamer *Virginius*. This outrage created intense excitement in the United States, and many statesmen were clamorous for war; but the president took more pacific measures, and, by acting with promptness and firmness, soon wrung from Spain ample apology and full reparation. Political troubles were still rife in certain states of the south. In March, 1871, the disorders in the southern states, growing out of the conflicts between the whites and the negroes, had assumed such proportions that the president sent a special message to Congress requesting "such legislation as shall effectually secure life, liberty and property, and the enforcement of law in all parts of the United States." On April 20 Congress passed an act which authorized the president to suspend, under defined circumstances, the writ of habeas corpus in any district, and to use the army and navy in suppressing insurrections. He issued a proclamation (May 4), ordering all unlawful armed bands to disperse, and after expressing his reluctance to use the extraordinary power conferred upon him, said he would "not hesitate to use that power to its full extent, whenever and wherever it should be necessary to do so for the purpose of securing to all citizens the peaceful enjoyment of the rights guaranteed to them by the constitution and the laws of the United States." As this did not produce the desired effect, he issued a proclamation of warning (October 12), and on October 17 suspended the writ of habeas corpus in parts of North and South Carolina. He followed this by vigorous prosecutions, which resulted in sending a number of prominent offenders to prison, and the outrages soon ceased.

312. Soon after President Grant entered upon his second term of office, the disputes in Louisiana concerning the result of the election in 1872 became more bitter, and armed violence was threatened in that state. Early in 1873 the president called the attention of Congress to the inadequacy of the laws applying to such cases, saying that he had recognized the officers installed by the decision of the returning-board as representing the *de facto* government, and if he had exercised undue interference by such a course he urged Congress to an immediate decision in regard to the matter. Congress, however, took no action, and left with the president the sole responsibility of dealing with this delicate question. The next year the difficulty was renewed and a fierce contest arose between the Republicans under Kellogg, and the Democrats under McEnery, the respective candidates of the two parties for the governorship, which resulted in armed hostilities. Kellogg, the *de facto* governor, called upon the federal government for protection, which it immediately granted by sending troops thither, and the outbreak was for a time suppressed. But troubles again arose, and General Sheridan was sent to report upon the situation of affairs, and if necessary, to take command of the troops and adopt vigorous measures to preserve the peace. Sheridan became convinced that his duty was to sustain the government of Kellogg, and on the demand of the governor he ejected some of McEnery's adherents from the state capitol. As Congress still omitted to take any action in the case, the president continued his recognition of the government of which Kellogg was the head until the election of a new governor. After this there was no serious trouble. Difficulties of the same nature arose in Arkansas and Texas, which were almost as perplexing to the executive as those in Louisiana; but these attracted less attention from the people.

The Inflation bill.

The resumption act.

313. In April, 1874, Congress passed a bill known as the "Inflation bill," which increased the paper currency of the country, and was contrary to the financial policy which the president had maintained and advocated in his state papers. Strenuous efforts were made by his warmest political supporters to convince him that the measure was financially wise and politically expedient. President Grant gave much thought and study to the question, and at length fully decided that the measure would in the end prove injurious to the true business interests of the country, and delay the resumption of specie payment. He, therefore, returned the bill to Congress with his veto (April 22). The arguments contained in his message were unanswerable, the bill was not passed over his veto, and his course was sustained by the whole country. The president now earnestly advocated the resumption of specie payment. In a letter addressed to Senator Jones, of Nevada, he gave a full statement of his views on the question. This letter was made public, and attracted much attention; and in January, 1875, the resumption act was passed, which to a large extent embodied the views that had been suggested by the president. There were doubts in the minds of many as to the ability of the government to carry it into effect; but it proved entirely successful, and the country was finally relieved from the stigma of circulating an irredeemable paper currency.

Indian troubles.

Murder of Canby.

Black Hills

The Custer massacre.

314. Great trouble was caused soon after the close of the war by the depredations of the Indian tribes of the west and southwest. The Sioux and Cheyennes having begun hostilities, an expedition was sent out against them under the direction of General Hancock in 1867, and another in 1868, beyond the Arkansas river, where General Custer gained an important victory. In an expedition against the Modocs of Oregon, in 1873, General Canby was treacherously murdered during a parley with the Indian chiefs. The Sioux had ceded to the United States a large tract of country in what was then Dakota territory, reserving to themselves the district known as the Black Hills. When it was rumored that gold had been found on their reservation, the whites began to push into this region, regardless of the rights of the Indians. The Sioux were a warlike tribe, and they retaliated by attacking the frontier settlements in Montana and Wyoming. United States troops were sent out against them, but met at first with a terrible disaster. In June, 1876, General Custer, with about two hundred and fifty soldiers, was surprised and the entire force massacred. The war lasted into the winter of 1877, when the Sioux, with their chiefs, Sitting Bull and Crazy Horse, went across the border into British territory.

315. During 1875, the president had reason to suspect that frauds were being practiced by government officials in certain states, in collecting the revenue derived from the manufacture of whiskey. He at once took active measures for their detection, and the punishment of the offenders. He issued a stringent order for their prosecution, closing with the famous

words, "Let no guilty man escape." Many indictments soon followed; the ringleaders were sent to the penitentiary, and an honest collection of the revenue was secured. The year for nominating a president was at hand, and the excitement ran high. Friends of the convicted, political enemies and rivals for succession in his own party, resorted to the most desperate means to break the president's power and diminish his popularity. The grossest misrepresentations were practiced, first in trying to bring into question the honesty of his purpose in the prosecution of offenders, and afterward in endeavoring to rob him of the credit of his labors, which had resulted in the purifying of the revenue service. But these efforts signally failed. In 1876 the United States celebrated the one hundredth anniversary of the Declaration of Independence. There were great rejoicings throughout the country, and the various battles of the revolution, as well as the signing of the Declaration, were commemorated by appropriate exercises. The centennial year was chosen for holding a great international exhibition at Philadelphia, to which all the nations of the world were invited to contribute. It was opened in May and closed in November, having been visited by about ten millions of people.

816. The changes at the south, and the dissatisfaction of many at the north with the rule of the Republican managers, were seen in the election of 1876. The Democrats nominated Samuel J. Tilden and Thomas A. Hendricks for president and vice-president; and the Republicans, Rutherford B. Hayes and William A. Wheeler. A national Greenback convention was also held, May 17, composed of men who desired national paper money instead of national bank notes, and who opposed resumption of specie payments. It nominated Peter Cooper and Samuel F. Cary. The contest was very close, and a dispute arose as to the counting of the votes of certain southern states, both sides claiming them. The controversy was finally settled by the appointment of an electoral commission of fifteen, eight of which decided in favor of Mr. Hayes. In this year, Colorado, the thirty-eighth state (and the last up to 1887) was admitted in time to take part in the election.

817. The administration of President Hayes, although much attacked by the politicians of both parties, was on the whole, very satisfactory to the people at large. By withdrawing the federal troops from southern state houses, and restoring to the people of those states practical self-government, it prepared the way for that patriotism among those lately estranged from the union, that fraternal feeling between the two sections of the country, and the wonderful material advancement of the south which we now witness. It conducted with wisdom and firmness the preparation for the resumption of specie payments, as well as the funding of the public debt at lower rates of interest, and thus facilitated the development of the remarkable business prosperity which continued to its close. While in its endeavors to effect a thorough and permanent reform of the civil service, there were conspicuous lapses and inconsistencies, it accomplished important and lasting results. Not only without any appropriations of money, and without encouragement of any kind from Congress, but in the face of the decided hostility of a large majority of its members, the system of competitive examinations was employed in some of the executive departments at Washington, and in some of the great government offices in New York, thus proving its practicability and usefulness. The removal by President Hayes of some of the most powerful party managers from their offices, avowedly on the ground that the offices had been used as part of the political machinery, was an act of high courage, and during his administration there was far less meddling with party politics on the part of the government officials than at any period since Andrew Jackson's time.

Financial condition.

818. The financial condition of the United States had been steadily improving since the war. A few months after the conclusion of peace the public debt had reached its highest amount, $2,800,000,000, and by the close of President Hayes' administration no less than one thousand million dollars of that amount had been paid off. The credit of the government rose, and the paper money, once worth only a third of its denomination in gold, increased in value. The operation of refunding the debt had been begun July 14, 1870. At that time Congress passed an act authorizing the issue of five, four and a half, and four per cent bonds to take the place of those at higher interest. $500,000,000 were issued in five per cent bonds, $185,000,000 in four and one half per cent, and $710,345,950 at four per cent, thus reducing the annual interest charge from $81,639,684 to $61,738,888. This first refunding operation was completed in the year 1879, at the time when specie payments were resumed. In 1881 about $200,000,000 of six per cent bonds fell due. Mr. Windom, secretary of the treasury, took the responsibility of allowing the holders of the bonds to exchange them for three and one-half per cent bonds, redeemable at the pleasure of the government. Holders of other bonds to the amount of $300,000,000 also availed themselves of this privilege, thus saving $10,000,000 interest. In 1875 Congress passed a law providing that the paper "fractional currency" used for small change should be redeemed at once in silver, and that after the 1st of January, 1879, the "greenbacks" should be paid on demand in coin.

Refunding the debt.

Election of 1880.

819. At the elections of 1880 the Republican candidates were General James A. Garfield for president, and General Chester A. Arthur for vice-president; while the Democrats nominated General Winfield S. Hancock and William E. English. The Republican ticket was successful, receiving the electoral votes (214 in number) of all the northern states except California—which was divided—Nevada and New Jersey. The Democratic electoral vote was 155 including 11 from Georgia, which, not having been cast on the day appointed by law, were objected to when the returns were opened. As they could not effect the result the question whether they should be counted or not was never decided. The new administration was inaugurated March 4, 1881, and the scramble for office which had marked each advent to the presidency since 1829, followed. There was bitter dissension in the party in New York over the distribution of offices. The New York senators, feeling aggrieved at certain appointments in their state, resigned, and then made efforts to be re-elected by their state legislature, in which they failed. In the midst of it all President Garfield was shot (July 2, 1881) by a crazy disappointed office-seeker. The avowed object was to promote to the presidential chair Vice-President Arthur, who represented the Grant or "stalwart" wing of the party. The president was not instantly killed. For three months he lay helpless, while the nation watched anxiously every turn in his condition. The sympathy shown by all parts of the country did much to draw the nation together and to lessen the old distrust. Garfield died September 19, 1881, and was succeeded by Vice-President Arthur.

Garfield's assassination.

Arthur's administration.

820. The prominent events of President Arthur's administration may be here summarized. Shortly after his accession to the presidency he participated in the dedication of the monument erected at Yorktown, Va., to commemorate the surrender of Lord Cornwallis at that place, Oct. 19, 1781. A convention was made with Mexico (July 29, 1882) for re-locating the boundary between that country and the United States from the Rio Grande to the Pacific, and on the same day an agreement was also effected permitting the armed forces of either country to cross the frontier in pursuit of hostile Indians. The death of President Garfield called

Chinese immigration bill.

Convict law.

general attention to that reprehensible system under which each party, while in office, had paid its party expenses by the use of minor offices for its adherents. The president's power of appointment could not be controlled: but the Pendleton Act (1883) permitted the president to make appointments to designated classes of offices on the recommendation of a board of civil service commissioners. From the British government a full recognition of the rights and immunities of naturalized American citizens of Irish origin was obtained, and all such who were under arrest in England or Ireland as suspects were liberated. A bill passed by Congress prohibiting the immigration of Chinese laborers for a term of twenty years was vetoed (April 4, 1882), as being a violation of the treaty of 1880 with China, which permitted the limitation or suspension of immigration, but forbade its absolute prohibition. The veto was sustained, and a modified bill. suspending immigration for ten years, was passed, May 6, 1882, which received the executive approval. A law was passed (August 3, 1882) for returning convicts to Europe, and on February 26, 1885, importation of contract laborers was forbidden.

Repeal of stamp taxes.

National banks.

Merchant marine bill and bureau of navigation

321. The suspension of the coinage of standard silver dollars and the redemption of the trade dollars were repeatedly recommended; also, the repeal of the stamp taxes on matches, proprietary articles, playing cards, bank checks, drafts, and of the tax on surplus bank capital and deposits. These taxes were repealed by act of congress (March 3, 1883); and by executive order of June 25, 1883, the number of internal revenue collection districts was reduced from 126 to 83. The tax on tobacco was reduced by the same act of congress. On July 12, 1882, an act became law enabling the national banks, which were then completing their twenty year terms, to extend their corporate existence. The attention of Congress was frequently called to the decline of the American merchant marine, and legislation was recommended for its restoration, and the construction and maintenance of ocean steamships under the United States flag. In compliance with these recommendations, the following laws were enacted: June 26, 1884, an act to remove certain burdens from American shipping; July 5, 1884, an act creating a bureau of navigation, under charge of a commission, in the treasury department; and March 3, 1885, an amendment to the postal appropriation bill granting $800,000 for contracting with American steamship lines for the transportation of foreign mails.

Reduction of letter postage.

French spoliation claims.

322. The reduction of letter postage from three to two cents was recommended, and was effected by the act of March 3, 1883; the unit of weight was made (March 3, 1885) one ounce instead of a half ounce; the rate on transient newspapers and periodicals was reduced (June 9, 1884,) to one cent for four ounces, and the rate on similar matter, when sent by the publisher to actual subscribers, was reduced to one cent a pound (March 3, 1885). The fast mail and free delivery systems were largely extended. Special letter deliveries were established March 3, 1885. The star service at the west was increased at reduced cost; the foreign mail service improved; and various postal conventions were negotiated. A law for the adjudication of the French spoliation claims was passed (January 20, 1885), and preparations made for carrying it into effect. On March 3, 1885, a bill was passed retiring General Grant with the rank of general of the army, and with full pay.

Election of 1884.

Cleveland's administration

"Offensive partisanship."

Oklahoma country.

323. In 1884 the Republicans nominated James G. Blaine and General John A. Logan, and the Democrats Cleveland and Hendricks. The greenback and anti-monopolist parties put forward the name of Benjamin F. Butler. The prohibitionists, also, had organized themselves into a party, and presented as their candidate Governor St. John. A small majority of the democratic candidates in the state of New York gave them its electoral votes, and decided the election in their favor. They were inaugurated March 4, 1885. The president announced in regard to official changes that, with the exceptions of heads of departments, foreign ministers, and other offices charged with the execution of the policy of the administration, no removals would take place except for cause. He therefore came into conflict with many influential members of his party who advocated the speedy removal of Republican office-holders and the appointment of Democrats, in order to strengthen the party as a political organization. While that class of politicians objected to the slowness with which removals were made, and to the appointment of independents, and in a few instances Republicans, the Republicans and some of the civil service reformers complained of other appointments as not being in accord with the professions of the president. He declared "offensive partisanships" to be a ground for removal; and numerous Republican functionaries were displaced under that rule, while the term itself became a by-word. On March 13, 1885, the president issued a proclamation announcing the intention of the government to remove from the Oklahoma country, in Indian territory, the white intruders who sought to settle there, which was done shortly afterwards by a detachment of soldiers.

Presidential succession

324. In his message at the opening of the XLIXth Congress, December 8, 1885, President Cleveland recommended the abolition of duties on works of art, the reduction of the tariff on necessaries of life, the suspension of compulsory silver coinage, more stringent laws for the suppression of polygamy in Utah, an act to prohibit the immigration of Mormons, and the extension of the civil service reform. In January, 1886, Congress passed the bill regulating the presidential succession in the event of a vacancy. Mr. Cleveland exercised the veto power beyond all precedent. Of 987 bills passed by both houses in the session ending August 5, 1886, 115 were vetoed. Of these 102 were private pension bills, and six were bills for the erection of public buildings. Of the general measures which failed to receive his signature, the most important was the Morrison resolution requiring the secretary of the treasury to apply to the redemption of bonds any surplus to the treasury exceeding $100,000,000. The river and harbor bill, containing appropriations, deemed by many useless and extravagant, and the bill taxing oleomargarine two cents a pound, which was considered an unjust discrimination against one class of producers for the benefit of another, were not vetoed. On signing the latter, the president sent a message to Congress, in which he gave as his reason that the stamps required by the act would mark the character of the substance and prevent it being fraudulently sold.

Election of 1888.

Harrison's administration.

325. The presidential campaign of 1888 was noted for the number of candidates in the field, who were as follows: Republican, Benjamin Harrison and Levi P. Morton; Democratic, Grover Cleveland (renominated) and Allen G. Thurman: prohibition, Clinton B. Fisk and John A. Brooks; union labor, A. J. Streeter and Charles E. Cunningham; industrial reform, Albert E. Redstone and John Colvin: united labor, Robert H. Cowdry and W. H. T. Wakefield: woman suffragists, Belva A. Lockwood and Albert H. Love. The main issue between the two leading parties, Republican and Democratic, was on the tariff question; the former favoring a modified protected tariff, while the latter demanded a tariff chiefly for revenue. The principles of the other parties related to labor, national currency, prohibition and woman's suffrage. The Republican party was successful, and Harrison as president, with Morton as vice-president, was inaugurated March 4, 1889. The administration of Mr. Harrison, thus far, has been characterized by the passage of the McKinley tariff bill, which both increases and diminishes the duties on many necessary articles

and adds to the duties on luxuries, and by the regulation of pension matters. The invalid pension bill has been passed, granting pensions to all disabled soldiers without reference to the time when the disability was contracted. **The census** On the beginning of June, 1890, the enumeration of the general census for the last decade was begun, under the control of Superintendent Porter, and the returns of the census enumerators give the population of the United States at 63,250,000, which is less than was anticipated. Many consider the returns as imperfectly made.

326. In the meanwhile the prosperity of the United States has known no cessation. During the civil war of 1861–1865, the emperor of France, Napoleon III., attempted to establish in Mexico a foreign government under Maximilian, an Austrian archduke, aided by a French army. The remonstrance of the United States and the resolution of the Mexicans compelled Napoleon to abandon the attempt. Maximilian was siezed by the Mexicans and executed (1867). A new invasion of Mexico from the United States was begun, but it was the peaceful invasion of commerce. Railways were pushed down along the great plateau which reaches from the United States into the heart of the country, making thus a closer connection between the two peoples. **Railways.** In 1869 the first of the great railroads, the Central Pacific, was finished, connecting the Atlantic and Pacific Oceans, and opening the country to settlement and travel. Since then other railroads have stretched their iron bands across the continent. Of the 290,000 miles of railroad in the world, there are, probably, about 135,000 miles in the United States. **Telegraph and telephone lines** This country possesses, also, more than 150,000 miles of telegraph lines; and the American telephone lines are still longer in the aggregate. **Atlantic telegraph.** In 1866, a previous attempt in 1857 having failed, a telegraphic cable was laid upon the bed of the Atlantic between America and Europe. This cable was followed by others, so that now the citizen of the United States may know each day the principal events which occur in the civilized world. The stimulus given to new territory possessing the requisites for settlement by the introduction of a new railway has been wonderful beyond description. Most of the western railways have had to build up their own traffic. The railway has been mainly constructed under land grants from the government, and the sales of these lands have brought into existence the towns and even the states which support it.

327 In the government reports of 1854 Nebraska was described as a desert country totally unsuited for agriculture, and in the maps of the time it was put down as a part of the Great American Desert. It is now one of the leading agricultural states of the union with a population of over a million. Since the admission of Colorado in 1876 six other states have been admitted to the union, namely, North and South Dakota, Washington, Montana, Wyoming and Idaho. There are yet five territories, including Alaska, not yet organized into states, and the District of Columbia. The mineral wealth of the country has become greatly developed. **Mineral wealth.** A few years after the discovery of gold in California the precious metal was found also at Pike's Peak, Colorado (1858). Since then it has been discovered in most of the Pacific states and territories. In 1858 silver was discovered in Nevada, and this metal has been found widely distributed in the country bordering on the Pacific coast. **Coal.** The extent of the vast coal fields of the country has been pretty clearly ascertained. In 1883 it was estimated at over 200,000 square miles. **Petroleum.** Petroleum was discovered in 1859 in northwestern Pennsylvania, numerous wells were sunk and vast quantities of the oil have been taken from the earth, but the reservoir seems to be unfailing. **Manufactures.** Manufacturing establishments of every variety have rapidly increased in every part of the country. The absolute free trade which exists between the states has resulted in a constant shifting of centers of production and an increasing development. Among the nations of the world, Great Britain, in 1870, stood first in wealth, France the second and the United States the third. In 1880 the United States had left France behind in the race and stood at least second. When all the census returns of 1890 shall be given they will doubtless show that this country ranks with the first. The United States, whose population has been developed within less than three centuries, does already more than one-third of the world's mining and one-fourth of its manufacturing. It embraces also one-fifth of its agriculture.

The south 328. In this wonderful progress and development the south, since the close of the war, has borne her share. Being relieved of the incubus of slavery she has come up "through great tribulation" to assume her rightful place as a most important factor in advancing the prosperity of an undivided nation. Under the stimulus of free labor her growth has been extraordinary. New railroads have been built and new territory opened up. Southern railways occupy a leading position in the railway systems of the country. Southern manufactures began to effect northern markets. Cotton mills have been successfully established, which have the advantage of an immediate contiguity to the cotton-raising states. The great mineral fields, over which contending armies fought fierce battles during the late war, have been brought to light and are being rapidly developed. Pennsylvania iron-masters have a new rival to contend with in the iron production of the south. The former slave is now a free laborer, and the white man is no longer ashamed to work. White labor produced ten per cent of the cotton crop of 1860 and fifty-five per cent of that of 1886. Under slavery, cotton-seeds were waste material; in 1886 600,000 tons of them were crushed, yielding a new production in the form of cotton-seed oil valued at $12,000,000 per annum.

Civil service reform 329. Among the political and economic questions demanding the attention of the government, no one of them is more important than the question of the reform of the civil service, but it is not avowedly made a party question. Twenty years ago both parties laughed at the idea of civil cervice reform, now each one makes a show at least of treating it with respect, and the control of the immediate political future, probably lies with the party which will treat it in the most serious and practical manner. It is a question that was not distinctly foreseen in the days of Hamilton and Jefferson, when the constitution was made and adopted, otherwise the founders of the constitution might have had something to say concerning it. The question as to the civil service arises from the fact that the president has the power of appointing a very large number of petty officials, chiefly postmasters and officers concerned with the collection of the government revenue. Such officials have properly nothing to do with politics; they are simply the agents or clerks or servants of the national government in conducting its business, and if this business is to be managed on the ordinary principles of prudence which prevail in the management of private business, such servants ought to be selected for personal merit and retained for life or during good behavior. **The civil service act of 1883.** In 1883 Congress passed the civil service act allowing the president to select a board of examiners and make appointments upon their recommendation. Candidates for office are subjected to an easy competitive examination. The system has worked well in other countries, and under Presidents Arthur and Cleveland it was applied successfully to a considerable part of the civil service. It has also been adopted in some of the states and principal cities of the union. **Objection** It is objected to by the opponents of reform, on the ground that its examinations are not always intimately connected with the work of the office; but even, if this were so, it removes the offices from the category of things known as "patronage," and this alone endows the system with great merit. Then again, it relieves the president of much needless work and wearisome importunity. The executive and heads of departments appoint (in many cases through subordinates) about 115,000 officials. It is therefore impossible for the principals to know much about the character or competency of those appointed. It becomes necessary to act by advice, and the advice of an examining board is sure to be much better than that of political schemers intent upon getting a salaried office for their needy friends. The examination system has made a fair beginning and will doubtless be gradually improved and made more stringent. Something has been also done toward stopping two old abuses attendant upon political canvasses, namely, that of forcing government clerks, under penalty of losing their places, to contribute part of their salaries for election purposes, and that of allowing them to neglect their work in order to take an active part in the canvass.

The Australian ballot system

830. Another political reform promising excellent results is, the adoption by many states of some form of the Australian ballot-system, for the purpose of checking intimidation and bribery at elections. The ballots are printed by the state, and contain the names of all the candidates of all the parties. Against the name of each candidate the party to which he belongs is designated, and against each name there is a small vacant space to be filled with a cross. At the polling place the ballots are kept in an enclosure behind a railing and no ballot can be brought outside under penalty of fine or imprisonment. One ballot is nailed against the wall outside the railing, so that it may be read at pleasure. The space behind the railing is divided into separate booths quite screened from each other, each booth is provided with a pencil and a convenient shelf on which to write. The voter goes behind the railing, takes the ballot which is handed to him, carries it to one of the booths, and marks a cross against the names of the candidates for whom he votes. He then puts his ballot into the box, and his name is checked off on the register of voters of the precinct This system is very simple; and it enables a vote to be given in absolute secrecy. It is favorable to independence in voting, and is unfavorable to bribery, because, unless the briber can follow his man to the polls and see how he votes, he cannot be sure that his bribe is effective. During the past few years, complaints of bribery and corruption have attracted especial attention in the United States, and it is highly creditable to the good sense of the people that preventive measures have been so promptly adopted by many of the states. With an independent and uncorrupted ballot, and the civil service taken "out of politics," all other reforms will become far more easily accomplished.

But a very few of the works treating of the History of the United States in its manifold phases can be here given, as they are so numerous. *The Histories of the United States*, by George Bancroft, David Ramsay, Richard Hildreth, Bryant Higginson, Lossing, Lester, Frost, Schouler, Von Holst, Ridpath, Hamilton, Hassard, Gray, Leeds; *American History*, edited by Edward L. Knapp; Gilman, *History of the American People*; H. H. Bancroft, *History of the Pacific Coast*; Willson, *American History*; Hazard, *Historical Collections*; Stephen H. Newman, *America*; Gilman, *History of the American People*; Winsor, *Narrative and Critical History*; Graham, *History of the United States*; Parkman's *Works*; Ludlow, *War of American Independence*; Gordon, *History of the Independence of the United States*; Edward D. Neill, *MacAllister, College Contributions to American History*; Gordon, *History of the American Revolution*, *Register of Debates in Congress*, *Congressional Globe*, *Annals of Congress*; Coles, *History of the Ordinance of* 1787; Adams, *New England Federalism*, 1800-15; Greene, *Historical View of the American Revolution*, The American Commonwealth Series: Lodge, *English Colonies in America*; Carrington, *Battles of the American Revolution*; Neill, *English Colonisation of America*; Duyckinck, *National Portrait Gallery*; Holmes, *Annals of America*; Marshall, *History of the Colonies*; Palfrey, *History of New England*; Story, *Commentaries*; Story, *On the Constitution*: Frothingham, *Rise of the Republic*; Harpers' *Cyclopædia of American History*; Appleton's *Cyclopædia of American Biography*; John Robert Ireland, *The Republic*; Scott, *Constitutional Liberty in the Colonies*; Benton, *Thirty Years in the Senate*; Irving, *Life of Washington*; Kent *Commentaries on American Law*; Johnston, *History of American Politics*; Johnston, *History of the United States*; Fiske, *American Political Ideas*; Fiske, *Civil Government in the United States*, *Johns Hopkin's University, Studies in History and Politics*; Howard, *Local Constitutional History of the United States*; A. O. Wright, *Constitution of the United States*; Brownson, *American Republic*; Lamphere, *American Government*; Wilson, *Congressional Government*; Mansfield, *The Political Manual*; Curtis, *History of the Constitution*; J. D Whitney, *United States*; *Tribune Almanac*. McPherson, *Political Manuals*; Spofford, *American Almanac*; Fallows, *The American Manual*; Congressional Records; Reports of the Officers of the Various States; Histories of the Various States; Compendium of the Census from 1850-1890; Cooper, *Naval History*; Preble, *History of the Navy*; Porter, *Constitutional History*; McKnight, *Electoral System*; McCrary, *Election Laws*; Cooley, *Constitutional Limitations, Taxation and Constitutional Law*; Alden, *Science of Government*; Austin, *Constitutional Republicanism*: Bradford, *History of the Federal Government*, 1789-1839; Coles, *History of the Ordinance of 1787*; Dwight, *History of the Hartford Convention*; Draper, *Civil Policy of America*; Handlin, *American Politics*; Sneider, *The American State*: Spaulding, *Administrations of the United States*; Sumner, *Works*; Thompson, *Church and State in the U S.*; Thompson, *Revolution Against Free Government*; Townsend, *Analysis of Civil Government*; Elliot's Debates: *Constitutional Convention*; Young, *American Statesmen*; Bancroft, *Formation of the Constitution of the U. S.*; Blaine, *Twenty Years in Congress*; Porter, *Constitutional History of the United States*; Preble, *History of the Flag of the United States*; Sumner, *Prophetic Voices Concerning America*; Wilson, *Rise and Fall of the Slave Power*; Woolsey and others, *First Century of the Republic*; Russell, *History of the War of* 1812; Ingersoll, *History of the War of* 1812; Abbott's *History of the Civil War*; Compte De Paris, *History of the Civil War in America*; Borcke, *Memoirs of the Confederate War*; Brownlow, *Rise and Progress of Secession*; Campaigns of the Civil War: Drew, *John Brown's Invasion*; Greeley, *American Conflict*; Harpers' *History of the Rebellion*; Pollard, *Lost Cause*; Pollard, *Lost Cause Regained*; Memoirs of Grant and Sherman—Life of Sheridan; Pollard, *General Lee and His Lieutenants*; Pollard, *Military Life of Jefferson Davis*; Stephens, *Constitutional View of Late War, with Supplement*; Blodgett, *Commercial Strength of the United States*; Bolles, *Financial History of the United States*; Sumner, *History of American Currency*; Taylor, *American Currency*; Knox, *Fifth Report of American Bankers' Association*; Law, *National Circulating Medium in United States*; Phillips, *History of American Paper Currency and Continental Money*; Wells, *Robinson Crusoe's Money*; Spaulding, *One Hundred Years of Banking*; Ely, *Labor Movement in America*; Gibbons, *Public Debt of the United States*; Mason, *The Tariff*; Young, *Tariff Legislation of the United States*; Hudson, *Railways and the Republic*; Hadley, *Railroad Transportation*; Poor, *Manual of U. S. Railroads*; Porcher, *Resources of the South*; Dresser, *United States Tariff*: Official Statistics of the United States, and the Several States.

PRESIDENTS AND VICE-PRESIDENTS OF THE UNITED STATES

TERMS.	PRESIDENTS.	VICE-PRESIDENTS.
1789-93	1. George Washington, Va.	1. John Adams, Mass.
1793-97	George Washington.	John Adams.
1797-1801	2. John Adams, Mass.	2. Thomas Jefferson, Va.
1801-05	3. Thomas Jefferson, Va.	3. Aaron Burr, N. Y.
1805-09	Thomas Jefferson.	4. George Clinton, N, Y.
1809-13	4. James Madison, Va.	George Clinton (d. 1812).
1813-17	James Madison.	5. Elbridge Gerry, Mass, (*d.* 1814).
1817-21	5. James Monroe, Va.	6. Daniel D. Tompkins, N. Y.
1821-25	James Monroe.	Daniel D. Tompkins.
1825-29	6. John Quincy Adams, Mass.	7. John Caldwell Calhoun, S. C.
1829-33	7. Andrew Jackson, Tenn.	John C. Calhoun (res. 1832.
1833-37	Andrew Jackson.	8. Martin Van Buren, N. Y.
1837-41	8. Martin Van Buren, N. Y.	9. Richard Mentor Johnson, Ky.
1841-45	9. William Henry Harrison, O. (*d.* 1841).	10. John Tyler, Va.
	10. John Tyler.	
1845-49	11. James Knox Polk, Tenn.	11. George Miflin Dallas, Pa.
1849-53	12. Zachary Taylor, La. (*d.* 1850.	12. Millard Fillmore, N. Y.
	13. Millard Fillmore.	
1853-57	14. Franklin Pierce, N. H.	13. William Rufus King, Ala. (*d.* 1853).
1857-61	15. James Buchanan, Pa.	14. John Cabell Breckinridge, Ky.
1861-65	16. Abraham Lincoln, Ill.	15. Hannibal Hamlin, Me.
1865-69	Abraham Lincoln (*d.* 1865)	16. Andrew Johnson, Tenn
	17. Andrew Johnson	
1869-73	18. Ulysses Simpson Grant, Ill	17. Schuyler Colfax, Ind.
1873-77	Ulysses S. Grant.	18. Henry Wilson, Mass. (*d.* 1875).
1877-81	19. Rutherford Birchard Hayes, O.	19. Wm. Almon Wheeler, N. Y.
1881-85	20. James Abram Garfield, O. (*d* 1881).	20. Chester Allan Arthur, N. Y.
	21. Chester Allan Arthur.	
1885-89	22. Grover Cleveland, N. Y.	21. Thomas Andrews Hendricks, Ind. (*d.* 1885.)
1889-	23. Benjamin Harrison, Ind	22. Levi Parsons Morton, N. Y

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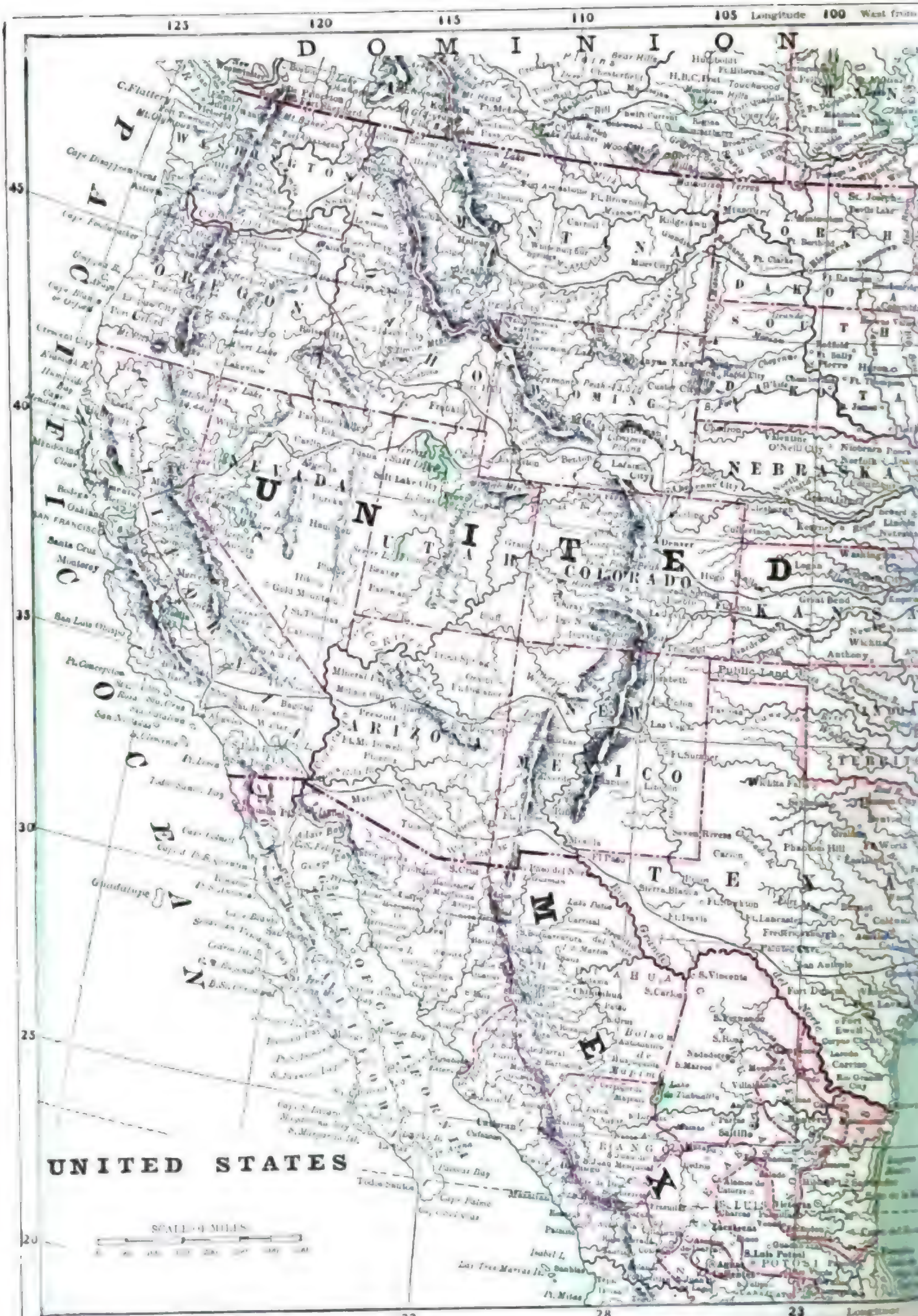
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WYOMING
UTAH
COLORADO
ARIZONA
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
TEXAS
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SAN FRANCISCO
Oakland
Santa Cruz
Monterey
San Luis Obispo
Pt. Concepcion
Guadalupe I.
Cape Mendocino
C. Flattery
Cape Disappointment
Denver
Pueblo
Salt Lake City
El Paso
San Antonio
Chihuahua
Saltillo
Laredo
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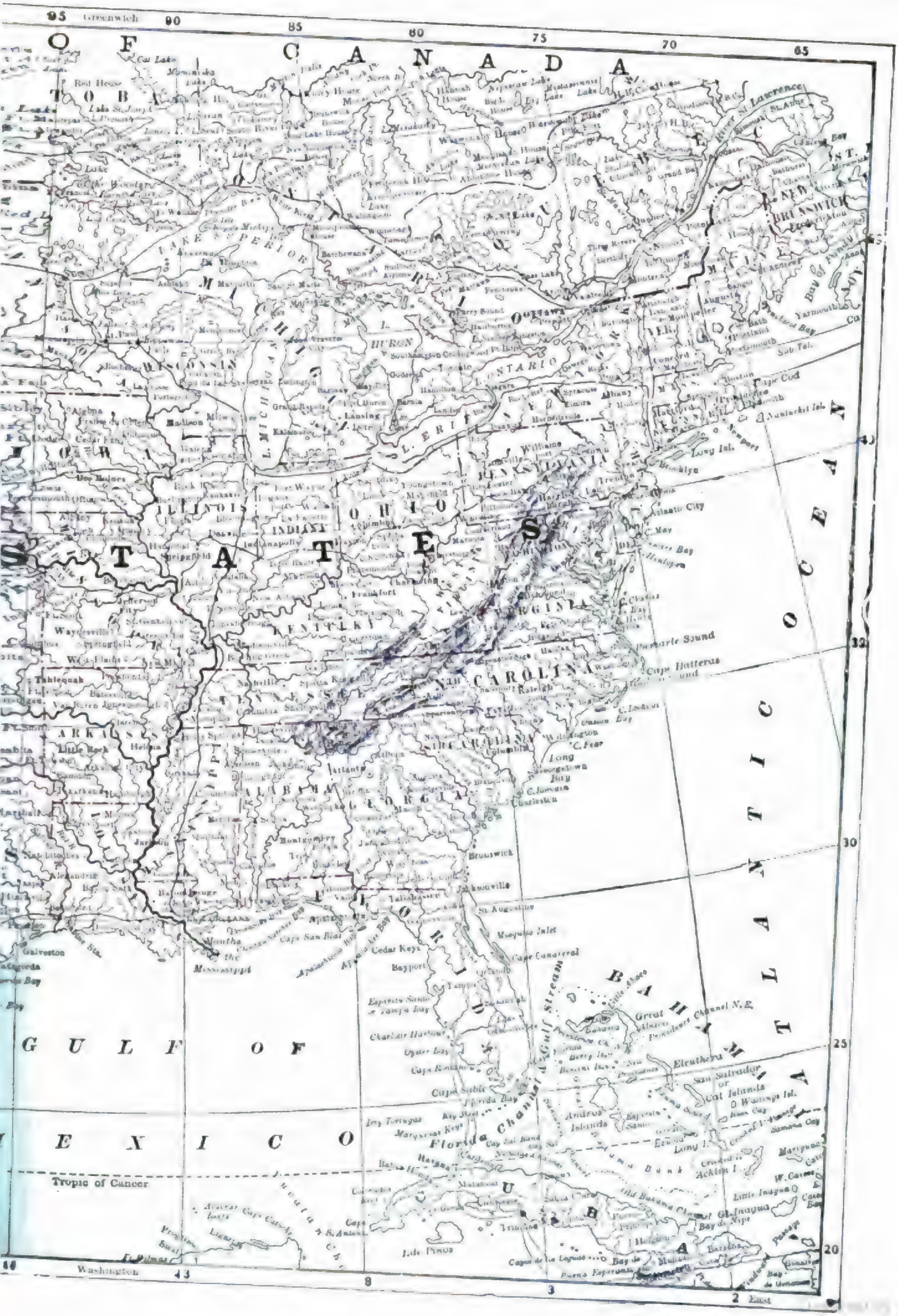
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OF CANADA
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Bay of Fundy
Lake Superior
L. Michigan
L. Huron
L. Ontario
L. Erie
Ottawa
Montreal
Quebec
Toronto
Boston
Cape Cod
Nantucket Isl.
Long Isl.
Brooklyn
Albany
Syracuse
Hartford
Newport
Portland
Portsmouth
Yarmouth
Augusta
Montpelier
Concord
WISCONSIN
MICHIGAN
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Madison
Springfield
Indianapolis
Columbus
Frankfort
Nashville
Raleigh
Columbia
Atlanta
Montgomery
Little Rock
Jackson
Baton Rouge
New Orleans
Tallahassee
Jacksonville
St. Augustine
Charleston
Brunswick
Wilmington
C. Fear
Cape Hatteras
Pamlico Sound
Atlantic City
C. May
Mouths of the Mississippi
Galveston
Cape San Blas
Apalachee Bay
Cedar Keys
Tampa
Cape Canaveral
Charlotte Harbour
Cape Sable
Key West
Florida Channel
Gulf Stream
BAHAMA
Great Abaco
Andros Islands
Eleuthera
San Salvador or Cat Islands
Long I.
Acklin I.
Great Bahama Bank
Old Bahama Channel
CUBA
Havana
Isle Pinos
Cape S. Antonio
Trinidad
Little Inagua
Great Inagua
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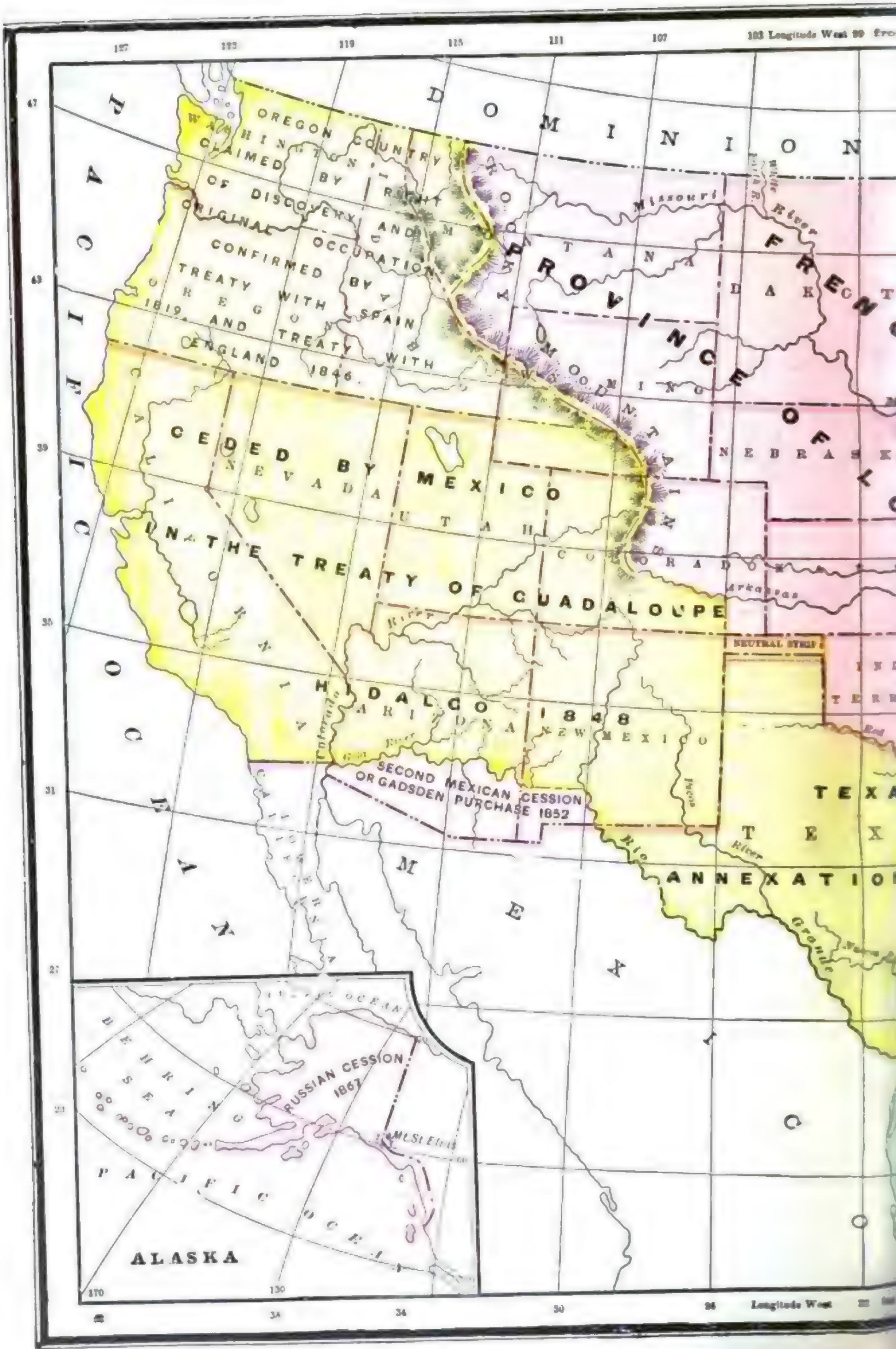
OREGON COUNTRY
CLAIMED BY RIGHT
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TREATY WITH SPAIN
1819, AND TREATY WITH
ENGLAND 1846.
WASHINGTON
OREGON
IDAHO
MONTANA
WYOMING
ROCKY MOUNTAINS
PROVINCE OF LO
FRENCH
DAKOTA
NEBRASKA
DOMINION
CEDED BY MEXICO
IN THE TREATY OF GUADALOUPE
HIDALGO 1848
NEVADA
UTAH
COLORADO
CALIFORNIA
ARIZONA
NEW MEXICO
SECOND MEXICAN CESSION
OR GADSDEN PURCHASE 1852
NEUTRAL STRIP
TEXAS
ANNEXATION
MEXICO
PACIFIC OCEAN
Missouri
River
Arkansas
Colorado
Rio Grande
Pecos
ALASKA
RUSSIAN CESSION
1867
BEHRING SEA
PACIFIC OCEAN
ARCTIC OCEAN
Mt. St. Elias
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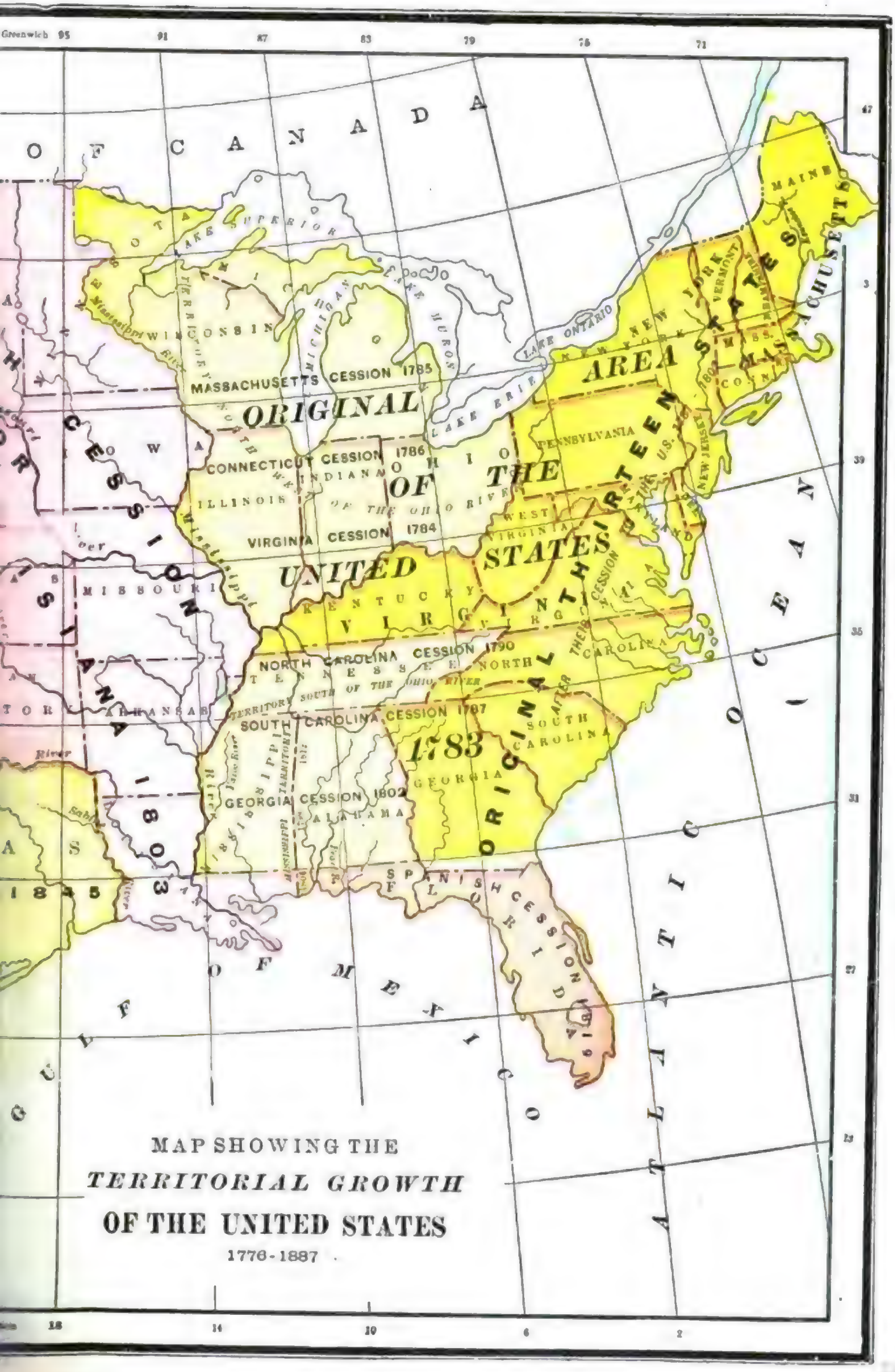
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NEW YORK
MASS.
MASSACHUSETTS
CONN.
PENNSYLVANIA
NEW JERSEY
DELAWARE
MARYLAND
VIRGINIA
WEST VIRGINIA
KENTUCKY
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
ORIGINAL AREA OF THE UNITED STATES 1783
ORIGINAL THIRTEEN STATES
MASSACHUSETTS CESSION 1785
CONNECTICUT CESSION 1786
VIRGINIA CESSION 1784
NORTH CAROLINA CESSION 1790
SOUTH CAROLINA CESSION 1787
GEORGIA CESSION 1802
TERRITORY NORTH WEST OF THE OHIO RIVER
TERRITORY SOUTH OF THE OHIO RIVER
WISCONSIN
MICHIGAN
OHIO
INDIANA
ILLINOIS
IOWA
MISSOURI
ARKANSAS
TENNESSEE
MISSISSIPPI
MISSISSIPPI TERRITORY
ALABAMA
LOUISIANA CESSION 1803
TEXAS 1845
SPANISH CESSION FLORIDA 1819
GULF OF MEXICO
ATLANTIC OCEAN
Mississippi River
Missouri
Sabine
Greenwich 95
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MAP SHOWING THE
TERRITORIAL GROWTH
OF THE UNITED STATES
1776-1887

Google

PART II.—PHYSICAL GEOGRAPHY AND STATISTICS.

PHYSICAL GEOGRAPHY AND STATISTICS.

North America is very unequally divided between races speaking English and those whose official language is Spanish. From the parallel of 30° south the continent narrows very rapidly, and nearly all the country to the north of this parallel is under the control of English-speaking people. It is true that many emigrants from various portions of Europe, and some from Asia, as well as the descendants of Africans, are mingled with the descendants of the English: but this does not materially affect the truth of the statement, that north of 30° the English language is not only dominant, but almost universal. This vast region, embracing an area of more than seven millions of square miles, is pretty equally divided, so far as area is concerned, between colonial possessions of Great Britain and a country of which the nucleus was once colonial and English, but which for a little more than a hundred years has been independent of the mother country, and which has greatly increased in area since that change took place, by the absorption, as explained elsewhere, of land formerly to a certain extent controlled by, or in nominal possession of, people speaking French and Spanish. The Spanish-speaking inhabitants of North America are known as Mexicans and Central Americans, the colonial English as Canadians; and owing to the difficulty of making a convenient and euphonious adjective-appellative out of the name United States, the citizens of "the States" are being more and more generally designated by the term "Americans."

oundaries nd area. The British possessions in North America, although about equal in area to the United States, are much less densely populated than this country, and will in all probability ever remain so, since in regard to climate, soil, and mineral productions, the northern portion of the continent stands in a position greatly inferior to that of the more southern region. To the United States belongs that portion of North America which by its position in latitude is, in large part, capable of supporting a dense population, and where the climatic conditions are highly favorable to intellectual and physical development.

The area embraced under the designation of "the United States" of North America, extends from the Atlantic to the Pacific Ocean. Its boundaries, other than these oceans, are in part natural and in part artificial. The Gulf of Mexico forms the southern boundary of the United States between the meridians of 83° and 97°. Between Mexico and the United States, the boundary is in part natural and in part arbitrary. The most essential feature of this boundary is the Rio Grande, from the mouth of which the division line between Mexico and the United States follows this river to the point where the parallel of 31° 47′ intersects it.

The boundary line between the United States and Canada follows the middle of the St. Lawrence River and the Great Lakes, from the point where the 45th parallel cuts that river to a point on Lake Superior where the Rainy Lake River enters that lake, thence up that river to a point on the west side of the Lake of the Woods, and thence along the 49th parallel to Puget Sound.

The triangular area between Lakes Ontario and Erie on one side and Lake Huron on the other extends far to the south of the remaining portion of Canada, and this southerly area constitutes the most valuable and thickly inhabited portion of the Dominion.

The United States, as thus limited, leaving out of consideration the remote territory of Alaska, comprises an area of 3,025,600 square miles. This includes 55,600 square miles of water surface, embracing the following items:—

Coast waters, bays, gulfs, sounds, etc.	17,200
Rivers and smaller streams	11,600
Lakes and ponds	23,900
Leaving the total land surface	2,970,000
Total	3,025,600

Under the head of "lakes and ponds," as given above, no portion of the Great Lakes is included. The area of Alaska is given in the Census Report of 1890 as being 531,409 square miles, which figures, however, can be only a rough approximation, and which differ greatly from those given in the Report of the Commissioner of the General Land Office for the year ending June 30, 1886. The total of the possessions of the United States is therefore, approximately, 3,557,000 square miles. The area of the British Possessions in North America, including Newfoundland, but not the Arctic Archipelago, is given by Behm and Wagner at 3,218,077, and by Mr. Selwyn, Government Geologist of Canada, at 3,580,000 square miles,—the latter estimate including Newfoundland, and also the islands in the Arctic Ocean and Hudson's Bay. The area of Mexico is given by Behm and Wagner as 751,177 square miles, and that of Central America 211,320 square miles. The total area of North America including the Arctic Archipelago and Central America, may therefore be approximately stated as follows:—

British Possessions	3,540,680
United States	3,557,000
Mexico	751,177
Central America	211,320
Total	8,060,177

graph- l posi- n. The area of the United States lies between the 67th and 125th degrees of longitude, and the 25th and 47th degrees of latitude.

The form and character of the coast lines of the United States may properly first claim our attention in a topographic sketch of the area under consideration. The facilities for good harbors are lacking on both coasts. The deficiency in this respect on the Pacific side is striking, there being only one important bay on this coast between San Diego and Puget Sound; namely, that of San Francisco. This, as compared with the mass of the land, is of insignificant size, but as furnishing a large, safe, and easily accessible harbor, is of the greatest importance. The indentation at San Diego is much smaller than that of San Francisco, but that also furnishes a commodious harbor. With these exceptions there are within the limits of the United States no satisfactory harbors on the Pacific coast except those of Puget Sound and Columbia River in the extreme north.

Ports and harbors. The eastern coast of the United States is provided with several good harbors and some large bays. On the Maine coast there is the harbor of Portland, which may be taken as a type of a number of safe and commodious ports along the coast. In Massachusetts, Cape Cod incloses a large and safe bay, at the lower end of which is situated the harbor of Boston. In New York, the situation of the city by the same name makes that port the most important center of commerce in the United States.

The superiority and commodiousness of the harbor of New York depends in part on the breadth of the Hudson near its mouth—this river being in fact almost an arm of the sea—and also on the position of Long Island, the western end of which is so placed with reference to the coast of New Jersey and a closely contiguous small island (Staten Island) as to inclose a large land-locked area called the Upper Bay.

Long Island, off the coast of Connecticut, has a length of 120 miles. It is the only island of any importance on the Atlantic coast. There are a number of smaller ones, such as Block Island, Nantucket and Martha's Vineyard.

Bays. South of New York are the Chesapeake and Delaware Bays. The latter receives the water of the Delaware River, and the Chesapeake that of the Potomac and the Susquehanna. The largest indentation on the coast of the United States is the Gulf of Mexico.

It is into this great reservoir that the superfluous waters of the larger portion of the United States are carried, chiefly by the Mississippi and Missouri, but also by direct drainage into the Gulf from the adjacent States. The peninsula of Florida, projecting from and extending five degrees south of the mainland, and forming the eastern boundary of the Gulf, is of more importance in its relations to the currents entering into the Gulf than it is as an addition to the inhabitable territory of the country.

A large portion of the northern boundary of the United States is of a peculiar kind. It is neither land, river, nor ocean, but fresh water; it being a line drawn through the central portion of four of the so-called "Great Lakes"—Ontario, Erie, Huron and Superior. Lake Michigan, on the other hand, is wholly within the limits of the United States.

The Great Lakes. The Great Lakes, which are five in number, constitute a most important feature in the topography of the country. They are remarkable for their size, and for the near approach to equality of altitude above the sea-level of the surface of the four largest ones. Navigation is entirely uninterrupted between Erie, Huron and Michigan, and these have the following elevations: Erie 573 feet; Huron, 582; Michigan, 582. Lake Superior is twenty feet higher than Lake Michigan, but this obstruction has been overcome by the building of a canal around the Falls of St. Mary (Saut Ste. Marie), with a single lock of sufficient dimensions to accommodate vessels and steamers of the largest size. Lake Ontario is 329 feet lower than Erie, and these two lakes are connected by a canal on the Canada side; while Erie is also thus connected, on the American side, with the Hudson River, and through this with the Atlantic.

As before remarked, the chief drainage of the United States is to the Gulf of Mexico, through the system of the Mississippi-Missouri and their tributaries, as will be seen by the following table, showing the extent of the various important divisions of the drainage area of the country, as given by the U. S. Census of 1890:—

Atlantic and Gulf	2,178,210
Great Basin	208,150
Pacific Slope	610,240

Drainage areas The drainage area of the Mississippi Missouri River is estimated at 1,240,039 square miles or somewhat over one third of the entire area of the country. The drainage into the Atlantic and Gulf, as stated above at 2,178,210 square miles, is divided as follows.—

New England coast	61,830
Middle Atlantic coast	83,020
South Atlantic coast	132,040
Great Lakes	175,340
Gulf of Mexico	1,725,980
Total	2,178,210

The drainage into the Gulf of Mexico is thus divided:—

Into the Gulf direct	485,941
Through the Mississippi River	1,240,039
	1,725,980

This indication of the overwhelming preponderance of the drainage of the territory of the United States into the Gulf of Mexico naturally opens the way to a recognition of the most important fact in the topography of the country — namely, the existence of such an orographic structure as compels the waters to concentrate themselves into one great system of tributaries coming in from the east and the west, and uniting in a main north-and-south channel. The cause of this state of things becomes evident when we notice the general relief of the country, and the positions of the various water-sheds. To acquire the best general idea of the relief of the surface of the United States, we may begin by supposing the land to be depressed, or the level of the ocean raised, to an amount equal to one thousand feet. By doing this we should flood a great strip of country across the continent. Mexico would remain on the west a great mass of land, while to the north of the United States the land would rapidly diminish as higher latitudes were reached.

GENERAL TOPOGRAPHY.

In describing the physical features of a country, it is necessary to consider its general plan, the skeleton or framework of mountains, to which its plains, valleys, and river systems are subordinate, and on the direction and elevation of whose parts its climate is, in a very large degree, dependent.

The skeleton of the United States is represented by two great systems of mountain ranges, or combinations of ranges, one forming the eastern, the other the western side of the framework by which the central portion of our continent is embraced. These two systems are the Appalachian ranges and the Cordilleras of North America. These systems are of very different magnitude and extent. Between them stretches a great interior valley, occupied by the Mississippi and the great lakes.

Mountain regions.

The central portion of the United States is nearly a level area, embracing a tract of country about 1250 miles east and west, and about 1200 miles north and south. It slopes gently downward to the center from the east and west, and towards the Gulf of Mexico, from its northern limits. The mountain regions, both on the east and west coasts, are not embraced under one continuous range, but are complicated in their orographic structure.

The eastern and western elevated regions being made up of a great number of topographically more or less detached portions, it was not until a comparatively recent period that these regions received such general distinctive appellations as would evidently be required in any discussion or description of the country as a whole. At the present time, by general consent of geographers and geologists, the eastern elevated side of the continent is called the APPALACHIAN Region; the western the CORDILLERAN, while the comparatively level country between these ranges is known as the MISSISSIPPI VALLEY.

The Great Basin of the Mississippi is bisected through its center by a supreme artery, which, above St. Louis, has received the name of the *Missouri*, and below the *Mississippi* River.

This is 5,000 miles in length, and its surface is a continuous inclined plane, descending seven inches in the mile. Into this central artery, as into a common *trough* descend innumerable rivers coming from the great mountain chains of the continent.

All of the immense area thus drained forms a single *basin*, of which the circumferent mountains form the rim. It may be also called an *amphitheatre*, embracing 1,500,000 square miles of surface. This has been, during the antediluvian ages, the bed of a great ocean, such as is now the Gulf of Mexico, or the Mediterranean, above the surface of which the mountains protruded themselves as islands. Gradually filled up by the filtration of the waters during countless ages, it has reached its present altitude above the other basins, over which the oceans now still roll, and into which the waters have retired.

Mississippi Basin.

The Basin of the Mississippi is, then, a pavement of calcareous rock, many thousand feet, in depth, formed by the sediment of the superincumbent water, deposited stratum upon stratum, compressed by its weight and crystallized into rock by its chemical fermentation and pressure. It is in exact imitation of this sublime process of the natural world that every housewife compresses the milk of her dairy into solid cheese and butter. It is, therefore, a homogeneous, undulating plain of the *secondary* or sedimentary formation, surmounted by a covering of soil from which springs the vegetation, as hair from the external skin of an animal. Through this coating of soil, and into the soft surface strata of rock, the descending fresh waters burrow their channels, converging everywhere, from the circumferent rim to the lowest level, and pass out to the sea.

The most noticeable facts in regard to this vast area are its slight elevation above sea-level and the general plain-like character of its surface. These conditions are well illustrated by the statement that at Cairo, the junction of the Ohio and the Mississippi, we are 1,100 miles from the Gulf, and yet only about 300 feet above the sea-level. At Pittsburgh, the head of the Ohio river proper, we have attained an elevation of only 699 feet. Going in the opposite direction, or following up the tributaries of the Mississippi and of the Missouri, which come in from the west, we have a similar condition of things. One may travel up the Platte or the Kansas for hundreds of miles, rising so gradually and so imperceptibly that the country seems all the time a level plain. From Council Bluffs to the source of Lodge Pole creek, along the line of the Union Pacific railroad, the ascent averages only 5 feet to the mile. From St. Paul, which is only 700 feet above the sea, we travel for 670 miles westerly before the mouth of the Yellowstone is reached, and here we have attained an altitude of only 2,010 feet, with an average rise of only 2 feet to the mile.

The great lakes, those vast expansions of the upper waters of the St. Lawrence, are among the grandest of the geographical features of the North American continent. They are remarkable for their immense area, and for their uniformity of elevation above sea-level, and the consequent facilities which they afford for commercial intercourse.

Their combined area is a little more than 90,000 square miles, Lake Superior having over 30,000, and Lakes Michigan and Huron each over 20,000 square miles of surface. Erie, Huron, and Michigan are nearly on the same level, the extreme difference between the first and the last-named being only about 16 feet, while Superior is only 20 feet higher than Michigan, or 36 above Erie. The divide between the great lakes and the waters flowing into the Mississippi and its tributaries is also everywhere low, and at the lower end of Lake Michigan it is so trifling that only a small amount of excavation has been required to cause waters which formerly flowed into that lake to run toward the Gulf of Mexico. Lake Ontario is, indeed, 323 feet lower than Lake Erie, about half the descent from one to the other being made in one single plunge of the vast body of water, forming a cataract which has, in all probability, no rival in the world.

The level and fertile region of the Mississippi valley is prolonged toward the far southwest, around the Gulf of Mexico and far into the interior of Texas, where it finally passes into the elevated, barren plateau of the Llano Estacado.

Tim

All that portion of the Mississippi basin lying between the Mississippi River and the Atlantic, is densely timbered, excepting only a portion of Indiana, Illinois, and Wisconsin; so also are the States of Louisiana, Arkansas, and South Missouri. An irregular line from the head of Lake Erie, running toward the south and west into Texas, defines the cessation of the timber. Between this line and the sea exists a continuous forest region, perpetually moistened by showers from the ocean. Beyond this line, and deeper into the continent, the upland ceases to nourish timber, which is replaced by luxuriant annual grasses, though narrow lines of forest continue upon the saturated bottoms of the rivers and in the islands. This is the Prairie region of luxuriant annual grasses and soft arable soil, over which the fires annually sweep after the decay of vegetation.

The termination of this belt is marked by an irregular line parallel to the first, where the rain ceases, and the timber entirely disappears. It is about 450 miles in width, and within it artificial irrigation is not practiced nor necessary, it being everywhere soft, arable and fertile.

To this succeeds the immense *rainless* region onward to the mountains, exclusively pastoral, of a compact soil, coated with the dwarf buffalo grass, without trees, and the abode of the aboriginal cattle. That no desert does or can exist within this basin, is manifest from the abundance and magnitude of the rivers; the uniform calcareous formation; the absence of a tropical sun; its longitudinal position across the temperate zone; and the greatness and altitude of the mountains on its western rim. The river system of the Mississippi Basin resembles a fan of palm-leaf. The stem in the State of Louisiana rests in the Gulf; above, the affluent rivers converge to it from all parts of the compass. From the east come in the Homochitto, the Yazoo, the Ohio, the Illinois, and the Upper Mississippi. From the *west*, the Red River, the Washita, the Arkansas, the White, St. Francis and Osage Rivers, the Kansas, the Triple Platte, the L'Eau qui Cours, and the Yellowstone, all navigable rivers of great length and importance. These rivers present a continuous navigable channel of 22.500 miles, having 45,000 miles of shore—an amount of navigation and coast equal to the Atlantic Ocean. The area of the Mississippi Basin classifies itself into one-and-a-half-fifths of the compactly growing forest, the same of prairie, and two-fifths of great plains. Through all of these the river system is ramified as minutely complex as are the veins and arteries of the human system.

Riv sys

Pl

Beyond this great main river stretch out the vast prairies of the west. These plains are not *deserts;* they are calcareous, and form the *Pastoral Garden* of the world. Their position and area may be easily understood. The meridian line which terminates the States of Louisiana, Arkansas, Missouri and Iowa on the west, forms their *eastern* limit, and the Rocky Mountain crest their *western* limit. Between these two limits they occupy a longitudinal parallelogram of less than 1,000 miles in width, extending from the Texan to the Arctic coasts. There is no timber upon them, and single trees are scarce. They have a gentle slope from the *west* to the *east*, and abound in rivers. They are clad thick with nutritious grasses, and swarm with animal life. The soil is not silicious or sandy, but is a fine *calcareous* mould. They run smoothly out to the navigable rivers, the Missouri, Mississippi, and St. Lawrence, and to the Texan coast. The mountain masses toward the *Pacific* form no serious barrier between them and that ocean. No portion of their whole sweep of surface is more than 1,000 miles from the most facile navigation. The prospect is everywhere gently undulating and graceful, being bounded, as on the ocean, by the horizon. Storms are rare, except during the melting of the snows upon the crest of the Rocky Mountains.

The climate is comparatively *rainless;* the rivers serve, like the Nile, to irrigate rather than drain the neighboring surface, and have few affluents. They all run from *west* to *east*, having beds shallow and broad, and the basins through which they flow are flat, long and narrow. The area of the Great Plains is equivalent to the surface of the twenty-four States between the Mississippi and the Atlantic Sea. They are one homogeneous formation, smooth, uniform, and continuous, without a single abrupt mountain, timbered space, desert, or lake. From their ample dimensions and position they define themselves to be the ***pasture-fields of the world***.

The Pastoral Region is *longitudinal*. The bulk of it is under the Temperate Zone, out of which it runs into the Arctic Zone on the north, and into the Tropical Zone on the south. The parallel Atlantic *arable* and *maritime* region flanks it on the east; that of the Pacific on the west.

While, on the whole, so nearly a plain, this vast area, comprising over a million and a half square miles, has considerable diversity of surface, it being not altogether destitute of mountains, some of which rise to a considerable altitude. To describe, even with a moderate amount of detail, the basin of the largest river system but one in the world would require many volumes. All that can be done is to indicate the salient features of its geology, as supplementary to that which has been said in regard to the structure of the great mountain systems by which this geologically comparatively undisturbed region is framed in.

Tertiary and Cretaceous rocks.

Geological formation.

The Tertiary and Cretaceous rocks, extending along the Gulf and up the Mississippi Valley as far as the Ohio River, underlie about one-half of Alabama and Arkansas, the entire State of Mississippi, Louisiana, parts of Tennessee, Kentucky, a small corner of Missouri, and nearly all of Texas. Thence this geological formation follows the general trend of the Rocky Mountains, on their eastern side and underlies the western half of Kansas, nearly all of Nebraska, North and South Dakota, a portion of Iowa, and the western part of Minnesota.

Triassic rocks stretch over a large area of Texas: they also extend into the Indian Territory and the southern part of Kansas. All but a small portion of the Northern Central group of States and portions of the Southern Central group of States, are of the Paleozoic rock formation, covered by post-Tertiary and recent detrital formations. In southeastern Missouri, the Azoic area is important from an economical standpoint. Iron ores of immense value occur in Pilot Knob, Iron Mountain and other localities. Iron is also found in the Azoic formations about Lake Superior, in the States of Wisconsin and northwestern Minnesota. North of this iron region is the copper-bearing rock of the lower Silurian age. Over New York, northern Pennsylvania, and the country bordering on the Great Lakes is found a large amount of "drift." How this so-called "drift" was distributed over this area is a question which has long been a subject of discussion among geologists. By far the larger number of those who have investigated the subject ascribe the origin of this coarse detrital material to glacial causes. It is believed that at one time the northern part of the continent was covered with ice, and that which we see on the present surface of the region that was thus covered, is the result of the action of these glaciers, or of the floods which were produced when they melted.

THE CORDILLERAN REGION.

The Cordilleras are a part of the great system or chain of mountains which borders the Pacific coast of both divisions of the American continent, South and North America, and forms its dominating and most imposing feature.

From Mexico the system of the Cordilleras enters our territory, widening and gaining in complexity. Just above the southern border of Arizona, along the parallel of 32°, occurs the greatest depression of the Cordilleras existing anywhere north of southern Mexico; and here the continent may be traversed without rising to an elevation of over 1,000 feet. The country along this line is a table land, with many short and broken ranges of no great altitude built upon it, but deeply excavated by numerous canons, as the narrow valleys of the streams in the Cordilleras are universally called, of which the canon of the Colorado may be taken as the type.

The Cordilleras.

On this plateau, in latitude 35°, is a group of extinct volcanoes, similar to the range which traverses Mexico. These grand volcanic cones, of which San Francisco mountain is the loftiest and the best known, rise to nearly double the altitude of the plateau on which they stand. The greatest width of the Cordilleras is along the line passing from the vicinity of San Francisco, by Great Salt Lake, to Fort Laramie, or between latitudes 38° and 42°. Here the mass of mountains and plateaus attains a breadth of fully a thousand miles; and if the Black Hills, an outlier of the Rocky Mountains, in latitude 44°, are included—as they may properly be—the total breadth of the *complexus* of ranges will be, in its maximum, over 1,100 miles. The whole area embraced within the mountainous belt which we call the Cordilleras is but very little, if any, short of a million of square miles, or one-third the area of the country. Hence it may, with propriety, be called the greatest physical feature of our territory.

To roughly indicate the shape of the mass of the Cordilleras we may consider it as having a lozenge-shaped figure, bounded by two parallel north and south sides and two northwest and southeast sides. The length of each side is approximately 600 miles. The western edge of the figure corresponds in trend to the line of the Pacific coast, which, as a glance at the map will show, is northwest and southeast as far as Cape Mendocino, and from there to Vancouver Island north and south nearly. The north and south trending portion of the Pacific edge of the Cordilleras is known as the Cascade range; the northwest and southeast range as the Sierra Nevada. Here, bordering on the Cascade and Sierra Nevada ranges, but still nearer the ocean, are the Coast ranges, parallel with the loftier masses on the east, and inosculating with them, at various points, in such a manner that a distinct separation between coast and interior ranges seems hardly possible, either on geographical or on geological grounds.

The Rocky Mountains proper form the eastern rim of the Cordilleras. Throughout New Mexico, Colorado, and southern Wyoming their face ranges north and south. The northern part of this system, lying in northern Wyoming and Montana, presents to the plains a northwest and southeast face, similar to that of the Sierra Nevada.

The lozenge-shaped figure thus indicated, framed in, as it were, by the Cascade range and Sierra Nevada on the west and the Rocky Mountains on the east, incloses a high plateau, which, through its center east and west, has an elevation of from 4,000 to 10,000 feet above sea-level, falling off toward both the north and the south from its central line

Let us consider it in its great general features. It may be divided into—

1st. The section of the Rocky Mountains,
2d. That of the plateaus,
3d. That of the Great Basin, and
4th. That of the Pacific

The country lying east of the first section is a great plain, extending to an undefinable eastern limit, which may be set, however, roughly at the 100th meridian. This plain is not strictly level, but undulating, like the swell of the sea. Most of the stream valleys are shallow depressions, and the divides between them are but slightly marked. These plains rise slowly westward, with an even gradient, to a height of 4,000 to 6,000 feet at the eastern base of the Rocky Mountains, being the highest in Colorado, decreasing thence northward and southward. They are covered with grasses almost throughout, and form a grazing-ground of almost incalculable capacity.

With the exception of the Missouri and the Yellowstone, none of the streams are of any importance to navigation, and they are of use only for irrigation. The capacity of this region for supporting life is largely dependent upon its rainfall, which will be discussed further on.

Rocky Mountains

The Rocky Mountains form the eastern member of the Cordilleran system,—a member made up of many subordinate ranges, each range or sub-group of ranges having a distinctive name, recognized by those living near, while the name "Rocky Mountains" is in general use as the proper appellation when a number of these sub-groups of ranges are intended to be included under one common name.

From the south border of the United States to about latitude 43° their general course is nearly north and south, and from this point northward to the British line it is nearly northwest, thus forming the two eastern sides of the lozenge above spoken of. They consist of a number of ranges, nearly all of which trend parallel to one another—a few degrees east of south and west of north, or roughly parallel to the northeastern side of this region.

In the southern portion the ranges run out one after another into the plains, forming an *echelon* arrangement, thus giving to the system a nearly north and south face.

In Colorado the underlying plateau attains a greater elevation than in any other part of the Cordilleran system, reaching an extreme height in the South Park of 10,000 feet. Here, too, the ranges reach a greater altitude than in any other part of the Rocky mountain system. Numberless peaks rise from 14,000 to 14,500 feet above sea-level. There are few passes in the ranges at a height much below timber-line, which is from 11,000 to 12,000 feet. Northward and southward the plateau decreases gradually in height, carrying downward the ranges which stand upon it. Southward through New Mexico the ranges not only decrease in height, but become broken and scattering, while the extent of level plateau country becomes much greater. Toward the north, in southern Wyoming, all the ranges stop abruptly, leaving to represent the Rocky mountain system only a line of plateaus of an elevation of 6,000 to 7,000 feet stretching from Bridger pass, in the southern part of the territory, northwestward to the South pass, at the south end of the Wind River chain. In this latitude a number of ranges rise abruptly from the plateau, beginning with the Big Horn on the east, then the Wind River range, some of whose peaks are more than 13,000 feet in altitude, and the multitudinous ranges which border the headwaters of the Snake river. From this point, as the system continues onward into Idaho and Montana, the underlying plateau and the ranges also greatly decrease in height, but not in complexity. In the northwestern part of Montana and northern Idaho, indeed, the whole country is a mass of mountain ranges, whose elevation is from 8,000 to 9,000 feet, separated in most cases, by very narrow valleys, the whole area being densely covered with forests.

THE PLATEAU PROVINCE.

The region of which the principal or more striking, topographical and geological features are next to be indicated, is that lying south of the Great Basin, and which is drained by the Colorado and its tributaries. It is included chiefly within the boundaries of the Territories of Utah and Arizona: but, to a certain extent, similar characteristic features are found in the adjacent portion of Colorado, New Mexico, and Nevada.

For convenience of geological discussion, that belt of country which lies between the meridian of Denver, Colorado, and the Pacific, and between the 34th and 43d parallels, is divided into provinces, each of which possesses topographical features which distinguish it from the others. The easternmost is named the Park Province. It is situated in the central and western parts of Colorado, and extends north of that State into Wyoming, and south of it into New Mexico. It is pre-eminently a mountain region, having several long ranges of the second order of magnitude. The structure and forms of these mountains are not exactly similar to those of any other region now well known, but possess some resemblance to the Alps, though not a very close one.

Platforms and terraces.

To the westward of these ranges in Colorado, there are, near the western boundary of that State, regions having a very different topography. The mountains disappear almost wholly, and in their stead there are platforms and terraces nearly or quite horizontal on their summits or floors, and abruptly terminated by long lines or cliffs. They lie at greatly varying altitudes, some as high as 11,000 feet above the sea, others no higher than 5,000, and with still others occupying intermediate levels. Seldom does the surface of the land rise into conical peaks, or into long, narrow, crested ridges; but the profiles are long, horizontal lines, suddenly dropping down many hundred or even two thousand feet, upon another flat plain below. This region has been very appropriately named, by Professor Powell, the Plateau Province. It occupies a narrow strip in the extreme western part of Colorado, a similar strip of western New Mexico, a large part of southern Wyoming, and rather more than half of Utah and Arizona.

This region may be roughly defined as comprising the drainage basin of the Colorado river and its tributaries. The upper portions of its tributaries flow, however, in the Rocky Mountains and the Wahsatch range, and enter the plateau region lower in their courses. This region lies west of the southern section of the Rocky Mountains and east of the Great Basin, and constitutes a great depression or valley in the Cordilleran region of a roughly triangular shape, its apex being in western Wyoming, near the head of the Green river, one of the forks of the Colorado. It is a region of table lands and canons; of table lands horizontal or nearly so, stretching for many miles with scarcely an undulation in the uniform surface, but suddenly ending abruptly in a line of cliffs, perhaps thousands of feet in height, and extending in an unbroken line for hundreds of miles. In this region every stream is in a gorge, cut hundreds, or even thousands of feet below the surface by the action of water on the soft, stratified sandstones and limestones. Most of this region is uninhabited and uninhabitable, not only by reason of the climate, which forbids agricultural pursuits, but from its almost hopeless impassableness.

Separating this region from the Great Basin is the Wahsatch range, which may be considered as a spur from the Rocky Mountains. It is a range of considerable breadth and altitude, extending from northern Utah nearly to the middle latitude of the State, and descending to the general level of the country on the south and east by a series of plateaus, forming a veritable giant's stairway. The elevation of this range in its highest portion is from 10,000 to 11,000 feet, one or two peaks only reaching an altitude of 12,000 feet. Joining this range in the northern part of Utah is that of the Uinta, which differs from nearly all the ranges of the Cordilleran region by having an east and west trend. It forms the southern limit of the Green River basin, the region upon which the fugitive name "*Great American Desert*" has been latest bestowed, and where it is probable it has at last found a final resting-place.

This range far exceeds the Wahsatch in elevation, a number of its peaks extending skyward nearly 14,000 feet, and its broad, plateau-like summit being for a considerable extent at an elevation of 12,000 feet.

Canons.

The Grand Canon District is a part of the Plateau Province. As already indicated, it lies between the Park and Basin Provinces, and its topography differs in the extreme from those divisions found on either side of it. It is the land of tables and terraces, of buttes and mesas, of cliffs and canons. Standing upon any elevated spot where the radius of vision reaches out 50 or 100 miles, the observer beholds a strange spectacle. The most conspicuous objects are the lofty and brilliantly colored cliffs. They stretch their tortuous courses across the land in all directions, yet not without system; here throwing out a great promontory, there receding in a deep bay, and continuing on and on until they sink below the horizon or swing behind some loftier mass or fade out in the distant haze. Each cliff marks the boundary of a geographical terrace, and marks also the termination of some geological series of strata, the edges of which are exposed like courses of masonry in the scarp-walls of the palisades. Very wonderful at times is the sculpture of these majestic walls. Each geological formation exhibits in its cliffs a distinct style of architecture which is not reproduced among the cliffs of other formations, and these several styles differ as much as those which are cultivated by different races of men. The character which appeals most strongly to the eye is the coloring. The gentle tints of an eastern landscape, the pale blue of distant mountains, the green of vernal or summer vegetation, the subdued colors of hill and meadow, are wholly wanting here, and in their place is the brilliant red, yellow and white, which are intensified rather than alleviated by alternating belts of gray. Like the architecture, the colors are characteristic of the geological formations, each series having its own group and range of colors. They culminate in intensity in the Permian and Lower Trias, where dark, brownish reds alternate with bands of chocolate, purple, and lavender, so deep, rich, and resplendent, that a painter would need to be bold to venture to portray them as they are.

Cliffs.

Gorges and ravines.

Drainage channels.

The Plateau country is also the land of canons, in the strictest meaning of that term. Gorges, ravines, *canadas* are found, and are more or less impressive in every high region; and in the vernacular of the West, all such features are termed canons indiscriminately. But these long, narrow, profound trenches in the rocks, with inaccessible walls, are seldom found outside the plateaus. There they are innumerable, and are the almost universal form of drainage channels. Nearly everywhere the drainage channels are cut from 500 to 3,000 feet below the general platform of the immediate country. They are abundantly ramified and every branch is a canon. All these drainage channels lead down to one great trunk channel cleft through the heart of the Plateau Province for eight hundred miles—*the chasm of the Colorado*, and the canon of its principal fork, the Green River.

The region is for the most part a desert of the barrenest kind. At levels below 7,000 feet the heat is intense, and the air is dry in the extreme. Vegetation is very scanty, and even the ubiquitous sage is sparse and stunted. Here and there the cedar is seen, the hardiest of arborescent plants, but it is dwarfed and sickly, and seeks the shadiest nooks. At higher levels the vegetation becomes more abundant and varied. Above 8,000 feet the plateaus are forest clad, and the ground is carpeted with rank grass and an exuberant growth of beautiful summer flowers. The summers there are cool and moist; the winters severe and attended with heavy snow-fall. The Plateau Province is naturally divided into two portions, a northern and a southern. The dividing barrier is the Uinta range. This fine mountain platform is, in one respect an anomaly among the western ranges. It is the only important one which trends east and west. Starting from the eastern flank of the Wasatch, the Uintas project eastward more than 150 miles, and nearly join perpendicularly the Park ranges of Colorado. Of the two portions into which the Plateau Province is thus divided, the southern is much the larger. Both have in common the plateau features; their topographies, climates, and physical features in general, are of similar types, and their geological features and history appear to be closely related. But each has also its peculiarities. The northern portion is an interesting and already celebrated field for the study of the cretaceous strata, and the Tertiary lacustrine beds. The southern part of the Plateau Province may be regarded as a vast basin, everywhere bounded by highlands, except at the southwest, where it opens wide and passes suddenly into a region having all the characteristics of the Great Basin of Nevada. The northern half of its eastern rim consists of the Park ranges of Colorado. Its northern rim lies upon the slopes of the Uintas. At the point where the Uintas join the Wahsatch, the boundary turns sharply to the south, and for 200 miles the High Plateaus of Utah constitute the elevated western margin of the Province. A crude conception of this region may be gained by imagining three lines, each 200 miles long, placed in the positions of three sides of a square; the fourth side being for the moment neglected. Upon the eastern side, conceive the Park Ranges of Colorado; upon the northern, the Uintas; and upon the western side, the southern portion of the Wahsatch and the High Plateaus of Utah; and all these highlands having altitudes ranging from 9,000 to 12,000 feet above sea-level, while the included area varies from 5,000 to 7,000 feet in height. The space thus partially bounded may represent the northern part of the southern Plateau Province. Along the line required for the fourth and south side of the complete square there is no boundary. The topography continues on beyond it to the southward, and also widens out both west and east and overspreads an additional area more than twice as great as that already defined. From the eastern coast of the High Plateaus may be obtained an instructive overlook of the northern portion of the southern Plateau country.

Utah plateaus

Carboniferous age

Throughout the great carboniferous age the entire area of the Plateau Province was submerged beneath the ocean. Deposition of strata went on continuously, leaving at the close of this age a subaqueous surface, which was exceedingly flat, and, except around the borders of the Province, quite free from any appreciable inequalities. The thickness of the carboniferous system is from 4,500 feet to 5,000 feet in the interior of the Province, but, around its borders, and in the Uinta mountains, it is sometimes found in far greater volume. After the Carboniferous came the Permian age, in which were laid down from 800 to 1,500 feet of sandy shales. The same state of affairs continued through the Trias, during which period sandstone beds were deposited. Directly upon the Trias rests the Jurassic,—a wonderful bed of sandstone 800 to 1,200 feet thick, and very white and sugary. Next comes the Cretaceous system,—a mass of yellow sandstones with clayey and marly shales, aggregating from 4,000 to 5,000 feet thick. At the close of the Cretaceous period there are evidences that extensive disturbances took place, resulting at some places in the dislocation and flexing of the strata.

Sandsto

Geologi history.

The last period of deposition was marked by the accumulation of the Eocene beds. Around the southern flanks of the Uintas their aggregate thickness exceeds 5,000 feet, but southward the upper members disappear, and 80 miles north of the Grand Canon only about 1,000 to 1,200 feet make their appearance. In the course of geological history, this area, which had been a region of deposition and subsidence, became one of elevation and denudation. Since that change took place, the havoc wrought by erosion has been stupendous, the thickness of strata removed exceeding 10,000 feet in some considerable areas, and averaging probably 5,500 to 6,000 feet over the entire Province.

THE GREAT BASIN.

West of the Plateau Province is the Great Basin, so named by Premont, because it has no drainage to the ocean.

Bonnevil and his party.

The first general idea of the drainage and principal topographical features of the Great Basin is due to Bonneville, who fitted out a party which started from Green River with the intention of making the entire circuit of Great Salt Lake. This, as Irving states, was a favorite idea of Bonneville's; and in preparing for this expedition all the resources at his command were taxed. The party, consisting of forty men, did not, however, succeed in carrying out Bonneville's plans, but were driven, by the difficult topography and utter barrenness of the country on the south side of the lake, toward the west, traveling in which direction they soon came upon the head-waters of the river called upon Bonneville's maps "Mary or Ogden's," but which is now known as the Humboldt. This river they followed until they found that "it lost itself in a great swampy lake (the sink of the Humboldt), to which there was no apparent discharge." From here the party crossed the Sierra Nevada and made their way to Monterey. Bonneville's party was thus the first to explore and map the route afterward generally followed by emigrants, and along which the Central Pacific—the first trans-continental railroad—was built. The peculiar course of Bear River, here already noticed, was shown on this map, and the general character of the drainage of the Pacific coast was, for the first time, correctly indicated by Bonneville. The first working out of any of the details of the topography of the Great Basin is due to Butler Ives, a topographer in the employ of the Central Pacific Railroad, the directors of this work having been desirous of ascertaining whether there was any practicable route across the Basin other than that through the valley of the Humboldt; which, however, was the one ultimately adopted, all other routes having been found too difficult. Still further and more detailed explorations and surveys were made on the western side of the Basin, first by the California Geological Survey, and later by the United States Engineers; and a belt t hundred miles in width was also surveyed across this region, starting from the crest of the Sierra Nevada and going east to the eastern base of the Rocky Mountains. This belt was the field occupied by the Fortieth Parallel Survey under the direction of Clarence King.

Topography of the Great Basin. The topography of the Great Basin is wholly peculiar, and bears no resemblance to either of the two just mentioned. It contains a large number of ranges, all of which are very narrow and short, separated from each other by wide intervals of smooth, barren plains. The mountains are of a low order of magnitude for the most part, though some of the ranges and peaks attain considerable dimensions. Their appearance is strikingly different from the noble and picturesque outlines displayed in Colorado. They are jagged, wild and ungraceful in their aspect, and, whether viewed from far or near, repel rather than invite the imagination.

The Wahsatch, however, is an exception. This noble range is properly a part of the Basin Province, and is one of the finest and most picturesque of the West, but so completely does it contrast with the other basin ranges that it may be regarded as an anomaly among them. The topographical features of this region are also found outside of the limits which Fremont assigned to the Great Basin, and reach southward towards Arizona, and northward towards Idaho and Oregon.

This Great Basin is of enormous extent, comprising nearly all of Nevada and large parts of Utah, Wyoming, Idaho, Oregon, and California. Instead of being one great basin, as its name implies, it consists in reality of a number of smaller basins. It is traversed by a series of narrow ranges, which are in general highly continuous, extending sometimes for hundreds of miles, having a general north and south trend. Between these ranges lie narrow, flat valleys floored with detritus from the mountains. The rainfall over this region is so light, and the atmosphere so dry, that there are few living streams within its whole expanse. The little rivulets which trickle down the mountain side in the spring are absorbed in the valleys at their bases, so that each valley in very many cases is a sink for its own waters. On the east and the west sides, however, at the bases respectively of the Wahsatch and the Sierra Nevada, is a lake, or a series of lakes, into which flow considerable bodies of water from these ranges.

Surroundings of Great Basin. On the east is Great Salt Lake, having an extent of 2,310 square miles, and receiving drainage from an area of 32,400 square miles, the larger part of which consists of high mountains. The rapidity of evaporation in this dry climate is so great that the lake is kept at approximately the same level despite the liberal contributions made to it by its tributary streams.

The middle portion of the basin, along a line running down eastern Nevada, is more elevated than that of the east or the west side, forming a sort of division, or water-parting, between the two portions. Such of the waters as do not immediately sink flow off toward the Great Salt Lake on the one side and the sinks at the base of the Sierras on the other. The latter are known as the Carson Lake and sink, Humboldt Lake, Mud and Pyramid Lakes, forming a line along the western part of Nevada.

Into this system of sinks flow not only the streams from the east slope of the Sierras, but the Humboldt River—a stream which rises in northwestern Utah, and, flowing directly across the trends of numberless ranges, receiving more or less water from them all, reaches the Carson sink scarcely larger than at its head.

A third system of sinks may be mentioned, viz., that lying in central Oregon, of which Harney's Lake is the principal one.

The Pacific Division. It remains to give a slight sketch of the ranges of the Pacific division. They consist of the Sierra Nevada of California, the Cascade range of Oregon and Washington Territory, and the system of Coast ranges which border the Pacific. These ranges have one very marked feature in common; they are almost precisely parallel throughout to the line of the Pacific coast. Trending in the southern half considerably east of south, they turn at about the parallel of 42° to a course almost directly north.

Cascade range. The great mass of the Cascade range has the form of a volcanic plateau of an elevation very little above the country on its eastern border. At intervals along its crest, however, are stationed high volcanic peaks, ranging from 8,000 to more than 14,000 feet above sea-level. Among these may be mentioned Mount Rainier, in Washington territory, 14,444 feet high; Mount Shasta, 14,442 feet high, in California; and Mount Hood, in Oregon, 11 225 feet in height. In northern California, just south of Mount Shasta, the range is very much broken down, and at this point the Pitt River, the head stream of the Sacramento, has cut its way through the range into California. Beyond this gorge again the range continues, with but slight change in its characteristics, until we have passed the head of the Feather River, where its character changes from that of a volcanic range to one of granite and gneissic rocks. With this change comes an increase in elevation, at first gradual, but ultimately attaining enormous proportions about latitude 36° 30′. Here the range has a great breadth, while most of the peaks reach elevations of more than 14,000 feet, and the passes have an elevation of about 12,000 feet. In this region is the highest peak of the Sierras, Mount Whitney, which falls but little short of 15,000 feet, and is the culminating point of this group.

West of the Sierras and the Cascades lies the great valley, extending from Puget Sound southward into the lower part of California. It is walled in from the Pacific on the west by the Coast ranges. In Washington territory it is drained by numerous minor streams flowing through the Cascade and the Coast ranges into the Columbia River and Puget Sound. In Oregon it comprises the valley of the Willamette and the upper valleys of the Rogue and the Umpqua Rivers. In California it comprises the valley of the Sacramento and the San Joaquin. These valleys are separated from one another by cross-ranges of mountains, which have the character of spurs sent down by the Cascade range, joining the Coast ranges on the west. The great valley is terminated by the westward trend of the Coast ranges and their junction with the Sierra Nevada in southern California.

Coast ranges. Of the Coast ranges little need be said, except that they are of minor elevation compared with the eastern part of the system, ranging from 3,000 to 4,000 feet south of the bay of San Francisco to 5,000 or 6,000 feet in the northern part of the State. They have, however, a very important effect in modifying the climate of the great valley—an effect quite as important as that of the Sierra Nevada and the Cascade ranges upon the climate of the region lying to the east of them. Want of navigability is the characteristic of all the streams which drain the Cordilleras. Instead of vast stretches open to steam navigation, as with the Mississippi and its tributaries, allowing access to areas 2,000 and 3,000 miles away from its mouth, we have the Colorado, which is of little account for the purposes of navigation, the Columbia, with two portages before the Cascade range is crossed, and the Sacramento and the San Joaquin, navigable for moderate sized boats for only a few score of miles. With these exceptions there is no stream of any importance opening access to the interior along the whole Pacific coast. On the other hand, the amount of water-power stored in the streams of the west is fabulous. All the streams fall rapidly through nearly their entire courses, and in and near the mountains there is an abundance of water.

THE APPALACHIAN REGION.

Leaving now the Cordilleras, we have next to consider the eastern border of our territory—the northeast and southwest-trending mass of ranges—known as the Appalachian region. In this portion of our brief *resume* of the physical features of the United States we shall have to rely mainly on the labors of others, and especially on those of Prof. Guyot and of Prof. J. P. Leslie, of the Pennsylvania Geological Survey, who have labored with great zeal and ability in making the topography of our eastern border intelligible.

A glance at the map shows that the central portion of North America, from the Gulf of Mexico to the Arctic ocean, is a region of great rivers and lakes, and not of mountains. A sinking of the land of less than 1,000 feet would open a water-way through from north to south; 2,000 feet of such a sinking, or an equivalent rise of the ocean, would divide our territory into two distinct and remote portions. On the east we should have a comparatively narrow belt of land, extending in a northeast and southwest direction from Pennsylvania to Georgia, with groups of outlying islands on the north, especially in about latitude 44°, where the tops of the Green, the White, and the Adirondack mountains would rise in the form of lofty and precipitous islands above the waste of waters. On the west the mass of land remaining uncovered would be of grand, almost continental dimensions, for its breadth would be fully equal to 1,500 miles, narrowing as we followed it northward, while in length, north and south, it would extend entirely across our present territory. The breadth of the ocean separating these masses of land would be not far from a thousand miles.

Appalachian chain. The Appalachian chain extends from the promontory of Gaspé, in a general southwesterly direction, for a distance of about 1,300 miles, into Alabama, where it dies out, and is buried under the horizontal strata of more recent geological formations, which cover nearly the whole surface of that state. The base from which this chain rises on the eastern side is the Atlantic seaboard, which, in the early history of the United States, seemed to be the whole country, and which is still commercially the most important, and is the seat of our largest cities. The plain is slightly inclined toward the Atlantic, and its elevation above the sea is inconsiderable. In New England it hardly exceeds 300 to 400 feet; but toward the south, after passing the bay of New York, where it is nearly at the sea-level, it gains in altitude, and also in width, finally attaining a height of a thousand feet at the base of the mountains and a breadth of some 200 miles. The western base of the Appalachian range is a plateau region, which descends gradually toward the great lakes and the tributaries of the Ohio, having a general elevation of a thousand feet or more, but deeply gashed by the streams which traverse it and run in valleys depressed from 300 to 500 feet below the general level of the country.

The Appalachian chain presents, in many of its features, a most marked contrast to the Cordilleras just described. Prof. Guyot calls attention to a conspicuous feature of the most folded portion of the Appalachians, characterizing the chain through its entire length; that is, the existence of a great central valley, running through the system from northeast to southwest, which can be traced without difficulty, although not perfectly uniform in its development. It is the Lake Champlain and Hudson River valley in New York, the Kittatinny valley of Pennsylvania, the great valley of Virginia, and finally, still farther south, the valley of East Tennessee. The chain, or the system of chains, bordering this central depression on the southeast is also a persistent feature of the Appalachian system; for it extends, with but few interruptions, from Vermont to Alabama, being known by a variety of names as it passes from one state into another. It is the Green Mountain range of Vermont, the Highlands of New York, the South Mountains of Pennsylvania, the Blue Ridge, of Virginia, and, finally, the Iron, Smoky, and Unaka mountains of North Carolina and Tennessee.

Possessing these features in common as a whole, the Appalachian chain presents three subdivisions, each exhibiting its own well-marked peculiarity of structure. These are the northern, extending from Gaspé to the Hudson; the middle, from New York to the Kanawha, or New river, in Virginia; the southern from New river to the southwestern extremity of the system. Each of these subdivisions has its peculiar curvature and general direction. The northern trends to the north from the Hudson river to near the Canada line, there bends to the eastward, sweeping a great curve, so as to present on the whole its concavity to the southeast; the middle subdivision also curves quite regularly, the ridges trending from east and west around to southwest, so that the concavity faces the Atlantic shore, while the most southern portion of the range, from New river southward, bends to the west again, so as to form a gentle curve concave toward the northwest.

The most northern division of the three is quite distinct from the one next south, both geographically and geologically. It includes all the mountain groups and ranges north and east of the valleys of the Mohawk and the Hudson rivers, which make a complete break through the system, both vertically and longitudinally, forming the great natural highway between the east and the west, or between the great lakes and the Atlantic seaboard. This was the first route across the country which was traversed by canal and by railroad. So complete is the physical break here that a rise of the ocean of 400 feet only would separate all the extensive region included between the St. Lawrence, the Atlantic ocean, and the Hudson and Mohawk valleys into a great island entirely detached from the rest of the continent. A rise of only 140 feet only would detach all that country which lies east of the Hudson and Lake Champlain.

In any geographical treatment of this eastern group of the Appalachians the subdivisions taken will necessarily be rather artificial, for the mass of elevation is very irregular in its development. The most continuous ranges are the White mountains, the Green mountains, and the Adirondacks. Of the first-named group Mount Washington is the culminating point, 6,288 feet high; of the last mentioned, Tahawas, or Mount Marcy, with an altitude of 5,379 feet, is the dominating peak. Greylock, in Massachusetts (3,505 feet), and Mount Mansfield, in Vermont, 4,430 feet, are the highest points in those states.

The line of summits extending through Massachusetts and New Hampshire, beginning with Wachusett, on the south, and extending up to the White mountains, through Monadnock, Sunapee, Kearsarge, and other peaks, is broken and irregular. Both the White mountains and the Adirondacks are rather isolated masses, while the Green Mountains proper are in more intimate connection with the Canadian range, which terminates in Gaspé.

The Central division of the Appalachian chain extends from the Hudson river to the Kanawha, which makes an almost complete cut across the chain, heading in the Blue Ridge, and marking an important change in the character of the topography. This central division is about 450 miles in length. It is very narrow toward its northern end, but widens out in Pennsylvania, decreasing again in Virginia. It is composed of a considerable number of subordinate chains, much curved toward the west, and remarkable for their regularity, their parallelism, their abrupt declivities, and their moderate elevation, both relative and absolute, which rarely rises to 2,500 feet above the sea-level.

West of this division of the Appalachian chain is the great plateau, which occupies all that part of New York which lies south of the Mohawk, and also the northwestern part of Pennsylvania, and reaches an elevation near Lake Erie of 2,000 feet. From this table-land the drainage descends by the great lakes to the St. Lawrence to the Gulf of Mexico by the Ohio, and to the Atlantic by the Susquehanna, which breaks across the whole chain, finding its way in the most unexpected manner through gaps in the different ranges.

The topography of the Appalachians in Pennsylvania has been carefully worked out by the State Geological Survey, and it is so remarkable in its character that some additional details may with propriety be given in regard to that portion of the chain.

According to Prof. H. D Rogers, the mountain-zone of Pennsylvania may be divided into five well-marked parallel belts, which are as follows, when enumerated in order from the east toward the west: 1st. The South mountains, already mentioned as being the continuation of the Highlands of New York, and the equivalent of the Blue Ridge of Virginia. 2d. The great Appalachian valley. 3d. The central Appalachian ridges, or the Appalachian chain proper. 4th. The sub Allegheny valley. 5th. The Alleghany Mountain, or the southeast escarpment of the Alleghany plateau.

The South Mountains have already been alluded to as part of the system of ranges bordering the great central depression of the Appalachians on the east. In Pennsylvania this belt consists of two detached ranges of hills, one of which is the prolongation of the New York Highlands, the other the northeastern termination of the Blue Ridge. Both of these groups of hills have a moderate elevation in Pennsylvania, hardly exceeding 600 or 700 feet.

The Appalachian valley, or Kittatinny valley, as it is usually called in Pennsylvania, stretches from the Delaware to Maryland, forming a part of the great central valley previously mentioned. It has an elevation of from 200 to 600 feet, and forms a broad, moderately undulating plain, having a width of from 10 to 18 miles. This valley is, beyond doubt, one of the most favored parts of our country—climate, soil, mineral resources, and scenery all combining to make it attractive to settlers.

The third division, or the Appalachian chain proper, may be thus described, using nearly the language of Professor H. D. Rogers: It is a complex chain of long, narrow, very level mountain ridges, separated by long, narrow, parallel valleys. These ridges sometimes end abruptly in swelling knobs, and sometimes taper off in long, slender points. Their slopes are singularly uniform, being in many cases unvaried by ravine or gully for many miles; in other instances, they are trenched at equal intervals with great regularity. Their crests are, for the most part, sharp, and they preserve an extremely equable elevation, being only here and there interrupted by notches or gaps, which sometimes descend to the water-level, so as to give passage to the rivers. The whole range is the combined result of an elevation of the strata in long, slender, parallel ridges, wave-like in form, and of excessive erosion of them by water; and the present configuration of the surface is one which demonstrates that a remarkable and as yet little understood series of geological events has been concerned in its formation. The ridges, which are but the remnants of the eroded strata, are variously arranged in groups, with long, narrow crests, some of which preserve remarkable straightness for great distances, while others bend with a prolonged and regular sweep. In many instances, two narrow, contiguous parallel mountain crests unite at their extremities and inclose a deep, narrow, oval valley, which, with its sharp mountain sides, bears not unfrequently a marked resemblance to a long, slender sharp pointed canoe.

Between the Appalachians and the Rocky Mountains there are within our borders no connected masses of mountain ranges; isolated hill-ranges rise like islands at various points, as in Missouri and Arkansas, and there are a few short ranges on the south shore of Lake Superior.

North of the great lakes and the St. Lawrence, however, there is the dividing ridge which separates the waters flowing into the last named stream from those which run into Hudson's bay. This is an imperfectly known region, wonderfully cut up by rivers and dotted with lakes. The highest point of the Laurentian range, as these mountains are called, is supposed to be where the Saguenay cuts the chain, and 4,000 feet is given as the approximate elevation, while peaks in the parallel ridges nearer the St. Lawrence exceed half that height. Among the summits seen with such picturesque effect from Quebec, Mt. St. Ann is the highest, and the elevation is given by Bayfield at 2,687 feet.

This range falls off in elevation as we follow it west, and in the country between the Ottawa and lake Huron the highest summits do not appear to exceed 1,500 to 1,700 feet. The range is made up of rounded hills, densely wooded on its highest portion, almost exclusively with coniferous trees. Its valleys are very wide and full of great ponds and lakes, so that one may traverse almost the whole region with the aid of the birch canoe. Sir William Logan noted, in 1863, that over a thousand lakes have already been laid down on the maps of the Canadian portion of the Laurentian mountains, although the region had been as yet only imperfectly explored.

The Atlantic Plains.

East of the Appalachian system, and separating it from the Atlantic, is the strip of country known as the Atlantic plain. This is the portion of the United States first occupied, and it is to-day the most densely settled portion of the country. In New England this region has a widely varying breadth and rough, irregular surface, while its soil in general is not sufficiently rich to enable the farmers of this region to compete successfully in the production of wheat or corn with those of the Mississippi valley.

The breadth of the Atlantic plain is least about the bay of New York, the ranges of the Appalachian system here reaching nearly to the sea-coast. Southward from this point it increases gradually in breadth, till it reaches its maximum in South Carolina and Georgia. This part, which comprises by far the larger portion of the Atlantic plain, has a very uniform, gentle slope from the foot of the mountains to the sea. The only feature about it which requires notice is the line of separation between the metamorphic formations, extending eastward from the Appalachians, and the recent stratified beds. This line is marked very generally by falls or rapids in the streams flowing seaward, which are in very many cases the sites of valuable water-powers, and mark the head of navigation in all streams of any considerable size, as in the Potomac at Georgetown, and in the James at Richmond.

General character.

The general character of the coast-line may be briefly described. In Maine it is bluff and rocky, with deep water immediately off the shore, which is deeply indented by numerous bays and arms of the sea. These in turn are dotted by hundreds of islands of greater or less size. Proceeding southward, the character of the coast gradually changes from this bluff, rocky nature at first to sandy beaches, as in Massachusetts and on Long Island, with small extents of coast swamp. This character develops farther in New Jersey, so that we have along the whole coast a line of sandy islands or reefs, back of which are coast marshes and swamps. The general character of these is briefly described by Professor Cook in his volume on the geology of New Jersey, under the head of "Tide Marshes":

> They are of very recent origin, and, in fact, are formed largely within the memory of the present generation. The interval between high-water mark on the shore and the beaches or barriers on the sea-side is mainly occupied by marsh. There are between 250,000 and 300,000 acres of marsh on the coast of New Jersey. The marshes are covered with grass, weeds, or coarse sedge; there is no growth of wood upon them: the upper surface is near the level of high water, the parts near the water-course being high enough not to be covered by ordinary tides, while the parts more remote from the water-course are lower, so as to be always wet. Underneath, the sod which covers them is made of soft earth of various qualities, the depth of this underlying mud is variable; all, however, coming within the extreme depth of 40 feet.

Farther southward the breadth of this swamp section along the coast increases. On the eastern shore of Maryland there is inside of the line of reefs a section, several miles in breadth, of swamp and overflowed land—a paradise for sea-fowl and for the hunter.

In North Carolina the reefs inclose, besides immense swamp regions, large bays or sounds, such as Pamlico and Albemarle. The character of the swamps and reefs of this state is well given by Professor W. C. Kerr (*Geology of North Carolina*, vol. 1, 1875):

> The chain of long, linear sand islands called "The Banks," which fringe the entire coast, constitutes a very remarkable feature of the region. Though composed of drifting sands, they form an impregnable barrier to the waves of the Atlantic. They are, in fact, sand dunes of various elevations, from a few feet above tide level (in many cases broken over by storm tides) to 25 or 30 feet, and sometimes more, as in Killdevil hills, along Corrituck sound. The breadth of these islands varies from a few rods to

more than 2 miles. The largest of them, and the widest, is known as Hatteras island, the easternmost point of which is the well-known Cape Hatteras. These islands are composed partly of flat marshes and partly of swells and ridges of beach sand, which the wind has heaped in ridges, often far beyond the reach of the highest waves.

As the sand and comminuted shells are rolled back in waves from the beach by the winds, they are in part caught and fixed by straggling tufts of coarse grass, which has the power of continuous growth upward with the rise of the knobs and ridges of sand, and they are in part carried over into the flats and marshes and the shallow sounds beyond, which are thus gradually silting up. The banks are generally covered with low, scrubby thickets of cedar, live-oak, pine, yaupon, myrtle, and a number of smaller shrubby growths.

Swamps, pocosins, and savannas.—There is a large aggregate of territory (between 3,000 and 4,000 square miles), mostly in the counties bordering on the sea and the sounds, known as swamp lands. They are locally designated "dismals," or "pocosins," of which the Great Dismal Swamp, on the borders of North Carolina and Virginia, is a good type. They differ essentially in their characteristic features from an ordinary swamp. They are not alluvial tracts, or subject to overflow. On the contrary, they occur on the divides or water-sheds between the rivers and sounds, and are frequently elevated many feet above the adjacent streams, of which they are the sources. Some of them are in large part mere peat swamps or bogs, being characterized by the occurrence of an accumulation of decayed and decaying vegetation, from 1 or 2 to 10 feet deep and even more, which, with the growing plants, acts as a sponge, arresting or retarding the escape of the rain-water, whether by evaporation or efflux. The prominent ingredients are peat and fine sand, in various proportions, and, when of any agricultural value at all, there are also small proportions of clay, iron, lime, and alkalies. The vegetation varies with the character of the soil, and serves, therefore, as an index of its fertility. The prevalent growth of the best swamp soils is black gum, poplar, cypress, ash, and maple. As the soil becomes more peaty, the proportion of cypress increases. Where juniper abounds peat is in excess, and the soil of little value or none. On the best lands there is often besides a rank growth of canes; but such a growth is also often found on soils too peaty to be of any value. Much of the poorest and most worthless tracts of swamp, which are covered with several feet of half-decayed wood and other vegetable matter saturated with water, is occupied by a stunted and scattered growth of bay, swamp pine, and other scrubby vegetation; or, if the drainage be a little better, with a thickety growth of bays, gallberries, and a few other shrubs, with an occasional pine and maple. Most of the large bodies of swamp contain lands belonging to all these descriptions, and inclose, besides, within their boundaries, knolls, hummocks, belts, and ridges, like islands, of firm land, and some of them large areas of barren, sandy soil, covered with a tangle of brambles and tufts of sedge, and in the middle of several of them occur fresh-water lakes of considerable extent.

These swamps are, taken as a whole, quite well settled, a large portion of the inhabitants being colored. This is particularly the case in South Carolina, in which State much of the swampy lower coast region is utilized for rice plantations. The Okeefenokee swamp, of Georgia and Florida, is rather an inland swamp, and is described elsewhere. The Everglades of Florida, which appear to offer great difficulties to settlement, are also sketched in another part of this report. The swampy region along the coast extends, with but few minor interruptions, all the way down the Atlantic coast and around the Gulf. It is not, however, so markedly characteristic along the Gulf coast in Alabama and Mississippi as farther west. In Louisiana it has a great breadth, and is almost uninhabitable. In Texas, although the character of the coast continues to be the same so far as relates to the line of low, sandy, outlying islands, yet the area of the coast swamp becomes very much less, being confined to a small patch about the Sabine lake and narrow strips along a number of the streams. Whether it is due to geological causes, or to the lighter rainfall upon this section of the coast, is a question which there is not space to discuss here.

The broken, irregular course of the whole Atlantic and Gulf coast affords many excellent harbors, particularly on the New England coast, where the harbors are large, deep and well sheltered; farther southward the entrances are narrow and shelving, and are liable to be choked up by sand drifted in by storms. The streams in nearly all cases form bars across their mouths, formed by the detritus brought down from the upper waters.

The Pacific coast, as compared to the Atlantic, is extremely simple. It contains few harbors, of any value to navigation. Those of San Diego and San Francisco are the principal and almost the only ones. The coast is, in general, bluff and rocky, and the water is deep immediately off shore.

THE POLITICAL AND NATURAL SUBDIVISIONS.

Having given a description of the physical character of the area covered by the United States, without reference to political divisions, it becomes necessary to state how this region is divided politically, and how these divisions can be grouped, in a manner as natural as possible.

Some difficulties are thrown in the way of such a subdivision of the country as shall meet with general acceptance by the fact that some of the States and Territories are so large that they include areas of very different physical character; and also because a nomenclature was introduced, and extensively made use of, when one-half the present area of the country was so little known or considered that a name for it was not thought of as being necessary.

The area of the United States is at present divided into forty-nine subdivisions, excluding Alaska. There are forty-four States, three Territories, and two other subdivisions, neither States nor Territories—the District of Columbia and the Indian Territory.

Any Territory is likely, at any time, to be received into the Union as a State; and this may be done by subdividing the Territory, making a State of one portion and allowing the remainder to remain in a Territorial condition, or by admitting the whole as one State, or by dividing it into two or more States. Only once has a State been divided after having been received into the Union—namely, Virginia—and this was the result of the Civil War; and it is not possible to say under what circumstances such a thing is likely to happen again. Nor has any State been remanded back to the Territorial condition after having been received into the Union; although one State—Nevada—has less than half the population required for the election of one representative to Congress, according to the last apportionment, based on the census of 1880. There is, in fact, no provision in the Constitution for this exigency.

The desirability of grouping these forty-nine political divisions (Alaska being omitted as not continuous with the rest of the United States) according to their geographical situation and topographical and climatic conditions, so that different regions may be spoken of by some collective name, will be evident to all.

Physical Character.

The plan suggested for the subdivision of the area included within the United States by Mr. Gannett, geographer of the census of 1880, was "to divide the country into three great divisions, corresponding to the three primary topographical divisions of the country: the Atlantic region, the region of the Great Valley, and the Western or Cordilleran region." The physical character of these different regions has already been indicated at some length in the preceding pages. The region of the Great Valley is called by Mr. Gannett the Central Region, which is again subdivided into two parts—the Northern Central and the Southern Central—the Ohio River and the southern boundary of Missouri and Kansas being the dividing line. The Atlantic Division is also divided by him into two subdivisions by a line following the south boundary of Pennsylvania and New Jersey—these two subdivisions being called, respectively, the North Atlantic and South Atlantic divisions. On the east, the Western or Cordilleran division is marked by the eastern boundaries of New Mexico, Colorado, Wyoming and Montana.

Political divisions.

The following table shows the area of each of these divisions in square miles and in percentage of the entire area of the United States:—

	Area.	Percentage of total area
North Atlantic.........	168,765	5.6
South Atlantic (including Delaware Bay)...	283,155	9.4
Northern Central.....	765,845	25.3
Southern Central......	614,560	20.3
Western...............	1,193,275	39.4
Total....................	3,025,600	100.0

[In the Western Division, as here limited, Mr. Gannett includes an area of 5,740 square miles of "unorganized territory," lying north of Texas and west of the Indian Territory.]

The adoption of this scheme of subdivision of the country does not the less render desirable and convenient for various purposes a different nomenclature for certain regions, based more exclusively on geographical position. Thus the States bordering on the Gulf of Mexico will naturally often be spoken of as the Gulf States; the region of the Great Lakes will be so designated, and this again subdivided into the Upper and Lower Lake Regions; while each great river will give a name to its own adjacent region, as the Ohio Valley, the Upper and Lower Mississippi Valley, the Upper Missouri, etc.

Appended is a statement of the names of the political divisions included in each subdivision of the United States, as suggested by Mr. Gannett:

Division.	Subdivision.	States Within Subdivision.
Atlantic.	**North Atlantic.**	Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania.
	South Atlantic.	Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida.
Central.	**Northern Central.**	Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, North Dakota, South Dakota, Iowa, Nebraska, Kansas, Missouri.
	Southern Central.	Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Indian Territory, Louisiana, Texas.
Western.		Montana, Idaho, Wyoming, Colorado, New Mexico, Utah, Nevada, Arizona, Washington, Oregon, California.

The tabular statement following gives for the States and Territories a *résumé* of their areas, population in 1880 and 1890, population per square mile at the latter date, and the increase per cent. during the decade 1881-90. The Territories are given in italics in the table.

POLITICAL AND NATURAL DIVISIONS.

AREAS AND POPULATION—CENSUS OF 1890.

States and Territories.	Area in Square Miles.	Population, 1880.	Population in 1890.		Increase Per Cent. 1880–1890.
			Total.	Per Sq. Mile.	
Alabama	51,540	1,262,505	1,508,073	29.3	19.5
Arizona	112,920	40,440	59,691	0.6	47.5
Arkansas	53,045	802,525	1,125,385	21.2	40.2
California	155,980	864,694	1,204,002	7.7	39.2
Colorado	103,645	194,327	410,974	3.9	111.5
Connecticut	4,845	622,700	745,861	153.9	19.8
North Dakota	71,100	36,909	182,425	2.6	393.2
South Dakota	76,620	98,268	327,848	4.3	235.7
Delaware	1,960	146,608	167,871	85.7	14.5
DIST. OF COLUMBIA	60	177,624	229,796	3,829.9	29.4
Florida	54,240	269,493	390,435	7.4	44.9
Georgia	58,980	1,542,180	1,834,366	31.1	18.9
Idaho	84,290	32,610	84,229	1.0	158.3
Illinois	56,000	3,077,871	3,818,536	68.2	24.1
Indiana	35,910	1,978,301	2,189,030	60.7	10.7
Iowa	55,475	1,624,615	1,906,729	34.4	17.4
Kansas	81,700	996,096	1,423,485	17.4	42.9
Kentucky	40,400	1,648,690	1,855,436	46.4	12.5
Louisiana	45,420	939,946	1,116,828	24.6	18.8
Maine	29,895	648,936	660,261	22.1	1.7
Maryland	9,860	934,943	1,040,431	105.5	11.3
Massachusetts	8,040	1,783,085	2,233,407	277.8	25.2
Michigan	57,430	1,636,937	2,089,792	36.4	27.7
Minnesota	79,205	780,773	1,300,017	16.4	66.5
Mississippi	46,340	1,131,597	1,284,887	27.7	13.5
Missouri	68,735	2,168,380	2,677,080	38.9	23.4
Montana	145,310	39,159	131,769	0.9	239.1
Nebraska	76,185	452,402	1,056,793	13.9	133.6
Nevada	109,740	62,266	44,327	0.4	−28.9
New Hampshire	9,005	346,991	375,827	41.7	8.3
New Jersey	7,455	1,131,116	1,441,017	193.3	27.4
New Mexico	122,460	119,565	144,862	1.2	21.3
New York	47,620	5,082,871	5,981,934	125.6	17.7
North Carolina	48,580	1,399,750	1,617,340	33.3	15.6
Ohio	40,760	3,198,062	3,666,719	89.9	14.6
Oklahoma	....	....	61,071	....	....
Oregon	94,560	174,768	312,490	3.3	78.8
Pennsylvania	44,985	4,282,891	5,248,574	116.7	22.6
Rhode Island	1,085	276,531	345,343	318.3	21.3
South Carolina	30,170	995,577	1,147,161	38.0	15.6
Tennessee	41,750	1,542,359	1,763,723	42.2	14.4
Texas	262,290	1,591,749	2,232,220	8.5	40.2
Utah	82,190	143,963	206,495	2.5	43.4
Vermont	9,135	332,286	332,205	36.4	−0.2
Virginia	40,125	1,512,565	1,648,911	41.1	8.9
Washington	66,880	75,116	349,516	5.2	365.3
West Virginia	24,645	618,457	760,448	30.9	22.9
Wisconsin	54,450	1,315,497	1,683,697	30.9	27.9
Wyoming	97,575	20,789	60,589	0.6	191.5
United States	2,900,170	50,156,783	62,480,540	21.5	24.6
Alaska	531,409	33,426	....	....	....
Indian Territory	69,830*	78,142†	....	....	....

* This includes "Unorganized Territory." † Estimate.

CLIMATE.

In endeavoring to set forth the principal features of the climate of the United States, it will be assumed that the reader has made himself acquainted with the topography of the country, as briefly described in the preceding pages. The great influence which many of these features have on the distribution of the winds, the rainfall, and the temperature will be sufficiently apparent from that which follows.

The United States extends from the tropics north across the temperate zone, and from sea-level to an elevation of over 14,000 feet—an elevation which carries with it an arctic climate. The mean annual temperature ranges over more than 40° F., while the extremes of recorded temperature run from 55° below zero up to a maximum above 115°. The mean temperature of the hottest month of the year, July, ranges from below 60° to above 90°, while the mean temperature of the coldest month ranges from zero to more than 60°. Were the country a plain, the mean temperature of the year would be almost purely a question of latitude; a difference of elevation, however, especially when it takes the form of a mountain range, causes a deflection southward of the isothermals, an abrupt rise of about 300 feet of elevation implying a decrease of annual temperature of one degree. Thus we find that the Appalachian system causes a very marked deflection to the southward of the isothermals. On the plains, however, where the upward slope is very gradual, it is to be noted that the elevation causes little or no deflection southward of the lines of temperature, the plains and plateaus generally having a mean annual temperature nearly or quite as high as points in the same latitude in the Mississippi valley or on the Atlantic coast. The temperature of the great western plains and plateaus is, however, modified locally to a marked extent by the exposure to west and northwest winds, which have an unbroken sweep in some places for hundreds of miles, acquiring tremendous force. Attention should be called here to the well-known fact that the climate of central Montana, including most of the settlements on the upper Missouri, is abnormally warm. It lies at a comparatively low elevation, being only 3,000 to 4,000 feet above sea-level, and is sheltered from the fierce westerly winds by the Missouri range, while the northerly winds, to which it is exposed, come from the moisture plains of the Saskatchewan.

The two maps showing the mean temperature of the warmest month, July, and the mean temperature of the coldest month, January, as given in the United States Census for 1880, Vol. 1—illustrate, though only to a limited extent, the range of temperature in different sections of the country. The former shows a comparatively limited number of grades, running from 60° to 90°, the lines following approximately the parallels of latitude, except where deflected by mountain masses. The influence of the coast in averaging the climate is distinctly perceptible on this map. There is apparently a northward movement of the temperature lines in the Cordilleran region, showing that in the summer the temperature is abnormally high in this arid section. These characteristics are illustrated conversely by the January map, which also shows the influence of the sea and other large bodies of water, while in the Cordilleran region the temperature lines are borne southward by the aridity and consequently extreme character of the climate. The fourth of these temperature maps, showing a generalization from the highest recorded readings of the thermometer, coupled with the fifth map, which shows a similar generalization with regard to the minimum temperature, illustrates the extreme range of the thermometer in different parts of the country. In the former we see a belt running along the seacoast from Maine to Texas, where the thermometer never rises above 100°, while within it is a region, stretching from New York southward along the Atlantic plain and the lower Mississippi valley, where the maximum reaches 105°, thus illustrating in the clearest manner the effect of the sea in averaging the temperature. The same thing is illustrated, though not so markedly, upon the map of minimum temperatures.

The fourth map shows also another peculiar characteristic, viz. the fact that as we pass up the slope of the plains the maximum temperature increases, not on a parallel, as in the case of the mean annual temperature, but approximately on a contour or on a meridian, being apparently proportional to the aridity of the atmosphere and the amount of rainfall. This characteristic is, to a certain extent, disguised in the heart of the Cordilleran region by reason of the great diversity of surface which is encountered there, but in general it holds good throughout.

The map showing minimum temperatures is not so clear on these points. Its lines follow parallels more nearly; but there is a marked deflection toward the southwest as we pass westward from the Mississippi valley. The characteristics of this map are still further concealed by the effect of the details of topography in the Cordilleran region. A marked change in temperature, as well as in rainfall, takes place at the crest line of the Sierra Nevada and the Cascade range. This change is not particularly apparent in the mean annual temperature, but on the map showing the temperature of July and January it is quite apparent, being shown by the slight difference between these maps. At the bay of San Francisco the difference between the mean temperature of July and that of January is but 10°. This effect is still more marked in the last two maps, where, in the Mississippi valley, the range between maximum and minimum averages 110°, and in the Cordilleran region 125°. On the Pacific coast it decreases to only 60°, showing that this section of the country enjoys by far the most uniform climate as regards temperature.

The material for these temperature and rainfall maps was drawn mainly from "Temperature Tables" and "Rainfall Tables" prepared by Professor Charles A. Schott, and published by the Smithsonian Institution. The map of mean annual temperature was compiled, very largely, directly from Mr. Schott's admirable chart in the first of the above-mentioned volumes. The rainfall maps were prepared previous to the publication of the last edition of the Smithsonian "Rainfall Tables," and, as much new material had been collected in addition to that published in the first edition, the maps were plotted from original sources.

No less than 85 per cent. of the total population lives between 40° and 70° F. of mean annual temperature, leaving a very small proportion to be distributed among the other sections. Of these groups, those having a temperature above 55° contain the entire cotton region; those above 70°, the sugar and rice regions; while between 50° and 60° is comprised most of the tobacco region. The prairie region of the Mississippi valley lies almost entirely below 55°, while the great wheat region of Minnesota and Dakota is mainly below 40° of mean annual temperature.

The hottest part of the country is, naturally, the southern end of Florida, while southern Texas and southwestern Arizona come next in degree of temperature.

A rough computation shows that the mean annual temperature of the country is about 53° F., to which the location of the population almost precisely corresponds, differing from it by only a fraction of a degree.

We give below a table prepared by selection from the voluminous records of the recent work on American temperature, showing the mean annual temperature of the atmosphere at a given point in each of the forty-nine States and Territories of the Union. The place is selected in either the capital or some leading city or town where observations have been most continuously kept:

State or Territ'y	Place of Observation.	Mean annual temperature.	State or Territ'y	Place of Observation.	Mean annual temperature.
Alabama	Mobile	66°	Mississippi	Jackson	61°
Alaska	Sitka	46°	Missouri	St. Louis	55°
Arizona	Tucson	69°	Montana	Helena	43°
Arkansas	Little Rock	63°	Nebraska	Omaha	49°
California	San Francisco	55°	Nevada	C'p Winf'ld Scott	50°
Colorado	Denver	48°	New Hampshire	Concord	46°
Connecticut	Hartford	50°	New Jersey	Trenton	53°
Dakota	Fort Randall	47°	New Mexico	Sante Fe	51°
Delaware	Wilmington	53°	New York	Albany	48°
Dist. of Columbia	Washington	55°	North Carolina	Raleigh	59°
Florida	Jacksonville	69°	Ohio	Columbus	53°
Georgia	Atlanta	58°	Oregon	Portland	53°
Idaho	Fort Boise	52°	Pennsylvania	Harrisburg	54°
Illinois	Springfield	50°	Rhode Island	Providence	48°
Indiana	Indianapolis	51°	South Carolina	Columbia	62°
Indian Territory	Fort Gibson	60°	Tennessee	Nashville	58°
Iowa	Des Moines	49°	Texas	Austin	67°
Kansas	Leavenworth	51°	Utah	Salt Lake City	52°
Kentucky	Louisville	56°	Vermont	Montpelier	43°
Louisiana	New Orleans	69°	Virginia	Richmond	57°
Maine	Augusta	45°	Washington T.	Steilacoom	51°
Maryland	Baltimore	54°	West Virginia	Romney	52°
Massachusetts	Boston	48°	Wisconsin	Madison	45°
Michigan	Detroit	47°	Wyoming	Fort Bridger	41°
Minnesota	St. Paul	42°			

The position of the isothermal lines in the United States may now be noticed: and in this connection the influence of the topography of the country becomes at once extremely apparent. The isothermal lines of the mean annual temperature have quite a marked regularity, from the Atlantic coast west to the foot of the Rocky Mountains, being in general only slightly modified in their direction, which is nearly east and west. This indication of a change of temperature, essentially dependent on that of latitude, is in striking contrast with the condition of things on the Pacific coast, as will be seen farther on. But as soon as the Cordilleran region is reached, the isothermal lines are bent away from their east and west course, and become irregular and often concentric in their passage across the various mountain ranges.

By the character of these isothermal lines, three climatic divisions of the United States are suggested: 1. The Eastern Region, including all the territory lying east of the foot of the Rocky Mountains; 2. The Plateau and Mountain Region of the Cordilleras; 3. The Narrow belt on the Pacific coast, west of the Cascade and Sierra Nevada Ranges.

The Eastern division is, of course, by far the most important and best known in its details, since it is that region where the statistics go back the farthest, and where the population and wealth are concentrated. Its climatic conditions will, therefore, first be considered. As the topographical features of this division are simple, and do not anywhere interpose any very decided or not easily overcome barrier to the movement of the people, so the climate partakes of a similar character, the passage from one type to another being gradual and decidedly uniform, although rapid.

The isothermal lines of mean annual temperature of 44° and 72°, include nearly the entire area of the United States. The corresponding degrees of latitude are about 45° and 29°, so that the average change of temperature with the latitude is a trifle over 1°.6 for each degree of latitude. The importance of this rapid change of temperature with the latitude, with reference to the intellectual and commercial development of the country is obvious, and has been already pointed out by eminent climatologists.

The isothermal of 72° passes through the center of Florida; then, entering Texas, is suddenly deflected southward, running parallel with the isothermals of 68° and 64° to the boundary line of Mexico. The isothermal of 78° crosses the extreme south end of Florida, almost on the parallel of 25°. The isothermal of 68° enters Florida just below the parallel of 31°, and crossing the state in an almost direct east and west line, passes through the southern part of Alabama, Mississippi, and Louisiana, and into Texas, to the meridian of 102°, where it is suddenly deflected southward to the boundary line of Mexico. The isothermal of 64° enters the United States on the South Carolina coast. It passes in a westerly direction very nearly on the parallel of 33° as far west as the meridian of 100°, when it is deflected southward, like the other isothermals, by the gradually increasing elevation of the Plateau Region. The isothermal of 60° is, in its general course, parallel with that of 64° except that the deflection to the south between the meridians of 83° and 87° is greater, owing to the influence of the lofty southern extremity of the Appalachians. It traverses North Carolina, South Carolina, Alabama; passes into the southern part of Tennessee; is deflected into Mississippi; then enters Tennessee again, passing across Arkansas and the Indian Territory into New Mexico, when it is deflected toward the south, making two loops as it runs nearly coincident with the meridian of 101° to the parallel of 31° in Texas, when it again bends to the west, and, after a southwest course, is deflected toward the northwest. The isothermal of 56° enters the United States on the Maryland coast. Its general direction to the meridian of 87° is southwest. Here, in central Alabama, it is deflected to the northeast, following this general direction to the parallel of 38° in Kentucky, when it bends again to the west and runs in an almost direct westerly course to the meridian of 101°, where it is deflected to the south, passing through New Mexico into Texas, where it suddenly bends back to the north, and, after making a long loop in New Mexico, passes in a northwesterly course across Arizona. The isothermal of 52°, west of the Appalachians runs almost coincidently with the Ohio river as far as Cincinnati, then in an undulating course passes in a nearly westerly direction through Indiana, Illinois, Northern Missouri, and near the northern boundary of Kansas to the eastern border of Colorado, where it is deflected to the south, and runs in a direction nearly south by west for a distance of fully five hundred miles along the eastern base of the Rocky Mountains. A large area is included between the isothermals of 44° and 52° It comprises: New England, except the larger part of Maine, New Hampshire and Vermont: the southern and central portions of New York; Pennsylvania; nearly all Ohio; the northern two-thirds of Indiana and Illinois; the southern half of Michigan and Wisconsin: nearly all of Iowa: the southeastern corner of Minnesota: nearly the whole of Nebraska: and the southern third of Dakota. The isothermal of 40° enters the United States on the eastern border of Maine, and, passing through the center of the state, traverses the northern end of New Hampshire and Vermont. It then passes out of the United States, but enters the country again at the western end of Lake Superior, crossing the central part of Minnesota, bending to the south on the meridian of 97°, and making a large loop in Eastern Dakota, then turning to the northwest, and again passing out of the United States at the meridian of 107°.

West of the meridian of 105°, within the second climatic division or the Cordilleran region, the course of the isothermal is largely determined by the position of the several mountain ranges embraced in that area of complicated topography to which the name of Cordilleras is given. These ranges, unlike the Appalachians, are lofty enough to produce a decided influence upon the climate, although nowhere reaching what may be called the region of perpetual snow. This deficiency of lasting accumulations of snow, however, is in very considerable part due to the smallness of the precipitation. If this were as great in the Rocky Mountains as it is in the Sierra Nevada, the former ranges would, no doubt, be covered to a large extent with permanent snow-fields and glaciers descending from them. Observations of mean temperature, however, on the higher ranges are extremely deficient, so that only a few generalizations can be given with regard to the position of the isothermals in that portion of the territory of the United States.

The isothermal of 44° follows a course in the Cordilleran region which embraces within a great loop to the south, the entire higher portion of the Rocky Mountains, as far south as parallel 34°. The tops of the Sierra Nevada, Blue Mountains, and Cascade Ranges are also included within the loop of the 44°. The Central portion of the Cascade Range, and the Rocky Mountains in the southwestern corner of Colorado, have a mean annual temperature of 40°. The highest part of the Rocky Mountains is indicated as having a mean temperature of less than 36°. Accurate and long continued observations in this region would, however, furnish an extremely complicated system of isothermal curves, since the ranges are numerous, and many of them high.

As the land assumes a more decidedly plateau character in Arizona, Utah and Nevada, the mean annual temperature rises in this portion of the country. In Nevada, the isothermal of 72° extends as far north as the parallel of 36°, and the isothermal of 52° reaches to the Trinity Mountains in parallel 40°. In the Cordilleran region, we find that a great change may be made in the latitude with but a very moderate one in the mean annual temperature, as shown by the parallelism of the isothermals with the coast line. The temperature is higher and more uniform along the Pacific coast than it is on the Atlantic coast of the United States. The isothermal of 60° runs nearly parallel with the coast, and not far from it from the 35th parallel nearly to the 39th. The isothermal of 52° follows the coast from San Francisco as far north as the parallel of 46°.

Summer isothermals.

The isothermals for the summer months—June, July, and August—show greater irregularity on Mr. Schott's chart than those of the year. This holds true especially in the eastern region of the country. The summer isothermals all bend to the north in a very characteristic manner, owing in great measure to the southerly winds, which are heated by the Gulf of Mexico. The summer isothermal of 80° bounds on the north an irregular area, including Florida, the southern part of Georgia, Alabama and Mississippi; Louisiana, the southeastern corner of Arkansas; the southeastern half of Texas; and a tongue of land in New Mexico. Within this area the mean summer temperature ranges from 80° to 88°. The southwestern half of Arizona, and patches in southern and central California have a like summer temperature of from 80° to 88°. A strip including the greater part of North and South Carolina, portions of Georgia, Alabama, Mississippi, Tennessee, Kentucky, Missouri, Arkansas, Kansas, the Indian Territory, Texas, New Mexico, Colorado, Utah, Arizona, and California, lies between the mean summer isothermals of 76° and 80°. The belt near the Ohio, extending north as far as the Great Lakes, and south along the Appalachian table-land into Tennessee, Mississippi, Alabama, and Georgia, and west through Indiana, Illinois, Iowa, portions of Wisconsin, Minnesota, Dakota, and Montana, Nebraska, and northern Kansas, lies between the summer isothermals of 68° and 76°. On the Pacific coast the summer isothermals approach more nearly to the mean annual isothermals in their character and position than do those on the Atlantic coast of the United States. The region of the United States lying north of the States named above has a mean summer temperature ranging from 56° to 68°.

Winter isothermals.

The isothermals for the winter months—December, January and February—in the eastern region of the United States, are more regular than the summer curves, thus approaching in this respect the character of the mean annual isothermals. The winter isothermal of 52° coincides almost exactly with the mean annual isothermal of 68°. It runs parallel with, and at a little distance from, the Gulf of Mexico. The winter curve of 48° corresponds very closely with that of 64° for the year and the winter curve of 44° with the mean annual isothermal of 60°. The winter isothermal of 32° enters the United States at the southern end of Massachusetts, and passes in a southwesterly course across Long Island, just south of New York City, through New Jersey and across the northern end of Maryland, where it is deflected to the south, and makes a long loop around the Appalachians; then near the Ohio, through Indiana, Illinois, Missouri, and Kansas, into New Mexico, where at the meridian of 105°, it is deflected to the southwest and passes around the Rocky Mountains and through the center of the Great Basin. On the Pacific coast, the winter isothermals also closely coincides with the mean annual isothermals. For example, the winter isothermal of 52° corresponds in character and position with the annual curve of 60°.

Winds.

The peculiarities of the North-American climate which most strongly impress themselves on newly arrived visitors, and which are not so apparent in general statistical statements as they are in Nature, may be best set forth and discussed after the more essential facts regarding the other principal climatic elements have been presented.

And it would seem to be next in order to state the principal facts regarding the distribution of the winds in the United States, since a knowledge of these will be essential to an understanding of the important subject of the amount and distribution of the precipitation.

The prevailing winds of the United States, as of all countries lying in the middle latitudes, are westerly. At the 40th parallel as an average position, and on the mean annual isothermal of 50°, the evidences of this prevalence and constancy are overwhelming. Dr Gibbons has noticed, with great care at San Francisco, the course of the higher strata of clouds—the cirrus, and the very high stratus—where they were visible, and has found them to come uniformly from some westerly point. During three years of very careful registry directed to this particular point in western New York, but three instances of a contrary direction were observed. During storms the lower clouds are from various points, and the wind is quite variable during the greater storms: two strata of different movement often lying beneath that from the west, yet the stratum from a westerly point usually deposits the rain, and when it ceases the rainfall ceases, though the lower strata may continue to run on the wind twenty-four hours, or even longer.

Below the 35th parallel and on the Gulf coast only, do the showers of summer take a different movement, showing that the stratum occupied by the cumulus of average height does not there move from the west, but from the east or southeast—an inflection of the trade-wind mingling with a local coast wind.

The following table, arranged from data furnished by the Signal Service Bureau, gives an idea of the direction of the wind in various parts of the country:

STATEMENT showing how many times the wind was observed blowing from the eight principal points of the compass during each season of the year ending June 30, 1880. Compared from observations taken at the several stations of observations at 7 a. m., 2 p. m. and 9 p. m. (local time).

Station.	Wind.	Spring.	Summer.	Autumn.	Winter.
Bismarck Dak	N.	59	32	33	42
	N. W.	56	51	70	75
	W.	24	27	34	15
	S. W.	18	12	17	16
	S.	16	31	22	17
	S. E.	36	60	37	38
	E.	32	34	15	38
	N. E.	25	17	18	13
	Calm.	11	9	27	21
	Blank.	0	0	0	0
Denver, Colo	N.	35	50	46	26
	N. W.	36	42	37	35
	W.	35	15	6	25
	S W.	24	14	12	20
	S.	64	60	111	93
	S. E.	33	34	26	13
	E.	25	29	12	15
	N. E.	23	28	20	23
	Calm.	1	4	3	0
	Blank.	0	0	0	0
Los Angeles, Cal.	N.	31	5	32	64
	N. W.	22	5	12	17
	W.	64	94	59	42
	S. W.	81	74	46	25
	S.	16	10	9	10
	S. E.	19	19	8	15
	E.	16	11	17	29
	N. E.	31	12	48	59
	Calm.	3	37	42	12
	Blank.	0	0	0	0
Saint Louis, Mo	N.	47	36	44	31
	N. W.	27	16	30	44
	W.	25	17	25	30
	S. W.	9	37	15	16
	S.	90	96	93	91
	S. E.	39	33	33	27
	E.	26	19	11	14
	N. E	13	20	22	15
	Calm.	0	2	0	3
	Blank.	0	0	0	0
New York, N. Y	N.	14	13	14	18
	N. W.	69	50	72	54
	W.	36	33	38	46
	S. W.	43	71	60	43
	S.	17	37	18	16
	S. E.	36	23	27	15
	E.	17	11	16	13
	N. E.	36	35	25	53
	Calm.	6	3	3	17
	Blank.	0	0	0	0
Boston, Mass	N	19	24	7	19
	N. W.	45	28	43	62
	W.	48	58	77	58
	S. W.	62	68	50	55
	S.	25	18	33	12
	S. E.	33	22	[illegible]	14
	E.	20	37	19	15
	N. E.	13	26	10	11
	Calm.	11	17	12	27
	Blank.	0	0	0	0
Augusta, Ga	N	14	5	3	13
	N. W.	16	22	21	28
	W.	14	16	5	26
	S. W.	23	41	25	17
	S.	29	27	12	24
	S. E.	31	52	32	16
	E.	14	16	31	4
	N. E.	27	45	64	24
	Calm.	108	46	80	121
	Blank.	0	0	0	0
Chicago, Ill	N.	18	21	21	17
	N. W.	24	6	35	31
	W.	29	29	37	61
	S. W.	69	72	63	60
	S.	42	39	59	37
	S. E.	41	25	19	20
	E.	24	24	13	15
	N. E.	26	39	14	16
	Calm.	2	20	13	16
	Blank.	1	0	0	0
Charleston, S. C	N.	14	6	24	34
	N. W.	19	11	12	20
	W.	21	23	12	25
	S. W.	92	91	39	67
	S.	27	27	7	10
	S. E.	25	30	25	16
	E.	35	45	63	41
	N. E.	32	40	62	56
	Calm.	11	4	6	6
	Blank.	0	0	0	0
New Orleans, La	N.	35	18	53	35
	N. W.	13	16	24	17
	W.	5	38	7	11
	S. W.	21	14	8	22
	S.	59	29	9	30
	S. E.	65	63	48	65
	E.	55	48	66	49
	N. E.	28	25	49	30
	Calm.	5	2	9	6
	Blank	0	0	0	0

The winds along the whole extent of the Atlantic Coast region have a marked resemblance in their important features, notwithstanding the great difference in latitude. Westerly winds predominate during the entire year; but they are chiefly southwesterly in summer, and northwesterly in winter.

In the district between the Appalachians and the Mississippi, westerly and southwesterly winds are prevalent both in winter and summer. On the other hand, over a large territory in the southwestern portion of the United States, covering an area of about one-third of the country, and including Nebraska, Kansas, eastern Wyoming and Colorado, Arkansas, Texas, Utah, New Mexico and Arizona, the summer winds are from the south, while the winds of winter are north and northwest. In northern Michigan, Wisconsin, and Minnesota, this reversal of the winter winds is less marked. In New Mexico and among the Rocky Mountains generally, the winds are of the most extremely irregular character. At the passes of the Sierra Nevada and at all entrances from the coast of the Pacific to the interior, arid districts and deserts, there are violent and continuous westerly winds. On the coast of California, the inward draft of air produced by interior rarefaction is decidedly developed. Capt. Wilkes has designated this as the locality of the "Mexican Monsoon," blowing alternately up and down this coast, or northwest and southeast. The duration of the northern monsoon is from December to May; the currents of air are from the northwest, and nearly parallel with the coast. During its prevalence fine weather is experienced. From May to September the currents of air are from the south and southwest. These are the stormy months, attended with great explosions of electricity, and with copious and constant precipitation. This interior rarefaction, above mentioned, is sufficient to bring a northwest wind on the coast from the 42nd to the 35th parallel, and a south or southwest wind for a long distance below the entrance to the Gulf of California—lines which, if projected to the interior, would cross nearly at right angles over the central areas of the dry interior. On the other side of the continent the southeast monsoon of Texas blows directly toward the northwest wind of California—all proving how great and important this agency of interior rarefaction is in producing the surface winds of the latitudes below the well-determined belt of westerly winds.

To sum up what has been said in regard to the winds of the United States, the following may be added:

1. The influence of the trades is but very slightly felt in the extreme southeasterly portion of the country.
2. The prevailing winds elsewhere are, in general, westerly.
3. On the Atlantic coast, east of the Appalachians, northwesterly winds prevail in winter; southwesterly in summer.
4. In the region between the Mississippi and the Appalachians, southwest and west winds prevail both in winter and summer.
5. Over a wide area, extending from southeastern California to Missouri, and along the base of the Rocky Mountains from New Mexico to southern Dakota, the winds of summer are nearly the reverse of those of winter, being south, southeasterly or southwesterly, with a great predominance of southerly; but north and northwest in winter.
6. On the Pacific coast, the prevailing and normal westerly direction is maintained through the year, intensified in summer by the superadded monsoon influence of the heated plateau region to the east.
7. Through the Plateau or interior Cordilleran region, the surface winds are variable and irregular in character, but the higher currents are in the normal westerly direction.
8. The region of the Lower Colorado is one in which southerly winds greatly predominate in summer, but where in winter there is not so complete a reversal of the summer wind as there is in the area specified under 5.

Rainfall.

The prosperity of a country depends largely upon its rainfall, as, to a very great extent, the primary industry, that upon which all others depend directly, viz., agriculture, may be said to flourish in a degree directly proportioned to the amount of moisture. Of rainfall, this country receives in its different parts a very different supply. Throughout the eastern half of the United States, the rainfall is ample for all purposes of agriculture, while in the western half, with the exception of a narrow strip along the Pacific coast, the supply is very deficient. With the exception of the Cordilleran region, the rainfall is nearly all derived from the Gulf of Mexico and the Atlantic ocean. Of the two, the principal source is the Gulf. The warm, moist currents which accompany the Gulf Stream from the Caribbean sea are not deflected toward the eastward in the Gulf of Mexico, as the great oceanic river is, but pass northward and eastward over the land in a broad belt extending from the coast of Texas to the peninsula of Florida. Judging from its effects in the form of rainfall, the central portion of this current passes over eastern Louisiana and Mississippi and western Alabama. The natural result of leaving the warm ocean surface and entering the continent is to cool these air currents, and make them deposit their vapor. The heaviest deposit is along the northern shore of the Gulf, in the States of Louisiana, Mississippi, and Alabama, and the western part of Florida, where the rainfall reaches 60 inches per annum. Were there no mountains or other irregular topographical features to modify the rainfall, this wave would move inland in a northeasterly direction, the precipitation decreasing eastward, northward, and westward, the lines of equal rainfall taking the form of great concentric ellipses. This form we see roughly outlined in the western part of the Mississippi valley, the rainfall decreasing regularly to the northward and westward. To the northeastward, however, these moisture-laden currents encounter the southern end of the Appalachian chain, and are driven at once up to high altitudes, where they are forced to disgorge their vapor, giving to this end of the mountain system a heavy rainfall; while farther along the chain, toward the northeast, the rainfall diminishes, becoming even less than that of the lower country on the east and west. The portion of the moisture-laden current which passes to the eastward of the Appalachian chain meets and mingles with moist air currents coming directly from the Atlantic, and produces, in the central parts of North and South Carolina, an area of abnormally heavy rainfall. A second source of moisture is the Atlantic ocean. Here the moist air currents from the Gulf Stream produce a line of heavy rainfall along the Atlantic coast, reaching from Florida to the neighborhood of the bay of New York. This strip is quite narrow, being confined to the coast and its immediate neighborhood. Back of that, and over the greater portion of the Atlantic plain, the precipitation is notably less. The conditions of the coast as regards rainfall are somewhat changed north of the latitude last mentioned; that is, near the bay of New York. The Gulf Stream, which has been gradually trending off shore, is here at a considerable distance from the coast. Between the coast and the Gulf Stream has appeared a polar current flowing southwesterly. The contact between the warm air currents of the Gulf Stream and the cold winds accompanying this polar current undoubtedly causes the heavy fogs which prevail on the banks of Newfoundland and St. George's Banks, extending, in a greater or less degree, to the New England coast. Although there is a decrease in the rainfall of this part of the coast from that farther south, yet it is not particularly marked. The precipitation is, however, greatest on the coast, and decreases inland.

Leaving now the eastern half of the country, let us trace the rainfall westward. The lines indicating a smaller degree of rainfall succeed one another at intervals more or less regular as we go west, out of the course of the great continental wave of moisture, and up the slope of the plains. The country here is uniform and generally level, and there is nothing to interrupt the regular decrease in the amount of precipitation until we reach the base of the Rocky Mountains. From this line westward to the Sierra Nevada, we find the conditions of rainfall which are incident to a mountain country accompanied by a dry atmosphere. Taking the Cordilleran region as a whole, with the exception of that part lying west of the Sierra Nevada and Cascades, the rainfall probably does not average more than 10 or 15 inches annually. This, however, is not deposited uniformly over the country: there are certain conditions under which the rainfall in some parts of this region is much greater than in others. Other things being equal, the higher the latitude and the greater the altitude, the greater will be the rainfall. Under this rule the more northern parts of the Cordilleran region enjoy a greater rainfall than the southern parts. The mountains and high plateaus are better watered than the low lands. The best-watered parts of this region are the northern parts of Washington and Idaho, the western part of Montana, northwestern Wyoming, which includes the elevated region known as the Yellowstone National Park, and the high plateaus and ranges of central Colorado. The most arid portions, and those which receive the least rainfall, are western Arizona, southern Nevada, and southeastern California. Although throughout this region we have but few and scattered observations of rainfall, the relative amount can be predicted with a considerable degree of certainty by the character of the vegetation. Everywhere arborescent vegetation implies a considerable amount of rainfall, and accordingly we find the higher plateaus, the mountains, and the regions in the higher latitudes covered with forests. A second zone of rainfall is indicated by the bunch and gama grasses which cover the plains and most of the mountain valleys. They indicate a rainfall not in general sufficient for the needs of agriculture. A third zone is indicated by *Artemisia*, or "sage brush," as this characteristic western shrub is popularly called; while a fourth zone is indicated by the cactus, the yucca, or by an absence of all vegetation whatever.

As has been suggested heretofore, the rainfall in the Cordilleran region east of the Sierra Nevada is in general insufficient for the needs of agriculture, excepting in a few isolated areas where local topography induces a rainfall greater than the normal one. In that section, irrigation is everywhere necessary for the production of cereal crops. Generally it may be stated that a less annual rainfall than 20 inches, or a less rainfall than 12½ inches during the growing season of crops—that is, during the spring and summer—is insufficient for their successful cultivation; and where this supply is not furnished naturally, an equivalent must be supplied by means of irrigation. This limit is reached along a line running approximately on a meridian, and passing through the middle of Dakota, western Nebraska, western Kansas, and central Texas. In the neighborhood of this line, and extending perhaps a degree on each side of it, is a debatable ground, where, in some seasons, the rainfall is sufficient for all crops, while in others it is insufficient. This is Powell's subhumid region. As a rule, wherever irrigation is necessary, the possible extent of agriculture, and in consequence the possible density of settlement, are dependent upon the amount of water carried in the streams. In most parts of the Cordilleran region, there is apparently a far greater amount of land suitable for cultivation than can ever be irrigated, even under the most economical distribution of water. Concerning this point, however, we are at present much in the dark, the capacity of few streams having been measured, even approximately. Under the wasteful system of irrigation at present practiced throughout the West (except in some portions of southern California), the limit of settlement will very soon be reached, so far as the population is dependent upon agriculture.

A question which has assumed practical importance of an almost national character is the effect of the planting of trees and the cultivation of the soil upon climate, many high authorities maintaining that these causes produce an increase in rainfall, and consequently that it is possible to redeem the whole Cordilleran region by a judicious system of cultivation and tree-planting, particularly of the latter. It is doubtful whether that effect can be produced by this or by any other means within the power of man

Such facts as we have within the form of rainfall records in the Cordilleran region do not substantiate the theory, the records showing that the rainfall has not increased in the regions covered by our border settlements since their earliest formation. At the same time, it seems highly probable that a change has been produced, which, while not affecting the climate, has modified decidedly the conditions of moisture. The effects of cultivation upon the soil in covering it with vegetation, and especially with trees, has in general been to retain the moisture upon and in the soil, instead of allowing it to run directly off into the streams, or to be taken up at once by evaporation. In other words, a much larger proportion of the rainfall is rendered effective for agricultural purposes. This effect is already very marked throughout Dakota, Kansas, and Nebraska, and even to some extent in Utah and Colorado.

It remains to sketch the rainfall of the Pacific coast. It is in all respects peculiar, and different from that of the rest of the country. There along the whole coast, and extending eastward as far as the Sierra Nevada and the Cascade range, well-defined wet and dry seasons—the former corresponding to the eastern winter, the latter to the eastern summer.. Taking the year through, the rainfall is very much heavier in the northern part of this section than in the southern. In western Washington Territory, it rains almost constantly for six months of the year, while even in the wet season, the supply of rain in southern California is scanty

An explanation of this peculiar climate is to be found in the ocean currents and the prevailing winds. The winds on the western coast are, as a rule, the "anti-trades," blowing from the west and southwest These winds pass, on nearing the coast, over the great Japanese current, which north of Oregon, is relatively to the land, a warm current, while south of Oregon it is, relatively, a cool current. In passing over this portion of the sea, the atmosphere becomes surcharged with moisture. In reaching the coast the amount of precipitation from this moisture-laden atmosphere depends upon the change of temperature which it encounters. North of Oregon, the land being, as stated above, colder than the sea, there is great precipitation, while south of that state the land being the warmest, the precipitation decreases, till in southern California, where the difference between the sea and land temperature is the greatest, it is almost nothing. The line of demarkation between the different temperatures varies with the season, ranging northward in the summer and southward in the winter, thus giving the alternations between the wet and dry seasons so peculiar to this coast. The influence of the mountains of the Pacific coast, although not sufficient to account for all the phenomena of this climate, still plays a very important part in it. The ascent of the warm currents up the mountain sides of course cools them very greatly, and causes them to deposit whatever remaining moisture they may contain. To illustrate the extent of the action of mountain ranges, it may be stated that, although in the valley of the San Joaquin the rainfall is very light, yet upon the high Sierras it has been found to reach 90 inches in a single year.

The colder months in the United States, including May and September of the warmer months, precipitate most of the rain and snow which falls in what are called general storms. Most of the rain falling before the middle of June in the latitude of Washington is in storms of two or three days' duration. A south or southeast wind, with high temperature and a palpable sense of preparation, usually begins the change; east and northeast winds follow next for a day or more, during which most of the rain falls, and west or northwest winds blow with unusual strength for two days following, restoring the equable and average weather for the month. In the Northern States, a greater number of months is included in those of general rains, which may occur in every month of summer, though they rarely do so. In the Gulf States the period of summer showers is more extended generally, though where the hurricanes of August and September occur, as they do in all the Southern States bordering the Gulf and the Atlantic, the number of extended rains in the summer is more nearly equal to that in New York and New England. In the southwest, at a distance from the coasts, they are rare from the close of April to the middle of October; in the interior farther west they are equally rare, and on the Pacific coast they belong only to the rainy months. But on the Pacific the rains have little, if any, correspondence at any season with those east of the Rocky Mountains.

Some general distinctions should be made at the outset of the examination of storms in the temperate latitudes. The hurricanes, typhoons and tornadoes, each of which more generally belong to the tropics, frequently enter these latitudes in their original forms, and subsequently become blended with the forms which originate here, either by encountering one of these, or by putting on such forms by a gradual process of change. The West India hurricanes impress their character on a series of successive or continuous storms along the Gulf Stream in nearly every case of their approach to temperate latitudes, and the tracks of these in the western Atlantic and along the coast present the most frequent instances of the mingling of storms which were originally wholly different, with the widely extended rains above the 35th parallel.

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The observations with respect to the general winter storms of the United States may be stated as follows:

1. The general winter storms of the United States often cover an area of from three to five hundred miles in diameter, which area is usually oblong or oval, with its greatest length from southwest to northeast.

2. They all move eastward with the westerly winds of the belt where they are formed, and in a line with the isothermals of the month in which they occur—coming from a point north of west at the Mississippi river, and leaving the Atlantic coast in a direction north of east. This course conforms in both cases to the course of the isothermals; or, in other words, they do not leave the measure of heat where they originate to go into colder or warmer climates.

3. Their movement is generally at the rate of movement of the air in these latitudes, or nearly twenty miles per hour; but it may be much greater, or very little.

4. They may be initiated at all points of this belt, and at any meridian, and they have equally no point at which they are more likely to become exhausted and to disappear than any other.

5. They are more violent at the Atlantic coast and at the Gulf Stream than elsewhere, because the contrast of land and sea air is there very great in the colder seasons, and because the direct line of their progress carries them into a belt of high temperature. When the contrast is not great, as in the warmer months, there is no decided increase of severity there.

Northeast winds.

6. They are more generally attended by northeast winds than any others during the first half; or, in other words, the rarefied area almost always induces a draft from that quarter first, and it continues over most of the district in which a draft contrary to the general movement is created.

7. None of the winds from other than westerly points are winds of propulsion, or propagated from their apparent point of origin; they are all, including a portion from the west, winds of aspiration, induced by the agitation, or by the disturbance of equilibrium itself.

8. All the movements and processes are usually carried past the mean by the forces set in motion in these storms; the minimum of heat, moisture, clouds and winds, following the removal of the excess of the first two; and this minimum, though a calm and quiescent state, is itself an extreme and not an average condition in these latitudes.

Tornadoes have less connection with general storms than hurricanes, though they often exist as the nucleus of a general rain inland, and, though belonging to the summer mainly, they are sometimes found in storms of mid-winter. The term *tornado* is one properly limited to local storms of excessive violence, afflicting but a narrow strip of surface a few miles in length, and usually while no storms of consequence exists anywhere in the vicinity, but sometimes as the nucleus of an extended rain. The leading characteristic is intense electrical action, and several lines or threads of tornado force are sometimes developed in a wide stratum of air of high temperature with clouds and rain, particularly if in a cool month, or when the general storm is of much more than the usual excess of temperature. These may be exhausted after traversing a short path, and may reappear, without disturbing the general condition and without producing any conformity to their peculiar violence in the whole area covered by the rain, as the hurricanes of the Atlantic do.

Hurricane

These hurricanes evidently control the movements of any storm or condition with which they come in contact, superadding to it the characteristics of hurricane violence, until this violence becomes exhausted by distance, while tornadoes have no general influence whatever. The following extract is taken from the report on tornadoes for 1880, by Mr. John P. Finley:

"A map prepared to show the entire topography of that portion of the United States included within the meridians of 89° and 101° would plainly illustrate an important truth in the tornado problem—viz., that there is not another section of our vast domain wherein there exists opportunities so unlimited for the unobstructed mingling and opposition of warm and cold currents and currents highly contrasted in humidity. As an area of low barometer (not necessarily a storm area) advances to the Lower Missouri valley warm and cold currents set in toward it from the north and south respectively, which, if the low pressure continues about stationary for some time, ultimately emanate from the warm and moist regions of the Gulf and the cold and comparatively dry regions of the British Possessions. Here lies the key to the marked contrasts of temperature and moisture, invariably foretelling an atmospheric disturbance of unusual violence, for which this region is peculiarly fitted by Nature, and in apparent recognition of which it has received the euphonious title of the "battle-ground of tornadoes." It cannot be disputed that, so far as the history of tornadoes is concerned, the majority have occurred over this region, because of its peculiar topography. From the Gulf northward to the central portion of the Lower Missouri valley, and from the British Possessions southward to the same locality, there is permitted an entirely free movement of the air; nothing in the shape of earth or water exists to modify its character, except, perhaps, to intensify the contrast of attributes. Over Texas, Louisiana, Arkansas, and Indian Territory occurs a broad expanse of rolling surface—sometimes abruptly hilly, but on the whole presenting a sameness of outline to a marked degree. Similarly conditioned are the States of Minnesota, Iowa, Nebraska, and the eastern half of Dakota Territory. West of the 101st meridian we find a rugged and abrupt country, traversed by great mountain chains, which deflect the course and modify the temperature and moisture of passing currents. On the east side of the 89th meridian, the Great Lakes introduce an equally important factor into the modification of passing currents."

As to the duration of the tornadoes observed in the year 18 he writes:

"The time of passing any point was variously estimated from five seconds to two minutes. "Quicker than thought,", was an expression often used as conveying the observer's idea of the rapidity of destruction. Estimating the average diameter of the cloud at 150 feet, and its average velocity at a mile in two minutes, we have its mean duration at any one point, about ten and a half seconds. There were times in the passage of the cloud when it appeared to remain almost stationary, whirling upon its narrow base like a top; again it was reported as moving no faster than a horse gently galloping, but only for half a mile or so, when it would make up for lost time by dashing forward at a rate of 50 or 60 miles per hour, and then gradually working down to its accustomed velocity of about 30 miles per hour."

Storms of March, 1888.

The storm of March 11-14, 1888, deserves a notice in this connection—for, although not a tornado, it caused much suffering. Its most interesting feature was the extraordinary amount of snow which fell: and as this fall took place in the most densely settled part of the country, and caused a complete stoppage for several days of all intercourse between New York and the adjacent cities, it was, probably, of all the storms which have occurred since this country was settled—the one which gave rise to the largest amount of comment. The average snow fall in central Connecticut and over a large part of eastern New York exceeded forty inches, and in places this was piled up in drifts of from fifteen to forty feet in height. The maximum precipitation reported (5.78 inches) was at Middletown, Conn. This remarkable storm was the result of a conflict between a cyclone advancing from the south, but deflected to the west on reaching New England, and a cold wave coming from the west.*

THE FORESTS OF NORTH AMERICA.

General Remarks.

The North American continent, or that part of it situated north of Mexico, which will alone be considered here, may be conveniently divided, with reference to its forest geography, into the Atlantic and Pacific regions, by a line following the eastern base of the Rocky Mountains and its outlying eastern ranges from the Arctic circle to the Rio Grande. The forests which cover these two divisions of the continent differ as widely, in natural features, composition, and distribution as the climate and typography of eastern America differ from the climate and topography of the Pacific slope. The causes which have produced the dissimilar composition of these two forests may be sought in the climatic conditions of a geological era earlier than our own and in the actual topographical formation of the continent; they need not be discussed here.

The forests of the Atlantic and Pacific regions, dissimilar in composition in the central part of the continent, are united at the north by a broad belt of subarctic forests, extending across the continent north of the fiftieth degree of latitude. One-half of the species of which this northern forest is composed extends from the Atlantic to the Pacific; and its general features, although differing east and west of the continental divide, in conformity with the climatic conditions peculiar to the Atlantic and the Pacific sides of the continent, still posses considerable uniformity. The forests of the Atlantic and the Pacific regions are also united at the south by a narrow strip of the flora peculiar to the plateau of northern Mexico, here extending northward into the United States. Certain characteristics species of this flora extend from the Gulf of Mexico to the shores of the Pacific, and while the peculiar features of the eastern and the western slopes of the interior mountain system of the continent are still maintained here, the Atlantic and Pacific regions of the Mexican forest belt possess many general features in common. Typical North American species, moreover, peculiar to the forest of the Atlantic or of the Pacific, mingle upon the Black hills of Dakota, and upon the Guadalupe and other mountains of western Texas, the extreme eastern ridges of the Rocky Mountain range, and the outposts between the Atlantic and the Pacific regions.

The Atlantic region.

The forests of the Atlantic Region may be considered under six natural divisions: the Northern Forest, the Northern Pine Belt, the Southern Maritime Pine Belt, the Deciduous Forest of the Mississippi Basin, and the Atlantic Plain, the Semi-tropical Forest of Florida, and the Mexican Forest of Southern Texas.

These natural divisions, although composed in part of species found in other divisions and possessing many general features in common, are still for the most part well characterized by predominant species or groups of species, making such a separation natural and convenient.

The *Northern Forest* stretches along the northern snores of Labrador nearly to the sixtieth degree of north latitude, sweeps to the south of Hudson bay, and then northwestward to within the Arctic circle. This Northern Forest extends southward to the fiftieth degree of north latitude on the Atlantic coast, and nearly to the fifty-fourth degree at the 100th meridian. It occupies 10 degrees of latitude upon the Atlantic sea-board and nearly 20 degrees in its greatest extension north and south along the eastern base of the Rocky Mountains. The region occupied by this Northern Forest, except towards its southwestern limits, enjoys a copious rain-fall; it is divided by innumerable streams and lakes, and abounds in swampy areas often of great extent. The nature of the surface and the low annual mean temperature check the spread of forest growth, and reduce the number of arborescent species, of which this forest is composed, to eight. Of these, four cross to the Pacific coast, while the remainder, with a single exception, are placed west of the continental divide by closely allied forms of the Pacific forest. The white and the black sprucer are characteristic trees of this region; they form an open, stunted forest upon the low divides of the water sheds, and reach a higher latitude than any other arborescent species of the continent; the valleys and wide bottoms are clothed with broad sheets of poplars, dwarf birches and willows. The forest of this entire region is scattered, open, stunted, and of no great economic value. It embraces, south of the sixtieth degree of north latitude, the northern extension of the great midcontinental plateau, which will be considered hereafter.

Northern pine belt.

South of the Northern Forest the *Northern Pine Belt* extends from the Atlantic coast to the ninety-sixth meridian of longitude; east of the Appalachian Mountain system it extends south over nearly 6 degrees of latitude, with a long, narrow spur following the higher Alleghany ridges for nearly 3 degrees farther south; west of the Alleghany Mountains, in the region of the great lakes, the pine forest is replaced south of the forty-third degree of latitude by the deciduous growth of the Mississippi basin. The second division of the Atlantic forest may be characterized by the white pine (*Pinus Strobus*), its most important if not its most generally-distributed species. East of the Appalachian system this tree often forms extensive forests upon the gravelly drift plain of the St. Lawrence basin, or farther south and west appears in isolated groves, often of considerable extent, scattered through the deciduous forest. Forests of black spruce are still an important feature of this region, especially at the north: and within its boundaries the hemlock, the yellow cedar, the basswood, the black and the white ash, the sugar-maple and several species of birch and elm find their northern limits, and the center of their most important distribution. The hickories and the oaks, characteristic features of the deciduous forests of all the central portion of the Atlantic region, reach here the northern limits of their distribution, as do the chestnut, the sassafras, the tulip tree, the magnolia (here represented by a single species) the red cedar, the tupelo, the sycamore, the beech, and other important genera.

Southern pine belt.

The *Southern Maritime Pine Belt* extends from the thirty-sixth degree of north latitude along the coast in a narrow belt, varying, from one hundred to two hundred miles in width, as far south as Cape Malabar and Tampa bay; it stretches across the Florida peninsula and along the coast of the Gulf of Mexico until the alluvial deposits of the Mississippi are encountered; it reappears west of that river in Louisiana, north and south of the Red river, and here gradually mingles with the deciduous forests of the Mississippi basin in Arkansas and eastern Texas. This belt is well characterized by the almost continuous growth, outside of the broad river bottoms and the immediate neighborhood of the coast, by the open forest of the long leaved pine (*P. palustris*). The live oak, the palmetto, and various species of pine characterize the coast forest of this region; through the river bottoms and along the borders of the shallow ponds, scattered through the pine forest, different gums, water oaks, hickories and ashes, attain noble dimensions. The southern cypress (*Taxodium*), although extending far beyond the limits of this natural division, here attains its greatest development and value, and, next to the long-leaved pine, may be considered the characteristic species of the maritime pine belt.

Deciduou forest.

The *Deciduous Forest of the Mississippi Basin and the Atlantic Plain* occupies, with two unimportant exceptions to be considered hereafter, the remainder of the Atlantic region. Through this deciduous forest, where peculiar geological features have favored the growth of *Coniferæ*, belts of pine, growing gregariously or mixed with oaks and other broad-leaved trees, occur especially upon some portions of the Atlantic plain and toward the limits of the Southern Maritime Pine Belt, west of the Mississippi river. The characteristic features of the forest of this whole region are found, however, in the broad-leaved species of which it is largely composed. Oaks, hickories, walnuts, magnolias, and ashes give variety and value to this forest; and here, with the exception of a few species peculiar to a more northern latitude, the deciduous trees of the Atlantic region attain their greatest development and value. Upon the slopes of the southern Alleghany mountains and in the valley of the lower Red river, regions of copious rainfall and rich soil, the deciduous forest of the continent attains unsurpassed variety and richness. Upon the Alleghany mountains northern and southern species are mingled, or are only separated by the altitude of these mountains; rhododendrons, laurels, and magnolias here attaining their maximum development, enliven the forests of northern pines and hemlocks which clothe the flanks of these mountains, or are scattered through forests of other broad-leaved species. The cherry, the tulip tree, and the chestnut here reach a size unknown in other parts of the country. The forest of the Red river valley is hardly less varied. The northern species which the elevation of the Alleghany mountains has carried south are wanting, but other species peculiar to the southern Atlantic and Gulf coasts are here mingled with plants of the southern deciduous forest. The seven species of *Carya* (the hickories) are nowhere else closely associated. A great variety of the most important oaks grow here side by side; here is the center of distribution of the North American hawthorns, which do not elsewhere attain such size and beauty. The osage orange is peculiar to this region; the red cedar, the most widely distributed of American *Coniferæ*, the southern and the yellow pine (*Pinus palustris* and *mitis*) here reach their best development. Just outside of this region, upon the "bluff" formation of the lower Mississippi valley and of western Louisiana, the stately southern magnolia, perhaps the most beautiful of the North American trees, and the beech, assume their greatest beauty, and give a peculiar charm to this southern forest.

The western third of the Atlantic region is subjected to very different climatic conditions from those prevailing in the eastern portion of the continent; it consists of an elevated plateau, which falls away from the eastern base of the Rocky Mountains, forming what is known as the Great Plains. This great interior region, on account of its remoteness from natural reservoirs of moisture, receives a meager and uncertain rainfall, sufficient to insure a growth of herbage, but not sufficient to support, outside the narrow bottoms of the infrequent streams, the scantiest forests. This treeless plateau extends north to the fifty-second degree of north latitude; it follows southward the trend of the Rocky Mountains far into Mexico, extending eastward at the point of its greatest width, in about latitude 40° N., nearly to the ninety-seventh meridian. This whole region is generally destitute of forest. The narrow bottoms of the large streams are lined, however, with willows, poplars, elms, and hackberries—trees adapted to flourish under such unfavorable conditions. These diminish in size and number with the rainfall, and often disappear entirely from the banks of even the largest streams toward the western limits of the plateau, south of the forty-fifth degree of latitude. North and east of these central treeless plains a belt of prairie extends from the sixtieth degree of north latitude to southern

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*See Winslow Upton, in Am. Met. Jour., May, 1888.

Texas. The average width east and west of this prairie region, through much of its extent, is not far from 150 miles. Its eastern extension, between the fortieth and forty-fifth degrees of latitude, is much greater, however, here reaching the western shores of lake Michigan, and forming a great recess in the western line of the heavy forest of the Atlantic region with a depth of nearly 600 miles. The transition from the heavy forest of the eastern and central portions of the Atlantic region to the treeless plateau is gradual. The change occurs within the prairie regions. Here is the strip of debatable ground, where a continuous struggle between the forest and the plain takes place. There is here sufficient precipitation of moisture to cause, under normal conditions, a growth of open forest: but, so nicely balanced is the struggle, that any interference quickly turns the scale. Trees planted within this prairie belt thrive if protected from fire and the encroachment of the tough prairie sod, and so extend the forest line westward; if the forest which fringes the eastern edge of the prairie is destroyed, it does not soon regain possession of the soil, and the prairie is gradually pushed eastward.

Forest plain

The eastern line of the plain, where arborescent vegetation is confined to the river bottoms, and which divides it from the prairie where trees grow naturally, to some extent, outside of the bottoms, and where they may be made to grow under favorable conditions everywhere, is determined by the rainfall enjoyed by this part of the continent. The extreme eastern point reached by this line is found, upon the fortieth degree of north latitude, near the northern boundary of the state of Kansas. North of the fortieth degree it gradually trends to the west, reaching the eastern base of the Rocky Mountains in about latitude 52°. This northwestern trend of the eastern plain line may be ascribed to the comparatively small evaporation which takes place during the shorter summer of the north, and to a slight local increase of spring and summer rainfall. South of the fortieth degree the plain line gradually trends to the southwest under the influence of the Gulf of Mexico, reaching its extreme western point in Texas upon the one hundredth meridian.

Other causes, however, than insufficient rainfall and a nicely balanced struggle between the forest and the plain have prevented the general growth of trees in the prairie region east of the ninety-fifth meridian. The rainfall of this region is sufficient to insure the growth of a heavy forest. The rain falling upon the prairies of Minnesota, Wisconsin, Iowa, Illinois, and Missouri equals in amount that enjoyed by the Michigan peninsula and the whole region south of lakes Ontario and Erie, while prairies exist within the region of the heaviest forest growth. It is not want of sufficient heat, or of sufficient or equally distributed moisture, which has checked the general spread of forest over these prairies. The soil of which the prairies are composed, as is shown by the fact that trees planted upon them grow with vigor and rapidity, is not unsuited to tree growth. It is not, perhaps, improbable that the forests of the Atlantic region once extended continuously as far west at least as the ninety-fifth meridian, although circumstantial evidence of such a theory does not exist; and the causes which first led to the destruction of the forests in this region, supposing that they ever existed, cannot, with the present knowledge of the subject, be even guessed at. It is, however, fair to assume that forests once existed in a region adapted, by climate, rainfall, and soil, to produce forests, and that their absence under such conditions must be traced to accidental causes. It is not difficult to understand that the forest once destroyed over such a vast area could not easily regain possession of the soil protected by an impenetrable covering of sod and subjected to the annual burnings which have occurred down to the present time; while the force of the wind, unchecked by any forest barrier, over such an area would, even without the aid of fires, have made the spread of forest growth slow and difficult. The assumption that these eastern prairies may have once been covered with forests is strengthened by the fact that since they have been devoted to agriculture, and the annual burning has been stopped, trees which were formerly confined to the river bottoms have gradually spread to the uplands. Small prairies situated just within the western edge of the forest have entirely disappeared within the memory of persons still living; the oak openings—open forests of large oaks through which the annual fires played without greatly injuring the full-grown trees—once the characteristic feature of these prairies, have disappeared. They are replaced by dense forests of oak, which only require protection from fire to spring into existence. In western Texas, the mesquit, forced by annual burning to grow almost entirely below the surface of the ground, is, now that prairie fires are less common and destructive, spreading over what a few years ago was treeless prairie. The prairies, then, or the eastern portions of them situated in the region of abundant rainfall, are fast losing their treeless character, and the forest protected from fire is gradually gaining in every direction; regions which fifty years ago were treeless outside the river bottoms now contain forests covering 10 or even 20 per cent. of their area. These eastern well-watered prairies must not, however, be confounded with their dry western rim adjoining the plains—the debatable ground between forest and plain—or with the plains themselves. There is now no gradual, constant spread of forest growth upon the plains. They are treeless on account of insufficient moisture to develop forest growth; and while trees may, perhaps, if planted, survive during a few years beyond the western limits of the prairie as here laid down, the permanent establishment of forests there does not seem practicable, and, sooner or later, a period of unusual drought must put and end to all attempts at forest cultivation in a region of such insufficient and uncertain rainfall.

It remains to consider the *Semi-tropical Forest of Florida* and the *Mexican Forest of Southern Texas*.

A group of arborescent species of West Indian origin occupies a narrow strip of coast and islands of southern Florida. This belt of semi-tropical vegetation is confined to the immediate neighborhood of the coast and to occasional hummocks or islands of high ground situated in the savannas which cover a great portion of southern Florida, checking, by the nature of the soil and want of drainage, the spread of forest growth across the peninsula. This semi-tropical forest belt reaches cape Malabar on the east and the shores of Tampa bay on the west coast, while some of its representatives extend fully 2 degrees farther north. It is rich in composition; nearly a quarter of all the arborescent species of the Atlantic forest are found within this insignificant region. The semi-tropical forest, in spite of its variety, is of little economic importance. The species of which it is composed here reached the extreme northern limit of their distribution; they are generally small, stunted, and of comparatively little value. Certain species, however, attain respectable proportions; the mahogany, the mastic, the royal palm, the mangrove, the sea-grape, the Jamaica dogwood, the manchineel, and other species here become considerable and important trees.

In western and southern Texas the trees of the Mississippi basin, checked by insufficient moisture from farther extension southward outside the river bottoms, are replaced by species of the plateau of northern Mexico. The streams flowing into the Gulf of Mexico are still lined, however, east of the one-hundredth meridian, with the species of the Atlantic basin, which thus reach southward to beyond the Rio Grande. The Mexican forest belt of Texas extends from the valley of the Colorado river, near the ninety-eighth meridian, to the Rio Grande. It touches the coast not far from the Nueces river, and extends to the eastern base of the mountain ranges west of the Pecos; here the species of which it is composed mingle with those peculiar to the Pacific Mexican forest. The forest of this region, like that of all countries of insufficient moisture, is open, stunted, and comparatively of little value. It is characterized by enormous areas covered with chaparral (dense and often impenetrable thickets of thorny shrubs and small trees), by a stunted and occasional arborescent growth upon the hills and plains, and by fringes of heavier timber along the river bottoms. The most valuable and perhaps the most characteristic species of this whole region—the mesquit—extends to the Pacific coast. With this exception, none of the arborescent species peculiar to this region attain any considerable size or importance, although the forest of small junipers which cover the low limestone hills of the Colorado valley are locally valuable in a country so generally destitute of trees. The region immediately adjoining the Rio Grande abounds in different species of *Acacia*, *Leucæna*, and other Mexican *Leguminosæ*: and farther west, upon the dry plains of the Presidio, the Spanish bayonet (*Yucca baccata*) covers wide areas with a low, open, and characteristic forest growth.

The Pacific forest region is coextensive with the great Cordilleran Mountain system of the continent. The causes which have influenced the present position and density of these forests must be sought in the peculiar distribution of the rainfall of the region. The precipitation of moisture upon the northwest coast is unequaled by that of any other part of the continent. It gradually decreases with the latitude until, in Southern California, the temperature of the land so far exceeds that of the ocean that precipitation is impossible through a large part of the year. The interior of all this great region, shut off by the high mountain ranges which face the ocean along its entire extent, is very imperfectly supplied with moisture. It is a region of light, uncertain, and unequally distributed rainfall, heavier at the north, as upon the coast, and decreasing gradually with the latitude in nearly the same proportion. This entire region is composed of a mass of mountain ranges with a general north and south trend separating long and generally narrow valleys. The precipitation of moisture within the interior region is largely regulated by the position of the mountain chains. Warm currents ascending their sides become cold, and are forced to deposit the moisture they contain. It follows that, while the interior valleys are rainless or nearly so, the mountain ranges, and especially the high ones, receive during the year a considerable precipitation of both rain and snow. If the distribution of the forests of any region is dependent upon the distribution and amount of moisture it receives, forests exceeding in density those of any other part of the continent would be found upon the northwest coast; they would gradually diminish toward the south, and entirely disappear near the southern boundary of the United States; while the forests of all the interior region, from the summit of the principal Coast Ranges to the eastern base of the Rocky Mountains, would be confined to the flanks and summits of the mountains. These forests would be heavy upon the high ranges, especially toward the north; they would disappear entirely from the valleys and low mountain ranges. An examination of the forests of the Pacific region will show that, in general distribution and density, they actually follow the distribution of the rainfall of the region. These forests well illustrate the influence of moisture upon forest growth. Within the Pacific region, the heaviest and the lightest forests of the continent coexist with its heaviest and lightest rainfall.

The forests of the Pacific region may be considered under four divisions: the Northern Forest, the Coast Forest, the Interior Forest, and the Mexican Forest.

The *Northern Forest* of the Pacific region extends from nearly the seventieth to about the fifty-eighth degree of north latitude, or, immediately upon the coast, is replaced by the Coast Forest nearly 2 degrees farther north; it extends from the continental divide, here mingled with the Northern Forest of the Atlantic region, to the shores of the Pacific. The southern limit of this open, scanty Northern Forest, composed of species which extend across the continent, or of species closely allied to those of the Northern Forest of the Atlantic region, is still imperfectly known, especially in the interior. The determination of the southern

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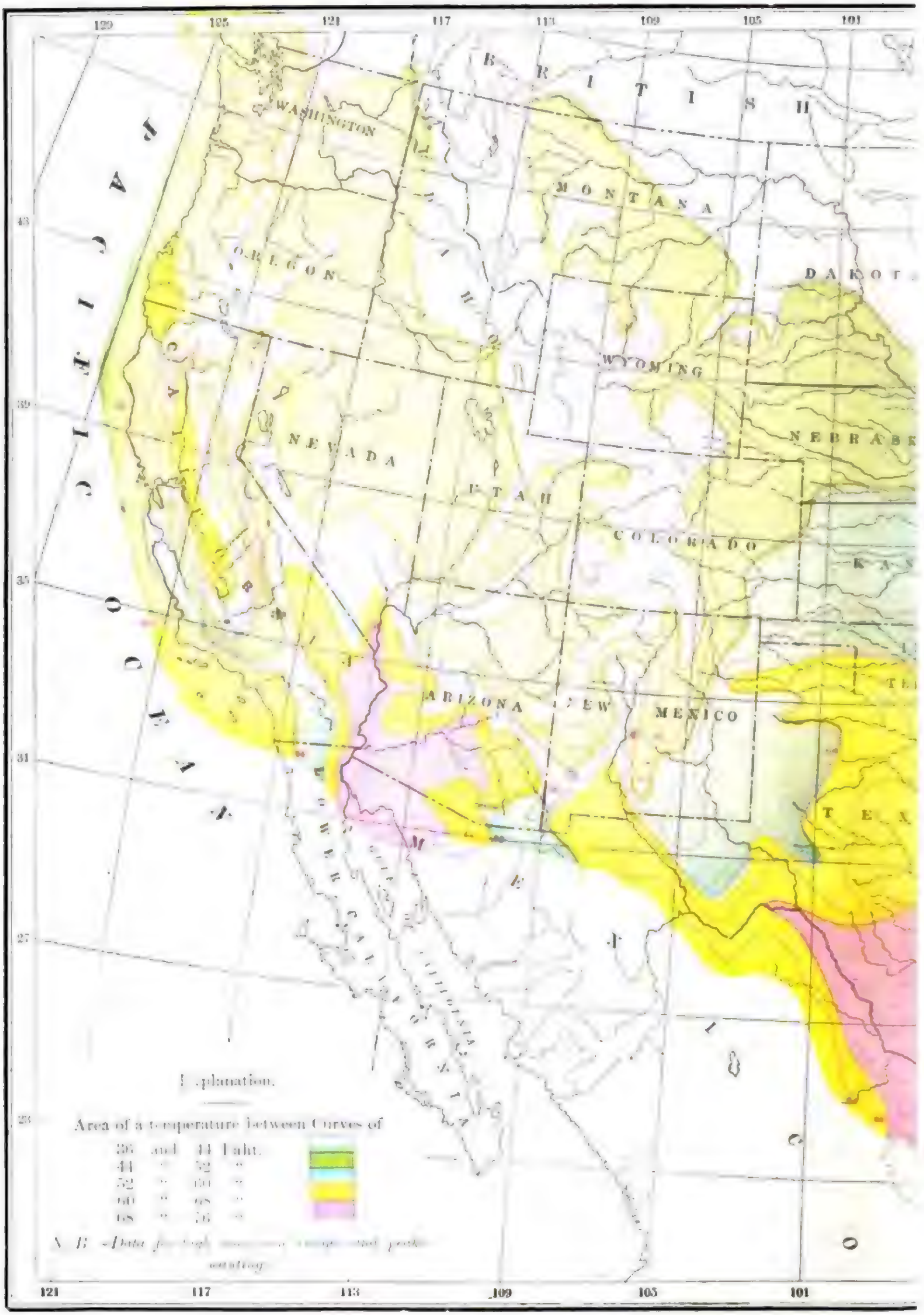
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ARIZONA
NEW MEXICO
TEXAS
PACIFIC OCEAN
LOWER CALIFORNIA
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GULF OF CALIFORNIA
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Explanation.
Area of a temperature between Curves of
36 and 44 Fahr.
44 " 52 "
52 " 60 "
60 " 68 "
68 " 76 "
N. B.—Data for high
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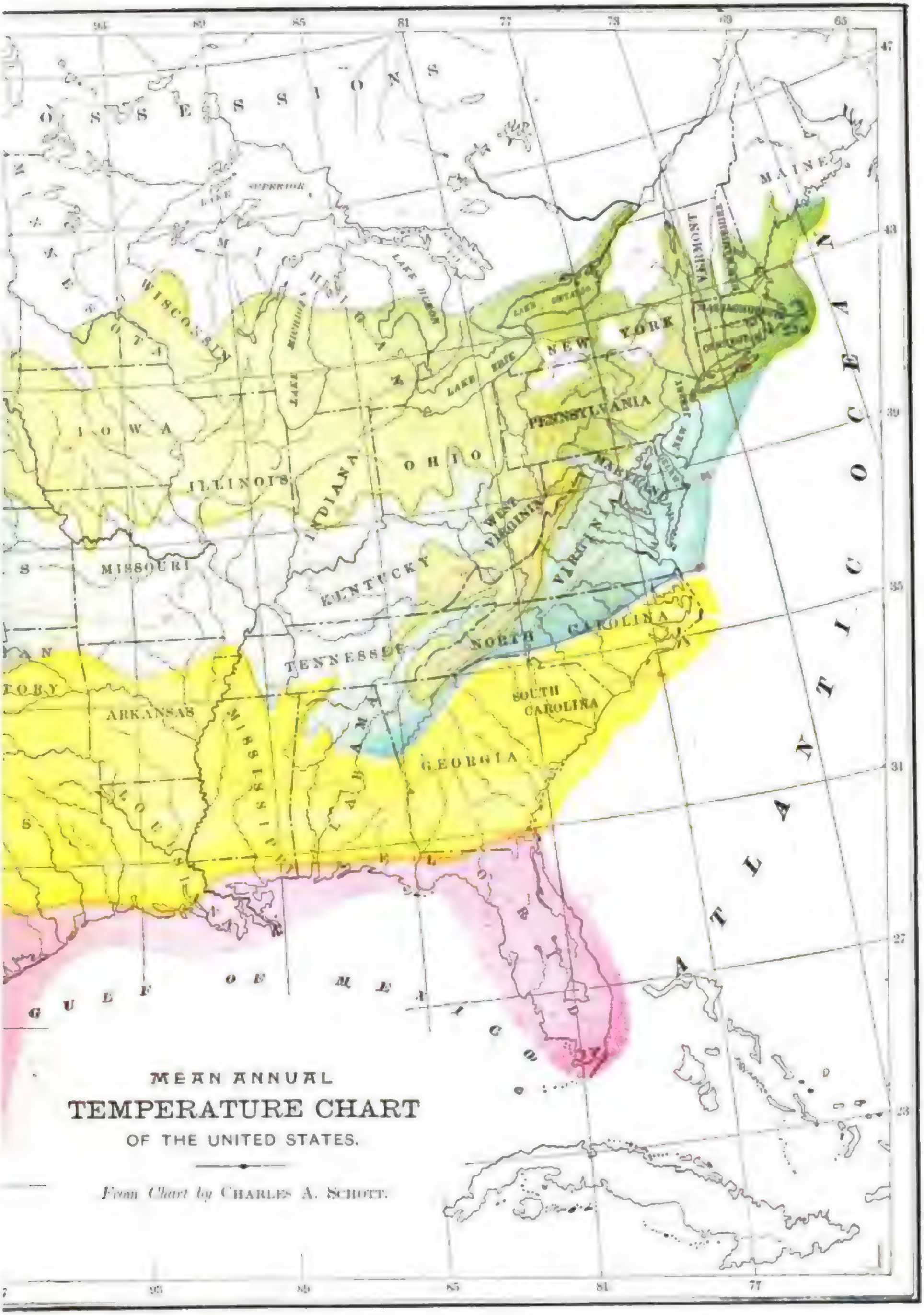
POSSESSIONS
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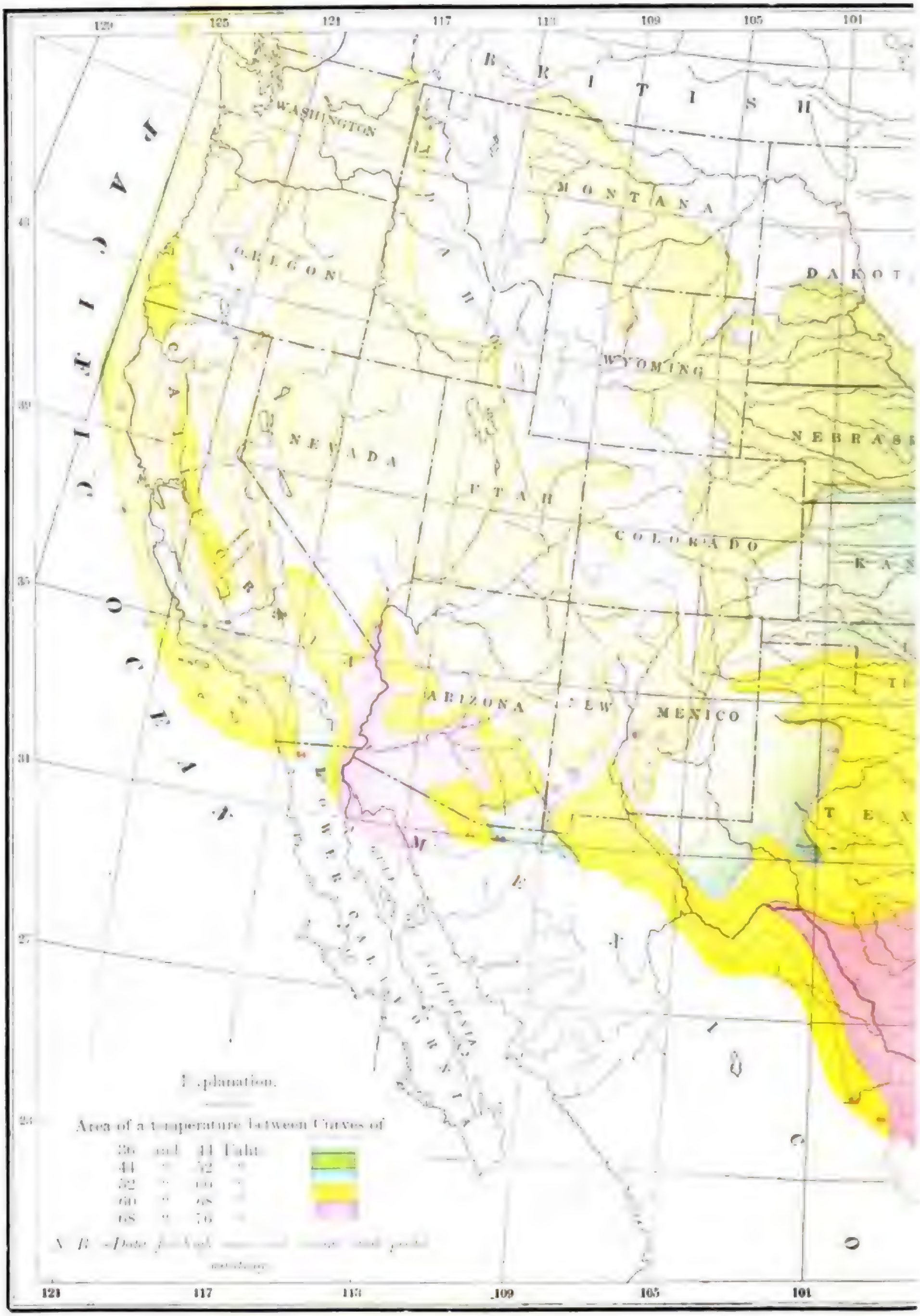
MEAN ANNUAL

TEMPERATURE CHART

OF THE UNITED STATES.

From Chart by CHARLES A. SCHOTT.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COLORADO
KANSAS
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ARIZONA
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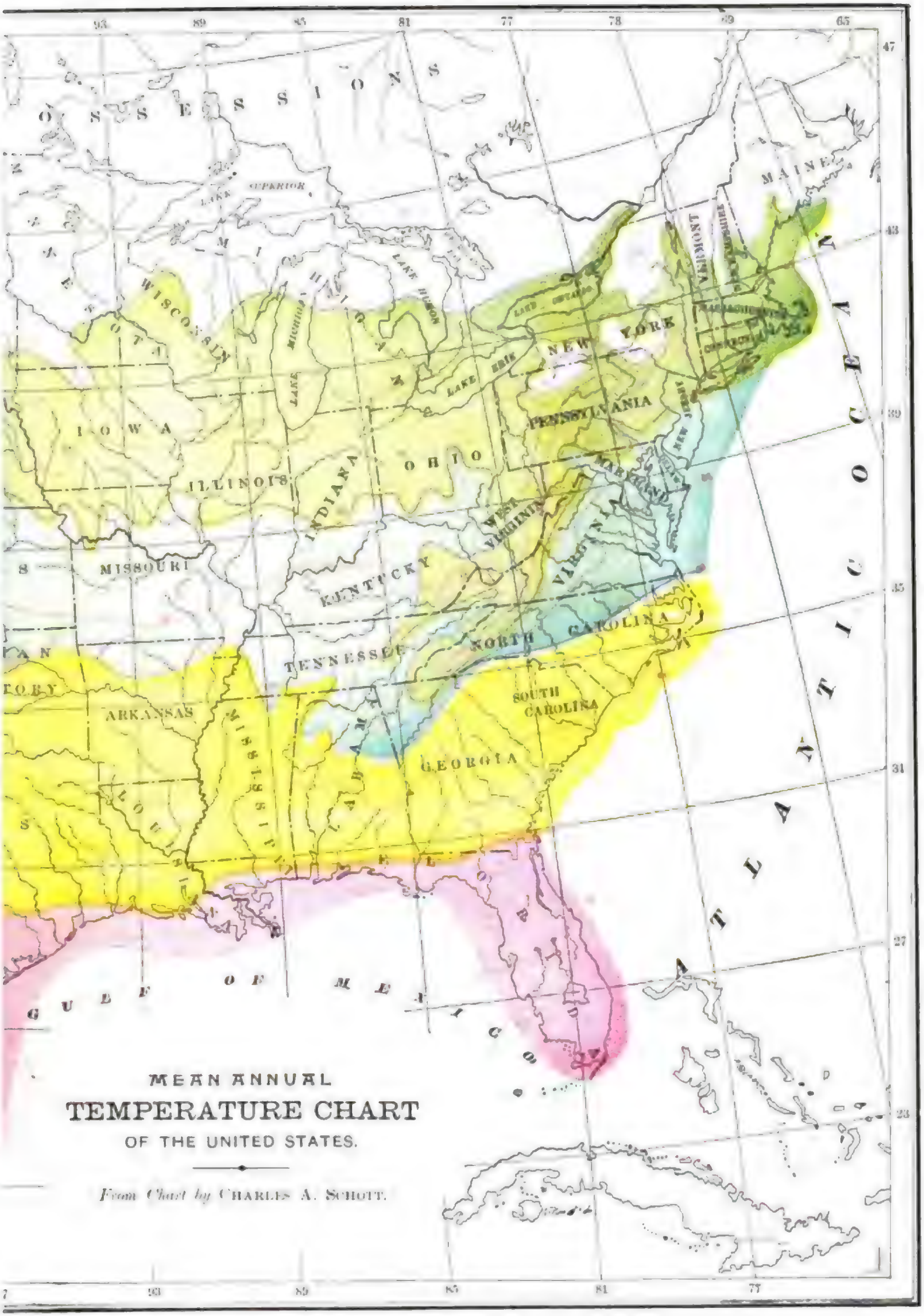
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MEAN ANNUAL

TEMPERATURE CHART

OF THE UNITED STATES.

From Chart by CHARLES A. SCHOTT.

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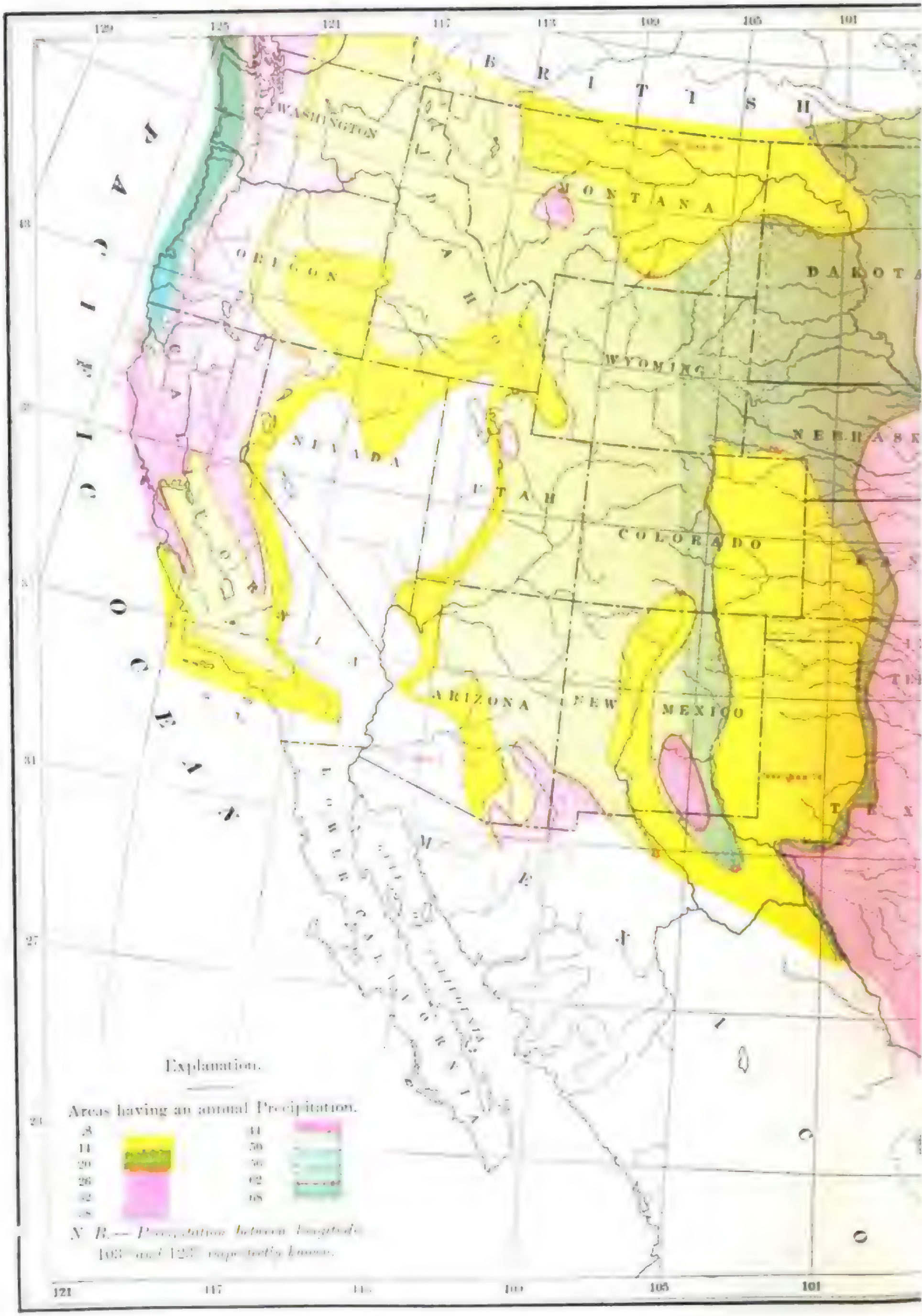
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MEXICO
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Explanation.
Areas having an annual Precipitation.
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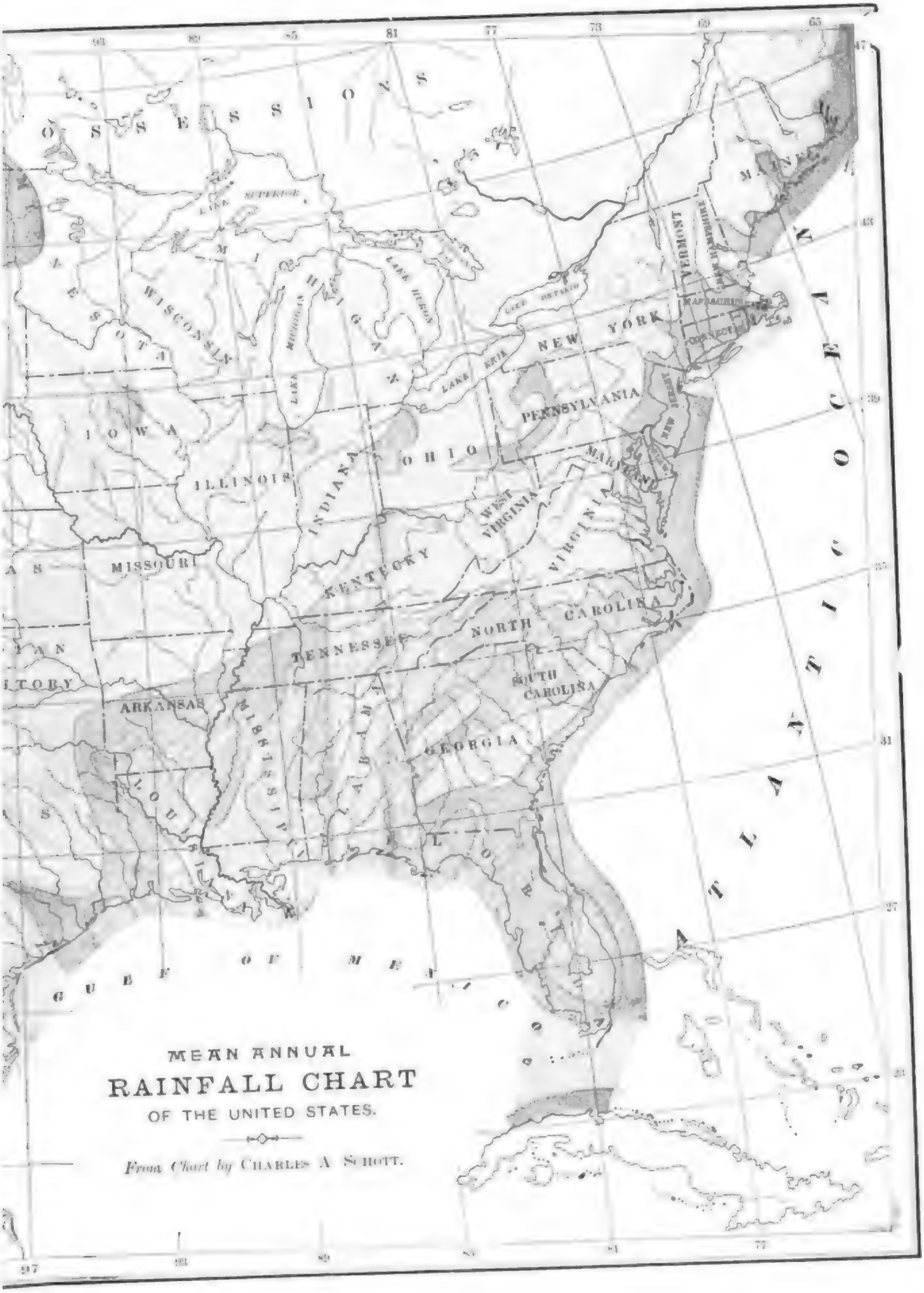
N. B.— Precipitation between longitude 103° and 123° imperfectly known.



MEAN ANNUAL
RAINFALL CHART
OF THE UNITED STATES.

From Chart by CHARLES A. SCHOTT.

POSSESSIONS
LAKE SUPERIOR
MINNESOTA
WISCONSIN
MICHIGAN
LAKE MICHIGAN
LAKE HURON
LAKE ONTARIO
LAKE ERIE
IOWA
ILLINOIS
INDIANA
OHIO
NEW YORK
PENNSYLVANIA
NEW JERSEY
MARYLAND
DELAWARE
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range in Alaska and British Columbia of several species, as well as the northern range here of a few others, must be still left to further exploration. The white spruce, the most important and the most northern species of the forest of the North Atlantic region, is here also the most important species. It attains a considerable size as far north as the sixty-fifth degree, forming, in the valley of the Yukon, forests of no little local importance. The canoe birch, the balsam poplar, and the aspen, familiar trees of the North Atlantic region, also occur here. The gray pine and the balsam fir of the Atlantic region are replaced by allied forms of the same genera. The larch alone, of the denizens of the extreme Northern Forest of the Atlantic coast, finds no congener here in the northern Pacific forest.

The Pacific *Coast Forest*, the heaviest, although far from the most varied, forest of the continent, extends south along the coast in a narrow strip from the sixtieth to the fiftieth parallel; here it widens, embracing the shores of Puget sound and extending eastward over the high mountain ranges north and south of the boundary of the United States. This interior development of the Coast Forest, following the abundant rainfall of the region, is carried northward over the Gold, Selkirk, and other interior ranges of British Columbia, in a narrow spur extending north nearly to the fifty-fourth parallel. It reaches southward along the Cœur d'Aleue, Bitter-Root, and the western ranges of the Rocky Mountain system to about latitude 47° 30′, covering northern Washington Territory, Idaho, and portions of western Montana.

The Coast Forest south of the fiftieth degree of latitude occupies the region between the ocean and the eastern slopes of the Cascade Range: in California the summits of the principal southern prolongation of these mountains, the Sierra Nevada, mark the eastern limits of the Coast Forest, which gradually disappears south of the thirty-fifth parallel, although still carried by the high ridges of the southern Coast Range nearly to the southern boundary of the United States. The Coast Forest, like the forests of the whole Pacific region, is largely composed of a few coniferous species, generally of wide distribution. The absence of broad-leaved trees in the Pacific region is striking; they nowhere form great forests, as in the Atlantic region; when they occur they are confined to the valleys of the coast and to the banks of mountain streams, and, economically, are of comparatively little value or importance. The characteristic and most valuable species of the northern Coast Forest are the Alaska cedar (*Chamæcyparis*), the tide-land spruce, and the hemlock. These form the principal forest growth which covers the ranges and islands of the coast between the sixty-first and fiftieth parallels. Other species of the Coast Forest reach here the northern limits of their distribution, although the center of their greatest development is found farther south.

d fir

The red fir (*Pseudotsuga*), the most important and widely distributed timber tree of the Pacific region, reaches the coast archipelago in latitude 51°; farther inland it extends fully 4 degrees farther north, and in the region of Puget sound and through the Coast Forest of Washington Territory and Oregon it is the prevailing forest tree. The characteristic forest of the northwest coast, although represented by several species extending south as far as cape Mendicino, near the fortieth parallel, is replaced south of the Rogue River valley by a forest in which forms peculiar to the south rather than to the north gradually predominate. The forest of the northwest coast reaches it greatest density and variety in the narrow region between the summits of the Cascade Range and the ocean. North of the fifty-first parallel it gradually decreases in density, and south of the forty-third parallel it changes in composition and character. This belt of Coast Forest is only surpassed in density by that of some portions of the redwood forest of the California coast. The red fir, the great tide-land spruce, the hemlock, and the red cedar (*Thuya*) reach here enormous dimensions. The wide river bottoms are lined with a heavy growth of maple, cottonwood, ash, and alder, the narrow interior valley with an open growth of oak. In this great coniferous forest the trunks of trees two or three hundred feet in height are often only separated by the space of a few feet. The ground, shaded throughout the year by the impenetrable canopy of the forest, never becomes dry; it is densely covered by a thick carpet of mosses and ferns, often of enormous size. The more open portions of this forest are choked by an impenetrable growth of various *Vacciniæ* of almost arborescent proportions, of hazel, the vine-maple, and other shrubs. The soil which has produced the maximum growth of forest in this region is, outside the river bottoms, a thin, porous gravel of glacial origin, rarely more than a few inches in depth; the luxuriance of vegetable growth, therefore, illustrates the influence of a heavy rainfall and temperate climate upon the forest.

The general character of this forest in the interior, although composed largely of the species peculiar to the coast, differs somewhat from the Coast Forest proper in composition and largely in natural features. The dense, impenetrable forest of the coast is replaced, east of the summit of the Cascade Range, by a more open growth, generally largely destitute of undergrowth. The red fir, the hemlock, and the red cedar (*Thuya*) are still important elements of the forest. Less valuable species of the Coast Forest —the white fir (*Abies grandis*), the yew, the alders, the mountain hemlock (*Tsuga Pattoniana*), the hawthorn, the buckthorn, and the white pine (*Pinus monticola*)—are still represented. The latter, a local species upon the coast, only reaches its greatest development toward the eastern limit of this region, here forming considerable and important forests. Other species peculiar to the Coast Forest, the maples, the ash, the oak, the arbutus, and the Alaska cedar, do not extend east of the Cascades. The tide-land spruce is replaced by an allied species of the interior region. The widely distributed yellow pine (*Pinus ponderosa*), barely represented in the northern portions of the immediate Coast Forest, becomes, east of the mountains, one of the most important and characteristic elements of the forest. The Coast Forest south of the forty-third degree of latitude changes in composition. The tide-land spruce, the hemlock and the *Thuya* are gradually replaced by more southern species. The sugar pine (*P. Lambertiana*) here first appears. The California laurel (*Umbellularia*) covers with magnificent growth the broad river bottoms. The *Libocedrus*, several oaks, and the chinquapin here reach the northern limits of their distribution. The change from the northern to the southern forest is marked by the appearance of the Port Orford cedar (*Chamæcyparis Lawsoniana*), adding variety and value to the forests of the southern Oregon coast. Farther south, near the northern boundary of California, the redwood forests (*Sequoia*) appear.

Coast of California

The Coast Forest of California will be most conveniently discussed under three subdivisions: the forest of the Coast Range, the forest of the western slope of the Sierra Nevada, which, toward the northern boundary of the state, extends to the coast, covering the mass of mountains which here unite the Sierra Nevada and the Coast Range; and, third, the open forest of the long, narrow valleys lying between the Coast Range and the Sierra Nevada south of this northern connection. The important feature of the Coast Range, as far south as the thirty-seventh degree of latitude, is the belt of redwood occupying an irregular interrupted strip of territory facing the ocean, and hardly exceeding thirty miles in width at the points of its greatest development. The heaviest growth of the redwood forest occurs north of the bay of San Francisco; and here, along the slopes and bottom of the narrow canons of the western slope of the Coast Range, the maximum productive capacity of the forest is reached. No other forest of similar extent equals in the amount of material which they contain the groups of redwood scattered along the coast of northern California. The red fir reaches, in the California Coast Range, a size and value only surpassed in the more northern forests of the coast; the yellow pine is an important tree in the northern portions of this region, and here flourish other species of the genus endemic to this region. The forest of the Coast Range is marked by the presence within its limits of several species of singularly restricted distribution. *Cupressus macrocarpa* and *Pinus insignis* are confined to a few isolated groves upon the shores of the bay of Monterey; *Abies bracteata* occupies three or four canons high up in the Santa Lucia mountains; it is found nowhere else; and *Pinus Torreyana*, the most local arborescent species of North America, has been detected only in one or two small groups upon the sand-dunes just north of the bay of San Diego. The characteristic forest of the Coast Range is checked from farther southern development a little below the thirty-fifth parallel by insufficient moisture, the scanty forests which clothe the high declivities of the Coast Range farther south belong in composition to the Sierra forests.

The Sierra Nevada forests

The heavy forest which covers the western slopes of the Sierra Nevada, a forest only surpassed in density by the redwood belt of the coast and the fir forest of Puget sound, occupies, in its greatest development, a belt situated between 4,000 and 8,000 feet elevation. This forest belt extends from about the base of mount Shasta at the north to the thirty-fifth parallel; farther south it diminishes in density and disappears upon the southern ridges of the Coast Range just north of the southern boundary of California. Its greatest width occurs in northern California, where to the south of mount Shasta, the Sierra system is broken down into a broad mass of low ridges and peaks. The characteristic species of this forest is the great sugar pine (*P. Lambertiana*), which here reaches its greatest development and value, and gives unsurpassed beauty to this mountain forest. With the sugar-pine are associated the red fir, the yellow pine, two noble *Abies*, the *Libocedrus*; and, toward the central part of the state, the great *Sequoia*, appearing first in small isolated groups, and then, farther south, near the headwaters of Kern river, in a narrow belt extending more or less continuously for several miles. This heavy forest of the Sierras, unlike the forest which farther north covers the western flanks of the Cascade Range, is almost destitute of undergrowth and young trees. It shows the influence of a warm climate and unevenly distributed rainfall upon forest growth. The trees, often remote from one another, have attained an enormous size; but they have grown slowly. Above this belt the Sierra forest stretches upward to the limits of tree growth. It is here subalpine and alpine in character, and of little economic value. Different pines and furs, the mountain hemlock, and the western juniper, are scattered in open stretches of forest upon the high ridges of the Sierras. The forest below the belt of heavy growth gradually becomes more open. Individual trees are smaller, while the number of species increases. The small pines of the upper foot-hills are mingled with oaks in considerable variety. These gradually increase in number. Pines are less frequent, and finally disappear.

Valley forests

The forest of the valleys is composed of oaks, the individuals often widely scattered and of great size, but nowhere forming a continuous, compact growth. The Coast Forest of the Pacific region, unsurpassed in density, is composed of a comparatively small number of species, often attaining enormous size. It presents the same general features throughout its entire extent, except as modified by the climatic conditions of the regions which it covers. The species which compose this forest range through nearly 26 degrees of latitude, or northern species, are replaced in the south by closely allied forms; and, as in the Atlantic region, the southern species far exceed in number those peculiar to the north.

The *Interior Forest* extends from the southern limits of the northern subarctic forest to the plateau of northern Mexico; it occupies the entire region between the eastern limits of the Pacific Coast Forest and the extreme western limits of the Atlantic region. The forests of this entire region, as compared with the forests east and west of it, are stunted and remarkable in their poverty of composition. They are confined to the high slopes and canons of the numerous mountain ranges composing the interior region, while the valleys are treeless, or outside of the narrow river bottoms, nearly treeless. The interior forest attains its greatest development and considerable importance upon the western slope of the California Sierras and upon the flanks of the high peaks of the southern Rocky Mountain system, from Colorado, where the timber line reaches an extreme elevation of 13,500 feet, to southern New Mexico and western Arizona. The minimum in North American forest development, outside the absolutely treeless regions, both in the number of species and in the proportion of forest to entire area, is found south of the Blue mountains of Oregon, in the arid region between the Wahsatch mountains and the Sierra Nevada, known as the Great Basin. Here the open, stunted forest is confined to the highest ridges and slopes of the infrequent canons of the low mountain ranges which occupy, with a general north and south trend, this entire region. The individuals which compose this forest are small, although often of great age, and everywhere show the marks of a severe struggle for existence. Seven arborescent species only have been detected in the forests of the northern and central portions of this region. The mountain mahogany (*Cercocarpus*), the only broad-leaved species of the region, with the exception of the aspen, which throughout the entire interior region borders, above an elevation of 8,000 feet, all mountain streams, reaches here its greatest development. This tree, with the nut pine (*Pinus monophylla*), characterizes this region. Stunted junipers are scattered over the lowest slopes of the mountains, or farther south often cross the high valleys, and cover with open growth the *mesas*, as the lower foot-hills are locally known. An open forest of arborescent yuccas (*Yucca brevifolia*) upon the high Mojave plateau is a characteristic and peculiar feature of the flora of this interior region. The red fir and the yellow pine, widely distributed throughout the Pacific region, do not occur upon the mountain ranges of the Great Basin.

Forests
interior

The heavy forests of the interior region, found along the western slopes of the California Sierras and upon the Rocky Mountain system, are, for the most part, situated south of the forty-second degree of latitude. The forests of the whole northern interior portion of the continent, outside the region occupied in the northern Rocky Mountains by the eastern development of the Coast Forest, feel the influence of insufficient moisture; the number of species of which they are composed is not large; the individuals are often small and stunted, while the forests are open, scattered, without undergrowth, and confined to the canons and high slopes of the mountains. The most generally distributed species of this northern region, a scrub pine, (*Pinus Murrayana*), occupies vast areas, almost to the exclusion of other species, and is gradually taking possession of ground cleared by fire of more valuable trees. South of the fifty second parallel the red fir (*Pseudotsuga*) and the yellow pine (*Pinus ponderosa*) appear; with them is associated, in the Blue Mountains and in some of the ranges of the northern Rocky Mountains, the western larch (*Larix occidentalis*), the largest and most valuable tree of the Columbian basin.

The forest covering the eastern slope of the Sierra Nevada consists almost exclusively of various species of pine, often of great size and value. The characteristic species of this region are the yellow pine and the closely allied *Pinus Jeffreyi*, here reaching its greatest development. The red fir is absent from this forest, while the oaks, multiplied in many forms on the western slopes of these mountains, have here no representative.

The forests of the southern Rocky Mountain region, less heavy and less generally distributed than those of the western slope of the Sierras, are, as compared with those of the Great Basin, heavy, dense, and valuable. They owe their existence to the comparatively large precipitation of moisture distributed over this elevated region. The characteristic species of the Colorado mountains is a spruce (*Picea Engelmanni*); it forms, at between 8,000 and 10,000 feet elevation, extensive and valuable forests of considerable density and great beauty; with it are associated a balsam fir of wide northern distribution, and various alpine and subalpine species of pine; at lower elevations forests of yellow pine and red fir cover the mountain slopes, while the bottoms of the streams are lined with cottonwood alder and maple, or with an open growth of the white fir (*Abies concolor*), a species of the Coast Forest, here reaching the eastern limits of its distribution; the foot-hills above the treeless plain are covered with scant groves of the nut-pine (*Pinus edulis*), stunted junipers, and a small oak, which in many forms extends through a large area of the southern interior region. A forest similar in general features to that of Colorado, and largely composed of the same species, extends over the high mountains of New Mexico to those of western Texas and western and northwestern Arizona, where a heavier forest of pine covers the elevated region lying along the thirty-fifth parallel, culminating in the high forest-clad San Francisco mountains of northern Arizona.

The species of the interior Pacific region mingle along its southern borders with the species peculiar to the plateau of northern Mexico. The Pacific-Mexican Forest, although differing widely in natural features from the Atlantic-Mexican Forest, possesses several species peculiar to the two. The forests of this region are confined to the high mountains and their foot-hills, and to the banks of the rare water-courses. They disappear entirely from the Colorado desert and from the valleys and low mountain ranges of southwestern Arizona. The most important and generally distributed species peculiar to the valleys of this region is the mesquit, the characteristic species of the Atlantic-Mexican region. The suwarrow, however, the great tree cactus, is perhaps the most remarkable species of the region, giving an unusual and striking appearance to the dry *mesas* of central and southern Arizona. The high mountain ranges, extending across the boundary of the United States, between the one hundred and fifth and the one hundred and eleventh meridians, enjoy a larger and more regularly distributed rainfall than the regions east, and especially west, of these meridians. The forests which cover these southern mountain ranges are often dense and varied. Upon their summits and almost inaccessible upper slopes the firs and pines of the Pacific region are mingled with pines, a juniper, an arbutus, and various other species peculiar to the Mexican plateau. Extensive forests of a cypress of Mexican origin also characterize this mountain vegetation. The bottoms of the canons are lined with a dense growth of cottonwood, hackberry, a noble sycamore, an ash, a cherry, and other deciduous trees. The high foot-hills and *mesas* are covered with open groves of various oaks peculiar to the Mexican-Pacific region, here reaching, within the United States at least, their greatest development.

Such are some of the prominent forest features of North America; a dense forest, largely composed, except at the north, of a great variety of broad-leaved species, and extending from the Atlantic sea-board in one nearly unbroken sheet until checked by insufficient moisture from further western development—the forest of the Atlantic region; a forest of conifers, occupying the ranges of the great Cordilleran mountain system, unsurpassed in density in the humid climate of the coast, open and stunted in the arid interior—the forest of the Pacific region.

A more detailed examination of the distribution of North American arborescent genera and species will serve to illustrate the wealth of the forests of the Atlantic and the comparative poverty of those of the Pacific region. It will show, too, more clearly how widely the forests of these two great regions differ in composition.

The economical importance of the forests.

The economical importance of the forests of the United States is very great, but can hardly be expressed by figures. Some facts, however, may be stated in this connection. The wood from the forest is used in the main for fuel. Although coal exists in abundance over certain regions, and although there are parts of the thickly settled regions where forests are scanty, there is no district where some wood is not used as fuel. In the cities of the East—even those which are in the immediate vicinity of coal—a good deal of wood is necessarily consumed in the form of kindlings,—an important item where anthracite is the coal supplied; and, moreover, open fires are extensively used by the wealthier class, in conjunction with coal in furnaces. In other regions where coal is abundant, forests are also abundant, and as these must be cut down to be sawn into lumber, or to clear the land for cultivation, there is a large supply of wood available as fuel, but not fit to be used for building or manufacturing. Except in the large cities, and occasionally in the towns of second and third rank, wood is used almost exclusively for the building of houses and barns in the United States. Fences also consume a very large amount of wood, this material being in common use for this purpose wherever timber is abundant, and often where it is not, as in the prairie States, where, however, within a few years, wire has begun to be very extensively used for fences. There is also a very large consumption of wood for furniture and for those portions of various implements, especially agricultural, which are made of this material. An even larger supply of wood is required for the boxes and barrels in which various articles of merchandise are transported. The consumption of wood in the form of barrels, as required by the two articles flour and salt, is very large.

Cheap wooden ware.

The great demand for cheap wooden ware, and the extensive use of wood in building houses, and for various portions of the finishing and fittings of houses and barns, has led to the invention of very ingenious machinery by the aid of which wood is wrought into almost every variety of forms with very little direct help from human hands. This makes the coarser kinds of furniture and of household implements exceedingly cheap. As an example, it may be mentioned that barrels strong enough to hold in transportation two hundred and eighty pounds of salt are made in Michigan for so small a sum as twenty cents.

Log houses.

The building of log houses—that is, of such dwellings as are made by piling trunks of trees on each other, either in their natural shape, or partly squared with the axe—is almost a thing of the past, although once extremely common. Very few districts in the region of abundant forests are so far away from saw-mills and railroads as to make a log house the most economical form of dwelling. Occasionally some large, substantial and well-finished buildings are erected "log-house fashion," either as a matter of fancy, or to attract attention by an exterior of exceptional appearance.

Some idea of the importance of the forests from an economical point of view can be gained from the following figures given by the census of 1880, in reference to the manufacture of sawn lumber:

Number of establishments	25,708
Capital invested	$181,186,122
Average number of hands employed	147,956
Feet of lumber produced	18,091,356,000
Number of laths	1,761,788,000
Number of shingles	5,555,046,000
Number of staves	1,248,226,000
Number sets headings	146,523,000
Feet of bobbin and spool stock	34,076,000
Total value of the above specified products	$230,685,061
Value of other products	2,682,668
Total value	$233,367,729

The consumption of wood "for domestic purposes"—that is, as fuel in houses—is given by the census of 1880 as amounting to 140,537,439 cords, having an estimated value of $306,950,040.

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The total consumption of wood as fuel is given as follows:—

	Cords.	Value.
For domestic fuel	140,537,439	$306,950,040
By railroads	1,971,813	5,126,714
By steamboats	787,862	1,812,083
In mining and smelting	624,845	3,548,286
In making bricks and tiles	1,157,522	3,978,331
In making salt	540,448	121,681
In woolen manufacture	158,208	425,239
Total	145,778,137	$321,962,373

The total value of the wood used as lumber and as fuel amounts, therefore, to no less than $555,330,102, if the figures given by the census of 1880 are to be trusted. The value of the wood consumed as fuel in the United States was more than three times as great as that of the coal mined. In fact, the timber of the country is the greatest of all its material possessions. The coal, once exhausted, can never be restored, not even with the lapse of an indefinite amount of time, for the conditions favorable to the production of coal on the earth have entirely ceased to exist. The timber, on the other hand, is restored, after destruction by man, by the kindly hand of Nature. This is the case, at least over the whole of the once densely timbered portion of the country, where the various growths succeeding each other after the primal forest has been removed offer a satisfactory substitute for that which has been made use of, either naturally or as an easily attainable result of cultivation. In regions where the rainfall is of insufficient amount, there appears to be a tendency in Nature to replace the original growth by one of inferior quality. Whether this inferiority would be lasting or not seems a doubtful matter. That there has been a diminution of the precipitation, certainly dating back to the Tertiary age, and, in all probability, to a much earlier time, is a geological fact established beyond all possible doubt. That this diminution has anything to do with the removal of the forests by the hand of man, or that man can to any perceptible extent influence the general climate of the country, there is not the slightest reason for believing.

SCENOGRAPHICAL.

The great extent of the territory occupied by the United States is a sufficient reason why there should be a corresponding variety in the scenery. In the early history of the country, when only the Atlantic coast and the eastern side of the Appalachian belt were known to travelers, the landscape was generally considered monotonous by those who visited this region as tourists, or with a view to the enjoyment and description of its scenery. This impression of uniformity and monotony was further confirmed, as the Mississippi Valley and the region of the Great Lakes were added to the tourist's range. Many persons visited the prairies of Illinois and the adjacent States for the purpose of getting an idea of a vast expanse of almost unbroken country such as could hardly be obtained elsewhere in the Northern Hemisphere without visiting Southeastern Russia and the country east of the Urals. The general resemblance of the Appalachian Mountain scenery to that of parts of Northern and Central Europe—as, for instance, that of the White Mountains to that of the Erzebirge, or that of Northern New England to that of Scandinavia—could hardly escape notice, similarity of topographical features being supplemented in many cases by the absence of any specially marked differences in the floras of the regions in question. Thus the writer, having spent a summer in a geological exploration of New Hampshire, found himself after a very short interval of time travelling through Southern Sweden. The impression of the scenic similarity of the two regions was extremely interesting. Not only were the rocks, rock-forms and topographical features the same, but the vegetation—although of course not identical so far as the species were concerned—made, from the scenic point of view, almost exactly the same impression on the eye in the Scandinavian country that it did over large portions of New England.

In those early days of travel, especially of English travel, to the United States, the dominating idea was to see Niagara Falls, which was the great point of attraction. Occasionally an adventurous traveler went farther West and down the Mississippi; but for ninety-nine out of a hundred tourists who visited this country and described its scenery, Niagara was the Ultima Thule. The opening of the "Farthest West" by roads and railroad, the scientific exploration of the Cordilleran region, the development of its mineral resources, and the rapidly growing desire on the part of many to see as much of the world as possible—all this has very greatly enlarged the range of experience in the enjoyment of scenery, while the art of photography has rendered it possible for those not caring to travel to understand and enjoy the scenic features of distant countries, and to compare understandingly the landscapes of regions widely separated from each other.

To attempt to describe the principal features of the scenery of a country having an area of more than three million square miles, is, of course, something not to be thought of in the present connection. All that can be done is to indicate some of the points most visited, and most worthy of being visited, by tourists, and to compare in a general way, some of the more striking features of the landscape of this country with those of regions of similar scenic character in other parts of the world.

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In doing this we may begin with the mountains. The Appalachian Mountain scenery is only to be compared with that of the minor chains of Europe, since these eastern ranges never rise to the snow-line, and are almost always wooded to their summits. The principal features of Appalachian topography have been already dwelt upon to as great an extent as space would allow; and it needs here only to be stated that, while these features are often of exceeding interest to geologists and other close students of nature, they do not exhibit any forms which in grandeur can be compared with those of common occurrence in the Cordilleras or the Alps or, still more, in the Himalaya. There are from the scenic point of view few, if any, unique figures in the Appalachian ranges. The nearest approach to such is perhaps the Natural Bridge in Virginia—an arch of limestone gracefully spanning a chasm about two hundred feet deep and sixty feet wide—and the Profile in the Franconia Notch, in which masses of rock are so disposed as to represent, in gigantic dimensions and with striking approach to accuracy in general outline, the profile of a human face. Fully as fine a profile as that in the White Mountains is to be seen in Colorado; but as this latter locality is not easily accessible, and is surrounded by an abundance of grand scenery, it is hardly known to the general tourist, and seems never to have been described, while of the Profile in the White Mountains the descriptions are numerous. To the trained eye of the topographer and geologist the extraordinary, intricate and exceptional forms of the ranges and valleys in Central Pennsylvania are of vastly greater interest than such accidental and fanciful occurrences as the Profile in the Franconia Notch.

White Mountain flume.

A purely American name for something which is not of uncommon occurrence in mountain regions is the word "flume," which as applied in the United States, and chiefly in the White Mountains, means a narrow passage or defile between nearly perpendicular rocks, through which runs a stream, and usually with a succession of cascades. The White Mountain flume, in the Franconia Notch, is the locality of this kind most visited. It is about four hundred feet in length, and the walls are from twenty to fifty feet in height. A deep cut in the sandstone at Keesville, New York, near Lake Champlain, on the Au Sable River, is called a "chasm." The term "notch" is used in the White Mountains, and to a limited extent in the Adirondacks, for pass or mountain valley. Similar passes or depressions in the Appalachian ranges farther South, especially in Pennsylvania, are called "gaps." Those which are deeply cut down, so as to give passage to streams, are called "water-gaps;" those in which the depression in the ridge is not sufficiently deep to give passage to a water-course, are known as "wind-gaps." The gorge at the great bend of the Delaware, where this stream traverses the Kittatinny Range, and which is known as the "Delaware Water-Gap," is a prominent scenic feature of this kind.

New England Mountains.

The points in the New England portion of the Appalachian system which are most visited by tourists for the sake of the panoramic views which they afford are Mount Washington—the only point over six thousand feet in elevation in the Appalachians north of North Carolina; Mount Lafayette, in the Franconia Range (5,290 feet); Moosilauke (4,790 feet), a little farther south; Monadnock, near the southern border of New Hampshire (3,169 feet); Mount Mansfield, in the Green Mountain Range in Vermont (4,389 feet); Greylock, in the northwest corner of Massachusetts (3,505 feet). The Adirondacks also attract great numbers of visitors, where the lakes and streams afford opportunities for boating and fishing, and where the scenery is extremely attractive, especially in the autumn after the leaves have begun to change their color, most of this region being still covered with the primeval forest. Mount Marcy or Tahawus 5,344 feet, and Whiteface (4,871 feet) are the points most frequently ascended in this region; but there are many others, ranging from three to five thousand feet in elevation, which offer fine views, and are not at all difficult of access. The Catskill group is also a region much resorted to by tourists, partly on account of the beauty of the scenery, and partly because it is so easily reached from New York. The high mountain region in North Carolina is too remote to attract many visitors from the Northern and Eastern States; and the facilities for travel in that region are as yet extremely deficient, in striking contrast with the condition of things in this respect in the mountain districts of New England and New York, where almost every point can be reached by railroad, and where hotels are numerous and commodious, and the business of receiving and taking care of "summer boarders" seems to be a most important one for the permanent residents.

Cordilleran Mountain scenery.

The mountain scenery of the Cordilleran region is extremely varied in character, as has already been made evident to the reader in the sketch of the topography of that part of the country given in the preceding pages. Only a few of its more important features can here be indicated.

In elevation the Cordilleran ranges are comparable to the Swiss Alps, although there is no point in the United States proper quite as high as Mont Blanc (15,784 feet), or Monte Rosa (15.217 feet); but there are several which surpass the Finster Aarhorn,—the culminating point of the Bernese Oberland (14,026 feet),—and there are a large number which have a greater elevation than the Jungfrau (13,671 feet). A very curious feature in the Cordilleras is the closeness with which the highest peaks approach each other in altitude, as shown by the following table of elevations of all the points in the United States supposed to be over fourteen thousand three hundred feet high, all of which are in the Rocky Mountains, and all in Colorado with the exception of the two volcanic cones, Shasta and Rainier:—

MOUNTAIN.	ELEVATION AT SEA-LEVEL.	AUTHORITY.
Blanca Peak	14,464	Hayden Survey.
Mount Rainier	14,444	U. S. Coast Survey.
Mount Shasta	14,442	Cal. Geol. Survey.
Mount Harvard	14,375	Hayden (14,452 Whitney).
Mount Elbert	14,351	Hayden Survey.
Gray's Peak	14,341	Hayden (14,319 Whitney).
Mount Rosalie	14,340	Hayden Survey.
Torrey's Peak	14,336	Hayden (14,375 Whitney).
Mount Evans	14,330	Hayden.
La Plata Mt.	14,311	Hayden Survey.

The above are all the points in the Cordilleras believed to be over fourteen thousand three hundred feet in elevation, with the exception of Mount Whitney, which has been several times measured, with rather discordant results, ranging all the way from 14,600 to 14,898 feet; there is good reason, however, for believing this to be the highest point in the United States, not including Alaska. All the heights given above, with the exception of Rainier, were obtained by the aid of the barometer, and are not to be taken as being absolutely accurate. The elevations in Colorado by the Hayden Survey, which are the result of a combination of barometrical and trigonometrical measurements, are probably pretty close approximations to the truth. The measurement of Rainier, depending as it did on trigonometrical measurements made at a great distance, are—in the writer's opinion—not to be accepted as final, and may be farther from the truth than a single barometrical observation would have been; but this mountain, although several times ascended, has not been measured barometrically.

Elevations in Colorado.

Comparison of Cordilleras and Alps.

The essential difference between the Cordilleran ranges and the Alps is that the latter are much more extensively covered with snow than are the former, and that this snow gives rise to permanent glaciers, descending far below the snow-line, and constituting a very prominent and exceedingly attractive feature in the scenery of the Higher Alps. With the exception of the great volcanic cones of the Sierra Nevada and Cascade Range there is no part of the Cordilleras where snow or ice forms a prominent feature in the scenery during the summer, at the time when the mountains are visited by tourists. The winter snow, of course, covers the mountains, often to a very large extent, and summer snow-falls do the same occasionally; but the effect of this latter kind of occurrence is in no respect to be compared with that of the permanent Alpine snows and glaciers; indeed, the irregular melting away of the summer's snow on the flanks of the ranges, leaving great patches promiscuously scattered here and there, is often rather a disagreeable than a pleasant feature. A remarkable exception is the cross of snow on the "Mountain of the Holy Cross," to which allusion has already been made. There are small masses of ice around the highest peaks of some of the Cordilleran ranges, but these are frequently covered and entirely concealed by snow, even during the summer; and whether properly called glaciers or not, they have no effect on the landscape, and are only seen by those ascending to the summits of the highest peaks, and then only in favorable seasons.

The snow and ice covering the higher portions of the great volcanic cones of the Pacific coast are, however, conspicuous features in the scenic effect produced by these grand masses; and the type of landscape which they present is a peculiar one, and, perhaps, the most impressive which this country offers. Lassen's Peak is the most southern of these volcanic masses, and it is nearly as high as Mount Hood; but it rises from a so much higher base, and, being so much farther south, is so much less covered with snow than that cone, that it is by no means as grand an object as its more northern rival. The snow-fields on the upper portion of the southern flank of Lassen's Peak have always presented nearly the same appearance in summer when seen in different years by the writer, indicating a considerable degree of permanency; yet when these fields were climbed over there was no indication of the existence of ice visible.

Mount Shasta.

Mount Shasta, seventy miles farther north, and nearly four thousand feet higher than Lassen's Peak, is, of course, much more covered with snow, which, although diminishing greatly in amount after several successive dry seasons, never disappears entirely, even on the south side. On that side, when this mountain was ascended by the writer in September, 1862, seven miles of the ascent were made over a snow field filling one of the great ravines by which this mighty cone is furrowed. Seven years later this field was almost entirely gone at the same season of the year, and the evaporation of the snow had uncovered a large field of ice on the north side of the cone, of which nothing had been visible in 1862, in looking from the summit down upon the flanks of the mountain in that direction. At all times of the year when seen by us, from 1860 to 1864, at a distance of fifty or sixty miles, Mount Shasta presented the appearance of a dazzling white cone when shone upon by the sun. The outline of the mass, as seen from a point fifty-three miles distant in a southerly direction, was that of an almost regular cone, growing slightly steeper toward the summit, and having a slope of 25°-27° on one side, and of 30°-31° on the other, with a smaller, somewhat steeper, subsidiary cone on the western side.

Mount Hood.

Mount Hood is a very conspicuous and grand mountain mass on account of its isolation, its regular form, and the extent to which it is covered with snow. It appears higher than it really is, because it can be seen from a point only about thirty miles distant, which is but little above the sea-level, and where the fine scenery of the Columbia River and of the basaltic region adjacent to it makes an admirable foreground. It is a favorite subject for landscape artists, and has been repeatedly climbed by tourists, the ascent being without special difficulty. The same may be said in regard to Mount Shasta.

Mount Rainier.

Mount Rainier, of which the aboriginal name is said to be Tacoma, is much less accessible than either Hood or Shasta, but has been climbed several times, and first in 1870 by Messrs. Stevens and Van Trump, of Olympia, Washington. As seen from the southern end of Puget Sound, at a distance of forty miles from its base, this mountain is an object of surpassing grandeur. It is of almost exactly the same height as Shasta, but is much more deeply and extensively covered with snow and ice than is that cone. As Rainier is in the midst of a tangled forest without roads, and almost without trails, it can only be reached by travelers fitted out with pack animals and camp equipage, and who are able and willing to bear the fatigues of camp life in a difficult forested country. So far as known to the writer, its higher portions have never been visited by any skillful photographer; while Shasta and Hood have been finely photographed from a great number of points of view by Mr. C. E. Watkins, of San Francisco.

On the whole, these great isolated snow-covered volcanic cones of the Pacific coast are, from the scenic point of view, the grandest objects which this country presents. In the picturesque effect which they produce they may be fairly placed on an equality with anything which the Alps have to show. Indeed, so far as an opinion can be relied on which is based on comparison of photographs only, these almost extinct volcanoes of the Cascade Range must be fully as attractive from a scenic point of view as the higher ones of Mexico, and, perhaps, not much less admirable as scenic objects than the much loftier cones of South America, which all rise from very high bases, and of which the snow-covered portions seem but insignificant in extent as compared with the uncovered rocky slopes.

Granitic masses.

Among the scenic features of the Cordilleras in the United States there are two forms of rock masses which are, in certain regions, developed to such an extent as to make them peculiar and exceedingly impressive as elements of the landscape. One is the pinnacled character of the granitic masses; the other the dome-shaped summits of the same rock. The pinnacles are something like the Aiguilles of the Mont Blanc group, but in the latter the rock is chiefly slaty and not granitic. In parts of the Cordilleras, notably in the vicinity of Mount Whitney; in a group of mountains called the Castle Range, near Mount Shasta, and in the Wind River Range, the granite occurs in the form of almost isolated pinnacles, or groups of pinnacles, which rise literally thousands of feet above the general lével or crests of the ridges on which they stand, so sharp and so vertical that the descriptive term "spike" is one which involuntarily suggests itself to the mind on seeing them. These pinnacles are, of course, too steep to be covered by snow; but they rise often from great snow-fields, presenting a wonderful appearance of mingled desolation and grandeur, and making, perhaps, as strong an impression on the mind as any type of mountain scenery can.

Yosemite Valley.

The dome structure of the granitic masses, so wonderfully exhibited in parts of the Sierra Nevada, is also a feature of great scenic interest, and one which, so far as known to the writer, is not seen anywhere else in the world on so grand a scale. These domes are especially well exhibited in the region just above the Yosemite Valley; and here also is that unique feature of the scenery—one of those great, rounded, and exceedingly steep masses, rising almost five thousand feet above the adjacent valley, and which has been split in two so that on the side fronting that valley it presents an absolutely vertical face of somewhat over fifteen hundred feet in height.

Next to mountains, water-falls, perhaps, offer the greatest scenic attractions, and the number and variety of form of those occurring in the United States is very great. Indeed, there are in the Cordilleras great numbers of water-falls which have been seen by explorers, but which have never been described or named; and some of these unknown localities are finer than any of the much-visited falls of the Alps, or even of Norway.

Waterfalls.

Among the well-known and frequently visited water-falls, there are three which deserve special notice—Niagara, the Shoshone, and the Yosemite Falls. The first is the type of a fall in which volume of water is the all-important feature. In the Shoshone fall, the volume of water is large, although greatly inferior to that of the Niagara; the height is considerable,—somewhat greater than that of Niagara,—and the surrounding scenery grand and entirely uninjured by the so-called "improvements" of civilization. The Yosemite fall, on the other hand, is one in which the volume of water is small, but the height extraordinary, while the setting of the fall is surpassingly grand. Niagara is so well-known that description is unnecessary. It is the one of the scenic attractions of the country most frequently visited, not only because it is one of the greatest of the water-falls of the world—only the Falls of the Zambezi surpassing it in elevation and, perhaps, in volume—but because it is within a few hours' easy ride of the Atlantic coast. The Yosemite Valley, with all its water-falls, is farther away from the East than the Shoshone Falls, but really much more accessible than the latter, which lies at a considerable distance from any inhabited region. Among the entirely unvisited regions of water-falls, that of the Canon of the Tuolumne River, a few miles north of the Yosemite Valley, is, perhaps, the most interesting. Here are falls and cascades of large volume and great height, set in the midst of the wildest and most romantic scenery—a region into which hardly a traveler has ever found his way. Very much the same may be said with truth of the region of the Southern High Sierra adjacent to Mount Whitney, where we find many of the same features as those which characterise the Yosemite, and on almost as grand a scale as in this now very frequently visited and comparatively accessible locality.

Southwest Colorado without a rival.

A most remarkable type of scenery, and one which combines features equally interesting to the tourist and the scientific observer, is that of the plateaux of the Cordilleras, of which a brief account has already been given in the preceding pages. The canons of the Colorado and its branches, once so remote, have now been brought comparatively near by the extension of railroads toward the Southwest, and the tide of pleasure travel is beginning to flow in that direction. In the peculiar type of scenery which is unfolded along the Colorado, this country is without a rival. The loess region of Northern China may be stranger and more unintelligible in the record which it presents of past geological events; but from a scenic point of view the tremendous canons of the Southern Plateau region, with their many-colored walls, may unhesitatingly be included in the list of the earth's greatest wonders.

A portion of the country which has within the past few years become the resort of travelers in search of the picturesque, and which is now quite accessible by railroad, is the Geyser region of the Yellowstone. Here the scientifically interesting and the picturesque unite to furnish a type of scenery without a rival of its kind, surpassing even the now devasted wonderland of New Zealand. The Yellowstone Park, as it is frequently called, because reserved by the United States and devoted to public use as a visiting ground or park, with the idea of protecting it from speculators and mischief-makers, was early known to some of the more adventurous of the fur-hunters who roamed over the Great Northwest; but it is only within a few years that descriptions of it have been published, and its extraordinary character so clearly established as to induce travelers to undertake the long journey necessary for its inspection. Thermal springs in great number, many of which are the periodically spouting, or geyser type; pools of hot water, both large and small, the sides and bottoms of which are lined with the most exquisitely and brilliantly colored microscopic vegetation; remarkable deposits from the hot springs, some of which exhibit curious forms, seen nowhere else, except in Asia Minor and in New Zealand, as it was before the volcanic eruption of 1886; grand mountain scenery, with water-falls, lakes and deep canons, whose walls are fantastically colored by volcanic deposits and sulphurous emanations—these are the principal features of the Yellowstone region. It can be reached by the Northern Pacific railroad, from a station on which road, called Livingstone, ten hundred and thirty-two miles from St. Paul, a branch fifty-one miles in length runs to Cinnabar, on the boundary line of the so-called "Yellowstone National Park." There are numerous excellent photographs of this region, which has also been finely illustrated in a folio volume with chromo, lithographs from paintings by Thomas Moran. The geological and scenic peculiarities of the Yellowstone region have been fully elucidated in various United States Geological reports, and especially in a voluminous one by Dr. A. C. Peale, included in the second volume of Hayden's Report for the year 1878.

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There is a type of scenery of a remarkable character well exhibited along the base of the Rocky Mountains at various points, and especially at a locality called the Garden of the Gods, near Pike's Peak, and easily accessible by railroad. The attraction here is the remarkable effect of the erosion and withering of the soft sandstones, which occur in beds of great thickness. Many fantastic shapes, such as columns or obelisks, of large dimensions, occurring either singly or in clusters, and often capped in the most curious manner by great flat tables of harder rock, are seen in this interesting region. Indeed, all along the eastern base of the Rocky Mountains in Colorado are many strange and picturesque forms, partly the result of direct uplift, and partly of erosion, which are alike interesting to the lover of the picturesque, and the student of geology. The long crested uplits of sedimentary rock worn into curved outlines, and often of grand dimensions, which characterize this region are known by the familar name of "hog-backs," and the region itself as the "hog-back country."

Of the scenic effect of the vegetation of the country, and especially its forests, notice has already been taken to as great an extent as space here permits.

MINERAL RESOURCES.

Iron ore was smelted at Falling Creek, Virginia, as early as 1620. The raids upon the whites at this time, made by the Indians, put a stop to the industry. From 1643 to 1671 the business of smelting and manufacturing iron was successfully carried on at Lynn, Massachusetts. About 1789 there were fourteen furnaces and more than thirty forges in operation in Pennsylvania.

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The business of mining for other metals than iron within the territory of the United States is of much more recent origin. To this statement, however, an exception must be made in reference to the metal copper, which had been extensively mined in the Lake Superior region long before the first visit of the English to these shores. Indeed, so ancient are these workings that no positive knowledge exists as to the people or tribes by whom they were executed. When the region in question was opened to the whites for settlement in 1844, it was found that the copper-bearing rocks had been mined through their whole extent along the southern shore of Lake Superior, and even on the almost inaccessible island called Isle Royale. There is no reason to suppose that these ancient workings, which in some places had been carried to a depth of more than fifty feet in the solid rock, were known to the Indians inhabiting that region at the time of the first visit of the Jesuit Fathers in 1659-60; and the appearance of the excavations indicates, beyond possibility of doubt, that they had been made long before that time.

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throp.

About the middle of the seventeenth century the metalliferous indications common in New England, and especially in Connecticut, engaged the attention of Governor Winthrop, by whom mineralogical notices of that region were sent to England and published in the Transactions of the Royal Society.

Just at the beginning of the eighteenth century a Frenchman, Le Sueur, explored the region of the Upper Mississippi, and sent back to France, rock which he had mined, supposing it to be an ore of copper; but it proved to be of no value. Later in 1719 and 1720, the French again attempted to explore what was then called the western portion of the country, along the Mississippi near the junction of the Missouri; and some mining of the lead ore, which at that time had already become known, was attempted. The precious metals being what was sought for, and there being none found in the region, the enterprise was soon abandoned.

At the beginning of the present century, as it appears from what has been stated, all that had been done in the way of discovering and developing the metallic wealth of the United States was the mining and smelting of the ores of iron, on a limited scale, in the Atlantic States, and a small production of lead in the mining region of Missouri. Exact statistics of these metals at the beginning of the nineteenth century are wanting. The amount of iron produced in 1810 has been estimated at fifty thousand tons; the production of lead about that time may have been approximately one thousand tons a year.

Gold

An event of great importance took place almost immediately after the value of the Lake Superior copper mining district had been fully ascertained, in the year 1841. This was the demonstration of the fact that gold existed in large quantities along the western slope of the Sierra Nevada.

The occurrence of gold on that portion of the Pacific coast, called by the Mexican-Spanish Upper California, had been known for several years prior to its discovery by immigrants from the United States and workings had been carried on for this metal in the Coast Ranges, far south of the locality where it was discovered in 1848.

The demonstration of the fact that over a vast extent of that distant country gold was to be had in almost unstinted quantity, as it at first—not without reason—appeared, led to an extraordinary excitement throughout the older States, and to an emigration from all parts of the world toward the newly discovered land of gold on an unprecedented scale of magnitude.

COAL

The area underlain by the coal-measures in the United States is very large, as will be seen from the following table, which represents approximately the coal areas of Carboniferous age east of the Cordilleran region. That different portions of the areas here designated are of very different value, as respects quality and quantity of coal, is certain; and that portions of them do not contain coal-beds of sufficient thickness or of good enough quality to be worked with profit, either at present or at any future time, is also an undoubted fact, although these unproductive portions are, except perhaps, in the case of the Western and Michigan fields, of comparatively small extent:—

Coal
beds

Name of the field.	Area.	
Rhode Island	500	sq. miles.
Appalachian	59,165	"
Central (Illinois Indiana, and Kentucky)	47,250	"
Western (Missouri, Iowa, Kansas, Arkansas and Texas)	78,430	"
Michigan	6,700	"
Total	192,045	sq. miles

Of these fields the Appalachian is at present by far the most important, and is likely to remain in this position for an indefinite period. The coal field of Rhode Island is not now, nor has it ever been, worked to such an extent as to be of special importance. The Michigan coal-field has also no present value, the quality of the coal being inferior, and the conditions not such as to allow successful competition with the coal of adjacent regions. The present relative importance of the different States as regards the production of coal and the yield of the various fields will be easily recognised from an inspection of the following table:—

Coal Produced in the Several States and Territories, not Including the Local and Colliery Consumption, and the Value of the Mines in 1885.

States and Territories	1882.	1883.	1884.	1885.
Pennsylvania:	*L'ng tons*	*L'ng tons*	*L'ng tons*	*Ln'g tons*
Anthracite	29,120,096	31,793,027	30,718,293	32,265,421
Bituminous	22,000,000	24,000,000	25,000,000	23,214,285
Illinois	9,000,000	10,350,000	10,000,000	8,742,745
Ohio	9,450,000	8,229,429	7,650,062	6,978,732
Maryland	1,540,466	2,206,172	2,469,051	2,865,974
Missouri	2,000,000	2,250,000	2,500,000	2,750,000
West Virginia	2,000,000	2,805,565	3,000,000	3,008,091
Indiana	1,976,470	2,560,000	2,260,000	2,120,535
Iowa	3,127,700	3,881,300	3,903,458	3,583,737
Kentucky	1,300,000	1,650,000	1,550,000	1,700,000
Tennessee	850,000	1,000,000	1,200,000	892,857
Virginia	100,000	225,000	300,000	567,000
Kansas	750,000	900,000	1,100,000	1,082,230
Michigan	130,000	135,000	135,000	45,178
Rhode Island	10,000	10,000	10,000	....
Alabama	800,000	1,400,000	2,000,000	2,225,000
Georgia	175,000	200,000	200,000	133,929
Colorado	947,749	1,097,851	1,008,950	1,210,769
Wyoming	631,932	696,151	805,911	720,828
New Mexico	146,421	188,703	196,924	271,442
Utah	250,000	250,000	250,000	190,286
California	150,000	175,000	150,000	63,942
Oregon	30,000	50,000	50,000	44,643
Washington	225,000	300,000	300,000	339,510
Texas	....	100,000	100,000	133,928
Arkansas	....	75,000	150,000	133,928
Montana	....	60,000	60,000	77,179
Dakota	....	50,000	31,250	23,214
Idaho	....	10,000	20,000	693
Indian Territory	....	175,000	400,000	446,429
Totals	86,710,834	96,828,198	97,518,899	95,832,709

States and Territories.		Value of Coal at Mines, 1885.
Pennsylvania:	Anthracite	$72,274,544
	Bituminous	24,700,000
Illinois		11,456,493
Ohio		8,206,998
Maryland		3,209,891
Missouri		3,850,000
West Virginia		3,369,062
Indiana		2,731,250
Iowa		4,819,230
Kentucky		2,004,400
Tennessee		1,100,800
Virginia		666,792
Kansas		1,410,438
Michigan		75,000
Rhode Island		.....
Alabama		2,900,000
Georgia		180,000
Colorado		3,051,590
Wyoming		2,421,984
New Mexico		918,606
Utah		425,000
California		214,845
Oregon		125,000
Washington		950,615
Texas		300,000
Arkansas		225,000
Montana		302,540
Dakota		91,000
Idaho		4,000
Indian Territory		750,000
Total		$152,915,268

Pennsylvania anthracite.

The commercial product, exclusive of that which is consumed at the mines, known as colliery consumption, during 1885, was: Pennsylvania anthracite, 36,137,272, short, or 32,265,421 long tons, the market value of which has been estimated to have been $72,274,544; bituminous, brown coal, lignite, and small lots of anthracite, mined in Colorado and Arkansas, 71,195,358 short, or 63,567,284 long tons, the market value of which has been estimated to have been $80,640,724, making a total production of 107,332,629 short, or 95,832,705 long tons, valued at $152,915,268. The total production, including colliery consumption, was Pennsylvania anthracite 38,335,973 short, or 34,228,548 long tons, all other coals 72,621,549 short, or 64,840,668 long tons, making the total absolute production of the coal mines of the United States for the year, 110,957,522 short, or 99,069,216 long tons.

The coal areas of Carboniferous age in the United States are five in number. They are:—

The Massachusetts-Rhode Island area, comprising approximately 500 square miles;

The Alleghany area, about 59,000 square miles;

The Michigan area, about 6,700 square miles;

The Illinois, Indiana and West Kentucky area, about 47,000 square miles; and

The Iowa, Missouri, Kansas, Arkansas and Texas area, about 78,000 square miles;

Forming a total of about 191,200 square miles, underlaid by coal-bearing strata, of which not over 120,000 square miles contain workable coal-beds.

Two general classes of coal are recognized, viz., anthracite and bituminous, the latter being often subdivided into bituminous and semi-bituminous coal.

Anthracite forms the whole of the coal found in the Massachusetts-Rhode Island area and in that portion of Pennsylvania occurring in the neighborhood of Pottsville, Mahanoy City, Shamokin, Hazleton, Mauch Chunk, Wilkes-Barre and Scranton. It also occurs to a limited extent in Virginia.

Bituminous coal occupies the rest of the districts just named.

A glance on a map of the coal-fields shows how unequally the coal areas are distributed over the United States. While New England and the seaboard Atlantic States contain practically no coal, the greatest development of the workable coal strata is in the Alleghany mountains and to the west of them, extending from Pennsylvania and Ohio in an unbroken line to Alabama.

Next to the one just mentioned the most important field is the one occurring in Illinois, Indiana and Western Kentucky. The coal area which extends from Iowa to Texas is of much less importance and extent, and the Michigan coal-field has scarcely been opened.

Different coal fields

THE MASSACHUSETTS-RHODE ISLAND AREA.—The coal is confined to eastern Rhode Island and Bristol and Plymouth counties in Massachusetts. At present the only mine worked is at Portsmouth, Rhode Island, where E one of the three beds found, is being exploited. The coal-beds in this area seem to vary from one to thirteen in number, but the explorations made in the past have been so unsystematic and pecuniarily, so unsatisfactory, that the data on which these views are founded are not very reliable. The character of the coal is the hardest kind of anthracite, often containing spangles and plates of graphite disseminated through it, which characteristics are due to the highly metamorphic action it has undergone. To this same action is due in a great measure the peculiarly folded character of the deposits, which has locally caused expansions and contractions of the coal-beds, so that in some places they are thirteen feet thick, and in others but a few inches. Such an irregularity renders the cost of mining the coal very great, owing to the large amount of "dead work" required, and to this cause may in part be ascribed the slight progress which has been made in the development of the region. The working is now confined to a single mine.

THE ALLEGHANY AREA, the most important in the United States in its extent in the number of workable coal-beds and in the quality and variety of the coals found, is situated in Pennsylvania, Ohio, West Virginia, Virginia, eastern Kentucky, East Tennessee and northern Alabama. This area is divided into numerous different fields, more or less contiguous to one another, and of which a brief mention follows:

THE ANTHRACITE COAL-FIELDS OF EASTERN PENNSYLVANIA.—These anthracite fields are confined to a limited area of not over 475 square miles, situated in the counties of Carbon, Schuylkill, Northumberland, Columbia, Dauphin, Luzerne and Lackawanna. Three districts are commonly recognized in this region, known as the first, second and third coal-fields. The Coal Measures within this region are almost universally surrounded by two mountain-ridges, the exterior one consisting of sub-Carboniferous sandstone. This is separated from the interior ridge by a valley, more or less broad, of easily decomposing red shale, overlying which occurs the true conglomerate, holding in its bosom the valleys or basins in which the anthracite occurs. These two series of ridges were the efficient protectors of the coal from the denuding agents, which removed it from the intervening barren districts, separating the different anthracite basins from each other and from the bituminous coal-fields of Central Pennsylvania.

Semi-anthracite beds in Sullivan county, Penn.

North of the anthracite coal-fields proper, is the semi anthracite of the Bernice basin in Sullivan county, Pennsylvania, where the principal coal bed, eight to nine feet thick, contains eight to nine per cent. volatile matter. The coal, while classed as an anthracite, lacks the brilliant anthracite luster and conchoidal fracture, generally breaking in cubes; in consumption it closely resembles the semi anthracite of Lykens Valley, in Dauphin county. The whole of this coal is carried North and West for distribution and consumption.

THE BROAD-TOP-COAL-FIELD OF PENNSYLVANIA.—The coals of this basin, which occupies about twenty-five square miles, all belong to the Lower Protective Coal Measures, of which more presently, with the exception of a few acres of coal of the Pittsburgh bed. The measures in this coal-field have been much disturbed, so that the relations of the strata are not fully understood, and consequently frequent errors have been made in identifying the coal in different portions of the district. There are apparently three workable beds. The coal of this district, while actually bituminous in character, is commonly called semi-bituminous on account of the comparatively small amount of volatile matter it contains, often as low as eight per cent. At one time the mines of this district were actively worked, the coal being used for steam-raising and rolling-mill purposes. Since the opening of the Clearfield coal-district and the more active exploitations of the Cumberland coal-beds, the mining interests of this district have languished, owing in part to an inferiority in quality of this coal to either of the others, in part to the greater cost of extraction due to the more disturbed condition of the strata.

THE BITUMINOUS COAL-FIELDS OF PENNSYLVANIA.—While the bituminous coal fields of Pennsylvania are contiguous to those of Ohio and West Virginia, the latter being actually but extensions of the former, they are, for the sake of description, separated geographically.

In the bituminous coal area of Pennsylvania, Ohio and West Virginia geologists and engineers have recognized (1) Upper Barren Measures, (2) Upper Productive Coal Measures; (3) Lower Barren Measures; (4) Lower Productive Coal Measures; (5) Interconglomerate coals.

The following coal strata occur in the Upper Productive Coal Measures, commencing with the upper bed: Waynesburg coal-bed, Sewickley coal-bed, Redstone coal-bed, Pittsburgh coal-bed. Of these the Pittsburgh is of far the greatest economical value, but the others are locally of importance.

In the Lower Barren Measures are a few beds which are most uncertain in character and of little economical value: they are most unreliable in character, and while locally they thicken, so as to be of some local value, they speedily thin out again.

Below the Lower Barren Measures are found the following coal strata, viz: Upper Freeport coal-bed, Lower Freeport coal-bed, Upper Kittanning coal-bed, Lower Kittanning coal-bed, Clarion coal-bed and Brookville coal-bed.

Still lower, geologically, are the coals occurring in the Great Conglomerate, which include the Clarion group, C the Quakertown bed of Lawrence county, and the Sharon bed of Mercer county. These coals occur in six different basins, of which the sixth is the most southwesterly in position and least distinct as to its dvision. Each basin is separated from its neighbor by an anticlinal wave, or rather by a series of separate anticlinals, the ends of which lap past each other

Having the Alleghany mountains as an eastern barrier, the coal fields extend westwardly in a more or less unbroken succession into Ohio. But the coal-beds are by no means equally distributed over this area. As middle Pennsylvania and middle New York were lifted, by geological action much higher above the old sea-level than southwestern Pennsylvania, Ohio and Virginia were, the destruction of the coal measures has been greatest in the North and Northeast, gradually diminishing toward the Southwest. Only the lowest, or two or three lowest, beds of coal have been left as isolated patches on the mountain tops of Wyoming, Sullivan, Lycoming, Clinton, Bradford, Tioga, Potter, Cameron, McKean and Warren counties.

The great productive bituminous coal-field may be said to commence in the belt of counties composed of Clearfield, Jefferson, Clarion, Venango and Mercer counties—a distance of 140 miles to the Ohio line from the crest of the Alleghanies. In the counties last mentioned, as well as in Cambria, Indiana, Armstrong, Butler, Lawrence, Beaver, Somerset (with the exception of the Salisbury patch), eastern Westmoreland and eastern Fayette, only the Lower Productive coal-beds, and in places the inter conglomerate coals have been left, while the Upper Productive Measures have been swept away. These latter are found in a great part with all the Lower Productive Coal Measures in Alleghany, western Westmoreland and western Fayette counties, while the whole of the Upper and Lower Productive Measures occur in Washington and Greene counties. In brief, the Coal Measures are most eroded toward the Northeast, and are least disturbed toward the Southwest.

The Ohio coal fields. THE COAL-FIELDS OF OHIO.—The Ohio coal fields are but the western extension of the bituminous coal-region of Pennsylvania; consequently, the coal-beds which are found in them are the same, with local modifications, as those of the latter State. Commencing at the Pennsylvania-Ohio line we find that "the margin of the coal basin forms a tortuous line, commencing in the northern part of Trumbull county, passing thence southwesterly to the Mahoning Valley, where it is deflected far to the southeast. West of Youngstown it runs through the southern townships of Trumbull county, where it is deflected north nearly to the center of Geauga county, where it incloses a long tongue and two or three small islands of coal. Thence returning into Portage, it passes southeasterly through the southern part of Summit, where it is deflected to the northwest. From here it runs southwesterly again to the southwest corner of Holmes. Thence it passes nearly southward along the western margin of Holmes and Coshocton; thence southwesterly through the eastern part of Licking. From here its course for fifty miles is nearly south to the center of Hocking, where it turns slightly westward, and passes through Vinton, Jackson, Pike and Scioto to the Ohio, where it crosses" into Kentucky. The counties more or less underlaid by coal in Ohio are Mahoning, Columbiana, Portage, Stark, Holmes, Carroll, Tuscarawas, Jefferson, Harrison, Belmont, Guernsey, Coshocton, Muskingum, Perry, Noble, Morgan, Washington, Monroe, Meigs, Athens, Jackson, Gallia, Lawrence, Trumbull, Summit, Medina, Wayne, Licking, Hocking, Pike and Scioto.

Virginian coal fields. THE COAL-FIELDS OF WEST VIRGINIA AND VIRGINIA.—No State in the Union surpasses West Virginia in the variety of coals it contains, nor does any contain an equal amount in proportion to its area; for, of the fifty-four counties in the State, but six are entirely destitute of this important fuel. In many of them, however, the coal is so deeply buried, and in others the means of transportation are so inadequate, that it will be many years before the mineral wealth they contain will even commence to be developed. In Virginia, on the other hand, there are but six counties which contain coal of Carboniferous age, and they are in the extreme southwestern corner of the State, adjoining West Virginia and Kentucky. The coal-field of West Virginia and Virginia is but an extension of the Appalachian coal field from Pennsylvania, Maryland and Ohio, and the general system of the measures, is the same, with the exception that locally some of the coal-beds in the Great Conglomerate are of a sufficient thickness to be profitably worked.

Maryland coal field. THE MARYLAND COAL-FIELD, better known as the Cumberland coal-basin, is but a prolongation of the Potomac basin mentioned under West Virginia. This coal field is one of the most important in the United States, due to the thickness of the main bed, its good quality, and the large annual production. The coal is most extensively used for rolling-mill and steam-raising purposes, its chief and only competitor among the bituminous coals being that from the Clearfield region of Pennsylvania. This coal-field is an outlyer of the main Alleghany coal area, of which there are several others in Pennsylvania, such as the Broad-Top, Snowshoe, Ralston and Blossburg basins. The coal is semi-bituminous in character, and does not coke quite so readily as those which contain more gas.

THE EASTERN KENTUCKY COAL-FIELD is but a continuation of that described in Ohio and West Virginia. The western boundary of the Alleghany coal area in Kentucky is approximately as follows, in a north-south direction: Starting at the Ohio river near Tygart's creek, the line runs through Greenup, Carter, Rowan, Morgan, Powell, Estill, Jackson, Laurel, Pulaski, Wayne and Clinton counties to the Tennessee line. This coal-field underlies the whole of fifteen counties and a portion of five others, containing 8,983 square miles. The boundary line is very crooked, throwing off numerous spurs, extending west of the line mentioned.

THE TENNESSEE COAL-FIELD is but a prolongation southward of the eastern Kentucky field. Its area is co-extensive with that of the Cumberland mountain or table-land. The Cumberland mountain crosses Tennessee obliquely, and although much indented by valleys and coves, is nowhere completely cut in two by them. The eastern border of this table-land is comparatively a nearly direct or gracefully curving line, the indentations made by the streams on this side being scarcely noticeable. It is very irregular, however, along its western border, being cut out and notched by deep valleys and coves, separated from each other by long spurs jutting to the West. These deep indentations give the western outline a very ragged appearance. Along the Kentucky line the coal field is about seventy miles wide, while it narrows along the Alabama line to fifty miles.

THE GEORGIA COAL-FIELD.—The Tennessee coal field west of the Sequatchie valley extends over the border into Alabama, and then soon dies out. That on the eastern side of the valley, on the contrary, extends through Dade, Walker and Chattooga counties in Georgia into Alabama. Almost the whole of the former is underlaid by an excellent quality of bituminous coal, while there is not quite such an extent of it in the other two counties.

THE ALABAMA COAL REGION is an extension southward of the Georgia into northern Alabama. It is divided into three fields, the Black Warrior, the Cahaba and the Coosa. Of these three the first is much the largest.

THE ILLINOIS, INDIANA AND WEST KENTUCKY AREA.—The coal measures of this portion of the United States form but one area.

THE INDIANA COAL-FIELD.—The Carboniferous Measures occur in the counties of Posey, Vanderburgh, Warwick, Spencer, Perry, Crawford, Gibson, Pike, Dubois, Knox, Daviess, Martin, Sullivan, Greene, Clay, Owen, Vigo, Parke, Vermillion, Fountain and Warren; or, in other words, in the southwestern part of the State. There are three beds of coking coal in this field, varying from four and a half to ten feet in thickness, and three seams of open-burning or splint coals that range from two and a half to five feet in thickness, the average thickness being four feet. One bed of cannel coal occurs in Daviess county, about four and a half feet thick. The principal coals mined with this exception are the block coals from Clay county.

PETROLEUM.

Petroleum has been known to exist in this country almost from its first settlement. The records of travels, especially through the region west of the Appalachian chain, in what was then known as the Great Ohio Valley, contain constant evidences of the existence of this material in the reports of burning springs and the oil that accompanied them.

It was not, however, until 1859, at the time of the drilling of Drake's first well, that it began to assume any commercial importance. The excitement attending the discoveries in the Pennsylvania oil field led to explorations in many States, and developed the fact that petroleum existed in many localities. These localities are chiefly on the western slopes of the Appalachian chain, reaching from Petrolea in Ontario to just across the Tennessee State line in Alabama. Some quite extensive fields are also found in California and in Wyoming, and later evidences of the existence of oil have been discovered in other States, but the Appalachian and the California oil fields are at present the only ones of commercial importance.

The most important of these fields are what are described further on as the Pennsylvania and New York oil fields. Next in importance to these is the Macksburg field in Ohio, near Marietta, the third in importance being the California field. West Virginia produces some small amounts of heavy oil for lubricating purposes, its light oil having been comparatively exhausted some years since. There are also oil fields that with better facilities for transportation might be of importance in both Tennessee and Kentucky. The Wyoming oil fields described farther on in this report are also of importance in the amount of petroleum that can some day be made available; but of this field, as of all others outside of the Pennsylvania and Macksburg regions, with the exception of California, it will be found that the expense of producing and transporting the oil to market will effectually prevent any great production in these fields until the price of Pennsylvania petroleum shall materially advance.

In the following table will be found a consolidation of the statistics of the production of petroleum in the various fields of the country, so far as the same could be obtained from the beginning of operations in these fields:—

PRODUCTION OF CRUDE PETROLEUM IN THE UNITED STATES FROM 1859 TO 1877.

(*In barrels.*)

Years.	Pennsylvania and New York.	West Virginia.	Ohio.	Kentucky, Tennessee, and other States.	California.	Total.
1859	2,000	....	....	....	....	2,000
1860	500,000	....	....	....	....	500,000
1861	2,113,609	....	....	....	....	2,113,609
1862	3,056,690	....	....	....	....	3,056,690
1863	2,611,309	....	....	....	....	2,611,309
1864	2,116,109	....	....	....	....	2,116,109
1865	2,497,700	....	....	....	....	2,497,700
1866	3,597,700	....	....	....	....	3,597,700
1867	3,347,300	....	....	....	....	3,347,300
1868	3,646,117	....	....	....	....	3,646,117
1869	4,215,000	....	....	....	....	4,215,000
1870	5,260,745	....	....	....	....	5,260,745
1871	5,205,234	....	....	....	....	5,205,234
1872	6,293,194	....	....	....	....	6,293,194
1873	9,893,786	....	....	....	....	9,893,786
1874	10,926,945	....	....	....	....	10,926,945
1875	8,787,514	3,000,000	220,000	....	175,000	12,182,514
1876	8,968,906	120,000	31,763	....	12,000	9,132,669
1877	13,135,475	172,000	29,888	....	13,000	13,350,363

PRODUCTION OF CRUDE PETROLEUM.—*Continued.*

Years.	Pennsylvania and New York.	West Virginia.	Ohio.	Kentucky, Tennessee, and other States.	California.	Total.
1878	15,163,462	180,000	38,179	....	15,227	15,396,868
1879	19,685,176	180,000	29,112	....	19,858	19,914,146
1880	26,027,631	179,000	38,940	....	40,552	26,286,123
1881	27,376,509	151,000	33,867	....	99,862	27,661,238
1882	30,053,500	128,000	39,761	....	128,636	30,349,897
1883	23,128,389	126,000	47,632	....	142,857	23,444,878
1884	23,772,209	90,000	90,081	....	262,000	24,214,290
1885	20,776,041	91,000	650,000	....	325,000	21,842,041
1886	25,798,000	102,000	1,782,970	225,000	377,145	28,285,115
1887	22,356,193	145,000	5,018,015	51,817	678,572	28,249,597
Total.	330,312,143	4,661,000	8,030,208	276,817	2,[illegible]9,709	345,573,177

Pennsylvania and New York fields.

More than 50 per cent. of all the oil produced in the United States is from the Bradford and Alleghany fields, these two districts being credited with 11,099,512 of the 21,842,041 barrels produced in the country in 1885. The production in these fields, however, is kept up only by the liberal use of nitro-glycerine, and even with the use of explosives to an extent before unknown the production is falling off, and it is a question if the vigor of these old fields can be restored.

California fields.

From the time of the first settlement of California by the whites there have been evidences, in the form of springs and seepage from the asphaltum beds, of the existence of petroleum in the State. No attempts, however, were made to utilize these deposits until the excitement following the Pennsylvania oil discoveries led to prospecting those surface deposits and the eager searching for others. During the years 1865 and 1866 upwards of seventy companies, each with a large nominal capital, were incorporated in California for the purpose of searching for petroleum. While a majority of these companies proceeded no further than to organize, having never expended any money in actual operations, some of them began active operations, sinking wells and driving tunnels in their search. Most of the work at this time was in Humboldt, Colusa, Contra Costa, Santa Clara, and Los Angeles counties.

About 1875 the oil business in California took on new life. Two wells put down that year yielded some 15 or 20 barrels each per day. Drilling by steam began to be more generally used in place of the spring pole. In 1877 the Ventura and the Pico Canon wells produced daily 80 and 40 barrels respectively. Some 20 barrels of refined oil were made daily at the Pico refinery at the latter place. The next year 60 barrels of crude oil were for a number of days taken from the Boyer well, in the Santa Cruz mountains, every 24 hours. The oil here, as in most cases in California, was brought to the surface by pumping, no flowing wells having as yet been struck in the State.

From this time there has been a steadily increasing output of oil in California.

Wyoming fields.

There are, as far as now known, two oil fields in this State, probably originally the same, but now divided by the range of mountains in which the headwaters of the North Platte and Wind rivers find their sources.

Washington fields.

As yet no valuable deposits of petroleum or its concomitant, asphaltum, have been found anywhere in the far west, except in California. Recently encouraging indications of mineral oil are reported to have been met with at Puyallup, in Washington.

NATURAL GAS.

According to Mr. Swank, natural gas was first used as a fuel in connection with the manufacture of iron and steel at Leechburg, Armstrong county, Pennsylvania, in 1874, when it was taken from a well twelve hundred feet deep, and where it at that time furnished all the fuel required for puddling, heating and making steam at the rolling-mill of Messrs Rogers and Burchfield. Between 1874 and 1881 the use of natural gas was introduced at various other establishments for puddling and rolling. The use of this new fuel spread so rapidly, that in 1887 there were ninety-six rolling-mills and steel works either wholly or in part using natural gas; and Mr. Swank states that at the present time nearly one-fourth of all the establishments of this kind in the United States are thus supplied with fuel. The territory in which are located iron and steel works using natural gas extends as far east as Johnstown, seventy-nine miles east of Pittsburg. Some gas is used in Ohio, piped from wells in the adjacent region of Pennsylvania, and some is also obtained from local wells. Pennsylvania gas is also used to a limited extent in West Virginia. Natural gas has also been obtained at various localities in Indiana.

According to Mr. Ashburner, of the Pennsylvania Survey, there were, in 1885, no less than 1,500 dwellings, 46 glass factories, 34 rolling mills, and 45 other industrial establishments supplied with natural gas in the city of Pittsburg alone; and this was estimated as representing or displacing an amount of coal equal to ten thousand tons a day. In the following table is given the amount and value of the coal displaced by natural gas throughout the country, as nearly as it could be estimated, for the years 1885–87:

	Amount.		Value.
1885	2,796,000	tons.	$4,857,200
1886	5,761,000	"	10,012,000
1887	8,900,000	"	15,838,500

The rapid increase in the amount of natural gas consumed during the past few years is easily seen in the above table. The surpassing importance of Pennsylvania in general, and of the Pittsburg District in particular, as consumers of this kind of fuel, and the progress which has been made in other States in the development of this branch of industry may be seen in the following table, in which the detailed statistics for the year 1887 are given:—

AMOUNT OF COAL DISPLACED BY NATURAL GAS.

Locality.	Coal Displaced.	Value.
Pennsylvania:		
Alleghany County..........	4,890,000 tons.	$6,846,250
Remainder of Pittsburg District..................	1,437,900 "	2,415,750
Western Pennsylvania (outside) of Pittsburg District	1,603,100 "	4,487,500
Total Pennsylvania.	7,931,000 tons.	$13,749,500
New York..................	94,600 "	333,000
Ohio..........................	446,000 "	1,000,000
West Virginia.............	53,500 "	120,000
Indiana......................	268,000 "	600,000
Illinois......................	2,500 "	6,000
Kansas.......................	4,466 "	15,000
Elsewhere..................	4,460 "	15,000
Total..............	8,904,520 tons.	$15,838,500

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The development of the iron and steel business in the United States during the last half century has been as rapid as that of the mining of coal. In 1850 the total production of iron throughout the world was about six million tons, of which fully half was to be credited to Great Britain; that of the United States was about one million tons, or one sixth of the whole amount. In the years from 1881 to 1887 the total production of pig iron throughout the world varied between nineteen and twenty-two millions of tons, averaging a little over twenty millions, of which about four-fifths were due to England, the United States and Germany. In the last fifteen years the proportional production of England has gradually declined; for the five years ending 1885 it was very nearly five-twelfths, and in 1887 a very little over one-third of the total. England and the United States together made in 1887 very nearly five-eighths of the total.

In regard to the geographical distribution of special products, the Special Agent of the Census of 1880 in charge of this department—Mr. J. M. Swank—makes the following statement:

"A glance at the statistics for 1880 shows that New England now makes but little pig iron, and that the South makes considerable pig iron and scarcely any rolled iron; that the West has largely embarked in the manufacture of steel by the Bessemer process, while New York cannot boast of a single Bessemer establishment, but has preferred the open-hearth process; that New York makes most of the blooms that are made from ore, and Pennsylvania most of the blooms that are made from pig and scrap iron; that Michigan is the leading producer of charcoal pig iron, and now makes no other kind; that West Virginia has developed a remarkably active interest in the manufacture of cut nails; that only five States make Bessemer steel; and two States, Pennsylvania and New Jersey, make nearly all of our crucible steel; and that Pennsylvania has made a greater effort than any other State to manufacture all kinds of iron and steel."

At the close of the year 1887 there were 613 blast furnaces, then either completed or building (not counting any of which had been abandoned) in the United States, and they were thus distributed:

Division.	Subdivision.	Number.	Total.
ATLANTIC	North Atlantic	315	
	Middle Atlantic	64	
	South Atlantic	6	
			375
CENTRAL	Northeastern Central	147	
	Northwestern Central	13	
	Southeastern Central	71	
	Southwestern Central	2	
			233
CORDILLERAN	Rocky Mountain	2	
	Plateau	0	
	Pacific Coast	3	
			5
	Total	8	613

Of the 613 blast furnaces, 243 were in Pennsylvania, Ohio coming next in order with seventy-eight. In the Northern States there were 459; in the Southern 154, of which forty-four were in Alabama (twenty-four completed and twenty building). Of 414 iron and steel rolling mills, 169 were in Pennsylvania, Ohio coming next with fifty-five. Of Bessemer and Clapps-Griffiths steel works there were forty-three, of which nineteen were in Pennsylvania and six in the Southern States. Of open-hearth steel works there were fifty, of which twenty-seven were in Pennsylvania and two in the Southern States. Of crucible steel works there were forty-one, of which twenty-one were in Pennsylvania, and two in the Southern States.

The production of pig iron and of Bessemer steel ingots and rails in the United States since 1880 is stated in the following table, compiled from the statistics collected by the American Iron and Steel Association:

	1881.	1882.	1883.	1884.
Pig-iron	4,144,253	4,623,323	4,595,510	4,097,868
Bessemer steel ingots	1,374,247	1,514,687	1,477,345	1,375,317
Bessemer steel rails	1,187,769	1,284,066	1,148,709	996,465

	1885.	1886.	1887.
Pig-iron	4,044,526	5,683,329	6,417,148
Bessemer steel ingots	1,519,426	2,269,190	2,396,033
Bessemer steel rails	959,470	1,562,409	2,101,903

From the above table it will be seen that 1882 and 1883 were years of large production, both of iron and steel; that in 1884 and 1885, there was a considerable falling off in the amount of pig-iron made, while the production of steel remained nearly the same; and it will also be noticed that in 1886 there was a large increase in both iron and steel, which increase was continued in 1887—the production of the latter year being more than a million and a half of tons greater than it was in 1884. The increased use of Bessemer steel for purposes other than the manufacture of rails is also clearly indicated in the following table:—

	1882.	1883.	1884.
Production of Bessemer steel	1,514,687	1,477,345	1,375,317
Percentage used in rails	85	78	72

	1885.	1886.	1887.
Production of Bessemer steel	1,519,426	2,269,190	2,936,033
Percentage used in rails	63	78	72

The production of Bessemer steel was forty-nine per cent. larger in 1886 than it was in 1885, and 29 per cent. larger in 1887 than in 1886. The total number of completed Bessemer steel works in the United States at the close of 1886 was thirty-three, with sixty-nine converters. Pennsylvania in that year made fifty-nine per cent. of the ingots produced; Illinois, 21; and other States, 20.

The rapid growth and present importance of the steel industry in the United States will be appreciated on examination of the following table, in which the amount of steel of all kinds, produced is given for each fifth year from 1870 on an also for the years 1886 and 1887, in tons:

Year.	Bessemer steel ingots.	Open-hearth steel ingots.	Crucible steel ingots.	All other steel.
1870	37,500	1,339	31,250	
1875	335,283	8,080	35,179	11,256
1880	1,074,261	100,850	64,664	7,558
1885	1,519,430	133,375	57,599	1,514
1886	2,269,190	218,973	71,972	2,386
1887	2,936,033	322,069	75,476	5,503

Year.	Total.
1870	70,089
1875	389,799
1880	1,247,334
1885	1,711,919
1886	2,562,502
1887	3,339,071

The production of rails of all kinds in the United States is given in the following table for the year 1867, in which the manufacture of Bessemer steel rails began, and also for 1870 and for each succeeding fifth year, as well as for the years 1886 and 1887:

Year.	Bessemer steel rails.	Open-hearth steel rails.	Total steel rails.	Iron rails, all kinds.
1867	2,277	....	2,277	410,319
1870	30,357	....	30,357	523,214
1875	259,699	....	259,699	447,900
1880	852,196	12,156	864,353	440,858
1885	959,471	4,279	963,750	13,227
1886	1,574,703	4,691	1,579,394	21,142
1887	2,101,903	17,145	2,119,048	20,591

Year.	Total iron and steel.
1867	412,596
1870	553,171
1875	707,600
1880	1,305,211
1885	976,977
1886	1,600,536
1887	2,139,639

The ores of iron are widely disseminated over the United States and are of very different qualities; but there are certain regions of greatly predominating importance, and certain geological horizons or formations from which much the larger portion of these ores is derived. To each of these a few words of description may be devoted.

General survey of various kinds of iron ore.

The great coal field of the Central United States is surrounded on the north, east and south by the uplifted older rocks of the Wisconsin—Michigan, the Appalachian and the Ozark regions.

This basin and its border contain the fuel and the ore on which and with which the material prosperity of the United States of the twentieth century must be built. It becomes, therefore, of importance to obtain a general survey of the distribution of the various kinds of iron ore both geographically and in the geological column.

On the extreme edge of the border that incloses the coal basin we find in the north and east the Archæan with its immense development of magnetic and specular ores. Next within this and overlying it is the Canadian-Cambrian series, the substructure of the first great longitudinal valley of the Appalachians extending from Canada to Alabama. This valley is not less remarkable for its enormous wealth in limonite ores than for the fertility and durability of its soil. Still farther inward the shales of the Clinton age mark a belt of hematite ore extending from central Alabama to and through eastern New York, and thence westward across the State. The belt thus outlined will be seen, on the map, to have a breadth of from fifty to over one hundred miles. Within it, but less persistent in longitudinal representation, are deposits of iron ores occurring—some here, some there—in strata of almost every age from the Archæan to the Coal Measures, and the great coal-field thus iron-bound, is itself rich in carbonate ores, generally occurring either as clay iron stone, or as black band, or in places as a ferriferous limestone altered to limonite. The map does not attempt to represent the actual distribution of the ores of the Coal Measures, but only the areas within which they were sampled for this investigation.

On the South the Archæan rocks come to the surface only in eastern Missouri, and they here exhibit a great development of magnetic and specular ores. But they occupy only a small area in the broad iron-bearing belt on the map that stretches with a breadth of one hundred miles or more northwesterly from Alabama to western Missouri. With the exception of the Missouri Archæan ores this belt consists wholly of later ores, viz: specular and limonite ores of the Cambrian in Missouri, and limonites on the Sub carboniferous limestones of Missouri, Tennessee and Kentucky.

On the North, far removed from the coal-field, are the extensive and numerous deposits of rich specular and magnetic ores of the Huronian in northern Minnesota and northern Michigan. Farther eastward the northern border is represented beyond our field of investigation by ores of different kinds, but especially Archæan in that part of the territory of the Dominion of Canada lying north of the great lakes.

Iron in various mineral conditions, and especially as an oxide, is among the most widely disseminated of the elements. It is a base with a strong affinity for the acids most frequent in the waters circulating in the upper crust of the earth, viz.: carbonic, sulphuric and the organic acids. It also has a stronger affinity for oxygen, and in the presence of this it forms the nearly indestructible and—in the ordinary processes of Nature—in the absence of organic matter, almost insoluble sesquioxide. As a sesquioxide, in the presence of organic matter, it provides the oxygen for decay, and its residuary protoxide is itself dissolved by the resulting organic acid, and enters into circulation. If the laboratory is a marsh or pond, the iron protosalt is reoxidized at the surface of the water and returns to the bottom as the higher oxide to again part with part of its oxygen and again to be dissolved as a protosalt, and this is continued until the organic matter is consumed; then the iron accumulates on the bottom as a hydrated oxide, or limonite, or "bog-ore."

Rock strata containing organic matter and diffused iron oxide have lived through similar processes, except that the iron, after furnishing its oxygen to the decaying matter and forming a soluable protosalt with the resulting organic acid, has entered into more extended circulation.

The most common solvents of iron in Nature are carbonic acid and sulphuric acid; the latter becomes an important agent in moving and concentrating iron, under certain circumstances, as in solfataric action and in the oxidation of pyritiferous rocks like the Devonian shales of Pennsylvania and Virginia. But doubtless carbonic acid is the most general agent. Besides arising from the oxidation of organic matter confined in sedimentary strata, it enters the earth as an accessory of rain water, and more is taken up by the water from the decaying vegetable mould; it is also liberated in depth from limestone by the action of chemical processes and enters the ascending currents. However formed, it becomes an accessory constituent of the water that permeates the rocks, and alone, or in connection with other agents, it decomposes the silicates and carries off the iron as a bicarbonate. It follows the channels of flow until it reaches an arresting cause. One such arresting cause, of ultimately great economic importance, is the carbonate of line in limestones and dolomites and calcareous sandstones, resulting in the replacement of lime by iron: another of equal importance is oxygen, whether at the surface, where the soluable iron protosalt, emerging in spring water is oxidized to a limonite, or in caverns or small cavities, where it is oxidized, and, parting with its acid, is deposited in successive thin films to form stalactitic and mammillary masses of hydrated sesquioxide; therefore when we consider the general diffusion of iron in both detrital and crystalline rocks in all sediments and all eruptions, and remarkable reciprocating relation in the most common and essential processes of Nature, it is not strange that we should find it represented by local accumulations in the rocks of every geological age

The annexed table, published by Mr. Swank, shows the production of iron ore in tons in the leading ore-producing districts for the years 1886, 1887:—

	1886.	1887.
Lake Superior mines of Michigan and Wisconsin	3,263,961	4,344,651
Vermillion Lake mines of Minnesota	304,396	394,252
Missouri mines	379,776	427,785
Cornwall, Pennsylvania	691,054	667,210
New Jersey mines	500,501	547,889
Chateaugay mines, New York	214,800	219,390
Crown Point mines, New York	60,084	64,940
Port Henry mines, New York	298,868	428,522
Other Lake Champlain mines, New York	15,000	29,000
Hudson River Ore and Iron Company, New York	75,000	142,422
Tilly Foster mines, New York	17,728	14,316
Forest of Dean mines, New York	18,000	21,164
Salisbury region, Connecticut	36,000	30,000
Cranberry mines, North Carolina	24,106	45,032
Tennessee Coal and Iron and Railroad Company's mines	81,650	102,601
Ohio (whole State)	344,484	377,465
Alleghany County, Virginia		150,000
Preston County, West Virginia		15,408
Calhoun, Etowah, and Shelby counties, Alabama		129,000
Total of the above districts	6,322,408	8,151,047

American imports of iron and steel.

AMERICAN IMPORTS OF IRON AND STEEL.—It has been sufficiently shown that this country is a large producer of iron and steel. The statistics of our production of these articles do not, however, show the magnitude of their consumption by our people. We export only very small quantities of iron and steel, principally in the form of machinery, but have been large importers of iron and steel in all forms, which we have consumed in addition to the large quantities we have ourselves produced. Our imports of iron and steel during the last fifteen calendar years have been as follows. The quantities of pig, bar, band, plate, and sheet iron, rails, old iron, and tin plates, are given for every year mentioned and for 1882 and succeeding years the quantities of other iron and steel which could not be obtained for preceding years are added:

Years.	Long tons.	Years.	Long tons.
1871	1,141,933	1879	769,984
1872	1,183,066	1880	1,886,919
1873	640,858	1881	1,180,749
1874	901,647	1882	1,192,296
1875	239,712	1883	694,330
1876	204,211	1884	654,696
1877	211,408	1885	578,478
1878	211,102		

Gold and silver.

The production of gold in the Southern States rose to nearly a million of dollars a year in a few years after the first mining excitement began in that region. This was in 1833 and 1834. Then there was a falling off to about half that; but from 1842 on, until the time of the discovery of gold in California by the Americans, there was a rise in the product of the Southern Appalachian region to nearly a million a year (1842–48).

The discoveries of the precious metal in California have already been noticed. By the end of the year at the beginning of which the first nugget of gold had been picked up in Sutter's mill-race on the American River (1848), miners were at work along the western slope of the Sierra Nevada from the Tuolumne to Feather River, a distance of full a hundred and fifty miles. There are supposed to have been not less than fifty thousand men mining for gold at the close of the year 1850; and those who had good opportunity for observing estimate the number thus engaged during the years 1852 and 1853 at not less than one hundred thousand. At first some assistance was had from the aboriginal population; but in general there was no hired help, each man working for himself, or a small number of persons owned the same claim and mined together as joint partners. The earliest washings were along the rivers, on the "bars," or gravel accumulations along the sides or on the beds of the streams, and in the "gulches," or ravines leading down the steep sides of the valleys, or canons, through which these rivers flow. Soon the rivers themselves were partially turned from their courses by means of wing-dams, or entirely carried to one side of their natural channels by "fluming," or building artificial channels of timber. The sands and gravels thus exposed were the most productive "placers"; and those who first got hold of the rich bars on the American, Yube, Feather, Stanislaus, and other smaller streams in the heart of the gold region made sometimes from one to five thousand dollars a day per man. These very rich spots were, however soon worked out, and it might be days or weeks before another of equal richness was found. From the spring of 1848 to 1851 nearly all the mining was of the character thus indicated, that in the river-beds being called "wet-diggings," and that in the ravines or gulches adjacent to the rivers "dry-diggings."

Yield of gold in California

The yield of gold in California during the ten years of its greatest productiveness—namely, from 1850 to 1859, inclusive—has been estimated as averaging as high as 58½ millions of dollars a year. During the pentad, 1860–64, there was a rapid falling off in the yield, which may be accounted for not only by the approaching exhaustion of the river diggings, but also by the fact that the discovery of the Comstock Lode turned the attention of the miners in the direction of Nevada, whither great numbers of stamp-mills were transported bodily in the course of the years 1861 and 1862, these mills being such as had been worked in California with little or no profit to the owners.

From 1865 on, the gold mining business in California assumed a certain degree of permanence; at least, the yield of the precious metal became, for a number of years, pretty nearly stationary, never falling below fifteen millions, nor rising quite as high as twenty millions; the average for the fifteen years, 1865–79, being about seventeen millions. The figures for the years 1881–87, as given in the reports of the Director of the Mint, are as follows:—

1881	$18,200,000
1882	16,800,000
1883	14,120,000
1884	13,600,000
1885	12,700,000
1886	14,725,000
1887	13,400,000

The most powerful impulse to mining operations, and the immediate cause of a somewhat lengthy period of wild excitement and speculation, was the discovery and successful opening of the so-called Comstock Lode—a metalliferous deposit, which, considering all the circumstances and conditions connected with it, may be truthfully said to be the most interesting one ever discovered. The conditions which have given this lode its pre-eminence are: the great extent and depth of its workings: the rapidity with which they have been carried on: the large amount of the precious metals produced: the extraordinary temperature encountered; and, finally, the very full record which has been kept of the facts observed.

The Comstock Lode.

The Comstock Lode lies on the east slope of the Virginia Range, a northeasterly offshoot from the range of the Sierra Nevada. The region is a desert, supporting scarcely any vegetation besides the sage brush. Potable water is found only in quantities too small to supply a settlement, and the town now depends for its supply on a point in the Sierra Nevada, thirty miles away. The mines were first opened in this inhospitable region in 1859, but have since been pushed with such vigor that their product is supposed seriously to have affected the silver market of the world. They have produced about $315,000,000 worth of bullion, of which $175,000,000 was silver (at the rate of one ounce equals $1.2929). Of the total yield, $115,871,000 has been disbursed in dividends.

The last great ore body discovered yielded $111,707,609.39, of which $74,250,000 was paid in dividends. The number of men employed in the mines on June 1, 1880, was 2,770, and the sum annually disbursed in wages is now $4,550,000. The aggregate horse power of the machinery of the mines is 24,130. The total length of shafts and galleries exceeds 150 miles, and the greatest depth reached is above 3,000 feet.

The gold regions of the United States are divided into three sections, the Pacific, Rocky Mountain and Eastern. These three great divisions will be taken up and treated in order.

STATISTICS OF THE PACIFIC DIVISION.

California

In production of gold California still holds the first place. The vast deposits of auriferous gravel continue to yield largely, though their final exhaustion in view of the enormous hydraulic operations now being prosecuted, is to be looked for at no distant day. Previous to the discovery of the Bodie district the placer mines furnished more than two-thirds of the total gold output of the State; but the large yield of that district, amounting to over two and three-quarter millions in gold during the years in addition to the considerable silver product, has placed the deep mines about on a par with the placers in point of productiveness.

California furnishes 71.47 per cent. of the total placer product of the United States, and 40.09 per cent. of the total gold product of the deep mines, or 51.38 per cent. of the gold product of the country (from all sources).

Nevada.

The production of this State shows a considerable decline, as compared with that of the preceding six years. This is not due to any general falling off in the prosperity of the mining industry of the State, but to the decrease in the yield of the leading source, the Comstock Lode.

The bullion product of Nevada represents an average of $14.16 gold, $112.29 silver, and $156.45 gold and silver for each square mile of its area. In this respect Nevada is surpassed by Colorado, the figures for which are $25.98 gold, $159.22 silver, and $185.20 total.

The bullion product of Utah is remarkably steady, varying latterly but little from year to year, while a marked impulse has been given to the mining industry of Arizona by the fine showing of the new Tombstone district, in Pima county.

The deposits of Idaho bullion (so far as it is possible to segregate them, a very large portion having passed through private refineries and thus losing their identity) up to the close of the fiscal year ending June 30, 1880, are stated by the director of the mint to have been $24,137,417 gold, $727,296 silver, and $24,864,713 total. This amount is far less than the actual output up to that date, vague unofficial estimates placing the total yield as high as $60,000,000.

Of the gold product for the census year 1880, 59.42 per cent. is from placers and 40.58 per cent from the deep mines. Idaho furnishes 7.32 per cent. of the placer output of the United States, 2.18 per cent, of the deep mine gold, and 4.43 per cent. of the total gold; 1.13 per cent. of the silver, and 2.60 per cent. of the entire product of the precious metals in the whole country. As a gold producer the territory ranks sixth, and in silver, seventh. The average yield per square mile is $17.45 gold, $5.30 silver, and $22.75 total. In this respect Idaho stands fifth in point of gold, seventh in silver, and sixth in developed richness in gold and silver.

Oregon is one of the oldest of the western mining States, the discovery of gold within its limits having followed closely upon that in California. Its output has never been very large in comparison with the yield of its neighbor State, but although the mines have become secondary to its agricultural resources in point of importance, they still furnish occupation and profit to many of its inhabitants. The quartz veins of Baker county, in the eastern portion of the State, adjoining Idaho Territory, continue to yield the larger portion of the total deep mine product of this State. The prevailing type of the Oregon ores is a free gold quartz, though rebellious gold ores, requiring special treatment, are found in some localities, and a small amount of silver is produced in Grant county.

Of the small product reported from the deep mines of Washington, nearly the whole comes from Peshaston district, in Yakima county, where gold quartz mining is conducted on a small scale.

The Upper Columbia placers furnish over one-half the total placer yield of the State.

This vast territory, occupying an area of over half a million square miles, is for the most part still an unexplored region. The small amount of prospecting which has been done has developed the fact that Alaska contains many gold bearing localities, none of which however, have yet yielded any considerable output.

STATISTICS OF THE DIVISION OF THE ROCKY MOUNTAINS.

From an average annual production of only three or four millions, Colorado has suddenly risen to the first rank as a producer of the precious metals among the States and Territories for gold and silver combined, as well as for silver alone, while for gold it holds the fourth rank. In the relation of production to area it holds the first rank likewise for gold and silver combined, and for silver alone, and the third for gold alone. In the relation of production to population, however, it ranks only third for gold and silver together, second for silver alone, and sixth for gold alone. The total value of its product during the census year in gold and silver was, in round numbers, nineteen and a quarter million dollars; and, if we add to this the value of lead and copper in crude metal produced, we have a total value of metallic product of twenty-two and three-quarters million dollars.

The metallic production of Dakota is derived from the region of the Black Hills, and in greater part from Lawrence county, where free milling gold quartz ores of low grade are reduced in amalgamating mills of great size.

Montana has within its boundaries the elements favorable to a large production of the precious metals—rich and varied ores and abundant fuel, both coal and wood. As yet, however, owing to lack of development and want of sufficient transportation facilities, it has not taken its proper rank as a producer.

The mines of New Mexico have been attracting much attention; but their practical development is awaiting the completion of the railroads which are about to intersect it.

Wyoming is surrounded on three sides by important mining regions, but has as yet developed but few mines within its borders.

The following table shows the yield of the States of the Eastern division, for the year 1880:—

EASTERN DIVISION.

Alabama	$1,300	....	$1,300
Georgia	81,030	$332	81,362
Maine	3,000	7,200	10,200
Michigan	....	25,858	25,858
New Hampshire	11,000	16,000	27,000
North Carolina	118,955	140	119,095
South Carolina	13,041	56	13,097
Tennessee	1,998	....	1,998
Virginia	9,322	....	9,322
Total	239,646	$49,586	$289,232

The relative quota contributed by each of the three great arbitrary divisions into which the country has been apportioned is indicated in the following table:—

Pacific Division	$25,261,828	$21,143,881	$46,405,709
Division of the Rocky Mountains	7,878,189	19,917,490	27,795,679
Eastern Division	239,646	49,586	289,232
Total	$33,379,663	$41,110,957	$74,490,620

The following table shows the production of gold and silver for each State and Territory during the year 1885:—

Alaska	$300,000	$2,000	$302,000
Arizona	880,000	3,800,000	4,680,000
California	12,700,000	2,500,000	15,200,000
Colorado	4,200,000	15,800,000	20,000,000
Dakota	3,200,000	100,000	3,300,000
Georgia	136,000	....	136,000
Idaho	1,800,000	3,500,000	5,300,000
Montana	3,300,000	10,060,000	13,360,000
Nevada	3,100,000	6,000,000	9,100,000
New Mexico	800,000	3,000,000	3,800,000
North Carolina	152,000	3,000	155,000
Oregon	800,000	10,000	810,000
South Carolina	43,000	....	43,000
Utah	180,000	6,750,000	6,930,000
Washington	120,000	70,000	190,000
Texas, Alabama, Tennessee, Virginia, Vermont, Michigan and Wyoming	90,000	5,000	95,000
Total	$31,801,000	$51,600,000	$83,401,000

GOLD AND SILVER PRODUCTION OF THE DIFFERENT STATES FOR THE YEAR 1887.

State or Territory.	Gold.	Silver. (Coining value.)	Total.
Alaska	$675,000	$300	$ 675,300
Arizona	830,000	3,800,000	4,630,000
California	13,400,000	1,500,000	14,900,000
Colorado	4,000,000	15,000,000	19,000,000
Dakota	2,400,000	540,000	2,940,000
Georgia	110,000	500	110,500
Idaho	1,900,000	3,000,000	4,900,000
Michigan	26,000	35,000	61,000
Montana	5,230,000	15,500,000	20,730,000
Nevada	2,500,000	4,900,000	7,400,000
New Mexico	500,000	2,300,000	2,800,000
North Carolina	225,000	5,000	230,000
Oregon	900,000	10,000	910,000
South Carolina	50,000	500	50,500
Utah	220,000	7,000,000	7,220,000
Washington	150,000	100,000	250,000
Other States and Territories	20,000	250,500	270,500
Total	$33,136,000	$53,941,800	$87,077,800

PRODUCTION OF GOLD AND SILVER IN THE UNITED STATES FOR THE YEARS 1880-1887.

Year.	Gold.*	Silver.	
		Coining Value.	Commercial Value.
1880	$36,000,000	$39,200,000	
1881	34,700,000	43,000,000	
1882	32,500,000	46,800,000	
1883	30,000,000	46,200,000	
1884	30,800,000	48,800,000	$42,000,000
1885	31,800,000	51,600,000	42,504,447
1886	35,000,000	51,000,000	39,445,312
1887	33,000,000	53,357,000	40,450,000

The annexed table still farther illustrates this branch of the subject by showing the consumption of the precious metals in the United States in the industrial arts, as reported by the Mint, for the years 1880, 1881, 1883 and 1885:—

	Gold.	Silver.
1880	$8,634,193	$3,464,169
1881	10,086,723	3,388,421
1883	14,459,464	6,556,530
1885	11,152,120	4,598 413

Quicksilver.

Nearly all the quicksilver produced in the United States comes from California. The total produce of the Californian mines, during the years 1880-1887, has been as follows:—

1880	59,926
1881	60,851
1882	52,732
1883	46,725
1884	31,913
1885	32,073
1886	29,981
1887	33,825

No new discoveries of localities of importance have been made during the past few years, and the mines which are now worked in California have been of late years in a rather depressed condition, owing to the low price of the metal, the increased expense of production consequent on the greater depth of the workings, and the growing scarcity of the ore. No quicksilver mine earned or paid any dividend in 1885; but since that time there has been a rise in the price of the metal, and a somewhat increased activity in its exploitation. Two mines paid dividends in 1886: the New Almaden, $118,010.75, and the Ætna, $20,000; the former also paid, in 1888, $282,063. A considerable portion of the quicksilver mined in California is used in that and the adjacent Cordilleran States, a part goes to Mexico, and there is a small and varying export to China. The low price of silver has materially affected the profits of exports to foreign countries.

Tin.

The ore of tin has been discovered in several localities in the United States, and there have been many attempts made to open mines in various parts of the country; but up to the present time the amount of this metal produced has been entirely insignificant. Among the localities in the Appalachian region where mining for tin has been attempted are, Winslow, Maine; Jackson, New Hampshire; one on the northwestern slope of the Blue Ridge, in Rockbridge county, Virginia; and one near Ashland, in Clay county, Alabama. The veins in the first two localities mentioned are unquestionably too small for successful working. In regard to the other places, it does not yet seem to be known whether the conditions there existing are sufficiently favorable to warrant the expectation that they will become profitable. The fact that there are no apparent indications—judging from the descriptions which have been published—of superficial deposits which could be successfully streamed for tin seems a strong reason for believing that in no one of these localities could there be a successful competition carried on with the stanniferous districts of the East Indies and of Australia, where the detrital ores of tin exist in the greatest abundance. Of course tin mining could be made profitable in this country if a sufficiently high duty were laid upon this metal.

The stanniferous region from which the most has been expected is the Black Hills of Dakota, at a locality of about twenty miles southwest of Rapid City.

According to the official report of Mr. A. Williams, Jr., on the mineral resources of the United States, for the years 1883-84, a large amount of money has been expended in opening and prospecting the Etta mine, and in erecting mills and reduction works.

So far as known, however, up to January, 1889, there has been no production of tin of commercial importance in Dakota, nor have regular shipments of this metal from that region been begun. Tin ore has also been found in the southern part of the State of California, and several attempts have been made to put the mines upon the market. The observations of the present writer in this region in 1860, did not lead him to the conclusion that it was likely ever to become of importance for its production of this metal.

Zinc.

Zinc has become within the past few years an important article of production in the United States.

The business of making metallic zinc had not become of any importance previous to 1875. Since that time it has increased at a moderate and pretty uniform rate.

The latest and most reliable statistics of zinc are those given by Mr. C. Kirchhoff, Jr., in the "Mineral Resources of the United States for 1887," as follows, in tons:—

State.	1882.	1883.	1884.	1885.	1886.	1887.
Illinois	16,250	14,992	15,709	17,345	18,818	19,892
Kansas	6,576	8,044	7,017	7,591	7,975	10,674
Missouri	2,232	5,118	4,669	4,176	5,241	7,732
Eastern and Southern States	5,087	4,768	7,019	7,216	6,037	6,648
Total	30,145	32,922	34,414	36,328	38,071	44,946

The production of zinc in the United States for the year 1888 is estimated at 50,800 tons—a moderate increase over the preceding year. This country furnishes, therefore, at the present time, a little over one-sixth of the total production of the world, which has increased since the beginning of the present decade from about 225,000 to very nearly 300,000 tons.

For a long term of years the production of lead in the United States was limited to the Mississippi valley. The deposits occur in two districts—one, the so-called "Upper Mines," covering an area of three to four thousand square miles included within the States of Wisconsin, Iowa, and Illinois; the other, the "Lower Mines," in Southeastern Missouri.

Upper and lower mines.

The mode of occurrence of the galena in both the Upper and Lower Mines of the Mississippi Valley is extremely simple. In the Upper Mines the geological age of the group of strata in which this ore is found is Lower Silurian. In these mines the principal lead-bearing rock is a crystalline dolomite, from 250 to 275 feet in thickness where not partially removed by erosion. The upper portion of this formation is somewhat argillaceous; the middle, a very pure heavy-bedded dolomite; the lower, a similar rock, but containing numerous cherty or flinty masses. This group of strata is locally known as the Upper Magnesian Limestone. It is separated from a rock of very similar lithological character, called the Lower Magnesian Limestone, by three groups of strata, which are commonly designated as the Blue Limestone, the Buff Limestone, and the St. Peter's Sandstone. The first of these is a thin bedded, highly fossiliferous, purely calcareous rock; the second, a heavy-bedded argillaceous dolomite; the third, a nearly chemically pure quartzose sandstone. The Blue Limestone is from fifty to seventy feet in thickness; the Bluff, fifteen to twenty; and the Sandstone, from eighty to a hundred. The Blue and the Bluff limestones are of about the same geological age as the Trenton and Black River groups of the New York Geological Survey.

The yield of the Upper Mines is gradually diminishing; and this will continue to be the case, since the extent of the lead-bearing rock is limited, and the vertical range of the crevices confined to a moderate thickness, there being no probability that paying mines will be discovered in the Lower Magnesian Limestone.

The lead ores of Missouri occur, and almost always in association with those of zinc, in three somewhat distinct districts: in the southeastern portion of the State, where also nickel and cobalt ores are found; in the central, and in the southwestern. The mines of the Southeastern district are in the Lower Silurian.

The numerous lead mines opened and worked in various States situated in the Appalachian region, from Maine to North Carolina, have nearly all proved unsuccessful ventures. A few have for a short time produced a moderate supply of this metal; one or two have been quite permanent, although yielding but a very small amount of lead; while much the larger number have proved entire failures.

While the Mississippi Valley lead mines have furnished, of late years, but a small proportion of the world's supply of this metal, the United States has largely increased its product; so that, from 1880 on, this country has furnished a quarter or more of the entire amount of lead smelted in the world.

Yield of metallic lead in United States.

The total yield of metallic lead throughout the United States for the years 1873-87 is given (in tons) in the following table, prepared by Mr. Kirchhoff.* The desilverized lead of the Cordilleran States is separated from the non-argentiferous of the Mississippi Valley, and its percentage of the total stated. The table as here presented extends back to the time when the argentiferous lead ores of the country began to be of importance:—

Year.	Desilverized Lead.		Non-Argentiferous Lead.	Total.
	Amount.	Per Cent. of Total.		
1873	17,999	47.7	19,983	37,982
1874	……	……	……	46,410
1875	31,168	58.5	22,082	53,250
1876	33,615	58.8	23,590	57,205
1877	45,310	62.0	27,815	73,125
1878	57,401	70.6	23,902	81,303
1879	57,723	69.7	25,116	82,839
1880	62,630	71.7	24,714	87,344
1881	77,067	73.7	27,473	104,540
1882	92,745	78.3	25,907	118,652
1883	109,068	84.8	19,465	128,533
1884	107,112	86.4	17,796	124,908
1885	95,926	83.0	18,728	114,654
1886	102,526	85.0	18,571	121,097
1887	121,028	84.3	22,454	143,482

The Engineering and Mining Journal estimates the production of lead in the United States for the year 1888 at no less than 163,700 tons. It is an interesting fact that Idaho is beginning to be of considerable importance as a lead producing State. The principal mines are in the Cœur d'Alene district.

Non-metalliferous minerals.

To other very important articles—such as lime, cement, and building-stone—only brief allusion can here be made, since their mode of occurrence is so varied, and the manner in which they are utilized so irregular, that they hardly come within the scope of the present work. Only very imperfect statistics could be obtained in regard to such materials as lime and building stones, of which the use is so wide-spread and so little under possible control. According to the estimates of the officer in charge of the division of Mining Statistics of the United States Geological Survey, the value of the lime and building-stone used in the country in the year 1887 was, for each of these articles, greater than that of the petroleum produced. The item of coal alone constitutes nearly seven-tenths of the value of the non-metalliferous minerals mined; and the five items of coal, petroleum, natural gas, building-stone, and lime together make up fully nineteen-twentieths of the sum total. Other important articles are: salt, of the produce of which in 1887 the value was $4,093,846; cement, $5,186,877; limestone for flux in the iron manufacture, $3,226,200; phosphate-rock, $1,836,818. The importance of the salt manufacture in the United States is so great that space may be found here for a few remarks on the geological mode of occurrence of salt, and the geographical distribution of the salt industry.

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*Mineral Resources of the United States, for the year 1887.

The common salt of the world is obtained for use in four different ways: namely, the evaporation of the ocean water, the evaporation of the water of saline lakes, the evaporation of saline water or brine obtained by boring, and the mining of solid or rock-salt. By each of these methods salt is, or has been, produced in the United States; but the third of these is at present by far the most important source of supply of this substance in this country.

In the early history of the country the salt used was in part imported from England, and in part produced by the evaporation of sea-water on the islands adjacent to the coast in a low latitude, and especially Turk's Island.

The present sources of supply for copper in the United States are chiefly the Lake Superior region and the Territories of Montana and Arizona. The produce of the other States is comparatively insignificant.

The mines of Lake Superior, of the date of the opening of which mention has already been made, are of a peculiar character. From these mines only is copper taken exclusively in its native state.

The "Cliff Mine," on Keweenaw Point, which was worked from 1845 to 1872 to a depth of nearly 1,500 feet, is of historical importance in the development of the mining industry of the country, as being the first permanent deep mine worked, and as being the first mine of any ore, other than that of iron to pay regular dividends. The Minnesota mine, near the Ontonagon river, was another one of interest, and, like most of those to the west of Keweenaw Point, of a somewhat different character from that of the Cliff mine, since the cupriferous lode ran parallel with the formation instead of across it. These longitudinal occurrences are, apparently, intermediate in character between contact deposits and segregated veins.

The Lake Superior region, soon after it was first opened, in 1845, began to produce largely and for many years it supplied from seven to nine-tenths of the copper furnished by the United States.

The growth in the production of copper in the United States compiled up to 1885, inclusive from the best data available, is shown in the following table It proves in a striking manner how preponderating was, until the past few years, the influence of the Lake Superior district; and again of one great mine in it, the Calumet and the Hecla, for more than a decade. In order to point out more clearly how preponderating has been the output of the Lake district from 1867 to 1880, a column has been added giving its percentage of the total product from year to year. It should be stated that the yield of copper from pyrites is not here included.

Production of copper in the United States from 1845 to 1885, inclusive.

Years.	Total production.	Lake Superior.	Calumet and Hecla.	Percentage of Lake Superior of total product.
	Long tons	*Long tons*	*Long tons*	
1845	100	12	....	12.0
1846	150	26	....	17.0
1847	300	213	....	71.0
1848	500	461	....	92.5
1849	700	672	....	96.0
1850	650	572	....	88.0
1851	900	779	....	86.6
1852	1,100	792	....	72.0
1853	2,000	1,297	....	64.9
1854	2,250	1,819	....	71.1
1855	3,000	2,593	....	86.4
1856	4,000	3,666	....	91.6
1857	4,800	4,255	....	88.7
1858	5,500	4,088	....	74.3
1859	6,300	3,985	....	63.3
1860	7,200	5,388	....	74.8
1861	7,500	6,713	....	89.1
1862	9,000	6,065	....	67.4
1863	8,500	5,797	....	67.0
1864	8,000	5,576	....	69.7
1865	8,500	6,410	....	75.4
1866	8,900	6,138	....	68.8
1867	10,000	7,824	663	78.2
1868	11,600	9,316	2,276	80.3
1869	12,500	11,886	5,497	95.1
1870	12,600	10,992	6,277	87.2
1871	13,000	11,942	7,242	91.9
1872	12,500	11,961	7,215	95.7
1873	15,500	13,433	8,414	87.3
1874	17,500	15,327	8,984	87.6
1875	18,000	16,089	9,586	89.4
1876	19,000	17,085	9,683	88.9
1877	21,000	17,422	10,975	82.9
1878	21,500	17,719	11,272	82.4
1879	23,000	19,129	11,728	83.2
1880	27,000	22,204	14,140	82.2
1881	32,000	24,363	14,000	76.1
1882	40,467	25,439	14,309	62.1
1883	51,574	26,653	14,788	50.1
1884	64,555	30,961	17,912	48.4
1885	74,053	32,209	21,093	43.5

The following is, in detail, the output of the Lake Superior mines. In the majority of cases it is the official product, based on smelting works returns; in a few instances it is an official estimate of the ingot product based on the known output of mineral. The Mass is the only larger mine in the case of which the ingot was estimated from the published statement of the output of mineral. The total is accurate, therefore, within a few thousand pounds.

The production of Lake Superior copper mines, 1880 to 1885.

Mines.	1880.	1881.	1882.	1883.	1884.	1885.
Calumet and Hecla	31,675,239	31,360,781	32,153,039	33,125,045	40,473,585	47,247,990
Quincy	3,096,263	5,506,848	5,665,796	6,012,234	5,650,436	5,848,530
Osceola	3,383,537	4,179,976	4,176,782	4,256,409	4,247,630	1,945,208
Franklin	2,336,466	2,677,932	3,264,129	3,488,768	3,748,652	4,007,105
Allouez	1,318,471	1,473,007	1,683,557	1,751,377	1,928,174	2,170,476
Atlantic	2,341,195	2,528,009	2,431,708	2,682,197	3,163,585	3,582,635
Pewabic	970,509	1,876,244	1,482,666	1,171,847	227,834	....
Central	2,026,078	1,418,465	1,353,597	1,268,556	1,446,747	2,157,408
Grand Portage	67,860	26,264	757,180	735,598	255,800	....
Conglomerate	243,814	386,091	734,249	222,117	1,198,691	....
Mass	517,159	407,081	737,440	659,474	481,396	365,000
Copper Falls	6,615	669,121	587,500	804,000	891,168	1,168,000
Phœnix	436,010	419,357	537,177	512,291	631,004	344,255
Hancock	3,032	671,897	640,575	484,906	562,636	203,037
Huron	70,285	254,515	364,579	720,213	1,927,600	2,252,484
Ridge	223,155	235,606	102,936	60,155	74,000	63,390
Saint Clair	13,195	135,492	87,126	125,225	139,407	....
Cliff	78,962	79,382	66,053	10,374	28,225	....
Wolverine	....	....	25,623	699,622	751,763	328,610
Nonesuch	55,584	119,061	46,450	....	23,867	28,484
Isle Royal	79,469	47,318	35,447	....	16,074	....
Minong	27,467	15,397	21,380	3,582	....	....
National	....	....	17,069	26,006	87,368	162,252
Minnesota	26,033	24,227	10,672	6,226	1,144	12,008
Belt	....	....	5,625	16,402	130,851	27,433
Sheldon and Columbia	26,931	10,031	3,299	....	9,828	....
Aztec	3,757	....	3,129	....	....	....
Adventure	2,951	7,500	429	....	4,333	4,000
Peninsula	....	....	....	849,400	1,225,981	....
Tamarack	....	....	....	7,435	....	181,669
Ogima	5,885	16,776	4,207	3,000	1,106	12,006
Concord	10,464	28,849	....	....	....	....
Evergreen Bluff	10,651	968	....	....	954	1,500
Flint Steel River	28,080	4,140	....	....	....	....
Madison	....	1,534	....	....	....	....
Northwestern	916	....	....	....	....	....
Ash Bed	....	24,804	72,636	....	1,517	....
Centennial	....	....	83,554	....	....	....
Sundry companies—tributers	6,166	1,642	....	....	21,696	34,000
Total	49,682,337	54,548,909	57,155,931	59,702,404	69,353,202	72,148,172

Montana is next in importance to the Lake Superior district as a copper-producing region. The mines are for the most part in the neighborhood of Butte City, covering an area of two and a half miles long by one mile wide.

Although there has, of late years, been a falling off in the production of copper in Arizona, so that at present this Territory is overshadowed by Lake Superior and Montana. it appears that this is due to its unfavorable situation with reference to a market, rather than to any exhaustion of its cupriferous deposits, which are numerous and important.

There are many localities in the Atlantic States, from Maine to North Carolina, where mining for copper has been attempted, but in few of these has anything like a permanent paying mine been developed. The Vermont Copper Company, located at Vernon, has made, perhaps, the nearest approach to a success of any copper-mining company on the eastern side of the Appalachians, since operations were carried on here for many years uninterruptedly and with moderate profit. This mine was abandoned for a time, but work has lately been resumed. The present high price of this metal has been a great stimulus to mining, and within the past few months many localities which had been abandoned have been taken hold of again by capitalists. This is true for both Eastern and Cordilleran States.

The effect of this excitement will be seen in the annexed table, arranged and condensed from the various official reports on the Mineral Resources of the United States. It affords a comprehensive view of the progress of the copper-mining business in this country during the years 1882 to 1888; the amounts are given in tons:—

States or Districts.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
Lake Superior	25.438	26,653	30,961	32,209	35,593	33,803	38,768
Montana	4,043	10,658	19,238	30,267	25,719	35,134	43,973
Arizona	8,029	11,010	11,935	10,137	6,989	7,910	14,821
Other States and Territories	2.957	3,253	2,574	1,438	1,340	4,031	5,563
Total Domestic Copper	40,467	51,574	64,708	74,051	69,809	80,768	103,125
From Imported Ores	446	726	1,276	2,271	2,000	1,674	2,232
Total	40,913	52,300	65,984	76,322	71,809	82,442	105,357

The total production of copper throughout the world for the ar 1888 has been estimated at 255,000 tons. Of this amount a little over two-fifths is to be credited to the United States.*

The following table gives the amount and value of metallic products in the United States:

Metals.	1883.		1884		1885.		1886.		1887.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value	Quantity.	Value.
Pig-Iron (tons)	4,505,510	$ 91,910.200	4,097,868	$ 73,761,621	4,044.525	$ 64,712,400	5,683,329	$ 95,195,760	6,417,148	$121,925,800
Silver (ounces)	35,733,622	46,200,000	37,744,605	48,800,000	39,910,279	51,600,000	39,445,312	51,000,000	41,269,240	53,441,300
Gold (ounces)	1,451,249	30,000,000	1,489,949	30,800,000	1,538,376	31,801,000	1,881,250	35,000,000	1,596,500	33,100,000
Copper (tons)	52,300	18,064,807	65,984	18,106,162	76,322	18,292,999	71,980	16,527,651	82,443	21,052,440
Lead (tons)	128,533	12,322,719	124,908	10.537.042	115,546	10,469,431	121,097	12,667,749	143,482	14,463,000
Zinc (tons)	32,921	3,311,106	34,414	3,422,707	36,328	3,539,856	38,072	3,752,408	44,946	4,782,300
Quicksilver (flasks)	46,725	1,253,632	31,913	936,327	32,073	979,189	29,981	1,000,000	33,825	1,429,000
Nickel (pounds)	58,800	52,920	64,550	48.412	277.904	191,753	214,992	127,157	205,556	133,200
Antimony (tons)	....	....	....	....	....	....	31	7,000	67	15,500
Platina (ounces)	200	600	150	450	250	187	50	100	448	1,838
Aluminium (ounces)	1,000	875	1,800	1,350	3,400	2,550	....	27,000	....	74,905
Total		$ 203,116,850		$ 186,414,074		$181,589,365		$215,364,825		$250,419,283

Salt

As will be seen from the table given farther on, the production of salt in Ohio and Virginia, at the present time, is much less than that of Michigan and New York. The advantages which the two last-named States offer are, on the whole, decidedly superior to those of the former; so that the production of Ohio has remained nearly stationary during the last six years, while that of the Kanawha Valley, once the most important salt-producing region in the country, has during that time decidedly decreased, so that at present it is hardly one-tenth as large as that of New York, and less than one-seventeenth of that of Michigan.

The quantity of rock-salt which has been shown by geological observation, or proved by the drill, to exist within the limits of the United States is very large. To the existence of large bodies of this material in Western New York and Michigan allusion has already been made. Salt has also recently been discovered in Kansas, by persons engaged in prospecting for oil and gas, in several localities, and in quantities said to be large. Neither in Kansas nor in any of the States mentioned as important producers of salt, has the mining for rock-salt been of any importance up to the present time. A locality where this material occurs in large quantity, and the existence of which has been known for a long time, namely, Petite Anse, an island in Vermilion Bay, on the coast of Louisiana, and which became of importance during the Civil War, is now quite extensively worked, and is the only source from which salt is obtained to any extent in Louisiana. The quantity mined at this locality has risen, from 276,000 barrels in 1882, to over 340,000 in 1887.

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*This is the estimate given in the Engineering and Mining Journal of Jan. 12, 1889, from which the figures given in the preceding table for the year 1888 are taken.

Rock salt also occurs in large quantity in various portions of the Cordilleran region, and it has been mined at some localities both for household and metallurgical purposes. A deposit has been long known to exist on the Rio Virgen, in Lincoln County, Nevada, where the salt appears to occur in very large quantity, it being—as is stated—exposed in a canon cut through it for a distance of two miles, the deposit occupying an extensive area, with an unknown, but certainly very considerable thickness. There are also large deposits of this mineral in Utah, especially in San Pete County, near the town of Nephi. Most of the salt used in that State at present, however, comes from the salt-farms around Salt Lake.

The following table gives, in barrels, the amount of salt produced in the United States from 1883 to 1887:*—

States.	1883.	1884.	1885.	1886.	1887.
Michigan.....	2,894,672	3,161,806	3,297,403	3,677,257	3,944,309
New York....	1,619,486	1,788,454	2,304,787	2,431,563	2,353,560
Ohio..........	350,000	320,000	306,847	400,000	365,000
West Virginia	320,000	310,000	223,184	250,000	225,000
Louisiana	265,215	223,964	299,271	299,691	341,093
California....	214,286	178,571	221,428	214,285	28,000
Utah..........	107,143	114,285	107,140	161,285	325,000
Nevada........	21,429	17,857	28,593	30,000	....
Other States..	400,000	400,000	250,000	240,000	250,000
Total.....	6,192,231	6,514,937	7,038,653	7,707,061	7,831,962

The astonishing rapidity with which the mineral and metalliferous resources of the Cordilleran region have been developed during the past thirty years will have been made apparent to the reader who has examined the preceding pages. In 1854 the present writer estimated the total value of the metals produced in the United States at $79,827,000, of which nearly $50,000,000 was to be credited to gold.† The change which has taken place since that time will be seen on examining the following tables, which give, in compact form, results obtained and published by the Chief of the Division of Mining Statistics, of the United States Geological Survey. The first table shows the total value of the non-metallic products of the United States for the years 1882 to 1887, and also the grand total of both metallic and non-metallic products for the same years. The second shows the amount and value of the metallic products of the United States for the years 1882–87. The value of the iron is the spot value; that of the gold and silver, the coining value; that of the copper lead, and zinc, the value at New York; that of the quicksilver, the value at San Francisco:—

	1882.	1883.	1884.	1885.	1886.	1887.
Metallic........	$219,755,109	$203,116,859	$186,414,074	$181,599,365	$215,364,825	$250,419,283
Non-Metallic......	228,410,380	242,111,889	220,059,674	240,114,544	243,963,063	285,861,942
Additional unspecified........	8,000,000	8,000,000	7,000,000	7,000,000	6,000,000	6,000,000
Total........	$456,165,489	$453,240,748	$413,455,748	$428,713,909	$465,327,888	$542,281,225

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*By W. A. Raborg, in Mineral Resources of the United States for the year 1887, p. 611. A barrel is five bushels of fifty-six pounds each.

†See Metallic Wealth of the United States, pp. 505–510.

PART III. POLITICAL GEOGRAPHY AND STATISTICS.

POPULATION AND IMMIGRATION.

The first census of the United States was taken in 1790, and there has been one taken every tenth year since that time. The following table shows the absolute number of inhabitants, "excluding Indians not taxed," at each decennial period, and also the rate per cent. of increase during the previous ten years:

Year.	Population.	Percentage of Increase.
1790........................	3,929,214	
1800........................	5,308,483	35.11
1810........................	7,239,881	36.40
1820........................	9,633,822	33.06
1830........................	12,866,020	33.55
1840........................	17,069,453	32.67
1850........................	23,191,876	35.86
1860........................	31,443,321	35.58
1870........................	38,558,371	22.63
1880........................	50,155,783	30.08
1890........................	63,231,428 estimate.	

The effect of the Civil War on the growth of population in the United States is easily seen in the diminished ratio of increase shown by the figures for the decade 1860–1870. With that exception the rate has been extraordinary large and uniform, but less in the decade 1870–80 than in any preceding one. That this rapid growth of the population, due in so large a part to immigration, will continue to be maintained is in the highest degree improbable. The fact that nearly the whole of the more valuable portion of the public lands has been already taken up, as will be seen farther on, can hardly fail to check immigration, although the population, is at present, far from dense, and far from being so large that there is not ample room for a much larger number.

The area embraced within the United States at the time of taking the first census was about eight hundred and fifty thousand square miles, a precise statement of the amount being impossible, owing to the peculiar wording of that part of the treaty in which the northern and western boundaries of the country are defined. The density of the population at that time was about 4.6 persons per square mile, this population being almost exclusively confined to the Atlantic sea-board. At that time not more than five per cent. of the inhabitants of the country lived west of the Appalachian range, the settlements being very closely limited to the borders of the navigable streams. At the time of taking the census of 1850, the boundaries of the United States had become definitely established, the only addition made since that time being the territory acquired in 1853 by the Gadsen purchase (about 47,330 square miles). At that time the average density of the population of the whole country was a little less than eight persons per square mile.

The following table shows the density of the population at the epoch of each census which has been taken during the time when the area of the country remained (with the exception of the purchase of Alaska, not here included) unchanged:—

Year.	Area of U. S.	Population per sq. mile.
1860........................	3,025,000	10.39
1870........................	"	12.74
1880........................	"	16.57

The movement of the population has, from the beginning, been from the east toward the west, the first settlements having been made on the Atlantic coast, and the emigration to the United States having been almost exclusively from European countries. The Pacific coast had, previously to the annexation of California, received a small number of whites coming from Mexico, and since that time there have been some accessions to the population in that region by means of emigration from China; but the number added from this direction is almost insignificant in comparison with that which has come into the country from the east. Hence the center of population has been moving westward, and the investigations of the Coast Survey and of the Census Bureau have shown that this movement has been in an almost exactly westerly direction, and that the center of population has always remained very near the parallel of 39°. In 1790 it was in the latitude 39° 16′.5, at a point of about twenty-three miles east of Baltimore; in 1880 it was eight miles west by south from Cincinnati, in latitude 39° 4.1,′ having moved westward 457 miles in ninety years The most southerly point reached was that of 1830, when the center was in latitude 38° 57′.9; the most rapid movement was in the period 1850–60—namely, eighty-one miles, this being due to the rapid transfer of a considerable population from the Eastern to the Pacific States, consequent on the discovery of the gold of California

The division of the population by sexes, as shown by the census of 1880, was as follows:

Males	25,518,820
Females	24,636,963

The number of females for each 100,000 males in 1870 and 1880 was as follows:

	1870.	1880.
Number of females to 100,000 males	96,514	97,801

Conditions influencing population.

As a natural result of the conditions influencing emigration from the older to the newer States, it is found that females are in excess in the Atlantic States. In the District of Columbia, Rhode Island and Massachusetts, the excess of females over males is five per cent, or more: in Connecticut, New Hampshire, North Carolina, South Carolina, New York, Virginia and Alabama, it is from two and a half to five per cent.; in Maryland, Georgia, New Jersey, Louisiana, Tennessee, Pennsylvania and Maine it is less than two and a half per cent. The States, on the other hand, in which the males are considerably in excess of the females, are those situated in the Cordilleran region, where mining is the chief pursuit, and where the conditions of life are such as are more easily borne by men than by women. In Michigan, Minnesota, Kansas and Nebraska, which are not Cordilleran States, but, which are on the extreme northern, western or southwestern borders of the Central region, the number of females is from eighty to ninety per cent, of that of the males, and New Mexico is in the same category. In the Pacific coast States the number of females is from fifty to eighty per cent that of the males: and the same is true of Colorado and Dakota, which are situated on the eastern borders of the Rocky Mountains, and which are partly agricultural and partly mining States. In those States in which mining and stock-raising are by far the predominating interests, and which are entirely inclosed in the Cordilleras, namely, Idaho, Nevada, Wyoming and Montana, the inequality in the numbers of the sexes is greatest, there being in these territories less than half as many females as males. The same inequality exists in the territory of Arizona.

Of the colored population the census of 1880 showed the number to be 6,580,793 to 43,402,970 whites, or 15,162 colored in every 100,000 whites. The slight increase in this ratio from that given by the census of 1870 (14,528 to 100,000) is believed to be chiefly, if not entirely, due to the imperfection of the census of 1870. The colored population is still, in spite of some slight emigration, almost entirely confined to the former slave States, and in three of them—South Carolina, Mississippi and Louisiana—the colored are in access of the whites. In Alabama, Florida, Georgia, Virginia, North Carolina and the District of Columbia the colored element runs from fifty to ninety per cent. of the white; in Arkansas, Texas, Tennessee and Maryland, from twenty-nine to thirty-five per cent; in Delaware and Kentucky, from nineteen to twenty-two per cent; in Missouri, Kansas, West Virginia, New Jersey, Ohio, Rhode Island, Pennsylvania and Indiana, from two to 7 per cent; in all the remaining States it is less than two per cent.; and in most of them, especially the more northern ones, it is less than one per cent.

DISTRIBUTION OF THE POPULATION OF THE UNITED STATES IN 1880, BY DRAINAGE BASINS.

Drainage Basin.	Area in sq. miles.	Population.	
		Total.	Per sq. mile.
New England Coast	61,830	3,788,334	61.2
Middle Atlantic Coast.	83,020	9,240,897	111.3
South Atlantic Coast.	132,040	4,114,563	31.2
Great Lakes.	175,340	5,684,147	32.4
Gulf of Mexico	1,725,960	25,884,117	14.9
Total Atlantic	2,178,210	48,717,293	22.4
Great Basin	228,150	227,107	1.0
Pacific Ocean	619,240	1,211,383	1.9
Total	3,025,600	50,155,783	

The distribution of the population in reference to the topographical and climatic features of the country is such as naturally arises from the constant operation of two causes, both acting in the same direction. Emigration and overflow from a more thickly settled region toward one more thinly inhabited takes place, with insignificant exceptions, from the east toward the west. Immigrants arrive from Europe, are landed on the Atlantic coast—about three-fourths at one point, New York—and thence in large part find their way westward in the direction of lands unoccupied or only thinly settled. To the east of the Mississippi the land is almost everywhere exceptionally fertile, and the climatic conditions are, over a large area, as explained elsewhere, very much the same, and on the whole highly favorable. Soon after crossing the Mississippi, we find that this favorable condition of things begins to change. Not only is the immigrant getting farther and farther from his home, but he is finding his environment less and less suited to the development of those conditions which favor the existence of a dense population. Never, by any possibility, can the region of small rainfall, and, in large part, of rugged mountains, extending from the first belt of States beyond the Mississippi to the belt lying directly on the Pacific coast, become a densely populated portion of the country. This dryer region is also the most elevated, as has already been fully explained. The results of the conditions thus indicated are sufficiently shown in the above table and the following:

GEOGRAPHICAL DISTRIBUTION OF THE POPULATION OF THE UNITED STATES IN ACCORDANCE WITH THE TOPOGRAPHICAL FEATURES.

Region.	Population.	Percentage of Total Populat'n
North Atlantic Coast	2,616,882	5.2
Middle Atlantic Coast	4,375,194	8.7
South Atlantic Coast	875,357	1.7
Gulf Coast	1,066,861	2.1
Northeastern Appalachian Region	1,669,226	3.3
Central Appalachian Region	2,344,223	4.7
Region of the Great Lakes	3,049,470	6.1
Interior Table-land	5,716,326	11.4
Southern Appalachian Region	2,695,085	5.4
Ohio Valley	2,442,792	4.9
Southern Interior Table-land	3,627,478	7.2
Mississippi River Belt, south	710,268	1.4
Mississippi River Belt, north	1,991,362	4.0
Southwestern Central Region	2,932,807	5.8
Central Region	4,401,246	8.8
Prairie Region	5,722,485	11.4
Missouri River Belt	835,445	1.7
Western Plains	323,819	0.7
Heavily Timbered Region of the Northwest	1,122,337	2.2
Cordilleran Region	932,311	1.9
Pacific Coast	715,789	1.4

The larger divisions of the country are represented as follows, both as to the aggregate population and its different elements:—

Region.	Percentage of Population.		
	Total	Foreign.	Colored.
Atlantic Plain	29.84	32.74	40.50
Central Valley	53.60	51.62	50.02
Appalachian Region	13.28	8.40	7.22
Cordilleran Region	3.28	7.24	2.26

In regard to the distribution of the population of the United States in towns and cities, and the positions of those centres, the following may be stated:—

In 1790 there were in the country four cities having a population of from 8,000 to 20,000 and two above 20,000, but not one surpassing 75,000 in number. Fifty years later, there were forty-four towns and cities having a population of 8,000 and over, and one of about 500,000. In 1880 there were 286 towns with over 8,000 inhabitants.

The following statement gives the names and population of al the cities having, in 1890, a population of over 100,000:—

Name.	Population in 1890.
OVER 1,000,000.	
New York	1,513,501
Chicago	1,098,576
Philadelphia	1,044,890
OVER 500,000 AND UNDER 1,000,000.	
Brooklyn	804,37
OVER 250,000 AND BELOW 500,000.	
St. Louis	460,357
Boston	446,507
Baltimore	433,639
San Francisco, Cal	297,990
Cincinnati	296,309
Cleveland, Ohio	261,546
Buffalo, N. Y	255,543

OVER 100,000 AND BELOW 250,000.

New Orleans, La	241,936
Pittsburg, Penn	238,473
Washington, D. C	228,160
Detroit, Mich	207,791
Milwaukee, Wis	203,979
Newark, N. J	182,020
Louisville, Ky	185,756
Minneapolis, Minn	164,780
Jersey City, N. J	163,987
Rochester, N. Y	135,302
Omaha, Neb	134,742
St. Paul, Minn	133,156
Providence, R. I	132,043
Denver, Col	126,186
Indianapolis, Ind	125,000
Kansas City, Mo	105,000
Alleghany City, Pa	104,967

OVER 75,000 AND BELOW 100,000.

Scranton, Pa	95,000
Albany, N. Y	93,523
New Haven, Ct	86,981
Worcester, Mass	82,133
Richmond	80,300
Paterson, N. J	78,300
Memphis, Tenn	75,360

The census of 1880 showed that of the total population, 50,155,783, there were 6,679,143 born in foreign countries, or 15,364 persons foreigners to 100,000 native born; this ratio was a little less than in 1870, when the number of foreign-born was 16,875 to 100,000 native.

Number of immigrants arriving in United States.

The following tables show the number of immigrants arriving in the United States for each decade from 1821 to 1880, and for each year from 1881 to 1887. The yearly average during each decade rose rapidly, from 14,314 in the decade 1821–30 to 294,469 for the decade 1871–80. The number of immigrants for the year 1881 was more than twice as great as the yearly average of the preceding decade. The maximum was reached in 1882, when the number of immigrants reached 730,349, from which time forward there was a falling off, the figures in 1885 being 350,510. A portion of this apparent decrease seems to be due to the fact that the statistics of the immigration by land from Canada and Mexico—the latter very small in amount, however—could not be collected; so that since July 1, 1885, arrivals of this kind have been excluded from the tables of immigration. In the first table herewith given, the nationality of the immigration is only imperfectly given, the British Islands being separated from the rest of Europe, and the figures also being for China. As will be noticed, the immigration from Europe and China made up about five-sixths of the total during the decade 1871–80. But in the decade 1851–60 the immigration from Europe made up twenty-four twenty-fifths of the total, that from China being practically null. The apparent increase of immigration from extra-European countries indicated in the table for the decades since 1860 is chiefly due to the rapid increase of immigration into the United States from the adjacent Dominion; but this is made up in part of persons who have come to the United States from Europe by way of Canada:

STATEMENT OF IMMIGRANT ARRIVALS IN THE UNITED STATES FOR THE DECADES 1821 80.

From	1821–30.	1831–40.	1841–50.	1851–60.	1861–70.	1871–80.
British Islands....	75,803	283,191	1,047,763	1,338,093	1,106,970	989,163
Rest of Europe...	23,013	212,497	549,730	1,114,564	1,073,429	1,357,801
China............	2	8	35	41,397	68,059	122,433
Rest of the World.	44,621	103,429	115,714	104,160	349,756	475,295
Total..	143,439	599,125	1,713,251	2,598,214	2,466,752	2,944,695
Yearly Average.	14,314	59,912	171,325	259,521	246,675	294,469

STATEMENT SHOWING IMMIGRANT ARRIVALS IN THE UNITED STATES FOR THE YEARS 1881–87.

From	1881.	1882.	1883.	1884.	1885.	1886.	1887.
British Islands.....	165,230	161,428	157,361	121,756	105,610	126,601	179,609
Rest of Europe.....	435,101	441,658	341,136	285,850	221,592	258,847	328,651
China..............	20,711	35,614	381	84	57	8	28
Rest of the World..	99,003	91,649	71,438	53,656	23,251	7,431	8,645
Total...........	720,045	730,349	570,316	461,346	350,510	392,887	516,933

[In this and the following table notice must be taken of the fact that for the last half of 1885 and for 1886 and 1887 the immigration from British North America and Mexico is not included.]

Still further light will be thrown on this subject by the following table, in which the nationality of the immigration into the United States is given in considerable detail for the years 1881 to 1887, in percentages of the total amount. From this table it will be seen that Germany has furnished during the last seven years somewhat less than one-third of the total immigration; Great Britain and Ireland somewhat more than a quarter; Norway and Sweden about a tenth: British North America about a tenth; Austro-Hungary a little over six per cent; Russia (including Poland), from four to five per cent; and Italy nearly the same. These nationalities together have furnished during the past six years about ninety-five per cent of the total. The immigration from Italy and Russia shows a moderately rapid, but pretty uniform, increase from year to year:—

PERCENTAGE TABLE SHOWING THE NATIONALITY OF IMMIGRANTS INTO THE UNITED STATES FOR THE YEARS 1881–87.*

Nationalities of immigrants.

	1881.	1882.	1883.	1884.
Great Britain..................	13.10	12.11	12.92	13.69
Ireland........................	9.85	9.99	14.67	12.70
Austro-Hungary.................	3.92	4.10	5.30	6.81
Belgium........................	.27	.15	.29	.37
Denmark........................	1.24	1.75	1.71	1.65
France.........................	.75	.76	.70	.80
Germany........................	34.66	31.80	32.33	33.72
Italy..........................	2.79	4.03	5.18	3.14
Netherlands....................	1.50	1.08	.88	.81
Norway and Sweden..............	11.51	12.00	9.45	8.22
Russia.........................	2.01	3.07	1.78	4.32
Spain and Portugal.............	.06	.06	.16	.11
Switzerland....................	1.62	1.62	2.00	1.76
Other European Countries.......	.06	.06	.08	.23
China..........................	2.87	4.87	.07	.02
British North America..........	13.22	11.90	11.74	10.39
All Other Countries............	.54	.65	.78	1.26
	100.00	100.00	100.00	100.00

PERCENTAGE TABLE SHOWING THE NATIONALITY OF IMMIGRANTS INTO THE UNITED STATES FOR THE YEARS 1885-87.[*]

	1885.	1886.	1887.
Great Britain	15.92	18.75	20.64
Ireland	14.21	13.47	14.06
Austro-Hungary	7.31	10.22	7.56
Belgium	.39	.42	.58
Denmark	1.67	1.69	1.80
France	.90	1.04	1.08
Germany	30.72	21.96	21.53
Italy	4.42	7.78	8.99
Netherlands	.71	.98	1.02
Norway and Sweden	9.47	11.73	13.46
Russia	5.72	8.45	5.95
Spain and Portugal	.26	.13	.01
Switzerland	1.46	1.15	1.26
Other European Countries	.19	.64	.25
China	.02	.00	.00
British North America	5.22	......	......
All Other Countries	1.41	1.89	1.81
	100.00	100.00	100.00

The immigration into the United States is very unequally distributed over the surface of the country. An inspection of the census tables and the accompanying maps shows that immigrants in very large proportion seek Northern regions. In the Southern States, with the exceptions of Florida, Louisiana, and Texas, the foreign element is practically null. Virginia, North Carolina, South Carolina, Alabama, Georgia, and Mississippi have less than one per cent of foreign-born population; and no State south of Pennsylvania and the Ohio River and east of the Mississippi has as much as four per cent. In the belt of States between the parallels of 41° and 45°, on the other hand, the foreign element is most strongly represented. Thus in Massachusetts, Connecticut, Rhode Island, New York, Michigan, Wisconsin, Minnesota, and Dakota the foreign-born population is over twenty-five per cent of the native, and in the two last-named States over fifty per cent. Iowa, Nebraska, and Kansas, forming a belt of States extending southwesterly from Wisconsin and Minnesota to the 37th parallel, have a foreign-born population ranging between ten and twenty-five per cent of the native, except in the case of Nebraska, where the foreign is a little over twenty-five per cent. In some of the thinly inhabited States farther west the foreign element is still more prominent, as in Colorado, Utah, Nevada, Arizona, and California. In Nevada, for example, according to the census of 1880, the foreign-born inhabitants were to the natives in the ratio of 70,065 to 100,000. But it must be remembered in this connection that the entire population of Nevada at that time was only 62,266, and that of Arizona 40,440. In no State or Territory does the foreign element equal the native, and only in Nevada, Arizona, Dakota, Minnesota, and California is it more than half as large, while in the two last-named States it is but little more than half. Texas forms an exception to the other Southern States, the foreign element being of importance, especially in the southwestern portion of the State. The State as a whole has, however, only a little less than eight per cent of foreign-born inhabitants.

The percentage increase of the native white element of the populations was, for the three decades 1851-80, as follows:—

1851-60	32.35
1861-70	22.95
1871-80	31.25

Early in 1882 an Act was passed by Congress suspending Chinese immigration into the United States for the term of twenty years. This was vetoed by the President, and another one was passed having nearly the same provisions as the first, but limiting the time of its operation to ten years. This Act was not vetoed; but became a law May 6, 1882. This second Act is entitled "An Act to execute certain treaty stipulations relating to Chinese." From and after ninety days after the passage of this Act the entrance of Chinese "laborers" into the United States was forbidden, and any master of a vessel bringing them here was punishable by a fine of $500 for each laborer so brought, and also by imprisonment for a term not exceeding one year. The pretext for this unprecedented Act was "that the coming of Chinese laborers to this country endangers the good order of certain localities" within the territory of the United States. The term "laborers" was held to mean "both skilled and unskilled laborers, and Chinese employed in mining."

Further legislation relating to the exclusion of the Chinese from the United States was had by Congress in 1888. The two Acts were passed, the first having been approved Sept. 13, 1888, and a second, supplementary to this, Oct. 1, of the same year. The object of these two Acts was to prevent the Chinese who were then in the United States from returning after having left this country. The first Act, (approved Sept. 13) allowed a native of China to return, provided he had a "lawful wife, child or parent within the United States, or property therein of the value of one thousand dollars, or debts of like amount due him and pending settlement." This privilege was entirely cancelled by the supplementary Act, approved Oct. 1; and as the matter now stands, only "Chinese officials, teachers, students, merchants, or travelers for pleasure or curiosity are permitted to enter the United States." Furthermore, it is provided that in order to become entitled to such entrance they must "obtain the permission of the Chinese Government or other Government of which they may at the time be citizens or subjects." This permission, and the personal identity of the party having obtained it, must be authenticated by the diplomatic or consular representative of the United States at the port or place from which the party comes. It is further provided that any master of a vessel landing, or attempting to land, any Chinese laborer, "in contravention to the provisions of this Act, shall be deemed guilty of a misdemeanor, and, on conviction thereof, shall be punished with a fine of not less than five hundred nor more than one thousand dollars, in the discretion of the Court, for every Chinese laborer or other Chinese person so brought, and may also be imprisoned for a term of not less than one year, nor more than five years, in the discretion of the Court." Exclusion of Chinese

Provisions have also been made by Act of Congress for the regulation of the immigrant carrying business, and rules have been prescribed as to food, water, light, space occupied, etc. A tax of fifty cents is also imposed on all immigrants landing in this country to be used "in defraying the expense of regulating immigration under this Act, and for the care of immigrants arriving in the United States, for the relief of such as are in distress, etc."[*]

Rules for immigrants By an Act of Congress, approved Aug. 3, 1882, it is provided that no convict, lunatic, idiot, or person "unable to take care of himself or herself without becoming a public charge" shall be permitted to land. Under the provisions of this Act it appears that from 1883 to Sept. 25, 1888, 7,764 immigrants had been returned from the United States to their own countries—or an average of about 1,300 persons a year. Of those thus returned from 1883 to 1888 inclusive, there were 27 convicts, 371 lunatics, and 131 idiots. The remainder (7,235 persons) were returned as "liable to become a public charge."[†]

THE PUBLIC LANDS.

The emigration from Europe and other countries consists largely of people seeking homes in the New World; and this want is chiefly supplied by the purchase of government land—"public lands," as usually designated by the authorities—that is, of such land as is offered for sale by authority of the General Government, under the direction of the General Land Office—a branch or sub-department of the Department of the Interior. It is desirable, therefore, that the way in which the General Government came in possession of these lands should be briefly stated, and some idea given of their extent and position. Extent and position.

The boundaries of the United States as fixed by the provisional treaty made with Great Britain in 1782, and by the definitive treaty in 1783, gave to the United States essentially the region south of the Great Lakes and east of the Mississippi, as far south as the parallel of 31°; and the southern boundary east of the Mississippi, as thus established, nearly along the 31st parallel, was, in 1795, re-affirmed by treaty with Spain, by which the line between the United States and the Floridas was fixed; but difficulties soon arose in regard to the northern boundary, both in its eastern and western portions, which were, during many years, the subject of heated discussion, and which more than once threatened to involve the two countries, Great Britain and the United States, in war. The most important points, were, however, peaceably settled in 1846, and the last point in dispute finally disposed of, by reference to the Emperor of Germany as arbitrator, in 1872.

At the time of the adoption of the Constitution by the original thirteen States, most of them had claims, rather vague, and in many cases decidedly conflicting, to a more or less indefinite area of country west of their settlements, and extending back to the Mississippi River. After much discussion, the States having these claims, influenced by the distinct realisation of the trouble which would ensue in case an attempt was made to maintain them, did, in response to a resolution of Congress, consent to a transfer of these claims to the United States. The first cession of this kind was that of New York, in 1781, and the last, that of Georgia, in 1802. The region thus ceded was divided into two territories, one of which was called the "Territory Northwest of the River Ohio," the other the "Territory South of the River Ohio." This region formed the nucleus of the public lands of the United States. This did not include the present States of Kentucky and Tennessee, the former having been admitted to the Union without any claim on the part of the United States to proprietorship in the soil, and similar rights in regard to the latter having been relinquished by Act of Congress. The total area of the United States at this time was about 850,000 square miles. The first addition made to this was by the French cession of the undetermined area known as Louisiana. This was brought about by Jefferson, who recognised the fact that France would not be able to hold the region against the English, with whom Bonaparte, at that time (1803-1804) First Consul, was about to go to war. The treaty of cession with Bonaparte gave no precise limits to the territory ceded, but only described it as being the same as that ceded by Spain to France according to the treaty of San Ildefonso. This vagueness was, no doubt agreeable to the wishes of the American negotiators, who did not lack foresight, and who must easily have comprehended the fact that the more vague the terms of the cession the better the chance of a future extension of the claims of the United States westward. In point of fact the French cession did not include the country west to the Pacific, as it was afterward held to do, for the French had no claim whatever to the region west of the head of the Missouri. As a consequence of this cession, however, this vast region did come into possession of the United States. the boundary having been finally settled in 1872, after ninety years of discussion. The final settlement was by a reference of the point in dispute to the Emperor of Germany, who decided in favor of the United States; the main question with regard to the extension of the boundary along the line of the 49th parallel to the Pacific, having been settled in 1846 by the Webster-Ashburton treaty, which fixed the boundary as far west as the Straits of Fuca. This cession of Louisiana, as finally settled by treaty with England, added largely to the area of the United States, extending its limits to the Pacific Ocean, and giving that country complete possession of the Central River system of the continent. The cost of this cession to the United States was about twenty-three and a half million dollars in principal and interest.

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[*] The immigration into the United States arriving at the six principal ports (embracing about ninety-eight per cent of the entire immigration) was, for the first nine months of the year 1888, 132,802, a slight increase over that of the corresponding months of the preceding year.

[*] This tax is not collected from immigrants coming from Canada or Mexico.

[†] A very stringent Act was passed by Congress in 1885, prohibiting the importation and immigration of foreigners and aliens "under contract or agreement to perform labor in the United States, its Territories, and the District of Columbia." This Act can have little practical effect on the number of immigrants arriving in this country; nor has the writer been able to procure any definite information as to whether any persons have ever been sent back under its provisions.

A further addition to the territory of the United States was by a cession from Spain of the territory comprised in the present State of Florida, which took place in 1819, the area thus conveyed being about 58,680 square miles, and the cost about six and a half millions of dollars. Previous to this cession, however, the United States had, by Act of Congress passed in secret session in 1812, but not promulgated until 1818, taken possession of an area of about 9,740 square miles in West Florida, which was claimed by the Spanish Government as its property, but which claim was relinquished by the cession of 1819.

The next acquisition of territory by the United States was the result of the admission into the Union of the Republic of Texas, a former province of Mexico, having an area of 265,780 square miles. This annexation led to a war with the country to which Texas had formerly belonged, the result of which was the conquest of Mexico, the occupation of its capital by the United States army, and the dictation of a treaty of peace called the "treaty of Gaudalupe-Hidalgo," which was proclaimed July 4, 1848. By this treaty the southern boundary of the United States was established; but subsequently, Dec. 30, 1853, a purchase was made of a strip of land lying south of the Gila River in New Mexico and Arizona, and containing about 47,330 square miles. This is known as the "Gadsden purchase."

The claims of both Great Britain and Mexico to the region lying west of the Missouri and northwest of Texas being extremely vague, it is not possible to state, with any approach to precision, what portions of this area originally belonged to the two powers in question. All that can be said is that, remotely, in consequence of the purchase of "Louisiana" from Bonaparte, and more directly, as the result of treaties with Great Britain and Mexico settling the northern and southern boundaries of the United States, the last named country came into possession of a little over 1,800,000 square miles of land, as shown in the following statement of the nature and size of the areas added from time to time to what was the original domain of the Colonies at the time of their establishment as an independent government:

	Square miles.
Original area of the United States......	849,145
Added by purchase of Florida, 1819, including 9,740 square miles previously in dispute, but in possession of the United States........	58,680
Annexation of Texas, 1848..........	265,780
Gadsden Purchase, 1853.............	47,330
Purchase of Louisiana and cessions by Mexico, 1804-48................	1,804,665
Total............................	3,025,600

One other addition to the area of the United States was made in 1867, namely, by the purchase from the Russian Government of the region known as Alaska, which comprises an area of about 530,000 square miles. The price paid for this piece of land was $7,200,000. The purchase of this territory, the nearest point of which is four hundred miles distant from the northern line of Washington, was an entirely unprecedented act on the part of the United States, all the rest of the possessions of this country forming one compact mass of land. Whenever, in the course of this work, mention is made of the United States, it will be understood that Alaska is not included, unless a statement to that effect is specially made in the same connection.

The entire area of the public lands of the United States (exclusive of Alaska, no portion of which has yet been surveyed) is estimated by the Commissioner of the General Land Office, in his report for the year 1886, at 2,836,725 square miles, or 1,815,504,147 acres. Of this area there had been surveyed, up to June 30, 1886, 971,174,878 acres, leaving 844,329,269 unsurveyed. In reference to this unsurveyed portion the Commissioner made the following remark: "The volume of land in the unsurveyed portion of the public domain suitable for homes and subject to settlement under the laws of the United States is of comparatively small proportions."

Of the public lands of the United States a large quantity has been sold for cash, and a much larger amount taken, under various Acts of Congress, for schools and other educational purposes; as military bounty; as "swamp land," given to the respective States where it occurs, or has been claimed to occur; as a bonus for the construction of various lines of railroad, especially those traversing the continent from east to west; as "homesteads" to actual settlers, and for various other purposes. It is impossible to state the exact amount of the public land which has been thus disposed of, but it is certain that nearly all the valuable portion of the nations great inheritance has been taken up already, or has passed out of the control of the Government. In regard to this point, the following quotation may be made from the introduction to the volume entitled "Statistics of Agriculture," forming a part of the report of the census of 1880, and published in 1883, the remarks here quoted being from the pen of General Walker, formerly superintendent of that census:

Valuable land already gone.

"It thus appears that, notwithstanding the imposing total of 1,400,000 square miles of still unsettled territory, the amount of land available for occupation for ordinary agriculture is not large. The Public Land Commission in their report of 1880, say: 'It was estimated June 30, 1879, that (exclusive of certain lands in Southern States) of lands over which the survey and disposition laws had extended, lying in the West, the United States did not own, of arable agricultural public lands, which could be cultivated without irrigation or other artificial appliances, more than the area of the present State of Ohio, namely, 25,566,960 acres. The quantity of land taken up in the arable region during the year ending June 30, 1880, was about 7,000,000 acres. The Commission, therefore, reaches the startling conclusion that, at the same rate of absorption, the arable lands so situated will all be taken up within three years, or by June 30, 1883.'

"It is indeed an astonishing announcement that the public land system, so far as relates to agricultural settlers, has virtually come to an end: that the homestead and pre-emption acts are practically exhausted of their contents."

Professor A. B. Hart has compiled from public documents the following approximate statement of the manner in which the public lands had been disposed of up to the various periods mentioned. The numbers given indicate acres:

Date.	Sales.	Grants to individuals other than for internal improvements.	Grants to States other than for internal improvements.	Grants for internal improvements to States and Corporations.	Total.
To 1790............	1,487,986	35,040	....	....	1,523,026
1801............	1,574,917	2,154,660	....	....	3,729,577
1820-21............	19,423,212	7,250,152	....	....	33,375,901
1841............	93,043,927	9,765,033	8,830,654	1,780,505	113,420,119
1861............	161,796,816	75,466,345	113,962,531	31,600,842	382,826,534
1881............	181,837,359	140,524,032	158,157,194	162,230,099	642,778,684
1884............	192,584,116	167,483,506	158,417,594	162,230,099	680,715,315

In reference to the wasteful and reckless manner in which the public lands of the United States had been given away, until but little of value remains, Professor Hart makes the following remarks:—

"Experts in the Land Office assure us that, making all deductions and allowances, the remaining lands are worth upwards of a thousand million dollars. There is no evidence in the past policy of the government for believing that we shall actually net one-tenth of that amount. The greater part of the region is officially classified as 'desert lands,' and is for sale in tracts of six hundred and forty acres, at a dollar and a quarter an acre. Nothing but the temporary increase of pre-emption enables the Land Office at present to pay its running expenses out of income. The golden time is past; our agricultural land is gone; our timber lands are fast going: our coal and mineral lands will be snapped up as fast as they prove valuable."*

AGRICULTURE.

The following statements and tables present a succinct view of the nature and importance of the agricultural interests of the United States, beginning with the cereals

I.—THE CEREALS.

The following table shows the production of the cereals in bushels, as returned by the census of 1880:—

	Production in bushels.
Barley	44,113,495
Buckwheat	11,817,327
Indian corn	1,754,861,535
Oats	407,858,999
Rye	19,831,595
Wheat	459,479,505

roduction f cereals. The production of barley was largest in California (twelve and a half million bushels); other States producing considerable quantities were: New York, Iowa, Minnesota, Nebraska, Ohio. No other State produced as much as one million bushels. In 1886 the total production of barley in the United States was 59,428,000 bushels; of that amount California produced 16,038,000 bushels; and New York, Minnesota, Wisconsin and Iowa each over five million and less than ten million bushels; while Nebraska, Michigan and Dakota each produced over one million and less than five million bushels.

The total production of buckwheat within the United States, according to the census of 1880, was 11,817,327 bushels; of this amount New York and Pennsylvania produced respectively, 4,461,200 and 3,592,326 bushels. No other State produced as much as half a million bushels; the production of this cereal in the Gulf States being extremely small, that of the Pacific States being also very insignificant. No one of the States, other than New York and Pennsylvania, produced as much as half a million bushels.

In 1886 the total production of buckwheat was 11,809,000 bushels, or almost exactly the same as in the last census year (1879).

Indian corn is the most bulky crop among the cereals, the total yield as reported by the census of 1880 being 1,754,861,535 bushels. The principal production of this crop is in the belt of States lying north of the Ohio, and in the same latitude on the west of the Mississippi, as will be seen from the following table:—

State.	Production in bushels in 1879.
Illinois	325,792,481
Iowa	275,024,247
Missouri	202,485,723
Indiana	115,482,300
Ohio	111,877,124

These five States produced, as will be seen, considerably more than half the total yield of the country in the year for which the statistics are given. As we go north, south, east and west from this belt we find the yield of Indian corn diminishing. Still, this cereal is a product of importance even as far south as the Gulf States, but is of comparatively little consequence in New England, the total production of the six New England States in 1879 being only 8,376,133 bushels.

In 1886 the total yield of Indian corn was 1,665,441,000 bushels, and the States producing over one hundred million bushels each were:

States.	Production in bushels in 1886.
Illinois	209,818,000
Iowa	198,847,000
Missouri	143,709,000
Kansas	126,712,000
Indiana	118,795,000
Nebraska	106,129,000

Yield of Indian corn. These six States produced in that year considerably more than half of the total, and the gradual advancement westward of the agricultural development of the country is shown in the appearance of Nebraska in the above column of figures as a producer of over a hundred millions of bushels. The yield of Indian corn in this State, according to the census of 1870, was 4,736,710 bushels, and in 1879 it had increased to 65,450,115 bushels. The figures for Dakota for the same years were 133,140 and 2,000,864 bushels.

Of this crop, so important as it is for home consumption, but a very small fraction is exported. The following table exhibits the total produce of the country for the years since the census year (1879) up to and including the year 1886, together with the percentage exported for each year:

Year.	Production in bushels.	Per cent. exported.
1880	1,717,434,543	5.5
1881	1,194,916,000	3.7
1882	1,617,025,100	2.6
1883	1,551,066,895	3.0
1884	1,795,528,000	2.9
1885	1,936,176,000	3.3
1886	1,665,441,000	2.5

The yield of corn in 1887 is given by the Department of Agriculture as 1,456,161,000 bushels, and that of 1888 is estimated at 1,987,790,000 bushels. Since 1879 the home consumption of this cereal has averaged about twenty-seven bushels per annum for each inhabitant of the country; in the ten years preceding it averaged about twenty-five bushels.

The total yield of oats, as reported by the census of 1880, was 407,858,999 bushels. The distribution of this crop is pretty uniform all over the country, with the exception of the Gulf and Pacific Coast States, where the yield of this cereal is very small, barley taking the place of oats in California almost entirely.

The following table exhibits the production of oats in the United States from 1880 to 1888:

Year.	Production in bushels.
1880	417,885,380
1881	416,481,000
1882	488,250,610
1883	571,302,400
1884	583,628,000
1885	629,409,000
1886	624,134,000
1887	659,618,000
1888	701,735,000

The increase in the number of acres cultivated in oats since the census year has been very marked; more so than in the case of wheat or Indian corn. The average for the decade, 1870-79 was 11,000,000 acres; that for the years 1880-87 was 21,000,000 acres.

Rye. The amount of rye grown in the United States as returned by the census of 1880 was 10,831,596 bushels; the principal States where this crop is raised being, in the order of their yield, Pennsylvania, 3,683,621; Illinois, 3,121,785; New York, 2,634,690; Wisconsin, 2,298,513; and Iowa, 1,518,606 bushels. The production of this cereal in the States south of Kentucky and Virginia is extremely small, but some rye is given as grown in every State and Territory, except Arizona and Nevada. The production of rye in 1886 was 24,489,000 bushels; Kansas appearing this year as a producer of a little over two million bushels, and Nebraska of nearly one million.

Wheat. Wheat is an extremely important crop in the United States, and is the only cereal of which the export is considerable. The great wheat-growing States are those along the north side of the Ohio, from New York westward and across the Mississippi into Iowa, Kansas and Northwest, including Nebraska, Minnesota and Dakota. The yield of the census year (1879) was 459,479,505 bushels. In that year, Illinois, Indiana, Ohio, Michigan, Minnesota and Iowa each produced over thirty million bushels; the total yield of those six States was somewhat more than half that of the whole country. In 1887 the total was very nearly the same (456,329,000 bushels), but the distribution of this yield was somewhat different. There were in that year also six States producing each more than thirty million bushels. Of these six, four are among those included in a similar category for the year 1879. Michigan and Iowa have dropped out of that list, and Dakota and California must be inserted in their places.* These six States, as before, produce almost exactly half the entire yield of the country. What is more remarkable is, that Dakota, which in 1879 only figured with a produce of 2,830,289 bushels, appears in 1877 as furnishing no less than 52,406,000 bushels, or more than one-tenth of the whole crop of this cereal. Other States of importance in 1887 were Missouri, Iowa and Michigan, each of which produced between twenty and thirty millions of bushels; and Nebraska, Oregon, Pennsylvania, Wisconsin, Kentucky and New York, each of which produced between ten and twenty millions of bushels.

In the tabular statement of the yield of wheat for the year 1887, as given by the Department of Agriculture, forty-two States and Territories appear as producing more or less of this cereal, but the quantity grown south of Kentucky and Virginia is very small. The yield of the Gulf States is entirely insignificant, Florida and Louisiana not appearing at all in the list; and that of New England is equally unimportant, the whole produce of that section of the country being in that year only 74,547 bushels.

The following table gives the production of wheat, total value, value per bushel, and amount exported for each of the years, 1880-87:—

Year.	Total production. (Bushels.)	Total value of crop	Av. value per bushel (in cents).	Amt. exported. (Bushels.)
1880	498,549,868	$474,201,850	95.1	186,321,514
1881	383,280,090	456,880,427	119.3	121,892,389
1882	504,185,470	444,602,125	88.2	147,811,316
1883	421,086,160	383,649,272	91.0	111,534,182
1884	512,765,000	330,862,260	64.5	132,570,367
1885	357,112,000	275,320,390	77.1	94,565,794
1886	457,218,000	314,226,020	68.7	153,804,970
1887	456,329,000	310,612,960	68.1	....
Aver'ge	448,815,699	373,794,413	83.3	135,500,076

The estimate of the Agricultural Department of the yield of wheat for the year 1888 is 415,868,000.

Gras and The grass crop is well understood to be the greatest of all the crops of the United States. Altogether, in addition to the very large amount consumed from the ground during the grazing season, the value of the harvested hay reaches nearly to that of the greatest of the cereal crops. The following statistics are presented:—

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*Quarterly Journal of Economics, vol. i. p. 181 (number for January, 1887).

* The yield of California remained nearly the same in 1887 that it was in 1879. In the former year it was a trifle over thirty millions: in the latter a trifle under that amount.

The area mown in 1879 was 30,631,054 acres; in 1886, 36,501,688 acres. The value of the hay cut in the latter year was $353,437,699.* In one State (New York) the value amounted to over fifty millions of dollars; in one (Pennsylvania), to over thirty and less than forty millions; in three States (Illinois, Ohio and Iowa), to over twenty and less than thirty millions.

The grass and hay producing industry decreases in importance as we go from the North toward the South. Thus, the thirteen States in each of which (in 1879) more than a million of acres were mown are all north of the parallel of 37°; and all but two (Missouri and Kansas) north of 39°, excepting very small fractions of Ohio, Indiana and Illinois.

The number and value of the animals on farms in the year 1886 was as follows:—

	Number.	Value.
Horses	13,172,936	$946,096,154
Mules	2,191,727	174,853,563
Milch cows	14,856,414	366,252,173
Oxen and other cattle	34,378,363	611,750,520
Sheep	43,544,755	89,279,926
Hogs	44,346,525	220,811,082

The importance of the crop of Indian corn has given a great development to the business of fattening swine, and an average of about fifteen per cent. of this production has, during the past twenty-seven years, been exported. The average value of "hog products" (live hogs, bacon, hams, pork and lard) exported has been, during the years 1881-87, $73,671,607 per annum, as against $65,136,498 in the decade 1871-80.

The statistics of dairy products given in the Agricultural Report of the Census of 1880 for the year 1879 are presented in a very condensed form, as follows:—

Milk sold, or sent to butter and cheese factories	530,129,755 gals.
Butter made on farms	777,250,287 lbs.
Cheese made on farms	27,272,489 lbs.

The very great extent and importance of the poultry industry in the United States is made apparent by the following statement of facts gathered by the census of 1880:—

Barnyard poultry on hand, June 1, 1880	102,272,135
Other poultry on hand June 1, 1880	23,235,187
Eggs produced in 1879	456,910,916

At twelve cents a dozen, the annual value of the egg product to the farm would reach nearly $55,000,000, and the value of the fowls consumed as food may fairly be estimated at $20,000,000. The average yield of eggs per fowl is fully twice as great in the Northern States as it is in the Southern.

The cotton production of the United States is of great importance, both from the extent to which this material is manufactured within the country, and because it is the first on the list in value among the exports.

Cotton is mentioned in the records of the Colony of South Carolina as early as 1664, and a small quantity was exported in 1747. The invention of the cotton-gin by Eli Whitney, in 1794, was followed by a rapid development of the cotton-raising business throughout the Southern States. The first crop of sea-island cotton was raised in 1790, from seed that came either from the Bahama or Barbadoes Islands.

The total production of the country in the year 1879 is given by the census of 1880 at 5,737,257 bales, of 375 pounds; this having been assumed to be the weight of the bale, in 1879—the average proportion of seed to fibre, or lint, in the crop as it comes from the field being given as two to one. The stated number of bales is equivalent, therefore, to 1,362,599 tons (of 2,000 pounds) of lint or fibre, and 2,725,197 of seed.

This production was divided among the States as follows:

	Field. Bales.	Av. Product per acre. Fraction of bale.
Mississippi	955,808	0.46
Georgia	814,441	0.31
Texas	803,642	0.37
Alabama	699,654	0.39
Arkansas	608,256	0.58
South Carolina	522,548	0.38
Louisiana	508,569	0.59
North Carolina	389,598	0.44
Tennessee	330,644	0.46
Florida	54,997	0.22
Missouri	19,733	0.60
Indian Territory	17,000	0.49
Virginia	11,000	0.46
Kentucky	1,367	0.51
Total	5,737,257	gen. av. 0.40

From the above table it will be seen that the limit of profitable cultivation of cotton is pretty sharply drawn at about the parallel of 37°; the production of Virginia and Kentucky—the southern border of which States is in the latitude 36° 30′—being exceedingly small. The production of Missouri is limited to a highly fertile region lying in the extreme southeastern portion of the State, while that of Kentucky pertains to the country lying adjacent to Western Tennessee and the rich bottom-lands along the Mississippi River. It does not appear that any cotton is produced north of the Ohio River.

According to Professor E. W. Hilgard, Special Agent of the Census of 1880, in charge of the subject of Cotton Production, the high production of Mississippi is due in part to the great fertility and large area of the "bottom-land" along the Mississippi River within the limits of that State, and in larger part to the fertility of the "uplands," or table-land bordering the Mississippi bluff, and the interior "prairie-belts." These favorable conditions have as a result that cotton culture is the one pursuit to which the population of this State devotes itself. It is rather great natural advantages than skill and industry which give Mississippi the first place in the production of cotton. Professor Hilgard thinks that by enlarging the area of tillable land in the Yazoo bottom, by simple exclusion of the overflows of the Mississippi, without any change in the methods of culture, the produce of the State might be raised to two and a quarter millions of bales; and that with improved cultivation the production might be brought up to five millions, so that under these conditions Mississippi alone could produce the entire crop now grown in the United States.

Georgia as a cotton producing State.

Georgia stands second in total production among the States, but the average production per acre is but two-thirds that of Mississippi. The area of what would be called in the last-named State first and second class cotton soil is in Georgia quite limited—far more so than is the case in the neighboring State of Alabama; yet the former State is slightly in advance of the latter in the average product per acre. The high position of Georgia as a cotton producing State is due therefore, not to natural advantages, but to better cultivation of the soil, the use of fertilizers, and the thrift of an industrious population.

Texas

Texas—much the largest in area of the cotton producing States, and also slightly larger in population than any of the other Gulf States—stands third on the list of total production. In the average product per acre it is among the very lowest. This fact seems to be due, in large part at least, to the position of Texas in reference to precipitation. In this State the total amount of rainfall is considerably less than in the other Gulf States, owing to its position in reference to the prevailing winds; and the diminution of rainfall is rapid as we recede from the coast. The precipitation is largest in the extreme northeastern portion of the State, and here—north of the 32d parallel and east of the 98th meridian—more than half the cotton product of the State is grown. The fact that Texas is so much larger than the other cotton producing States must also be borne in mind in connection with its position as the third on the list. It has, in fact, an area more than five times as great as the average area of the six other principal cotton States.

Alabama

Alabama is naturally as well suited for the growth of cotton as the two States adjacent to it on the east and west, Georgia and Mississippi; and its position as fourth on the list, and as inferior to both these States, is considered by Professor Hilgard to be due to the fact that Mississippi is still within the period of the first flush of fertility, while Georgia has reached the stage where her fields are being renovated by the use of fertilizers; while the soil of Alabama has begun to be exhausted, but this exhaustion has not yet proceeded so far that the cultivators realise the necessity of making good this deficiency by proper modes of cultivation, as is done to a certain extent in Georgia.

South and North Carolina.

In South and North Carolina the average cotton production per acre is high as compared with that of Alabama and Georgia, and in the case of North Carolina approaches that of Mississippi itself. The reason for this condition of things is to be found chiefly in the introduction of improved methods of culture, and the use of fertilisers. In South Carolina the so-called sea-island cotton is produced—a variety of cotton of great value, although small in amount, the production of it for the year 1880 being set down in the Census Report as 9,966 bales. The finest cotton ever known to have been produced is the long-staple cotton of Edisto Island, which sold for two dollars a pound when other cottons were only bringing nine cents. The islands where this crop is grown line the coast, sometimes forming three or four parallel belts, having their greatest development at the mouth of Broad River, from which in each direction along the coast they diminish in numbers.

All the important cotton-producing States with the exception of Arkansas and Tennessee, lie either on the Gulf of Mexico or the Atlantic coast; but the principal cotton-producing areas in the case of each of these States are at a considerable distance from the coast. Thus, in Mississippi by far the greater portion of the area planted in cotton lies in the northern and western part of the State, while in the extreme south there is an area where cotton culture is either very subordinate or practically non-existent; nor is this decrease of cotton culture accompanied by a corresponding increase of some other production. In Louisiana an obvious fact—rendered apparent by a glance at the map showing the relative areas given to cotton culture in the State—is the decrease of cotton culture as we advance southward. In Alabama the central prairie region, or black-soil belt, a narrow strip of country only about twenty-five miles wide, running east and west through the centre of the State, more than a hundred miles from the coast, produces forty per cent of the entire cotton crop. Adjacent to this particularly rich belt on the north and south is a belt of less but still large productiveness, making the total width of the central cotton belt about seventy-five miles; and here at least sixty per cent. of the cotton of the State is raised. In Georgia the principal cotton-producing belt runs nearly parallel with the coast, and at a distance of from one hundred to one hundred and fifty miles from it. A similar condition of things is clearly indicated in both North and South Carolina.

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* This includes only hay cut on farms, and not that cut on public lands and lands of non-residents.

On comparing the facts here stated with the position of the isothermal and isohyetal curves in the region where cotton is grown, it will be seen that nearly the entire production of cotton comes from the area included between the isothermals of 60° and 64°, and there is none cultivated in any region of lower mean annual temperature than 56°. It also appears that the cotton-producing area is one of comparatively large precipitation, being nowhere less than thirty-eight inches, and generally considerably over that amount; and also that this precipitation is pretty uniformally distributed throughout the year. From this it is seen that the climatic conditions favoring the growth of cotton are of such a nature as to limit its successful production to a comparatively small area, differing in this respect materially from some of the other staples of the country, especially Indian corn and wheat. It will also be evident that the conditions existing on the Pacific coast do not favor the successful cultivation of cotton in that region.

Table of Cotton Production

The following table exhibits the production of cotton and the amount exported for each year from 1880 to 1887. The average annual yield during the twenty years previous to 1861 was 1,235,000,000 pounds; during the twenty-three years from 1865 to 1886 it was 2,207,000,000 pounds—an increase of 65.3 per cent. During the pentad 1883–87 the average was 2,036,345,355 pounds, or a little less than the average of the years 1865 to 86:—

Year.	Production in Pounds	Exports in Pounds.
1880	3,199,822,682	2,190,928,772
1881	2,588,296,636	1,739,975,961
1882	3,405,070,410	2,208,075,062
1883	2,757,544,422	1,862,572,530
1884	2,742,966,011	1,891,659,472
1885	3,182,350,631	2,058,037,444
1886	3,157,378,443	2,169,457,330
1887*	3,900,000,000	2,200,000,000

*Approximate

The climatic conditions under which tobacco can be raised seem to be quite variable, since more or less of this crop is furnished by almost every State in the Union. The yield of the extreme Southern and extreme Northern States is, however, very small; as (in 1879), of Maine only 250 pounds; of Oregon, 17,325; of New Mexico, 890; of Louisiana, 55,954.

Kentucky largest tobacco producing State.

The largest tobacco-producing State is Kentucky, with 171,120,784 pounds in 1879, according to the census of 1880. Next comes Virginia, with 79,988,868; then Pennsylvania, 36,943,272; Ohio, 34,735,235; Tennessee, 29,365,052; North Carolina, 26,986,213; Maryland, 26,082,147; Missouri, 12,015,657; Wisconsin, 10,608,423. From this it is evident that the culture of tobacco is carried on most successfully in the Middle Atlantic States and those bordering on the Ohio River, diminishing gradually in this latitude westerly, and having no importance in the extreme Western States. The mean temperature of the chief tobacco-producing area is indicated by the statement that it lies between the isothermals of 52° and 60°. As regards precipitation, a somewhat moist climate seems to be required, and there is little tobacco raised where the rainfall averages less than thirty-eight inches. The isothermal of thirty-two inches seems to be the limit beyond which it cannot pass. The total yield of the United States in the year 1879 was 472,661,159 pounds, having an estimated value as raised in the producers' hands, of $51,104,870.

The production of tobacco in 1886 was about eleven per cent. larger than in 1879—namely, 532,537,000 pounds. The relative rank of the States in the production of this crop was almost exactly the same at the two periods. Kentucky and Virginia together furnished in 1886 more than half the total, or 285,104,000 pounds. The entire value of the tobacco raised in 1886 was $39,468,218.

Rice.

The production of rice for the year 1879 as returned by the census of 1880 was as follows:—

	Pounds.	Average yield per acre.
Alabama	810,889	514
Florida	1,294,677	508
Georgia	25,369,687	725
Louisiana	23,188,311	552
Mississippi	1,718,951	491
North Carolina	5,609,191	517
South Carolina	52,077,515	664
Texas	62,152	186
Total	110,131,378	gen. av. 632

Sugar.

The production of sugar from the sugar-cane is extremely small as compared with the consumption of this article. Louisiana is the only State of any importance in this connection, although a small quantity of sugar is made in each of the following States: Georgia, Florida, Texas, Alabama, Mississippi and South Carolina. The total production in the year 1879, as returned by the census of 1880, was—of sugar, 178,872 hogsheads, and of molasses, 16,573,273 gallons, of which Louisiana furnished 171,706 hogsheads and 11,696,248 gallons.

The census of 1880 gives the following statistics of the production for that year of sugar and molasses from sorghum and the maple:

	Sugar	Molasses.
Sorghum	12,792 lbs.	28,444,202 gals.
Maple	36,576,061	1,796,048

The principal production of sorghum molasses is in the States of Missouri, Tennessee, Kentucky, Illinois, and Iowa; that of maple sugar, in Vermont and New York, in each of which States the produce was over 10,000,000 pounds.

General summary

The following additional facts in regard to the agriculture of the United States are condensed and arranged from the volume entitled "Statistics of Agriculture," in the Census Report for 1880:—

	1870.	1880.
Total number of farms	2,659,985	4,008,907

The term "farm," as here used, is understood to mean a tract of not less than three acres, unless $500 worth of produce has actually been sold off from it during the year, and owned or leased by one man and cultivated under his care:—

Total area of United States in acres	1,856,108,800
Number of acres in farms	536,081,835

	1860.	1870.	1880.
Proportion of unimproved land in farms to improved, in percentage	59.9	53.7	46.9

Of the 4,008,907 farms returned, 74 per cent were cultivated by their owners, 8 per cent by tenants on basis of fixed money rental, and 18 per cent by tenants paying a share of the product or rent.

The total value of the farms of the United States, including land, buildings and fences, is given by the census of 1880 at $10,197,096,776; and the estimated value of all farm productions sold consumed, or on hand, in 1879, was $2,12,540,927.

The following tabular statement, from the volume of the Census Report of 1880, entitled "Statistics of Agriculture," and published in 1883, presents a resume of the principal facts connected with the agricultural interests of the country, so far as concerns the amounts or values of the different products:—

Tabular statement

CONDENSED TABULAR VIEW OF AGRICULTURAL PRODUCTS CHIEFLY IN THE YEAR 1879, ARRANGED FROM THE CENSUS REPORT, VOLUME ENTITLED "STATISTICS OF AGRICULTURE," PUBLISHED 1883.

Number of farms	4,008,907	
Value of farms, including land, fences, and buildings	$10,197,096,776	
Estimated value of farm products for 1879	$2,212,540,927	
Wool produced	240,681,751	pounds
Milk (not including that sent to butter or cheese factories)	530,129,755	gallons
Butter (including that made on farms and in factories)	806,672,071	pounds
Cheese (made on farms and in factories)	243,157,850	"
Barley	43,997,495	bushels
Buckwheat	11,817,327	"
Indian corn	1,754,591,676	"
Oats	407,858,999	"
Rye	19,831,595	"
Wheat	459,483,137	"
Cotton	5,755,359	bales
Flaxseed	7,170,951	bushels
Flaxstraw	421,098	tons
Flax fibre	1,565,546	pounds
Hemp	5,025	tons
Sugar (sugar-cane)	178,872	hhds.
Molasses (sugar-cane)	16,573,273	gallons
Sugar(sorghum)	12,792	pounds
Molasses (sorghum)	28,444,202	gallons
Sugar (maple)	36,576,061	pounds
Molasses (maple)	1,796,048	gallons
Hay mown	35,150,711	tons
Clover-seed	1,922,952	bushels
Grass-seed	1,317,701	"
Eggs	456,910,916	dozen
Honey	25,743,208	pounds
Wax	1,105,689	"
Rice	110,131,373	"
Tobacco	472,661,157	"
Potatoes, Irish	169,458,539	bushels
Potatoes, sweet	33,378,693	"
Orchard products (sold or consumed)	$50,876,154	
Market-garden products	$21,761,250	
Hops	26,546,378	pounds
Broom corn	29,480,106	"
Peas	5,514,977	bushels
Beans	3,075,050	"
Wood, amount cut	51,442,624	cords
Forest products, value of all consumed or sold	$96,774,735	

The following general summary presents in one table the estimated quantities, number of acres cultivated, and aggregate value of the principal crops of the country in the year 1886:—

Products.	Quantity.		No. of Acres	Value.
Indian corn	1,665,441,000	bushels	75,694,208	$610,311,000
Wheat	457,218,000	"	36,806,184	314,226,020
Rye	24,489,000	"	2,129,918	13,181,330
Oats	624,134,000	"	23,658,474	196,137,930
Barley	59,428,000	"	2,652,957	31,840,510
Buckwheat	11,869,000	"	917,915	6,465,120
Potatoes	168,051,000	"	2,287,136	78,441,940
Total	3,010,630,000	bushels	144,146,792	$1,240,603,850
Tobacco	532,570,000	pounds	750,210	39,468,218
Hay	41,796,499	tons	36,501,688	353,437,699
Cotton	6,445,864	bales	18,454,603	257,295,327
Grand total			199,853,293	$1,890,805,094

MANUFACTURES.

The most important facts connected with the manufacturing interests of the United States, as revealed by the census of 1880 and those of the preceding decades, may be stated, in the most condensed form, as follows:—

First, a table is given showing certain of the principal items connected with manufactures in the form of totals for the whole United States, for the three census years 1860, 1870, and 1880:—

TABULAR STATEMENT OF MANUFACTURES IN THE UNITED STATES.

	1860.	1870.	1880.
Number of Establishments	140,433	252,148	253,852
Capital Invested	$1,009,855,715	$2,118,208,769	2,790,272,606
Average Number of Hands Employed			
Males above 16 years	....	1,615,598	2,019,035
Females above 15 yrs.	....	323,770	531,639
Children and Youths	....	114,628	181,921
Total am't. paid in wages during the year.	$378,878,966	$775,584,343	$947,953,795
Value of Materials used.	1,031,605,092	2,488,427,242	3,396,823,549
Value of Products	1,885,861,676	4,232,325,442	5,369,579,191

The proportion in which the various branches of manufacture are geographically distributed over the country, according to the census of 1880, is shown by the following percentage statement:—

TABLE OF GEOGRAPHICAL DISTRIBUTION OF MANUFACTURES IN THE UNITED STATES.

	Proportion of total Area.	Number of Establishments.	Amount of Capital invested	Hands Employed.	Wages Paid.	Gross Product
N. Atlantic	5.6	44.57	61.94	62.23	64.33	59.64
S. Atlantic	9.4	10.16	5.59	7.59	4.99	5.26
N. Central	25.5	34.23	25.78	24.39	24.86	28.94
S. Central	20.3	7.55	3.75	3.85	3.11	3.47
W. (Cordilleran).	39.4	3.09	2.61	1.94	2.71	2.69

Next may follow a statement of the various most extensive manufacturing industries arranged in the order of their importance, with reference to the value of their products. In this table all branches of manufacture are included in which the total production exceeds $40,000,000 in value:—

TABLE OF INDIVIDUAL MANUFACTURING INDUSTRIES IN THE UNITED STATES, ACCORDING TO THE CENSUS OF 1880.

Products.	Number of Establishments.	Number of Hands employed.
Flouring and Grist Mill Products	24,338	58,407
Slaughtering and Meat Packing	872	27,297
Iron and Steel	1,005	140,978
Woolen of all classes	2,689	161,557
Lumber, Sawed	25,708	147,956
Foundry and Machine Shop Products	4,958	145,357
Cotton Goods	1,005	185,472
Clothing, Men's	6,166	160,813
Boots and Shoes	17,972	133,819
Sugar and Molasses, Refined	49	5,857
Leather, Tanned	3,105	23,812
Liquors, Malt	2,191	26,220
Carpentering	9,184	54,138
Printing and Publishing	3,467	58,478
Furniture	5,227	59,304
Leather, Curried	2,319	11,453
Agricultural Implements	1,943	39,580
Mixed Textiles	470	43,973
Bread and other Bakery Products	6,396	21,488
Carriages and Wagons	3,841	45,394
Tobacco, Cigars, etc	7,145	53,297
Paper	692	24,422
Tobacco, Chewing, Smoking and Snuff	477	32,756
Tin ware, Copper ware, and Sheet Iron ware	7,596	26,248
Blacksmithing	28,101	34,526
Liquors, Distilled	844	6,502
Silk and Silk Goods	382	31,337

Products.	Amount paid in Wages.	Value of Materials.	Value of Products.
Flouring and Grist Mill Products	$17,422,316	$441,545,225	$505,185,712
Slaughtering and Meat Packing	10,508,530	267,738,902	303,562,413
Iron and Steel	55,476,785	191,271,150	296,557,685
Woolen of all classes	47,389,087	164,371,551	267,252,913
Lumber, Sawed	31,845,974	146,155,385	233,268,729
Foundry and Machine Shop Products	65,982,133	103,345,083	214,378,468
Cotton Goods	45,614,419	113,765,537	210,950,383
Clothing, Men's	45,940,353	131,263,282	209,548,460
Boots and Shoes	50,995,144	114,966,575	196,920,481
Sugar and Molasses, Refined	2,875,032	144,698,499	155,484,915
Leather, Tanned	9,304,243	85,919,207	113,348,336
Liquors, Malt	12,198,053	56,836,509	101,058,385
Carpentering	24,582,077	51,621,120	94,152,139
Printing and Publishing	30,531,657	32,460,395	90,789,341
Furniture	23,696,080	35,860,205	77,845,725
Leather, Curried			
Agricultural Implements	4,845,413 15,359,610	59,306,509 31,531,170	71,351,297 68,640,486
Mixed Textiles	13,316,753	37,227,741	66,221,703
Bread and other Bakery Products	9,411,328	42,612,027	65,824,896
Carriages and Wagons	18,988,615	30,597,086	64,951,617
Tobacco, Cigars, etc.	18,464,762	29,577,853	63,979,575
Paper	8,525,355	39,951,257	55,109,914
Tobacco, Chewing, Smoking and Snuff	6,419,024	34,397,072	52,793,056
Tin ware, Copper ware and Sheet-iron ware	10,722,974	25,232,281	48,096,038
Blacksmithing	11,128,001	14,572,373	43,774,271
Liquors, Distilled	2,663,967	27,744,245	41,063,663
Silk and Silk Goods	9,146,705	22,467,701	41,033,045

The remarkable concentration of the manufacturing interests of the United States in the extreme northeastern portion of the country will be evident from the above table. New England, New York, New Jersey, and Pennsylvania, embracing only a little over one-twentieth of the area of the whole country, produce six-tenths of the total gross product of its manufactures. Similar conditions are shown in contrasting the northern with the southern sections of the country. The North Atlantic and North Central divisions, with thirty-one per cent of the total area, furnish over eighty-eight per cent. of the gross product. The Western or Cordilleran region, with nearly forty per cent. of the total area of the country, furnishes only a little over two and a half per cent. of its manufactures.

The Census Report of 1882 gives a great mass of statistics in reference to the manufacture of cotton in the country, from which the following are selected as representing the most essential features of this extremely important business:—

Number of spindles	10,653,435
Number of looms	225,759
Bales of cotton consumed	1,570,344
Number of persons employed	172,544
Wages paid	$42,040,510

These are said to be the final figures of the specific manufacture of cotton yarn and woolen fabrics, including some cotton hosiery; and by the term "specific" is meant cotton "worked into a fabric known and sold under that name."

Including the cotton used in mixed goods and upholstery, the total consumption is estimated at 1,760,000 bales. The total number of operatives employed, including those engaged in print and dye works and bleacheries, and also in manufacturing special fabrics in which cotton forms a part, is 195,334. The operatives employed in the specific cotton mills are thus classed as to age and sex:—

Men	59,685
Boys	15,107
Women	84,539
Girls	13,213
Total	172,544

The average wages earned in the cotton mills amount, for 300 days in the year, to 81 cents per day. Since 1840 the hours of labor have been reduced from 13 or 14 to 10 or 11, and the average earnings per hour are now more than double what they were at that time.

The manufacture of cotton is carried in nearly all the Atlantic, Central, and Southern States, but is principally developed in and near Massachusetts. This State alone consumed considerably more cotton in 1880 than all the other States outside of New England. Of 1,570,344 bales consumed in "specific" cotton manufacture in the country, in 1880, 1,129,498 were taken by New England. Massachusetts and Rhode Island, having together about ten thousand square miles of area, consumed 742,337 bales, or nearly half the whole consumption of the United States.

Some cotton cloth is still made by hand in the mountainous sections of the South, some two or three hundred thousand persons being supplied in this way. As a measure of their work, it is said by Mr. Atkinson, Special Agent of the Census in charge of the subject of Cotton, that "two carders, two spinners, and one weaver could produce eight yards of coarse cotton cloth in a day of ten hours." To this he adds: "Of the whole force engaged in the specific cotton manufactures, about 160,000 are employed on goods for home consumption. It would take 16,00,000 to make the same number of yards by hand-work, and the cloth would be of a far different kind—more durable, it is true, but coarse and unsightly."

The following table will furnish the necessary data for an understanding of the importance of the petroleum business in the United States:—

Year ending June 30.	Production in Barrels of 42 Gallons.	Exports, in gallons.			Total Value of Exports.
		Illuminating Oil.	Crude Oil.	Total.	
1864	2,478,709	12,791,518	9,930,651	23,210,369	$10,782,689
1865	2,421,905	12,722,005	12,290,597	25,496,849	16,563,413
1866	3,165,700	34,255,921	16,067,943	50,987,341	21,530,887
1867	3,591,900	62,686,657	7,344,248	70,255,481	24,407,642
1868	3,613,709	67,909,961	10,029,659	79,456,888	21,810,676
1869	4,046 558	84,403,492	13,425,566	100,636,684	31,127,433
1870	4,411,016	97,902,505	10,403,314	113,735,294	32,668,960
1871	5,536,775	132,078,965	9,859,038	149,892,691	36,894,810
1872	5,842,497	122,539,575	12,530,768	145,171,583	34,058,390
1873	7,242,843	158,102,414	18,439,407	187,815,187	42,050,756
1874	11,188,741	217,220,504	17,776,419	247,806,483	41,245,815
1875	10,063,828	191,551,933	14,718,114	221,955,308	30,078,568
1876	8,823,142	204,814,673	20,520,397	243,660,152	32,915,786
1877	10,822,871	262,441,844	26,819,202	339,196,914	61,789,438
1878	14,738,262	289,214,541	26,936,727	338,841,303	46,574,974
1879	16,917,606	331,586,442	25,874,438	378,310,010	40,305,249
1880	22,882,509	367,325,823	28,297,997	423,964,699	36,218,625
1881	25,805,363	332,283,045	39,934,844	397,660,262	40,315,609
1882	28,650,181	498,213,033	41,304,997	559,954,590	51,232,706
1883	25,662,836	419,821,081	52,712,306	505,931,622	44,913,079
1884	23,744,924	415,615,693	67,186,329	513,660,692	47,103,248
1885	21,750,619	453,243,192	81,037,992	574,628,180	50,257,947
1886	22,463,744	469,471,451	80,216,763	577,781,752	50,199,844
1887	25,816,000	480,845,811	76,062,873	592,803,267	46,824,933
1888	28,249,597	456,417,221	85,538,725	578,351,638	47,042,409

Industries. The relation of materials to product, in the statistics of industry, needs to be carefully borne in mind; and for the purpose of throwing light on this subject, the Census Report of 1880, in the volume devoted to manufactures (published in 1883) groups the manufacturing and mechanical industries into four classes, as follows: I. Those industries in which the subject-matter is of a distinct and immediate commercial value, but the property does not reside in the person who treats it; II. Those industries in which the entire value of the subject-matter is carried into the value of "materials," and appears again in the product, enhanced by the value of labor, use of capital, rent, freight, etc., but in which the value is small compared to the cost of labor; III. Industries which are otherwise under the same conditions as those of the second class, but in which the value of the materials approaches, or even moderately exceeds, the value of the labor employed, and becomes thus an important element in the final value of the product, enhancing the apparent production of the industry in a high degree; and IV. Industries in which the value of the materials far exceeds all other elements in the cost of production combined, although, in fact, comparatively little value has been added by these operations, and only a small number of artisans or laborers supported. The following table is intended to illustrate the relation of materials to product, indicated above:—

RELATIONS OF WAGES AND MATERIALS TO PRODUCTS IN MANUFACTURING AND MECHANICAL INDUSTRIES.*

1880.

Class.	Number of Hands Employed.	Amount paid in Wages.	Value of Materials.	Value of Products.	Excess of Products over Materials.	Excess of Products over Wages and Materials.	Wages in $100 of Products.	Materials in $100 of Products.	Wages and Materials in $100 of Products.	Product, per capita, gross.	Product, per capita, deducting Materials.
I.	123,787	$46,972,802	$64,875,494	$164,523,518	$99,648,024	$52,675,222	$28.55	$39.43	$67.98	$1,329.08	$804.99
II.	240,365	91,618,876	86,007,672	252,180,128	166,172,456	74,553,580	36.33	34.10	70.43	1,049.15	691.33
III........	2,254,204	768,628,877	2,227,225,636	3,796,006,063	1,568,780,427	800,151,550	20.25	58.67	78.92	1,683.96	695.93
IV.........	114,239	40,733,240	1,018,714,747	1,156,869,482	138,154,735	97,421,495	3.52	88.05	91.57	10,126.74	1,209.34
Total	2,732,595	$947,953,795	$3,396,823,549	$5,369,579,191	$1,972,755,642	$1,024,801,847	$17.65	$63.26	$80.91	$1,965.01	$721.93
1870.†											
I.	110,504	$35,689,883	$67,860,482	$154,692,177	$86,831,695	$51,151,812	$23.07	$43.86	$66.93	$1,400.00	$785.87
II.	380,112	160,543,329	172,617,561	503,281,690	330,664,129	170,120,800	31.89	34.30	66.19	1,324.03	869.91
III........	1,420,345	535,293,694	1,483,961,729	2,636,790 545	1,152,838,816	617,545,122	20.30	56.28	76.58	1,856.44	811.66
IV.........	98,778	30,769,841	692,676,576	822,792,139	130,115,563	99,345,722	3.74	84.18	87.92	8,329.71	1,317.25
Total ...	2,009,739	$762,296,747	$2,417,096,348	$4,117,556,551	$1,700,460,203	$938,163,456	$18.51	$58.70	$77.21	$2,048.80	$846.11

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* All the industries tabulated were assigned entire to one class or another, according to the principles indicated in the text. The lines of division taken for the second, third, and fourth classes were: (1) where the value of the materials is less than two-fifths of that of the ultimate product; (2) where the value of the materials is from two-fifths to four-fifths of that of the ultimate product; and (3) where the value of the materials is over four-fifths of the of the ultimate product.

† In this table the same groups of industries in 1870 are compared with each other. The table differs from that contained in the volume on Manufactures of the Ninth Census and in the Compendium of that census in this, that the mining and fishing interests, and the statistics of a few industries which form the subject of special reports in the census of 1880 are, for purposes of comparison, excluded herefrom.

VALUES IN DOLLARS OF THE PRODUCTS OF DOMESTIC AGRICULTURE EXPORTED FROM THE UNITED STATES FOR THE YEARS 1886, 1887 AND 1888.

	1886.	1887.	1888.
Animals	12,518,660	10,598,362	12,885,000
Animal Oils	718,654	810,670	924,136
Provisions, including Meat and Dairy Products	90,625,216	92,783,296	93,068,705
Breadstuffs	125,846,558	165,768,662	127,191,687
Fruits	3,308,308	2,669,965	3,510,208
Seeds	1,949,990	1,907,409	1,516,690
Textiles, Unmanufactured	205,561,916	206,300,069	223,022,032
Vegetable Oils and Oil-cake	9,255,170	9,011,451	8,458,608
Tobacco Leaf	27,158,457	25,948,277	21,936,064
All Other Agricultural Products	8,011,666	7,275,647	8,356,746
Total Value of Agricultural Products	484,954,595	523,073,798	500,840,086
Total Value of all Exports of Domestic Merchandise	665,964,852	703,022,923	683,862,104
Percentage Value of Agricultural Products	73.82	74.40	73.23

From a comparison of the facts given in the various tables herewith presented, it will be evident that, with the exception of those items called "manufactures" in the Census Reports which are not properly manufactures, but the conversion of articles of food into a more suitable and convenient form for shipment to foreign countries—as, for instance, slaughtering of animals, and grinding and packing of wheat in barrels—the manufactures of the United States are intended and used for home consumption. The amount of these exported is very small as compared with the total of the exports. There is no one manufactured article of which the United States has anything like a monopoly abroad, or which greatly predominates in importance as an article of export over any other article.

The following data, compiled from the reports of the Bureau of Statistics, will give a sufficiently complete and comprehensive view of the nature of the imports into the United States.

The imported articles, including those admitted free of duty and the dutiable, are thus classified:—

A. *Articles of food and live animals.* B. *Articles in a crude condition which enter into the various processes of domestic industry.* C. *Articles wholly or partially manufactured for use, as materials in the manufactures and mechanic arts.* D. *Articles manufactured ready for consumption.* E. *Articles of voluntary use, luxuries, etc.* The following table gives the amount in value of each of these classes imported during the years 1884 and 1885, and the average for the five years (1881-85); also the ad valorem rate of duty on the dutiable articles of each class, and the percentage relation of the ad valorem duty to the entire duty collected:—

Year.	1884 and 1885.				Average of Years 1881-85.			
	Free of Duty.	Dutiable.	Ad Valorem Rate on Duitable.	Per Cent. of Total. Duty.	Free of Duty.	Dutiable.	Ad Valorem Rate on Dutiable.	Per Cent. of Total. Duty.
1884 A.	$92,589,286	$132,136,969	44.75	31.15	$86,851,648	$130,072,238	44.90	29.47
1885	86,569,991	107,706,369	57.28	34.79	86,066,234	129,907,732	46.41	30.57
1884 B.	94,039,567	44,457,174	26.82	6.28	97,895,975	54,358,668	29.96	8.21
1885	82,507,747	37,101,595	25.45	5.33	95,001,401	49,163,935	28.57	7.12
1884 C.	12,186,427	60,774,216	26.48	9.73	11,719,623	66,492,197	29.42	9.87
1885	11,185,487	61,045,053	27.88	9.61	11,850,883	66,169,652	29.01	9.73
1884 D.	11,085,112	123,205,489	47.54	30.86	10,207,857	135,602,292	47 22	37.31
1885	10,617,405	108,636,576	48.28	29.58	10,504,966	133,155,050	47.52	32.08
1884 E.	1,429,873	86,721,276	48.12	21.98	1,199,322	78,128,835	51.09	20 14
1885	2,041,004	72,178,227	50.84	20.69	1,453,551	79,690,207	50.69	20 49
Total 1884	$211,280,265	$456,195,194	av. 41.61	100.00	$207,904,425	$464,634,230	av. 42.06	100.00
" 1885	192,912,234	386,667,820	45.90	100.00	204,877,035	458,086,570	43.05	100.00

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UNIVERSALIST CHURCH, a religious body in the United States of America, especially in the New England States, which has for its distinguishing tenet the doctrine of the final salvation of all souls from sin through Christ. The pioneers of Universalism in America were Dr George De Benneville, who taught from 1741 principally in Pennsylvania; Dr Charles Chauncy, of the First Church, Boston (notably in *The Salvation of All Men*, published in 1784); Dr Joseph Huntington, of Coventry, Conn. (whose *Calvinism Improved* was published after his death in 1796); John Murray, Elhanan Winchester, Caleb Rich, and, very specially, Hosea Ballou. Murray is, however, regarded as "the father of Universalism in America." In 1750 James Relly had avowed himself a Universalist, basing his belief on a theory quite peculiar; Murray, who had preached as a Methodist in England and Ireland, was Relly's most distinguished convert. In 1770 he came to America, and, under circumstances so strange that most Universalists regard them as providential, overcoming a deep reluctance, he preached at Good Luck, New Jersey, and organized a society, "The Independent Christian Church," at Gloucester, Massachusetts. Hosea Ballou—a convert from the Calvinist Baptists—took up the cause in 1790, and published the work that is regarded by Universalists as epoch-making, *A Treatise on Atonement*. The number of ministers increased, and societies were formed. These in due time became the constituents of larger organizations, till a "New England convention" saw occasion, in 1803, to adopt a "profession of faith," which in three short articles avowed belief in the Bible as making known in a Divine revelation the nature of God, the mission of Christ, the final holiness of all souls, and the necessity of good works. In 1866 a general convention, composed of delegates from the State conventions, was incorporated. It has jurisdiction throughout the United States and Canada. It has a "Murray fund" of about $135,000. Under the auspices of the Universalist Church are the "woman's centenary association," the "Universalist historical society," several organized charities, four colleges, three theological schools, and five academies,—the total value of the schools, including endowments, being hardly less than 3 million dollars. It publishes eight periodicals. The *Year Book* for 1887 gives the following summary:—1 general convention; 22 State conventions; 945 parishes, 38,429 families; 696 churches, 35,550 members; 634 Sunday schools, 51,871 members; 789 church edifices, value above indebtedness, $7,493,927; 673 clergymen in fellowship and 120 licensed lay preachers.

UNIVERSITIES[1]

riginal eaning ' the rm ani- rsity "

THE mediæval Latin term *universitas* (from which the English word "university" is derived) was originally employed to denote any community or corporation regarded under its collective aspect. When used in its modern sense, as denoting a body devoted to learning and education, it required the addition of other words in order to complete the definition,—the most frequent form of expression being "universitas magistrorum et scholarium" (or "discipulorum"). In the course of time, probably towards the latter part of the 14th century, the term began to be used by itself, with the exclusive meaning of a community of teachers and scholars whose corporate existence had been recognized and sanctioned by civil or ecclesiastical authority or by both. But the more ancient and customary designation of the university in mediæval times (regarded as a place of instruction) was "studium generale" (or sometimes "studium" alone), a term implying a centre of instruction for all.[2] The expressions "universitas studii" and "universitatis collegium" are also occasionally to be met with in official documents.

, limi- tion in edi- al ces.

It is necessary however, to bear in mind, on the one hand, that a university often had a vigorous virtual existence long before it obtained that legal recognition which entitled it, technically, to take rank as a "studium generale," and, on the other hand, that hostels, halls, and colleges, together with complete courses in all the recognized branches of learning, were by no means necessarily involved in the earliest conception of a university. The university, in its earliest stage of development, appears to have been simply a scholastic guild,—a spontaneous combination, that is to say, of teachers or scholars, or of both combined, and formed probably on the analogy of the trades guilds, and the guilds of aliens in foreign cities, which, in the course of the 13th and 14th centuries, are to be found springing up in most of the great European centres. The design of these organizations, in the first instance, was little more than that of securing mutual protection,—for the craftsman, in the pursuit of his special calling,—for the alien, as lacking the rights and privileges inherited by the citizen. And so the university, composed as it was to a great extent of students from foreign countries, was a combination formed for the protection of its members from the extortion of the townsmen and the other annoyances incident in mediæval times to residence in a foreign state. It was a first stage of development in connexion with these primary organizations, when the chancellor of the cathedral, or some other authority, began, as we shall shortly see, to confer on their masters the right of teaching at any similar centre that either already existed or might afterwards be formed throughout Europe,—"facultas ubique docendi." It was a still further development when it began to be recognized that, without a licence from either pope, emperor, or king, no "studium generale" could be formed possessing this right of conferring degrees, which originally meant nothing more than licences to teach.

Chief facts in the history of learning before the university era.

In order, however, clearly to understand the conditions under which the earliest universities came into existence, it is necessary to take account, not only of their organization, but also of their studies, and to recognize the main influences which, from the 6th to the 12th century, served to modify both the theory and the practice of education. In the former century, the schools of the Roman empire, which had down to that time kept alive the traditions of pagan education, had been almost entirely swept away by the barbaric invasions. The latter century marks the period when the institutions which supplied their place—the episcopal schools attached to the cathedrals and the monastic schools—attained to their highest degree of influence and reputation. Between these and the schools of the empire there existed an essential difference, in that the theory of education by which they were pervaded was in complete contrast to the simply secular theory of the schools of paganism. The cathedral school taught only what was supposed to be necessary for the education of the priest; the monastic school taught only what was supposed to be in harmony with the aims of the monk. But between the pagan system and the Christian system by which it had been superseded there yet existed something that was common to both: the latter, even in the narrow and meagre instruction which it imparted, could not altogether dispense with the ancient text-books, simply because there were no others in existence. Certain treatises of Aristotle, of Porphyry, of Martianus Capella, and of Boetius continued consequently to be used and studied; and in the slender outlines of pagan learning thus still kept in view, and in the exposition which they necessitated, we recognize the main cause which prevented the thought and literature of classic antiquity from falling altogether into oblivion.

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[1] It is the design of the present article to exhibit the universities in their historical development, each being brought under notice, as far as practicable, in the order of its original foundation. In the alphabetical enumeration in the table at the end, the date of foundation thus serves to indicate approximately the place where any university is first referred to.

[2] Denifle, *Die Universitäten des Mittelalters*, i. 39.

Revival in time of Charles the Great.

Under the rule of the Merovingian dynasty even these scanty traditions of learning declined throughout the Frankish dominions; but in England the designs of Gregory the Great, as carried out by Theodorus, Bede, and Alcuin, resulted in a great revival of education and letters. The influence of this revival extended in the 8th and 9th centuries to Frankland, where Charles the Great, advised and aided by Alcuin, effected a memorable reformation, which included both the monastic and the cathedral schools; while the school attached to the imperial court, known as the Palace School, also became a famous centre of learned intercourse and instruction.

Its connexion with university of Paris doubtful.

But the activity thus generated, and the interest in learning which it served for a time to diffuse, well nigh died out amid the anarchy which characterizes the 10th century in Latin Christendom, and it is at least questionable whether any real connexion can be shown to have existed between this earlier revival and that remarkable movement in which the university of Paris had its origin. On the whole, however, a clearly traced, although imperfectly continuous, succession of distinguished teachers has inclined the majority of those who have studied this obscure period to conclude that a certain tradition of learning, handed down from the famous school over which Alcuin presided at the great abbey of St Martin at Tours, continued to survive, and became the nucleus of the teaching in which the university took its rise. But, in order adequately to explain the remarkable development and novel character which that teaching assumed in the course of the 12th and 13th centuries, it is necessary to take account of the operation of certain more general causes to which the origin of the great majority of the earlier universities may in common unhesitatingly be referred. These causes are—(1) the introduction of new subjects of study, as embodied in a new or revived literature; (2) the adoption of new methods of teaching which were rendered necessary by the new studies; (3) the growing tendency to organization which accompanied the development and consolidation of the European nationalities.

General causes of formation of first universities.

Rise of university of Salerno.

That the earlier universities took their rise to a great extent in endeavours to obtain and provide instruction of a kind beyond the range of the monastic and cathedral schools appears to be very generally admitted, and this general fact has its value in assisting us to arrive at a conclusion with respect to the origin of the first European university,—that of Salerno in Italy, which became known as a school of medicine as early as the 9th century. The circumstances of its rise are extremely obscure, and whether it was monastic or secular in its origin has been much disputed. One writer[1] derives its origin from an independent tradition of classical learning which continued to exist in Italy down to the 10th century. Another writer[2] maintains that it had its commencement in the teaching at the famous Benedictine monastery of Monte Cassino, where the study of medicine was undoubtedly pursued. But various facts may be urged in contravention of such a theory. The school at Salerno, so far as its history can be traced, appears to have been entirely a secular community; it was distinguished also by its catholic spirit, and, at a time when Jews were the object of religious persecution throughout Europe, members of this nationality were to be found both as teachers and learners at Salerno. Situated, moreover, as it was on the seacoast, its communication with the neighbouring island of Sicily was easy and frequent; and it would accordingly seem far more probable that it was owing to the new knowledge gained from the Saracens, after their occupation of that island, that Salerno acquired its reputation. It was by a band of these invaders that Bertharius, abbot of Monte Cassino, and the author of certain medical treatises, was massacred along with his monks in the year 883. The Saracens were famed for their medical skill, and, by their translations of Galen and Hippocrates, did much to advance the study; and, according to Jourdain,[3] there were translations from the Arabic into Latin long before the time of Constantine the African, but these versions have perished. In the course of the 11th century, under the teaching of Constantine the African (d. 1087), the celebrity of Salerno became diffused all over Europe. Ordericus Vitalis, who wrote in the first half of the 12th century, speaks of it as then long famous. In 1231 it was constituted by the emperor Frederick II. the only school of medicine in the kingdom of Naples.

Teaching of Irnerius at Bologna.

It was at a considerable interval after the rise of the school at Salerno, about the year 1113, that Irnerius commenced at Bologna his lectures on the civil law. This instruction, again, was of a kind which the monastic and cathedral schools could not supply, and it also met a new and pressing want. The states of Lombardy were at this time rising rapidly in population and in wealth; and the greater complexity of their political relations, their increasing manufactures and commerce, called for a more definite application of the principles embodied in the codes that had been handed down by Theodosius and Justinian. But the distinctly secular character of this new study, and its intimate connexion with the claims and prerogatives of the Western emperor, aroused at first the susceptibilities of the Roman see, and for a time Bologna and its civilians were regarded by the church with distrust and even with alarm. These sentiments were not, however, of long duration. In the year 1151 the appearance of the *Decretum* of Gratian, largely compiled from spurious documents, invested the studies of the canonist with fresh importance; and numerous decrees of past and almost forgotten pontiffs now claimed to take their stand side by side with the enactments contained in the *Corpus Juris Civilis*. They constituted, in fact, the main basis of those new pretensions asserted with so much success by the popedom in the course of the 12th and 13th centuries. It was necessary, accordingly, that the *Decretum* should be known and studied beyond the walls of the monastery or the episcopal palace, and that its pages should receive authoritative exposition at some common centre of instruction. Such a centre was to be found in Bologna. The needs of the secular student and of the ecclesiastical student were thus brought for a time into accord, and from the days of Irnerius down to the close of the 13th century we have satisfactory evidence that Bologna was generally recognized as the chief school both of the civil and the canon law.[4] It has indeed been asserted that university degrees were instituted there as early as the pontificate of Eugenius III. (1145-53), but the statement rests on no good authority, and is in every way improbable. There is, however, another tradition which is in better harmony

Decretum of Gratian and the canon law.

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[1] De Renzi, *Storia Documentata della Scuola Medica di Salerno*, ed. 1857, p. 145.

[2] Puccinotti, *Storia della Medicina* i. 317-326.

[3] *Sur l'Âge et l'Origine des Traductions Latines*, &c., p. 225.

[4] Denifle, *Die Universitäten*, &c., i. 48

Barbarossa grants privileges to foreign students at Bologna.

with the known facts. When Barbarossa marched his forces into Italy on his memorable expedition of 1155, and reasserted those imperial claims which had so long lain dormant, the professors of the civil law and their scholars, but more especially the foreign students, gathered round the Western representative of the Roman Cæsars, and besought his intervention in their favour in their relations with the citizens of Bologna. A large proportion of the students were probably from Germany; and it did not escape Frederick's penetration that the civilian might prove an invaluable ally in the assertion of his imperial pretensions. He received the suppliants graciously, and, finding that their grievances were real, especially against the landlords in whose houses they were domiciled, he granted the foreign students substantial protection, by conferring on them certain special immunities and privileges (November 1158).[1] These privileges were embodied in the celebrated *Authentica, Habita*, in the *Corpus Juris Civilis* of the empire (bk. iv. tit. 13), and were eventually extended so as to include all the other universities of Italy. In them we may discern the precedent for that state protection of the university which, however essential at one time for the security and freedom of the teacher and the taught, has been far from proving an unmixed benefit,—the influence which the civil power has thus been able to exert being too often wielded for the suppression of that very liberty of thought and inquiry from which the earlier universities derived in no small measure their importance and their fame.

The "universities" at Bologna.

But, though there was a flourishing school of study, it is to be observed that Bologna did not possess a university so early as 1158. Its first university was not constituted until the close of the 12th century. The "universities" at Bologna were, as Denifle has shown, really student guilds, formed under influences quite distinct from the protecting clauses of the *Authentica*, and suggested, as already noted, by the precedent of those foreign guilds which, in the course of the 12th century, began to rise throughout western Europe. They had their origin in the absolute necessity, under which residents in a foreign city found themselves, of obtaining by combination that protection and those rights which they could not claim as citizens. These societies were modelled, Denifle considers, not on the trade guilds which rose in Bologna in the 13th century, but on the Teutonic guilds which arose nearly a century earlier in north-western Europe, being essentially "spontaneous confederations of aliens on a foreign soil." Originally, they did not include the native student element.

Democratic character of these communities.

The power resulting from this principle of combination, when superadded to the privileges conferred by Barbarossa, gave to the students of Bologna a superiority of which they were not slow to avail themselves. Under the leadership of their rector, they extorted from the citizens concessions which raised them from the condition of an oppressed to that of a specially privileged class. The same principle, when put in force against the professors, reduced the latter to a position of humble deference to the very body whom they were called upon to instruct, and imparted to the entire university that essentially democratic character by which it was afterwards distinguished. It is not surprising that such advantages should have led to an imitation and extension of the principle by which they were obtained. Denifle considers that the "universities" at Bologna were at one time certainly more than four in number, and we know that the Italian students alone were subdivided into two,—the Tuscans and the Lombards. In the centres formed by secession from the parent body a like subdivision took place. At Vercelli there were four "universitates," composed respectively of Italians, English, Provençals, and Germans; at Padua there were similar divisions into Italians, French (*i.e.*, *Francigenæ*, comprising both English and Normans), Provençals (including Spaniards and Catalans). When accordingly we learn from Odofred that in the time of the eminent jurist Azo, who lectured at Bologna about 1200, the number of the students there amounted to some ten thousand, of whom the majority were foreigners, it seems reasonable to conclude that the number of these confederations of students ("societates scholarium") at Bologna was yet greater. It is certain that they were not formed simultaneously, but, similarly to the free guilds, one after the other,—the last in order being that of the Tuscans, which was composed of students from Tuscany, the Campagna, and Rome. Nor are we, again, to look upon them as in any way the outcome of those democratic principles which found favour in Bologna, but rather as originating in the traditional home associations of the foreign students, fostered, however, by the peculiar conditions of their university life. As the Tuscan division (the one least in sympathy, in most respects, with Teutonic institutions) was the last formed, so, Denifle conjectures, the German "university" may have introduced the conception which was successively adopted by the other nationalities.

Other similar communities in Italy.

The rector.

In marked resemblance to the guilds, these confederations were presided over by a common head,—the "rector scholarium," an obvious imitation of the "rector societatum" or "artium" of the guild, but to be carefully distinguished from the "rector scholarum," or directer of the studies, with whose function the former officer had, at this time, nothing in common. Like the guilds, again, the different nations were represented by their "consiliarii," a deliberative assembly with whom the rector habitually took counsel.

Mature age of the students.

While recognizing the essentially democratic character of the constitution of these communities, it is to be remembered that the students, unlike the majority at Paris and later universities, were mostly at this time of mature years. As the civil law and the canon law were at first the only branches of study, the class whom they attracted were often men already filling office in some department of the church or state,—archdeacons, the heads of schools, canons of cathedrals, and like functionaries forming a considerable element in the aggregate. It has been observed, indeed, that the permission accorded them by Frederick I. of choosing, in all cases of dispute, their own tribunal, thus constituting them, to a great extent, *sui juris*, seems to presuppose a certain maturity of judgment among those on whom this discretionary power was bestowed.

Amalgamation of the "universitates" into two divisions.

With the middle of the 13th century, these various confederations became blended, for the first time, into one or other of the two great divisions already referred to,—those of the Ultramontani and the Citramontani, Johannes de Varanis being rector of the former and Pantaleon de Venetiis of the latter. Innocent IV., in according his sanction to the new statutes of the university in 1253, refers to them as drawn up by the "rectores et universitas scholarium Bononiensium." With the commencement of the 16th century, the two corporations were combined under one rector.

Faculties instituted.

About the year 1200 were formed the two faculties of medicine and philosophy (or the arts[2]), the former being somewhat the earlier. It was developed, as that of the civil law had been developed, by a succession of able teachers, among whom Thaddeus Alderottus was especially eminent. The faculty of arts, down to the 14th century, scarcely attained to equal eminence. The teaching of theology remained for a long time exclusively in the hands of the Dominicans; and it was not until the year 1360 that Innocent VI. recognized the university as a "studium generale" in this branch,—in other words, as a place of theological education for all students, with the power of conferring degrees of universal validity.

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[1] See Savigny, *Gesch. d. röm. Rechts*, iii. 152, 491–492. See also Giesebrecht, *Gesch. d. Kaiserzeit* (ed. 1880), v. 51–52. The story is preserved in a recently discovered metrical composition descriptive of the history of Frederick I.; see *Sitzungsberichte d. Bairisch. Akad. d. Wissenschaft, Phil.-Hist. Klasse*, 1879, ii. 285. Its authenticity is called in question by Denifle, but it would seem to be quite in harmony with the known facts.

[2] The arts course of study was that represented by the ancient *trivium* (*i.e.*, grammar, logic, and rhetoric) and the *quadrivium* (*i.e.*, arithmetic, geometry, music, and astronomy), as handed down from the schools of the Roman empire. See J. B. Mullinger, *History of the University of Cambridge*, i. 24–27.

Account of the university by Anglicus.

In the year 1371 the cardinal legate, Anglicus, compiled, as chief director of ecclesiastical affairs in the city, an account of the university, which he presented to Urban V. The information it supplies is, however, defective, owing to the fact that only the professors who were in receipt of salaries from the municipality are mentioned. Of these there were twelve of civil law and six of canon law; three of medicine, three of practical medicine, and one of surgery; two of logic, and one each of astrology, rhetoric, and notarial practice. The professors of theology, who, as members of the religious orders, received no state remuneration, are unmentioned.

The earliest colleges.

Colleges existed at Bologna at a very early date, but it is not until the 14th century that we find them possessing any organization. They were designed solely for necessitous students, not being natives of Bologna. A separate house, with a certain fund for the maintenance of a specified number of scholars, was all that was originally contemplated. Such was the character of that founded by Zoen, bishop of Avignon, in February 1256 (O.S.), the same month and year, it is to be noted, in which the Sorbonne was founded in Paris. It was designed for the maintenance of eight scholars from the province of Avignon, under the supervision of three canons of the church, maintaining themselves in the university. Each scholar was to receive 24 Bolognese lire annually for five years. The college of Brescia was founded in 1326 by William of Brescia, archdeacon of Bologna, for poor foreign students without distinction as to nationality. The Spanish college, founded in 1364, for twenty-four Spanish scholars and two chaplains, is noted by Denifle as the one college founded in mediæval times which still exists on the Continent.

Origin of university of Paris.

Of the general fact that the early universities rose in response to new wants the commencement of the university of Paris supplies us with a further illustration. The study of logic, which, prior to the 12th century, was founded exclusively on one or two meagre compends, received about the year 1100, on two occasions, a powerful stimulus,—in the first instance, from the memorable controversy between Lanfranc and Berengar; in the second, from the no less famous controversy between Anselm and Roscellinus. A belief sprang up that an intelligent apprehension of spiritual truth depended on a correct use of prescribed methods of argumentation.

Study of logic.

Dialectic was looked upon as "the science of sciences"; and, when, somewhere in the first decade of the 12th century, William of Champeaux opened in Paris a school for the more advanced study of dialectic as an art, his teaching was attended with marked success. Among his pupils was Abelard, in whose hands the study made a yet more notable advance; so that, by the middle of the century we find John of Salisbury, on returning from the French capital to England, relating with astonishment, not unmingled with contempt, how all learned Paris had gone well nigh mad in its pursuit and practice of the new dialectic.

Teaching of Abelard.

Abelard taught in the first instance at the cathedral school at Notre Dame, and subsequently at the schools on the Montagne Sainte-Geneviève, of which he was the founder, and where he imparted to logic its new development. But in 1147 the secular canons of Ste Geneviève gave place to canons regular from St Victor; and henceforth the school on the former foundation was merely a school for the teaching of theology, and was attended only by the members of the house.[1] The schools out of which the university arose were those attached to the cathedral on the Île de la Cité, and presided over by the chancellor, —a dignitary who must be carefully distinguished from the later chancellor of the university. For a long time the teachers lived in separate houses on the island, and it was only by degrees that they combined themselves into a society, and that special buildings were constructed for their class-work. But the flame which Abelard's teaching had kindled was not destined to expire. Among his pupils was Peter Lombard, who was bishop of Paris in 1159, and widely known to posterity as the compiler of the famous volume of the *Sentences*. The design of this work was to place before the student, in as strictly logical a form as practicable, the views (*sententiæ*) of the fathers and all the great doctors of the church upon the chief and most difficult points in the Christian belief. Conceived with the purpose of allaying and preventing, it really stimulated, controversy. The logicians seized upon it as a great storehouse of indisputable major premises, on which they argued with renewed energy and with endless ingenuity of dialectical refinement; and upon this new compendium of theological doctrine, which became the text-book of the Middle Ages, the schoolmen, in their successive treatises *super Sententias*, expended a considerable share of that subtlety and labour which still excite the astonishment of the student of metaphysical literature.

Study of theology.

Lombard's *Sentences*.

Rise of other early universities.

It is in these prominent features in the history of these early universities—the development of new methods of instruction concurrently with the appearance of new material for their application—that we find the most probable solution of the question as to how the university, as distinguished from the older cathedral or monastic schools, was first formed. In a similar manner, it seems probable, the majority of the earlier universities of Italy—Reggio, Modena, Vicenza, Padua, and Vercelli—arose, for they had their origin independently alike of the civil and the papal authority. Instances, it is true, occur, which cannot be referred to this spontaneous mode of growth. The university of Naples, for example, was founded solely by the fiat of the emperor Frederick II. in the year 1224; and, if we may rely upon the documents cited by Denifle, Innocent IV. about the year 1245 founded in connexion with the curia a "studium generale,"[2] which was attached to the papal court, and followed it when removed from Rome, very much as the Palace School of Charles the Great accompanied that monarch on his progresses.

Early organization of university of Paris.

As the university of Paris became the model, not only for the universities of France north of the Loire, but also for the great majority of those of central Europe as well as for Oxford and Cambridge, some account of its early organization will here be indispensable. Such an account is rendered still further necessary by the fact that the recent and almost exhaustive researches of Denifle, the Dominican father, have led him to conclusions which on some important points run altogether counter to those sanctioned by the high authority of Savigny.

The original university, as already stated, took its rise entirely out of the movement carried on by teachers on the

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[1] The view of Thurot (*De l'Organisation de l'Enseignement dans l'Université de Paris*, pp. 4–7) that the university arose out of a combination of these several schools is rejected by Denifle (see *Die Universitäten*, &c., i. 653–694).

[2] Where the words *studium generale* are placed within marks of quotation they occur in the original charter of foundation of the university referred to.

The teaching that formed its nucleus.

Inception.

Bachelor of arts.

island, who taught by virtue of the licence conferred by the chancellor of the cathedral. In the second decade of the 13th century, it is true, we find masters withdrawing themselves from his authority by repairing to the left bank of the Seine and placing themselves under the jurisdiction of the abbot of the monastery of Ste Geneviève; and in 1255 this dignitary is to be found appointing a chancellor whose duty it should be to confer "licentia docendi" on those candidates who were desirous of opening schools in that district. But it was around the bestowal of this licence by the chancellor of Notre Dame, on the Île de la Cité, that the university of Paris grew up. It is in this licence that the whole significance of the master of arts degree is contained; for what is technically known as admission to that degree was really nothing more nor less than receiving the chancellor's permission to "incept," and by "inception" was implied the master's formal entrance upon, and commencement of, the functions of a duly licensed teacher, and his recognition as such by his brothers in the profession. The previous stage of his academic career, that of bachelordom, had been one of apprenticeship for the mastership; and his emancipation from this state was symbolized by placing the magisterial cap (*biretta*) upon his head, a ceremony which, in imitation of the old Roman ceremony of manumission, was performed by his former instructor, "under whom" he was said to incept. He then gave a formal inaugural lecture, and, after this proof of magisterial capacity, was welcomed into the society of his professional brethren with set speeches, and took his seat in his master's chair.

The university formed.

This community of teachers of recognized fitness did not in itself suffice to constitute a university, but some time between the years 1150 and 1170, the period when the *Sentences* of Peter Lombard were given to the world, the university of Paris came formally into being. Its first written statutes were not, however, compiled until about the year 1208, and it was not until long after that date that it possessed a "rector." Its earliest recognition as a legal corporation belongs to about the year 1211, when a brief of Innocent III. empowered it to elect a proctor to be its representative at the papal court. By this permission it obtained the right to sue or to be sued in a court of justice as a corporate body.

Difficulties attending its first development.

This papal recognition was, however, very far from implying the episcopal recognition, and the earlier history of the new community exhibits it as in continual conflict alike with the chancellor, the bishop, and the cathedral chapter of Paris, by all of whom it was regarded as a centre of insubordination and doctrinal licence. Had it not been, indeed, for the papal aid, the university would probably not have survived the contest; but with that powerful assistance it came to be regarded as the great Transalpine centre of orthodox theological teaching. Successive pontiffs, down to the great schism of 1378, made it one of the foremost points of their policy to cultivate friendly and confidential relations with the authorities of the university of Paris, and systematically to discourage the formation of theological faculties at other centres. In 1231 Gregory IX., in the bull *Parens Scientiarum*, gave full recognition to the right of the several faculties to regulate and modify the constitution of the entire university,—a formal sanction which, in Denifle's opinion, rendered the bull in question the Magna Charta of the university.

The "nations."

In comparing the relative antiquity of the universities of Paris and Bologna, it is difficult to give an unqualified decision. The university of masters at the former was probably slightly anterior to the university of students at the latter; but there is good reason for believing that Paris, in reducing its traditional customs to statutory form, largely availed itself of the precedents afforded by the already existing code of the Transalpine centre, while its rectorship, proctorships, and four "nations" are all clearly distinct adaptations of the corresponding divisions at Bologna. These nations, which included both professors and scholars, were—(1) the French nation, composed, in addition to the native element, of Spaniards, Italians, and Greeks; (2) the Picard nation, representing the students from the north-east and from the Netherlands; (3) the Norman nation; (4) the English nation, comprising, besides students from the provinces under English rule, those from England, Ireland, Scotland, and Germany. These several nations first came into existence some time before the year 1219, and all belonged to the faculty of arts; but the fully developed university was divided into four faculties,—three "superior," viz., those of theology, canon law, and medicine, and one "inferior," that of arts. The head of each faculty was the dean; the head of each nation was the proctor. The rector, who in the first instance was head of the faculty of arts, by whom he was elected, was eventually head of the whole university. Each of the nations and each of the superior faculties, while subject to the general authority which he represented, was, like a royal colony, in a great measure self-governed, and made statutes which were binding simply on its own members. Congregations of the faculty of arts were presided over by the rector, who discharged the same function when general congregations of the whole academic community were convened. In the former the votes on any question were taken by nations, in the latter by faculties and nations. Only "regents," that is, masters actually engaged in teaching, had any right to be present or to vote in congregations. Neither the entire university nor the separate faculties had thus, it will be seen, originally a common head, and it was not until the middle of the 14th century that the rector became the head of the collective university, by the incorporation under him, first, of the students of the canon law and of medicine (which took place about the end of the 13th century), and, secondly, of the theologians, which took place about half a century later.

Paris and Bologna contrasted.

Papal policy in relation to the universities.

Apart from the broad differences in their organization, the very conception of learning, it will be observed, was different at Bologna from what it was at Paris. In the former it was entirely professional,—designed, that is to say, to prepare the student for a definite and practical career in after life; in the latter it was sought to provide a general mental training, and to attract the learner to studies which were speculative rather than practical. In the sequel, the less mercenary spirit in which Paris cultivated knowledge added immensely to her influence and reputation. The university became known as the great school where theology was studied in its most scientific spirit; and the decisions of its great doctors upon those abstruse questions which absorbed so much of the highest intellectual activity of the Middle Ages were regarded as almost final. The popes themselves, although averse from theological controversies, deemed it expedient to cultivate friendly relations with a centre of such importance for the purpose of securing their influence in a yet wider field. Down therefore to the time of the great schism (1378), they at once conciliated the university of Paris and consulted what they deemed to be the interests of the Roman see, by discouraging the creation of faculties of theology elsewhere. The apparent exceptions to this policy are easily explained: the four faculties of theology which they sanctioned in Italy—Pisa (1343), Florence (1349), Bologna (1362), and Padua (1363)—were designed to benefit the Italian monasteries, by saving the monks the expense and dangers of a long journey beyond the Alps; while that at

Toulouse (1229) took its rise under circumstances entirely exceptional, being designed as a bulwark against the heresy of the Albigenses. The popes, on the other hand, favoured the creation of new faculties of law, and especially of the canon law, as the latter represented the source from which Rome derived her most warmly contested powers and prerogatives. The effects of this twofold policy were sufficiently intelligible: the withholding of each charter which it was sought to obtain for a new school of theology only served to augment the numbers that flocked to Paris; the bestowal of each new charter for a faculty of law served in like manner to divert a certain proportionate number from Bologna. These facts enable us to understand how it is that, in the 13th and 14th centuries, we find, even in France, a larger number of universities created after the model of Bologna than after that of Paris.

In their earliest stage, however, the importance of these new institutions was but imperfectly discerned alike by the civil and the ecclesiastical power, and the first four universities of Italy, after Bologna, rose into existence, like Bologna itself, without a charter from either pope or emperor. **Foundation of universities of Reggio and Modena,** Of these the first were those of Reggio and Modena, both of which are to be found mentioned as schools of civil law before the close of the 12th century. The latter, throughout the 13th century, appears to have been resorted to by teachers of sufficient eminence to form a flourishing school, composed of students not only from the city itself, but also from a considerable distance. **Vicenza,** Both of them would seem to have been formed independently of Bologna, but the university of Vicenza was probably the outcome of a migration of the students from the former city, which took place in the year 1204. In the course of the century Vicenza attained to considerable prosperity; its students were divided into four nations, each with its own rector; and in 1264 it included in its professoriate teachers, not only of the civil law, but also of medicine, grammar, and dialectic. **Padua,** The university of Padua was founded in 1222 as the direct result of the migration of a considerable number of students from Bologna. Some writers, indeed, have inferred that the "studium" in the latter city was transferred in its entirety, but the continued residence of a certain proportion in Bologna is proved by the fact that two years later we find them appealing to Honorius III. in a dispute with the civic authorities. In the year 1228 the students of Padua were compelled by circumstances to transfer their residence to Vercelli, and the latter city guaranteed them, besides other privileges, the right to rent no less than five hundred lodging-houses at a fixed rental for a period of eight years. At first Padua was a school only of the civil and canon law; and during the oppressive tyranny of Ezzelin (1237–1260) the university maintained its existence with some difficulty. But in the latter part of the century it incorporated the faculties of grammar, rhetoric, and medicine, and became known as one of the most flourishing schools of Italy, and a great centre of the Dominicans, at that time among the most active promoters of learning.

Naples, The university of Naples was founded by the emperor Frederick II. in the year 1225, as a school of theology, jurisprudence, the arts, and medicine,—his design being that his subjects in the kingdom of Naples should find in the capital adequate instruction in every branch of learning, and "not be compelled in the pursuit of knowledge to have recourse to foreign nations or to beg in other lands." In the year 1231, however, he decreed that the faculty of medicine should cease to exist, and that the study should be pursued nowhere in the kingdom but at Salerno. The university never attained to much eminence, and after the death of Frederick came for a time altogether to an end, but was restored in 1258 by King Manfred. In 1266 its faculty of medicine was reconstituted, and from 1272–74 Thomas Aquinas was one of its teachers of theology. **Vercelli,** The commencement of the university of Vercelli belongs to about the year 1228; it probably included, like Naples, all the faculties, but would seem to have been regarded with little favour by the Roman see, and by the year 1372 had ceased to exist, although mention of colleges of law and medicine is to be found after that date. **Piacenza,** The two universities of Piacenza and Pavia stand in close connexion with each other. The former is noted by Denifle as the earliest in Italy which was founded by virtue of a papal charter (6th February 1248), although the scheme remained for a long time inoperative. At length, in the year 1398, the university was reconstituted by Giovanni Galeazzo Visconti, duke of Milan, who in the same year caused the university of Pavia to be transferred thither. Piacenza now became the scene of a sudden but short-lived academic prosperity. We are told of no less than twenty-seven professors of the civil law,—among them the celebrated Baldus; of twenty-two professors of medicine; of professors of philosophy, astrology, grammar, and rhetoric; and of lecturers on Seneca and Dante. The faculty of theology would appear, however, never to have been duly constituted, and but one lecturer in this faculty is mentioned. With the death of Galeazzo in 1402, this precarious activity came suddenly to an end; and in 1404 the university had ceased to exist. Its history is, indeed, unintelligible, unless taken in conjunction with that of Pavia. **Pavia,** Even before Irnerius taught at Bologna, Pavia had been widely known as a seat of legal studies, and more especially of the Lombard law, although the evidence is wanting which would serve to establish a direct connexion between this early school and the university which was founded there in 1361, by virtue of the charter granted by the emperor Charles IV. The new "studium" included faculties of jurisprudence, philosophy, medicine, and the arts, and its students were formally taken under the imperial protection, and endowed with privileges identical with those which had been granted to Paris, Bologna, Oxford, Orleans, and Montpellier; but its existence in Pavia was suddenly suspended by the removal, above noted, of its students to Piacenza. It shared again in the decline which overtook the university of Piacenza after the death of Giovanni Galeazzo, and during the period from 1404 to 1412 it altogether ceased to exist. But in October 1412 the lectures were recommenced, and the university entered upon the most brilliant period of its existence. Its professors throughout the 15th century were men of distinguished ability, attracted by munificent salaries such as but few other universities could offer, while in the number of students who resorted thither from other countries, and more especially for the study of the civil law, Pavia had no rival in Italy but Padua. **Arezzo,** Arezzo appears to have been known as a centre of the same study so early as 1215, and its earliest statutes are assigned to the year 1255. By that time it had become a school of arts and medicine also; but for a considerable period after it was almost entirely deserted, and is almost unmentioned until the year 1338, when it acquired new importance by the accession of several eminent jurists from Bologna. In May 1355 it received its charter as a studium generale from Charles IV. After the year 1373 the school gradually dwindled, although it did not become altogether extinct until about the year 1470. **Rome,** The university of Rome (which is to be carefully distinguished from the school attached to the curia) owed its foundation (1303) to Boniface VIII., and was especially designed by that pontiff for the benefit of the poor foreign students sojourning in the capital. It originally included all the faculties; but in 1318 John XXII. decreed that it should possess the power of conferring degrees only in the canon and civil law. The university maintained its existence throughout the period of the residence of the popes at Avignon (see POPEDOM), and under the patronage of Leo X. could boast in 1514 of no less than eighty professors. This imposing array would seem, however, to be but a fallacious test of the prosperity of the academic community, for it is stated that many of the professors, owing to the imperfect manner in which they were protected in their privileges, were in the receipt of such insufficient fees that they were compelled to combine other employments with that of lecturing in order to support themselves. An appeal addressed to Leo X. in the year 1513 represents the number of students as so small as to be sometimes exceeded by that of the lecturers ("ut quandoque plures sint qui legant quam qui audiant"). **Perugia.** Scarcely any of the universities in Italy in the 14th century attracted a larger concourse than that of Perugia, where the study chiefly cultivated was that of the civil law. The university received its charter as a studium generale from Clement V. in the year 1308, but had already in 1306 been formally recognized by the civic authorities, by whom it was commended to the special care and protection of the "podestà." In common with the rest of the Italian universities, it suffered severely from the great plague of 1348–49; but in 1355 it received new privileges from the emperor, and in 1362 its first college, dedicated to Gregory the Great, was founded by the bishop of Perugia. **Treviso.** The university of Treviso, which received its charter from Frederick the Fair in 1318, was of little celebrity and but short duration. It is doubtful, indeed, whether it continued to exist after the city became subject to the republic of Venice in the year 1339; but in 1409 the Venetian senate issued a decree that no subjects of the republic should resort for study to any city in its dominions save that of Padua, and from this date the studium at Treviso must be held to have been no longer in existence. **Florence.** The circumstances of the rise of the university of Florence are unknown, but the earliest evidence of academic instruction belongs to the year 1320. The dispersion of the university of Bologna, in the March and April of the following year, afforded a favourable opportunity for the creation of a studium generale, but the necessary measures were taken somewhat tardily, and in the meantime the greater number of the Bolognese students had betaken themselves to Siena. The charter of foundation for Florence was accordingly not granted until 31st May 1349, when Clement VI. decreed that there should be instituted a studium generale in theology, jurisprudence, medicine, and every other recognized faculty of learning, the teachers to be professors who had obtained the degree of doctor or master either at Bologna or Paris, or "some other studium generale of celebrity." On 2d January 1364 the university also obtained the grant of imperial privileges from Charles IV. On 14th February 1388 it adopted a body of statutes which are still extant, and afford an interesting study in connexion with the university history of the period. The university now entered upon that brilliant period in its history which was destined to so summary an extinction. "It is almost touching," says Denifle, "to note how untiringly Florence exerted herself at this period to attract as teachers to her schools the great masters of the sciences and learning." In the year 1472, however, under the influence of Lorenzo de' Medici, it was decided that Florence was not a convenient seat for a university, and its students were removed to Pisa. **Siena.** The commencement of the university of Siena belongs to about the year 1241, but its charter was first granted by the emperor Charles IV., at the petition of the citizens, in the year 1357. It was founded as a studium generale in jurisprudence, the arts, and medicine. The imperial charter was confirmed by Gregory XII. in 1408, and the various bulls relating to the university which he subsequently issued afford a good illustration of the conditions of academic life in these times. Residence on the part of the students appears to have been sometimes dispensed with. The bishop of Siena was nominated chancellor of the university, just as, says the bull, he had been appointed to that office by the imperial authority. The graduates were to be admitted to the same privileges as those of Bologna or Paris; and a faculty of theology was added to the curriculum of studies. **Ferrara.** The university of Ferrara owes its foundation to the house of Este,—Alberto, marquis of Este, having obtained from Boniface IX. in 1391 a charter couched in terms precisely similar to those of the charter for Pisa. In the first half of the 15th century the university was adorned by the presence of several distinguished humanists, but its fortunes were singularly chequered, and it would appear for a certain period to have been altogether extinct. It was, however, restored, and became in the latter part of the century one of the most celebrated of the universities of Italy. In the year 1474 its circle of studies comprised all the existing faculties, and it numbered no less than fifty-one professors or lecturers. In later times Ferrara has been noted chiefly as a school of medicine.

Oxford. Of the universities modelled on that of Paris, Oxford would appear to have been the earliest, and the manner of its development was probably similar. Certain schools, opened within the precincts of the dissolved nunnery of St Frideswyde and of Oseney abbey, are supposed to have been the nucleus round which the university grew up. In the year 1133 one Robert Pullen, a theologian of considerable eminence (but whether an Englishman or a Breton is uncertain), arrived from Paris, and delivered lectures on the Bible. He was followed a few years later by Vacarius, a native of Lombardy, who as a student at Bologna had inherited the tradition of the teaching of Irnerius. Although both the pope and King Stephen regarded the civil law at this time with considerable distrust, Vacarius maintained his ground, and the study became one of the recognized faculties at Oxford. Towards the close of the 12th century Giraldus Cambrensis describes the town as a place "where the clergy in England chiefly flourished and excelled in clerkly lore." In one respect, indeed, Oxford was more favoured than even Paris, for the town authorities could not pretend to assert any right of interference with the university such as that to which the French monarch and the court frequently laid claim. In the 13th century mention first occurs of university "chests," especially the Frideswyde chest, which were benefactions designed as funds for the assistance of poor students. Halls, or places of licensed residence for students, also began to be established. In the year 1257, when the bishop of Lincoln, as diocesan, had trenched too closely on the liberties of the community, the deputies from Oxford, when preferring their appeal to the king at St Albans, could venture to speak of the university as "schola secunda ecclesiæ," or second only to Paris. Its numbers about this time were probably some three thousand; but it was essentially a fluctuating body, and whenever plague or tumult led to a temporary dispersion a serious diminution in its numerical strength generally ensued for some time after. Against such vicissitudes the foundation of colleges proved the most effectual remedy. Of these the three earliest were University College, founded in 1249 by William of Durham; Balliol College, founded about 1263 by John Balliol, the father of the king of Scotland of the same name; and Merton College, founded in 1264. The last-named is especially notable as associated with a new conception of university education, namely, that of collegiate discipline for the secular clergy, instead of for any one of the religious orders, for whose sole benefit all similar foundations had hitherto been designed. The statutes given to the society by Walter de Merton are not less noteworthy, as characterized not only by breadth of conception, but also by a careful and discriminating attention to detail, which led to their adoption as the model for later colleges, not only at Oxford but at Cambridge. Of the service rendered by these foundations to the university at large we have significant proof in the fact that, although representing only a small numerical minority in the academic community at large, their members soon obtained a considerable preponderance in the administration of affairs.

Cambridge. The university of Cambridge, although it rose into existence somewhat later than Oxford, may reasonably be held to have had its origin in the same century. There was probably a certain amount of educational work carried on by the canons of the church of St Giles, which gradually developed into the instruction belonging to a regular studium. In the year 1112 the canons crossed the river and took up their residence in the new priory in Barnwell, and their work of instruction acquired additional importance. Then, as early as the year 1224, the Franciscans established themselves in the town, and, somewhat less than half a century later, were followed by the Dominicans. At both the English universities, as at Paris, the Mendicants and other religious orders were admitted to degrees, a privilege which, until the year 1337, was extended to them at no other university. Their interest in and influence at these three centres was consequently proportionably great. In the years 1231 and 1233 certain royal and papal letters afford satisfactory proof that by that time the university of Cambridge was already an organized body with a chancellor at its head; and in 1229 and 1231 its numbers were largely augmented by migrations from Paris and from Oxford. Cambridge, however, in its turn suffered from emigration; while in the year 1261, and again in 1322, the records of the university were wantonly burnt by the townsmen. Throughout the 13th century, indeed, the university was still only a very slightly and imperfectly organized community. Its endowments were of the most slender kind; it had no systematic code for the government of its members; the supervision of the students was very imperfectly provided for. An important step in the direction of reform in this last respect was, however, made in the year 1276, when an ordinance was passed requiring that every one who claimed to be recognized as a scholar should have a fixed master within fifteen days after his entry into the university. But the feature which most served to give permanence and cohesion to the entire community was, as at Oxford, the institution of colleges. The earliest of these was Peterhouse, first founded as a separate institution by Hugh Balsham, bishop of Ely, in the year 1286, with a code which was little more than a transcript of that given by Walter de Merton to his scholars at Oxford. About forty years later was founded Michaelhouse, and at nearly the same time (1326) Edward II. instituted his foundation of "king's scholars," afterwards forming the community of King's Hall. Both these societies in the 16th century were merged in Trinity College. To these succeeded Pembroke Hall (1347) and Gonville Hall (1348). All these colleges, although by no means conceived in a spirit of hostility to either the monastic or the Mendicant orders, were expressly designed for the benefit of the secular clergy. The foundation of Trinity Hall (1350) by Bishop Bateman, on the other hand, as a school of civil and canon law was probably designed to further ultramontane interests. That of Corpus Christi (1352), the outcome of the liberality of a guild of Cambridge townsmen, was conceived with the combined object of providing a house of education for the clergy, and at the same time securing the regular performance of masses for the benefit of the souls of departed members of the guild. But both Trinity Hall and Corpus Christi College, as well as Clare Hall, founded in 1359, were to a great extent indebted for their origin to the ravages caused among the clergy by the great plague of 1349.

Montpellier. Turning to France, or rather to the territory included within the boundaries of modern France, we find Montpellier a recognized school of medical science as early as the 12th century. William VIII., lord of Montpellier, in the year 1181 proclaimed it a school of free resort, where any teacher of medical science, from whatever country, might give instruction. Before the end of the century it possessed also a faculty of jurisprudence, a branch of learning for which it afterwards became famed. The university of medicine and that of law continued, however, to be totally distinct bodies with different constitutions. Petrarch was sent by his father to Montpellier to study the civil law. On 26th October 1289 Montpellier was raised by Nicholas IV. to the rank of a "studium generale," a mark of favour which, in a region where papal influence was so potent, resulted in a considerable accession of prosperity. The university also now included a faculty of arts; and there is satisfactory evidence of the existence of a faculty of theology before the close of the 14th century, although not formally recognized by the pope before the year 1421. In the course of the same century several colleges for poor students were also founded. **Toulouse.** The university of Toulouse is to be noted as the first founded in any country by virtue of a papal charter. It took its rise in the efforts of Rome for the suppression of the Albigensian heresy, and its foundation formed one of the articles of the conditions of peace imposed by Louis IX. on Count Raymond of Toulouse. In the year 1233 it first acquired its full privileges as a "studium generale" by virtue of a charter given by Gregory IX. This pontiff watched over the university with especial solicitude, and through his exertions it soon became a noted centre of theological and especially of Dominican teaching. As a school of arts, jurisprudence, and medicine, although faculties of each existed, it never attained to any reputation. **Orleans.** The university of Orleans had a virtual existence as a studium generale as early as the first half of the 13th century, but in the year 1305 Clement V. endowed it with new privileges, and gave its teachers permission to form themselves into a corporation. The schools of Orleans had an existence, it is said, as early as the 6th century, and subsequently supplied the nucleus for the foundation of a university at Blois; but of this university no records now exist.[1] Orleans, in its organization, was modelled mainly on Paris, but its studies were complementary rather than in rivalry to the older university. The absorbing character of the study of the civil law, and the mercenary spirit in which it was pursued, had led the authorities at Paris to refuse to recognize it as a faculty. The study found a home at Orleans, where it was cultivated with an energy which attracted numerous students. In January 1235 we find the bishop of Orleans soliciting the advice of Gregory IX. as to the expediency of countenancing a study which was prohibited in Paris. Gregory decided that the lectures might be continued; but he ordered that no beneficed ecclesiastic should be allowed to devote himself to so eminently secular a branch of learning. Orleans subsequently incorporated a faculty of arts, but its reputation from this period was always that of a school of legal studies, and in the 14th century its reputation in this respect was surpassed by no other university in Europe. **Angers,** Prior to the 13th century it had been famed for its classical learning; and Angers, which received its charter at the same time, also once enjoyed a like reputation, which, in a similar manner, it exchanged for that of a school for civilians and canonists. The roll of the university forwarded in 1378 to Clement VII. contains the names of 8 professors *utriusque juris*, 2 of civil and 2 of canon law, 72 licentiates, 284 bachelors of both the legal faculties, and 190 scholars. **Avignon,** The university of Avignon was first recognized as a "studium generale" by Boniface VIII. in the year 1303, with power to grant degrees in jurisprudence, arts, and medicine. Its numbers declined somewhat during the residence of the popes, owing to the counter attractions of the "studium" attached to the curia; but after the return of the papal court to Rome it became one of the most frequented universities in France, and possessed at one time no less than seven colleges. **Cahors,** The university of Cahors enjoyed the advantage of being regarded with especial favour by John XXII. In June 1332 he conferred upon it privileges identical with those already granted to the university of Toulouse. In the following October, again following the precedent established at Toulouse, he appointed the *scholasticus* of the cathedral chancellor of the university. In November of the same year a bull, couched in terms almost identical with those of the Magna Charta of Paris, assimilated the constitution of Cahors to that of the oldest university. The two schools in France which, down to the close of the 14th century, most closely resembled Paris were Orleans and Cahors. The civil immunities and privileges of the latter university were not, however, acquired until the year 1367, when Edward III. of England, in his capacity as duke of Aquitaine, not only exempted the scholars from the payment of all taxes and imposts, but bestowed upon them the peculiar privilege known as *privilegium fori*. Cahors also received a licence for faculties of theology and medicine, but, like Orleans, it was chiefly known as a school of jurisprudence. **Grenoble,** It was as a "studium generale" in the same three faculties that Grenoble, in the year 1339, received its charter from Benedict XII. The university never attained to much importance, and its annals are for the most part involved in obscurity. At the commencement of the 16th century it had ceased altogether to exist, was reorganized by Francis of Bourbon in 1542, and in 1565 was united to the university of Valence. **Perpignan,** The university of Perpignan, founded, according to Denifle, in 1379 by Clement VII. (although tradition had previously ascribed its origin to Pedro IV. of Aragon), and **Orange,** that of Orange, founded in 1365 by Charles IV., were universities only by name and constitution, their names rarely appearing in contemporary chronicles, while their very existence becomes at times a matter for reasonable doubt.

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[1] See Ch. Desmaze. *L'Université de Paris* (1200-1875).

Palencia, Huesca, Lerida, To some of the earlier Spanish universities—such as Palencia, founded about the year 1214 by Alfonso VIII.; Huesca, founded in 1354 by Pedro IV.; and Lerida, founded in 1300 by James II.—the same description is applicable; and their insignificance is probably indicated by the fact that they entirely failed to attract foreign students. **Valladolid,** Valladolid, founded in 1346 by Pope Clement VI., attained, however, to some celebrity; and the foreign teachers and students frequenting the university became so numerous that in 1373 King Henry II. caused an enactment to be passed for securing to them the same privileges as those already accorded to the native element. But the total number of the students in 1403 was only 116, and grammar and logic, along with jurisprudence (which was the principal study), constituted the sole curriculum. Whatever reputation, indeed, was enjoyed by Spain for nearly five centuries after the commencement of the university era, centred mainly in Salamanca, to which Seville, **Salamanca and Seville,** in the south, stood in the relation of a kind of subsidiary school, having been founded in 1254 by Alfonso the Wise, simply for the study of Latin and of the Semitic languages, especially Arabic. Salamanca was founded in 1243 by Ferdinand III. of Castile as a "studium generale" in the three faculties of jurisprudence, the arts, and medicine. Ferdinand extended his special protection to the students, granting them numerous privileges and immunities. Under his son Alfonso (above named) the university acquired a further development, and eventually included all the faculties save that of theology. But the main stress of its activity, as was the case with all the earlier Spanish universities, excepting only Palencia and Seville, until the commencement of the 15th century, was laid on the civil and the canon law. But, notwithstanding the favour with which Salamanca was regarded alike by the kings of Castile and by the Roman see, the provision for the payment of its professors was at first so inadequate and precarious that in 1298 they by common consent suspended their lectures, in consequence of their scanty remuneration. A permanent remedy for this difficulty was thereupon provided, by the appropriation of a certain portion of the ecclesiastical revenues of the diocese for the purpose of augmenting the professors' salaries. The earliest of the numerous colleges founded at Salamanca was that of St Bartholomew, long noted for its ancient library and valuable collection of manuscripts, which now form part of the royal library in Madrid.

Coimbra, The one university possessed by Portugal had its seat in mediæval times alternately in Lisbon and in Coimbra, until, in the year 1537, it was permanently attached to the latter city. Its formal foundation took place in 1309, when it received from King Diniz a charter, the provisions of which were mainly taken from those of the charter given to Salamanca. In 1772 the university was entirely reconstituted.

Prague, Of the German universities, Prague, which existed as a "studium" in the 13th century, was the earliest, and was at first frequented mainly by students from Styria and Austria, countries at that time ruled by the king of Bohemia. On 26th January 1347, at the request of Charles IV., Pope Clement VI. promulgated a bull authorizing the foundation of a "studium generale" in all the faculties. In the following year Charles himself issued a charter for the foundation. This document, which, if original in character, would have been of much interest, has but few distinctive features of its own, its provisions being throughout adapted from those contained in the charters given by Frederick II. for the university of Naples and by Conrad for Salerno,—almost the only important feature of difference being that Charles bestows on the students of Prague all the civil privileges and immunities which were enjoyed by the teachers of Paris and Bologna. Charles had himself been a student in Paris, and the organization of his new foundation was modelled on that university, a like division into four "nations" (although with different names) constituting one of the most marked features of imitation. The numerous students—and none of the mediæval universities attracted in their earlier history a larger concourse—were drawn from a gradually widening area, which at length included, not only all parts of Germany, but also England, France, Lombardy, Hungary, and Poland. Contemporary writers, with the exaggeration characteristic of mediæval credulity, even speak of thirty thousand students as present in the university at one time,—a statement for which Denifle proposes to substitute two thousand as a more probable estimate. It is certain, however, that Prague, prior to the foundation of Leipsic, was one of the most frequented centres of learning in Europe, and Paris suffered a considerable diminution in her numbers owing to the counter attractions of the great studium of Slavonia.

Cracow. The university of Cracow in Poland was founded in May 1364, by virtue of a charter given by King Casimir the Great, who bestowed on it the same privileges as those possessed by the universities of Bologna and Padua. In the following September Urban V., in consideration of the remoteness of the city from other centres of education, constituted it a "studium generale" in all the faculties save that of theology. It is, however, doubtful whether these designs were carried into actual realization, for it is certain that, for a long time after the death of Casimir, there was no university whatever. Its real commencement must accordingly be considered to belong to the year 1400, when it was reconstituted, and the papal sanction was given for the incorporation of a faculty of theology. From this time its growth and prosperity were continuous; and with the year 1416 it had so far acquired a European reputation as to venture upon forwarding an expression of its views in connexion with the deliberations of the council of Constance. Towards the close of the 15th century the university is said to have been in high repute as a school of both astronomical and humanistic studies.

Vienna. The Avignonese popes appear to have regarded the establishment of new faculties of theology with especial jealousy; and when, in 1364, Duke Rudolph IV. founded the university of Vienna, with the design of constituting it a "studium generale" in all the faculties, Urban V. refused his assent to the foundation of a theological school. Owing to the sudden death of Duke Rudolph, the university languished for the next twenty years, but after the accession of Duke Albert III., who may be regarded as its real founder, it acquired additional privileges, and its prosperity became marked and continuous. Like Prague, Vienna was for a long time distinguished by the comparatively little attention bestowed by its teachers on the study of the civil law.

No country in the 14th century was looked upon with greater disfavour at Rome than Hungary. It was stigmatized as the land of heresy and schism. **Fünfkirchen.** When, accordingly, in 1367 King Louis applied to Urban V. for his sanction of the scheme of founding a university at Fünfkirchen, although theological learning was in special need of encouragement in those regions, Urban would not consent to the foundation of a faculty of theology; he even made it a condition of his sanction for a "studium generale" that King Louis should first undertake to provide for the payment of the professors. We hear but little concerning the university after its foundation, and it is doubtful whether it survived for any length of time the close of the century, having been about that period absorbed in all probability in the university of Ofen. **Ofen.** The foundation of this university is also involved in considerable obscurity, and its original charter is lost. We only know that it was granted by Boniface IX., at the request of King Sigismund, in the year 1389. In the first half of the 15th century it ceased for a long period to exist, but was revived, or rather founded afresh, by King Mathias Corvinus, an eminent patron of learning, in the last quarter of the century. "The extreme east of civilized continental Europe in mediæval times," observes Denifle, "can be compared, so far as university education is concerned, only with the extreme west and the extreme south. In Hungary, as in Portugal and in Naples, there was constant fluctuation, but the west and the south, although troubled by yet greater commotions than Hungary, bore better fruit. Among all the countries possessed of universities in mediæval times, Hungary occupies the lowest place—a state of affairs of which, however, the proximity of the Turk must be looked upon as a main cause."

Heidelberg. The university of Heidelberg received its charter (23d October 1385) from Urban VI. as a "studium generale" in all the recognized faculties save that of the civil law,—the form and substance of the document being almost identical with those of the charter granted to Vienna. It was granted at the request of the elector palatine, Rupert I., who conferred on the teachers and students, at the same time, the same civil privileges as those which belonged to the university of Paris. In this case the functionary invested with the power of bestowing degrees was non-resident, the licences being conferred by the provost of the cathedral at Worms But the real founder, as he was also the organizer and teacher, of the university was Marsilius of Inghen, to whose ability and energy Heidelberg was indebted for no little of its early reputation and success. The omission of the civil law from the studies licensed in the original charter would seem to show that the pontiff's compliance with the elector's request was merely formal, and Heidelberg, like Cologne, included the civil law among its faculties almost from its first creation. No mediæval university achieved a more rapid and permanent success. Regarded with favour alike by the civil and ecclesiastical potentates, its early annals were singularly free from crises like those which characterize the history of many of the mediæval universities. The number of those admitted to degrees from the commencement of the first session (19th October 1386 to 16th December 1387) amounted to 579.[1]

Cologne. Owing to the labours of the Dominicans, Cologne had gained a reputation as a seat of learning long before the founding of its university; and it was through the advocacy of some leading members of the Mendicant orders that, at the desire of the city council, its charter as a "studium generale" (21st May 1388) was obtained from Urban VI. It was organized on the model of the university of Paris, as a school of theology and canon law, and "any other recognized faculty,"—the civil law being incorporated as a faculty soon after the promulgation of the charter. In common with the other early universities of Germany—Prague, Vienna, and Heidelberg—Cologne owed nothing to imperial patronage, while it would appear to have been, from the first, the object of special favour with Rome. This circumstance serves to account for its distinctly ultramontane sympathies in mediæval times and even far into the 16th century. In a report transmitted to Gregory XIII. in 1577, the university expressly derives both its first origin and its privileges from the Holy See, and professes to owe no allegiance save to the Roman pontiff. **Erfurt.** Erfurt, no less noted as a centre of Franciscan than was Cologne of Dominican influence, received its charter (16th September 1379) from the anti-pope Clement VII. as a "studium generale" in all the faculties. Ten years later (4th May 1389) it was founded afresh by Urban VI., without any recognition of the act of his pretended predecessor. In the 15th century the number of its students was larger than that at any other German university—a fact attributable partly to the reputation it had acquired as a school of jurisprudence, and partly to the ardour with which the philosophic controversies of the time were debated in its midst.

The collegiate system is to be noted as a feature common to all these early German universities; and, in nearly all, the professors were partly remunerated by the appropriation of certain prebends, appertaining to some neighbouring church, to their maintenance.

Relations of the popes to the universities. Throughout the 15th century the relations of the Roman pontiffs to the universities continued much the same, although the independent attitude assumed at the great councils of Constance and Basel by the deputies from the universities, and especially by those from Paris, could not fail to excite their apprehensions. Their bulls for each new foundation begin again to indicate a certain jealousy with respect to the appropriation of prebends by the founders. Where such appropriations are made, and more particularly in France, a formal sanction of the transfer generally finds a place in the bull authorizing the foundation; while sometimes the founder or founders are themselves enjoined to provide the endowments requisite for the establishment and support of the university. In this manner the control of the pontiff over each newly-created seat of learning assumed a more real character, from the fact that his assent was accompanied by conditions which rendered it no longer a mere formality. The imperial intervention, on the other hand, was rarely invoked in Germany,—Greifswald, Freiburg, and Tübingen being the only instances in which the emperor's confirmation of the foundation was solicited.[1] But whatever influence the Roman see may have gained by increasing intervention was more than counteracted by those other tendencies which came into operation in the second half of the century. These were of a twofold character:—the first directly modifying the studies themselves, as the results of the discovery of printing and the new spirit awakened by the teaching of the humanists; the second affecting the external conditions, such as the multiplication of schools, and the growing demand for skilled physicians and learned civilians,—circumstances which afforded increased employment for the services of men of academic training. In northern Germany and in the Netherlands, the growing wealth and prosperity of the different states especially favoured the formation of new centres of learning. Foundation of Louvain. In the flourishing duchy of Brabant the university of Louvain (1426) was to a great extent controlled by the municipality; and their patronage, although ultimately attended with detrimental results, long enabled Louvain to outbid all the other universities of Europe in the munificence with which she rewarded her professors. In the course of the next century the "Belgian Athens," as she is styled by Lipsius, ranked second only to Paris in numbers and reputation. In its numerous separate foundations and general organization—it possessed no less than twenty-eight colleges—it closely resembled the English universities; while its active press afforded facilities to the author and the controversialist of which both Cambridge and Oxford were at that time almost destitute. It embraced all the faculties, and no degrees in Europe stood so high as guarantees of general acquirements. Erasmus records it as a common saying, that "no one could graduate at Louvain without knowledge, manners, and age." Sir William Hamilton speaks of the examination at Louvain for a degree in arts as "the best example upon record of the true mode of such examination, and, until recent times, in fact, the only example in the history of universities worthy of consideration at all." He has translated from Vernulæus the order and method of this examination.[2] In 1788 the faculties of jurisprudence, medicine, and philosophy were removed to Brussels, and in 1797 the French suspended the university altogether. When Belgium was formed into an independent state in 1831, the university was refounded as a Roman Catholic foundation.

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[1] The statistics of Hautz (*Gesch. d. Univ. Heidelberg*, i. 177-8) are corrected by Denifle (*Die Entstehung der Universitäten*, p. 385).

Leipsic. The circumstances of the foundation of the university of Leipsic are especially noteworthy, it having been the result of the migration of almost the entire German element from the university of Prague. This element comprised (1) Bavarians, (2) Saxons, (3) Poles (this last-named division being drawn from a wide area, which included Meissen, Lusatia, Silesia, and Prussia), and, being represented by three votes in the assemblies of the university, while the Bohemians possessed but one, had acquired a preponderance in the direction of affairs which the latter could no longer submit to. Religious differences, again, evoked mainly by the preaching of John Huss, further intensified the existing disagreements; and eventually, in the year 1409, King Wenceslaus, at the prayer of his Bohemian subjects, issued a decree which exactly reversed the previous distribution of votes,—three votes being assigned to the Bohemian nation and only one to all the rest. The Germans took deep umbrage, and seceded to Leipsic, where, a bull having been obtained from Alexander V. (9th September 1409), a new "studium generale" was founded by the landgrave of Thuringia and the margraves of Meissen. The members were divided into four nations—composed of natives of Meissen, Saxony, Bavaria, and Poland. Two colleges were founded, a greater and a smaller, but designed, not for poor students, but for masters of arts,—twelve being admitted on the former and eight on the latter foundation. Rostock. The first university of northern Germany was that of Rostock, founded by the dukes John and Albert of Mecklenburg, the scheme receiving the sanction of Martin V. in a bull dated 13th February 1419 as that of a "studium generale" in all the faculties excepting theology. The faculty of theology was added in the year 1432. Two colleges were also founded, with the same design and on the same scale as at Leipsic.

No little illustration is afforded by the circumstances attending the foundation of the French universities of the struggle that was going on between the crown and the Roman see. Poitiers. The earliest foundation in the 15th century was that of Poitiers. It was instituted by Charles VII. in 1431, almost immediately after his accession, with the special design of creating a centre of learning less favourable to English interests than Paris had at that time shown herself to be. Eugenius IV could not refuse his sanction to the scheme, but he endeavoured partially to defeat Charles's design by conferring on the new "studium generale" only the same privileges as those possessed by Toulouse, and thus placing it at a disadvantage in comparison with Paris. Charles rejoined by an extraordinary exercise of his own prerogative, conferring on Poitiers all the privileges collectively possessed by Paris, Toulouse, Montpellier, Angers, and Orleans, and at the same time placing the university under special royal protection. Caen. The foundation of the university of Caen, in the diocese of Bayeux, was attended by conditions almost exactly the reverse of those which belonged to the foundation of that at Poitiers. It was founded under English auspices during the short period of the supremacy of the English arms in Normandy in the 15th century. Its charter (May 1437) was given by Eugenius IV., and the bishop of Bayeux was appointed its chancellor. The university of Paris had by this time completely forfeited the favour of Eugenius by its attitude at the council of Basel, and Eugenius inserted in the charter for Caen a clause of an entirely novel character, requiring all those admitted to degrees to take an oath of fidelity to the see of Rome, and to bind themselves to attempt nothing prejudicial to her interests. To this proviso the pragmatic sanction of Bourges was the reply given by Charles in the following year. On 18th May 1442 we find King Henry VI. writing to Eugenius, and dwelling with satisfaction on the rapid progress of the new university, to which, he says, students had flocked from all quarters, and were still daily arriving.[3] On 30th October 1452 its charter was given afresh by Charles in terms which left the original charter unrecognized; both teachers and learners were made subject to the civil authorities of the city, while all privileges conferred in the former charter in cases of legal disputes were abolished. From this time the university of Caen was distinguished by its loyal spirit and firm resistance to ultramontane pretensions; and, although swept away at the French Revolution, it was afterwards restored, owing to the sense of the services it had thus once rendered to the national cause.[1] **Bordeaux, Valence, Nantes.** No especially notable circumstances characterize the foundation of the university of Bordeaux (1441) or that of Valence (1452), but that of Nantes, which received its charter from Pius II. in 1463, is distinguished by the fact that it did not receive the ratification of the king of France, and the conditions under which its earlier traditions were formed thus closely resemble those of Poitiers. It seems also to have been regarded with particular favour by Pius II., a pontiff who was at once a ripe scholar and a writer upon education. He gave to Nantes a notable body of privileges, which not only represent an embodiment of all the various privileges granted to universities prior to that date, but afterwards became, with their copious and somewhat tautological phraseology, the accepted model for the great majority of university charters, whether issued by the pope or by the emperor, or by the civil authority. The bishop of Nantes was appointed head of the university, and was charged with the special protection of its privileges against all interference from whatever quarter.[2] **Bourges.** The bull for the foundation of the university of Bourges was given in 1465 by Paul II. at the request of Louis XI. and his brother. It confers on the community the same privileges as those enjoyed by the other universities of France. The royal sanction was given at the petition of the citizens; but, from reasons which do not appear, they deemed it necessary further to petition that their charter might also be registered and enrolled by the parlement of Paris.

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[1] Meiners, *Gesch. d. hohen Schulen*, i. 370.

[2] *Dissertations and Discussions*, Append. iii.

[3] Bekynton's *Correspondence*, i. 123.

Greifswald. In Germany, the first of the universities representing the new influences above referred to is that of Greifswald. A wealthy burgomaster, who had graduated as a master of arts at Rostock, was the chief mover; and, his proposal being cordially seconded by the city council, the duke of the province, and certain abbots of neighbouring monasteries, the necessary bull was obtained from Calixtus III. (29th May 1456). The first session was commenced in October of the same year. Three colleges were at the same time founded,—two for masters of arts, as at Leipsic and Rostock, and a third for jurists. The chairs in the different faculties were distributed as follows: theology 3, jurisprudence 5, medicine 1, arts 4,—the number of jurists showing that the study of the civil law still obtained a certain preponderance. **Freiburg.** The university of Freiburg was founded by the archduke Albert, brother of the emperor Frederick III.,—the papal bull being given 20th April 1455, and the imperial ratification in the following year. The first session was opened in 1460, under the presidency of Matthew Hummel, a privy councillor, and the original numbers soon received considerable additions by secessions from Vienna and from Heidelberg. The endowment was further augmented by an annual allowance from the city council, and by certain canonries and livings attached to neighbouring parishes. **Basel.** In the same year, and probably in a spirit of direct rivalry, was opened the university of Basel. The cathedral school in that ancient city, together with others attached to the monasteries, afforded a sufficient nucleus for a "studium," and Pius II., who, as Æneas Sylvius, had been a resident in the city, was easily prevailed upon to grant the charter (12th November 1459). In the character of its endowments, and in the relative importance attached to the study of the civil law, Basel much resembled Greifswald, but its success throughout the 15th century was marred by the languid character of the support afforded it by the civic authorities. Before he had signed the bull for the foundation of the university of Basel, Pius II., at the request of duke William of Bavaria, had issued another bull for the foundation of a university at Ingolstadt (7th April 1459). **Ingolstadt.** But it was not until 1472 that the work of teaching was actually commenced there. Some long-existing prebends, founded by former dukes of Bavaria, were appropriated to the endowment, and the chairs in the different faculties were distributed as follows:—theology 2, jurisprudence 3, medicine 1, arts 6,—arts in conjunction with theology thus obtaining the preponderance. As at Caen, twenty-two years before, an oath of fidelity to the Roman pontiff was imposed on every student admitted to a degree.[3] That this proviso was not subsequently abolished, as at Caen, is a feature in the history of the university of Ingolstadt which was attended by important results. Nowhere did the Reformation meet with more stubborn resistance, and it was at Ingolstadt that the Counter-Reformation was commenced. In 1556 the Jesuits made their first settlement in the university.

Treves. The next two universities took their rise in the archiepiscopal seats of Treves and Mainz. That at Treves received its charter as early as 1450; but the first academical session did not commence until 1473. Here the ecclesiastical influences appear to have been unfavourable to the project. The archbishop demanded 2000 florins as the price of his sanction. The cathedral chapter threw difficulties in the way of the appropriation of certain livings and canonries to the university endowment; and so obstinate was their resistance that in 1655 they succeeded in altogether rescinding the gift on payment of a very inadequate sum. It was not until 1722 that the assembly of deputies, by a formal grant, relieved the university from the difficulties in which it had become involved. **Mainz.** The university of Mainz, on the other hand, was almost entirely indebted to the archbishop Diether for its foundation. It was at his petition that Sixtus IV. granted the charter, 23d November 1476; and Diether, being himself an enthusiastic humanist, thereupon circulated a letter, couched in elegant Latinity, addressed to students throughout his diocese, inviting them to repair to the new centre, and dilating on the advantages of academic studies and of learning. The rise of these two universities, however, neither of which attained to much distinction, represents little more than the incorporation of certain already existing institutions into a homogeneous whole, the power of conferring degrees being superadded. **Tübingen.** But the university of Tübingen, founded by charter of Sixtus IV. (9th November 1476), represents an entirely new creation. Its real founder was Mathilda, the mother of Count Eberhard of Würtemberg, who appropriated five livings and eight prebends to the endowment. Of the chairs, 3 were for theology, 3 for the canon and 2 for the civil law, 2 for medicine, and 4 for arts. The general financial condition of this university in the year 1541-42, and the sources from whence its revenues were derived, have been illustrated by Hoffmann in a short paper which shows the fluctuating character of the resources of a university in those days,—liable to be affected, as they were, both by the seasons and the markets.[4]

Upsala and Copenhagen. Nearly contemporaneous with these foundations were those of Upsala (1477) and Copenhagen (1479), which, although lying without the political boundaries of Germany, reflected her influence. The charter for Copenhagen was given by Sixtus IV. as early as 1475. The students attracted to this new centre were mainly from within the radius of the university of Cologne, and its statutes were little more than a transcript of those of the latter foundation.

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[1] De la Rue, *Essais Hist. sur la Ville de Caen*, ii. 137-40.

[2] Meiners, i. 368.

[3] Paulsen, in speaking of this proviso as one "die weder vorher noch nachher sonst vorkommt," would consequently seem to be not quite accurate. See *Die Gründung der deutschen Universitäten*, p. 277.

[4] *Oekonomischer Zustand der Universität Tübingen gegen die Mitte des 16ten Jahrhunderts*, 1845.

Wittenberg, The electorates of Wittenberg and Brandenburg were now the only two considerable German territories which did not possess a studium generale, and the university founded at Wittenberg by Maximilian I. (6th July 1502) is notable as the first established in Germany by virtue of an imperial as distinguished from a papal decree. Its charter is, however, drawn up with the traditional phraseology of the pontifical bulls, and is evidently not conceived in any spirit of antagonism to Rome. Wittenberg is constituted a "studium generale" in all the four faculties,—the right to confer degrees in theology and canon law having been sanctioned by the papal legate some months before, 2d February 1502. The endowment of the university with church revenues duly received the papal sanction,—a bull of Alexander VI. authorizing the appropriation of twelve canonries attached to the castle church, as well as of eleven prebends in outlying districts—*ut sic per omnem modum unum corpus ex studio et collegio prædictis fiat et constituatur.* No university in Germany attracted to itself a larger share of the attention of Europe at its commencement. And it was its distinguishing merit that it was the first academic centre north the Alps where the antiquated methods and barbarous Latinity of the scholastic era were overthrown.

Frankfort-on-the-Oder, The last university founded in Germany prior to the Reformation was that of Frankfort-on-the-Oder. The design, first conceived by the elector John of Brandenburg, was carried into execution by his son Joachim, at whose request Pope Julius II. issued a bull for the foundation, 15th March 1506. An imperial charter, identical in its contents with the papal bull, followed on 26th October. The university received an endowment of canonries and livings similar to that of Wittenberg, and some houses in the city were assigned for its use by the elector.

t An-rews, The first university in Scotland was that of St Andrews, founded in 1411 by Henry Wardlaw, bishop of that see, and modelled chiefly on the constitution of the university of Paris. It acquired all its three colleges—St Salvator's, St Leonard's, and St Mary's—before the Reformation,—the first having been founded in 1456 by Bishop James Kennedy; the second in 1512 by the youthful archbishop Alexander Stuart (natural son of James IV.) and John Hepburn, the prior of the monastery of St Andrews; and the third, also in 1512, by the Beatons, who in the year 1537 procured a bull from Pope Paul III. dedicating the college to the Blessed Virgin Mary of the Assumption, and adding further endowments. The most ancient of the universities of Scotland, with its three colleges, was thus reared in an atmosphere of mediæval theology, and undoubtedly designed as a bulwark against heresy and schism. But "by a strange irony of fate," it has been observed, "two of these colleges became, almost from the first, the foremost agents in working the overthrow of that church which they were founded to defend." St Leonard's more especially, like St John's or Queens' at Cambridge, became a noted centre of intellectual life and Reformation principles. That he "had drunk at St Leonard's well" became a current expression for implying that a theologian had imbibed the doctrines of Protestantism.

lasgow, The university of Glasgow was founded as a "studium generale" in 1453, and possessed two colleges. Prior to the Reformation it acquired but little celebrity; its discipline was lax, and the number of the students but small, while the instruction was not only inefficient but irregularly given; no funds were provided for the maintenance of regular lectures in the higher faculties; and there was no adequate executive power for the maintenance of discipline.

Aberdeen The university of Aberdeen, which was founded in 1494, at first possessed only one college,—namely, King's. Marischal College, founded in 1593 by George Keith, fifth Earl Marischal, was constituted by its founder independent of the university in Old Aberdeen, being itself both a college and a university, with the power of conferring degrees. Bishop Elphinstone, the founder both of the university and of King's College (1505), had been educated at Glasgow, and had subsequently both studied and taught at Paris and at Orleans. To the wider experience which he had thus gained we may probably attribute the fact that the constitution of the university of Aberdeen was free from the glaring defects which then characterized that of the university of Glasgow.[1] But in all the mediæval universities of Germany, England, and Scotland, modelled as they were on a common type, the absence of adequate discipline was, in a greater or less degree, a common defect. In connexion with this feature we may note the comparatively small percentage of matriculated students proceeding to the degrees of B.A. and M.A. when compared with later times.

Degrees taken at Leipsic. Of this disparity the following table, exhibiting the relative numbers in the university of Leipsic for every ten years from the year 1427 to 1552, probably affords a fair average illustration,—the remarkable fluctuations probably depending quite as much upon the comparative healthiness of the period (in respect of freedom from epidemic) and the abundance of the harvests as upon any other cause:—

Years.	Matriculations.	Years.	B.A.	M.A.	Percentage of	
					B.A's.	M.A's.
1427-1430	737	1429-1432	151	28	20·4	3·8
1437-1440	715	1439-1442	199	50	27·8	6·9
1447-1450	808	1449-1452	274	(50)	33·9	...
1457-1460	1,447	1459-1462	559	81	38·6	5·6
1467-1470	1,137	1469-1472	410	61	36·0	5·4
1477-1480	1,163	1479-1482	458	49	39·4	4·2
1487-1490	1,858	1489-1492	714	62	38·4	3·4
1497-1500	1,288	1499-1502	497	59	38·5	4·6
1507-1510	1,948	1509-1512	510	65	26·1	3·4
1517-1520	1,445	1519-1522	247	35	17·0	2·4
1527-1530	419	1529-1532	77	33	18·4	7·9
1537-1540	686	1539-1542	122	27	17·8	3·9
1547-1550	1,318	1549-1552	200	72	15·2	5·5
	14,969		4418	672	29·5	4·5

General aspects of German mediæval universities. The German universities in these times seem to have admitted for the most part their inferiority in learning to older and more favoured centres; and their consciousness of the fact is shown by the efforts which they made to attract instructors from Italy, and by the frequent resort of the more ambitious students to schools like Paris, Bologna, Padua, and Pavia. That they took their rise in any spirit of systematic opposition to the Roman see (as Meiners and others have contended), or that their organization was something external to and independent of the church, is sufficiently disproved by the foregoing evidence. Generally speaking, they were eminently conservative bodies, and the new learning of the humanists and the new methods of instruction that now began to demand attention were alike for a long period unable to gain admission within academic circles. Reformers such as Hegius, John Wessel, and Rudolphus Agricola carried on their work at places like Deventer remote from university influences. That there was a considerable amount of mental activity going on in the universities themselves is not to be denied; but it was mostly of that unprofitable kind which, while giving rise to endless controversy, turned upon questions in connexion with which the implied postulates and the terminology employed rendered all scientific investigation hopeless. At almost every university—Leipsic, Greifswald, and Prague (after 1209) being the principal exceptions—the so-called Realists and Nominalists represented two great parties occupied with an internecine struggle. At Paris, owing to the overwhelming strength of the theologians, the Nominalists were indeed under a kind of ban; but at Heidelberg they had altogether expelled their antagonists. It was much the same at Vienna and at Erfurt,—the latter, from the ready reception which it gave to new speculation, being styled by its enemies "novorum omnium portus." At Basel, under the leadership of the eminent Johannes a Lapide, the Realists with difficulty maintained their ground. Freiburg, Tübingen, and Ingolstadt, in the hope of diminishing controversy, arrived at a kind of compromise, each party having its own professor, and representing a distinct "nation." At Mainz the authorities adopted a manual of logic which was essentially an embodiment of Nominalistic principles.

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[1] *Fasti Aberdonenses*, Pref. p. xvi.

Abandonment of logical studies in Italy.

In Italy, almost without exception, it was decided that these controversies were endless, and that their effects were pernicious. It was resolved, accordingly, to expel logic, and allow its place to be filled by rhetoric. It was by virtue of this decision, which was of a tacit rather than a formal character, that the expounders of the new learning in the 15th century, men like Emmanuel Chrysoloras, Guarino, Leonardo Bruni, Bessarion, Argyropulos, and Valla, carried into effect that important revolution in academic studies which constitutes a new era in university learning, and largely helped to pave the way for the Reformation.[1] This discouragement of the controversial spirit, continued as it was in relation to theological questions after the Reformation, obtained for the Italian universities a fortunate immunity from dissensions like those which, as we shall shortly see, distracted the centres of learning in Germany. The professorial body also attained to an almost unrivalled reputation. It was exceptionally select, only those who were in receipt of salaries being permitted, as a rule, to lecture; it was also famed for its ability, the institution of concurrent chairs proving an excellent stimulus. These chairs were of two kinds—"ordinary" and "extraordinary,"—the former being the more liberally endowed and fewer in number. For each subject of importance there were thus always two and sometimes three rival chairs, and a powerful and continuous emulation was thus maintained among the teachers. "From the integrity of their patrons, and the lofty standard by which they were judged," says Sir W. Hamilton, "the call to a Paduan or Pisan chair was deemed the highest of all literary honours. The status of professor was in Italy elevated to a dignity which in other countries it has never reached; and not a few of the most illustrious teachers in the Italian seminaries were of the proudest nobility of the land. While the universities of other countries had fallen from Christian and cosmopolite to sectarian and local schools, it is the peculiar glory of the Italian that, under the enlightened liberality of their patrons, they still continued to assert their European universality. Creed and country were in them no bar,—the latter not even a reason of preference. Foreigners of every nation are to be found among their professors; and the most learned man in Scotland (Dempster) sought in a Pisan chair that theatre for his abilities which he could not find at home."[2]

High reputation of Italian professors.

Events producing divisions in university history.

The Reformation represents the great boundary line in the history of the mediæval universities, and also, for a long time after, the main influence in the history of those new foundations which subsequently arose in Protestant countries. Even in Catholic countries its secondary effects were scarcely less perceptible, as they found expression in connexion with the Counter-Reformation. In Germany the Thirty Years' War was attended by consequences which were felt long after the 17th century. In France the Revolution of 1789 resulted in the actual uprooting of the university system.

Pernicious influences of sectarianism.

The influences of the New Learning, and the special character which it assumed as it made its way in Germany in connexion with the labours of scholars like Erasmus, John Reuchlin, Ulrich von Hutten, and Melanchthon, augured well for the future. It was free from the frivolities, the pedantry, the immoralities, and the scepticism which characterized so large a proportion of the corresponding culture in Italy. It gave promise of resulting at once in a critical and enlightened study of the masterpieces of classical antiquity, and in a reverent and yet rational interpretation of the Scriptures and the fathers. The fierce bigotry and the ceaseless controversies evoked by the promulgation of Lutheran or Calvinistic doctrine dispelled, however, this hopeful prospect, and converted what might otherwise have become the tranquil abodes of the Muses into gloomy fortresses of sectarianism. Of the manner in which it affected the highest culture, the observation of Henke in his *Life of Calixtus* (i. 8), that for a century after the Reformation the history of Lutheran theology becomes almost identified with that of the German universities, may serve as an illustration.

Marburg.

The first Protestant university was that of Marburg, founded by Philip the Magnanimous, landgrave of Hesse, 30th May 1527. Expressly designed as a bulwark of Lutheranism, it was mainly built up out of the confiscation of the property of the religious orders in the Hessian capital. The house of the Dominicans, who had fled on the first rumour of spoliation, was converted into lecture-rooms for the faculty of jurisprudence. The church and convent of the order known as the "Kugelherrn" was appropriated to the theological faculty. The friary of the Barefooted Friars was shared between the faculties of medicine and philosophy. The university, which was the object of the margrave's peculiar care, rapidly rose to celebrity; it was resorted to by students from remote countries, even from Greece, and its professors were of distinguished ability. How much, however, of this popularity depended on its theological associations is to be seen in the fact that after the year 1605, when, by the decree of Count Maurice, its formulary of faith was changed from Lutheran to Calvinistic, its numbers greatly declined. This dictation of the temporal power now becomes one of the most notable features in academic history in Protestant Germany. The universities, having repudiated the papal authority, while that of the episcopal order was at an end, now began to pay especial court to the temporal ruler, and sought in every way to conciliate his goodwill, representing with peculiar distinctness the theory,—*cujus regio, ejus religio.* This tendency was further strengthened by the fact that their colleges, bursaries, and other similar foundations were no longer derived from or supported by ecclesiastical institutions, but were mainly dependent on the civil power.

Königsberg.

The Lutheran university of Königsberg was founded 17th August 1544 by Albert III., margrave of Brandenburg, and the first duke of Prussia, and his wife Dorothea, a Danish princess. In this instance, the religious character of the foundation not having been determined at the commencement, the papal and the imperial sanction were both applied for, although not accorded. King Sigismund of Poland, however, which kingdom exercised at that time a protectorate over the Prussian duchy, ultimately gave the necessary charter (29th September 1561), at the same time ordaining that all students who graduated as masters in the faculty of philosophy should rank as nobles of the

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[1] For an excellent account of this movement, see Georg Voigt, *Die Wiederbelebung des classischen Alterthums*, 2d ed., 2 vols., 1880.

[2] Hamilton, *Discussions*, 2d ed., p. 373.

Polish kingdom. When Prussia was raised to the rank of a kingdom (1701) the university was made a royal foundation, and the "collegium Fridericianum," which was then erected, received corresponding privileges. In 1862 the university buildings were rebuilt, and the number of the students is now nearly one thousand

Jena. The Lutheran university of Jena had its origin in a gymnasium founded by John Frederick the Magnanimous, elector of Saxony, during his imprisonment, for the express purpose of promoting Evangelical doctrines and repairing the loss of Wittenberg, where the Philippists had gained the ascendency. Its charter, which the emperor Charles V. refused to grant, and which was obtained with some difficulty from his brother, Ferdinand I., eventually enabled the authorities to open the university, 2d February 1558. Distinguished for its vehement assertion of Lutheran doctrine, its hostility to the teaching of Wittenberg was hardly less pronounced than that with which both centres regard Roman Catholicism. For a long time it was chiefly noted as a school of medicine, and in the 17th and 18th centuries it was in bad repute for the lawlessness of its students, among whom duelling prevailed to a scandalous extent. The beauty of its situation and the eminence of its professoriate have, however, generally attracted a considerable proportion of students from other countries. Its numbers in 1885 were 566.

Helmstädt. The Lutheran university of Helmstädt, founded by Duke Julius (of the house of Brunswick-Wolfenbüttel), and designated after him in its official records as "Academia Julia," received its charter, 8th May 1575, from the emperor Maximilian II. No university in the 16th century commenced under more favourable auspices. It was munificently endowed by the founder and by his son; and its "Convictorium," or college for poor students, expended in the course of thirty years no less than 100,000 thalers, an extraordinary expenditure for an institution of such a character in those days. Beautifully and conveniently situated in what had now become the well-peopled region between the Weser and the lower Elbe, and distinguished by its comparatively temperate maintenance of the Lutheran tenets, it attracted a considerable concourse of students, especially from the upper classes, not a few being of princely rank. Throughout its history, until suppressed in 1809, Helmstädt enjoyed the special and powerful patronage of the dukes of Saxony.

Altdorf. The "Gymnasium Ægidianum" of Nuremberg, founded in 1526, and removed in 1575 to Altdorf, represents the origin of the university of Altdorf. A charter was granted in 1578 by the emperor Rudolph II., and the university was formally opened in 1580. It was at first, however, empowered only to grant degrees in arts; but in 1623 the emperor Ferdinand II. added the permission to create doctors of law and medicine, and also to confer crowns on poets; and in 1697 its faculties were completed by the permission given by the emperor Leopold I. to create doctors of theology. Like Louvain, Altdorf was nominally ruled by the municipality, but in the latter university this power of control remained practically inoperative, and the consequent freedom enjoyed by the community from evils like those which brought about the decline of Louvain is thus described by Hamilton:—"The decline of that great and wealthy seminary (Louvain) was mainly determined by its vicious patronage, both as vested in the university and in the town. Altdorf, on the other hand, was about the poorest university in Germany, and long one of the most eminent. Its whole endowment never rose above £800 a year; and, till the period of its declension, the professors of Altdorf make at least as distinguished a figure in the history of philosophy as those of all the eight universities of the British empire together. On looking closely into its constitution the anomaly is at once solved. The patrician senate of Nuremberg were too intelligent and patriotic to attempt the exercise of such a function. The nomination of professors, though formally ratified by the senate, was virtually made by a board of four curators; and what is worthy of remark, as long as curatorial patronage was a singularity in Germany, Altdorf maintained its relative pre-eminence, losing it only when a similar mean was adopted in the more favoured universities of the empire."[1]

Giessen. The conversion of Marburg into a school of Calvinistic doctrine gave occasion to the foundation of the universities of Giessen and of Rinteln. Of these the former, founded by the margrave of Darmstadt, Louis V., as a kind of refuge for the Lutheran professors from Marburg, received its charter from the emperor Rudolph II., 19th May 1607. When, however, the margraves of Darmstadt acquired possession of Marburg in 1625, the university was transferred thither; in 1650 it was moved back again to Giessen. The number of matriculated students at the commencement of the century was about 250; in 1887 it was 484. In common with the other universities of Germany, but with a facility which obtained for it a specially unenviable reputation, Giessen was for a long time wont to confer the degree of doctor *in absentia* in the different faculties without requiring adequate credentials. This practice, however, which drew forth an emphatic protest from the eminent historian Mommsen, has within the last few years been entirely abandoned. Rinteln. The university of Rinteln was founded 17th July 1621 by the emperor Ferdinand II. Almost immediately after its foundation it became the prey of contending parties in the Thirty Years' War, and its early development was thus materially hindered. It never, however, attained to much distinction, and in 1819 it was suppressed. Strasburg. The university of Strasburg was founded in 1621 on the basis of an already existing academy, to which the celebrated John Sturm stood, during the latter part of his life, in the relation of "rector perpetuus," and of which we are told that in 1578 it included more than a thousand scholars, among whom were 200 of the nobility, 24 counts and barons, and three princes. It also attracted students from all parts of Europe, and especially from Portugal, Poland, Denmark, France, and England. The method of Sturm's teaching became the basis of that of the Jesuits, and through them of the public school instruction in England In 1621 Ferdinand II. conferred on this academy full privileges as a university; in the language of the charter, "in omnibus facultatibus, doctores, licentiatos, magistros, et baccalaureos, atque insuper *poetas laureatos* creandi et promovendi."[2] In 1681 Strasburg became French, and remained so until 1870.

Dorpat. The university of Dorpat (now Russian) was founded by Gustavus Adolphus in 1632, and reconstituted by the emperor Alexander I. in 1802. A special interest attaches to this university from the fact that it has for a long time been the scene of the contending influences of Teutonism and Slavonianism. Situated in Livonia, which at the time of its foundation represented a kind of debateable land between Russia and Poland, its gradual monopoly by the former country has not been without resistance and protests on the part of that Teutonic element which was at one time the more potent in its midst. The study of the Slavonic languages has here received considerable stimulus, and by a decree in May 1887 the use of the Russian language having been made obligatory in all places of instruction through the Baltic provinces, Russian has now taken the place of German as the language of the lecture-room. Dorpat possesses a fine library of over 80,000 volumes, and is also noted for its admirable botanical collection. The

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[1] *Discussions*, &c., 2d ed., pp. 388–9.

[2] *Promulg. Acad. Privil.*, &c., Strasburg, 1628.

Russian minister has also recently instituted a professorship of the comparative grammar of the Slavonic dialects (now filled by J. Baudouin de Courtenay). The general influence of the university has been rapidly extending during the last few years far beyond the Baltic provinces. The number of students, which in 1879 was 1106, in 1886 was 1751.[1]

Prague.

A like contest between contending nationalities has recently met with a final solution at Prague, where a Czech university has been established on an independent basis, the German university having commenced its separate career in the winter session of 1882–83. The German foundation retains its endowments, but the state subvention is divided between the two.

The repudiation on the part of the Protestant universities of both papal and episcopal authority evoked a counter-demonstration among those centres which still adhered to Catholicism, while their theological intolerance gave rise to a great reaction, under the influence of which the mediæval Catholic universities were reinvigorated and reorganized (although strictly on the traditional lines), while new and important centres were created. It was on the tide of this reaction, aided by their own skill and sagacity, that the Jesuits were borne to that commanding position which made them for a time the arbiters of education in Europe.

Bamberg.

The earliest university whose charter represented this reaction was that of Bamberg, founded by the prince-bishop Melchior Otto, after whom it was named "Academia Ottoniana." It was opened 1st September 1648, and received both from the emperor Frederick III. and Pope Innocent X. all the civil and ecclesiastical privileges of a mediæval foundation. At first, however, it comprised only the faculties of arts and of theology; to these was added in 1729 that of jurisprudence, and in 1764 that of medicine. In this latter faculty Dr Ignatius Döllinger (the father of the historian) was for a long time a distinguished professor.

Innsbruck.

The university of Innsbruck was founded in 1672 by the emperor Leopold I., from whom it received its name of "Academia Leopoldina." In the following century, under the patronage of the empress Maria Theresa, it made considerable progress, and received from her its ancient library and bookshelves in 1745. In 1782 the university underwent a somewhat singular change, being reduced by the emperor Joseph II. from the status of a university to that of a lyceum, although retaining in the theological faculty the right of conferring degrees. In 1791 it was restored to its privileges by the emperor Leopold II., and since that time the faculties of philosophy, law, and medicine have been represented in nearly equal proportions. In 1886 the number of professors was 74, and of students 869.

Breslau.

The foundation of the university of Breslau was contemplated as early as the year 1505, when Ladislaus, king of Hungary, gave his sanction to the project, but Pope Julius II., in the assumed interests of Cracow, withheld his assent.

The Jesuits in the university.

Nearly two centuries later, in 1702, under singularly altered conditions, the Jesuits prevailed upon the emperor Leopold I. to found a university without soliciting the papal sanction. When Frederick the Great conquered Silesia in 1741, he took both the university and the Jesuits in Breslau under his protection, and when in 1774 the order was suppressed by Clement XIV. he established them as priests in the Royal Scholastic Institute, at the same time giving new statutes to the university. In 1811 the university was considerably augmented by the incorporation of that at Frankfort-on-the-Oder. At the present time it possesses both a Catholic and a Lutheran faculty. Its medical faculty is in high repute. The total number of students in 1887 was 1347.

In no country was the influence of the Jesuits on the universities more marked than in France. The civil wars in that country during the thirty years which preceded the close of the 16th century told with disastrous effects upon the condition of the university of Paris, and with the commencement of the 17th century its collegiate life seemed at an end, and its forty colleges stood absolutely deserted.

Condition of the university of Paris.

To this state of affairs the obstinate conservatism of the academic authorities not a little contributed. The statutes by which the university was still governed were those which had been given by the cardinal D'Estouteville, the papal legate, in 1452, and remained entirely unmodified by the influences of the Renaissance. In 1579 the edict of Blois promulgated a scheme of organization for all the universities of the realm (at that time twenty-one in number),—a measure which, though productive of unity of teaching, did nothing towards the advancement of the studies themselves. The eminent lawyers of France, unable to find chairs in Paris, distributed themselves among the chief towns of the provinces. The Jesuits did not fail to profit by this immobility and excessive conservatism on the part of the university, and during the second half of the 16th century and the whole of the 17th they had contrived to gain almost a complete monopoly of both the higher and the lower education of provincial France.

Colleges of the Jesuits in France.

Their schools arose at Toulouse and Bordeaux, at Auch, Agen, Rhodez, Périgueux, Limoges, Le Puy, Aubenas, Béziers, Tournon, in the colleges of Flanders and Lorraine, Douai and Pont-à-Mousson,—places beyond the jurisdiction of the parlement of Paris or even of the crown of France. Their banishment from Paris itself had been by the decree of the parlement alone, and had never been confirmed by the crown. "Lyons," says Pattison, "loudly demanded a Jesuit college, and even the Huguenot Lesdiguières, almost king in Dauphiné, was preparing to erect one at Grenoble. Amiens, Rheims, Rouen, Dijon, and Bourges were only waiting a favourable opportunity to introduce the Jesuits within their walls."[2] The university was rescued from the fate which seemed to threaten it only by the excellent statutes given by Richer in 1598, and by the discerning protection extended to it by Henry IV.

Edinburgh.

The "college of Edinburgh" was founded by charter of James VI., dated 14th April 1582. This document contains no reference to a studium generale, nor is there ground for supposing that the foundation of a university was at that time contemplated. In marked contrast to the three older centres in Scotland, the college rose comparatively untrammelled by the traditions of mediævalism, and its creation was not effected without some jealousy and opposition on the part of its predecessors. Its first course of instruction was commenced in the Kirk of Field, under the direction of Robert Rollock, who had been educated at St Andrews under Andrew Melville, the eminent Covenanter. "He began to teach," says Craufurd, "in the lower hall of the great lodging, there being a great concourse of students allured with the great worth of the man; but diverse of them being not ripe enough in the Latin tongue, were in November next put under the charge of Mr Duncan Narne, . . ., who, upon Mr Rollock's recommendation, was chosen second master of the college."[3] In 1585 both Rollock and Nairne subscribed the National Covenant, and a like subscription was from that time required from all who were admitted to degrees in the college.

Results of the Thirty Years' War.

Disastrous as were the effects of the Thirty Years' War upon the external condition of the German universities, resulting in not a few instances in the total dispersion of the students and the burning of the buildings and libraries, they were less detrimental and less permanent than those which were discernible in the tone and temper of these communities. A formal pedantry and unintelligent method of study, combined with a passionate dogmatism in matters of religious belief, and a rude contempt for the amenities of social intercourse, became the leading characteristics, and lasted throughout the 17th century.

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[1] See *Die deutsche Universität Dorpat im Lichte der Geschichte*, 1882.

[2] *Life of Casaubon*, p. 181.

[3] Craufurd, *Hist. of the Univ. of Edinburgh*, pp. 19–23.

Halle.

But in the year 1693 the foundation of the university of Halle opened up a career to two very eminent men, whose influence, widely different as was its character, may be compared for its effects with that of Luther and Melanchthon, and served to modify the whole current of German philosophy and German theology. Halle has indeed been described as "the first real modern university." It was really indebted for its origin to a spirit of rivalry between the conservatism of Saxony and the progressive tendencies of the house of Brandenburg, but the occasion of its rise was the removal of the ducal court from Halle to Magdeburg. The archbishopric of the latter city having passed into the possession of Brandenburg in 1680 was changed into a dukedom, and the city itself was selected as the ducal residence. This change left unoccupied some commodious buildings in Halle, which it was decided to utilize for purposes of education. A "Ritterschule" for the sons of the nobility was opened, and in the course of a few years it was decided to found a university. Saxony endeavoured to thwart the scheme, urging the proximity of Leipsic; but her opposition was overruled by the emperor Leopold I., who granted (19th October 1693) the requisite charter, and in the following year the work of the university commenced. Frankfort-on-the-Oder had by this time become a centre of the Reformed party, and the primary object in founding a university in Halle was to create a centre for the Lutheran party, but its character, under the influence of its two most notable teachers, Christian Thomasius and A. H. Francke, soon expanded beyond the limits of this conception to assume a highly original form.

Influence of Thomasius and Francke.

Thomasius and Francke had both been driven from Leipsic owing to the disfavour with which their liberal and progressive tendencies were there regarded by the academic authorities, and on many points the two teachers were in agreement. They both regarded with contempt alike the scholastic philosophy and the scholastic theology; they both desired to see the rule of the civil power superseding that of the ecclesiastical power in the seats of learning; they were both opposed to the ascendency of classical studies as expounded by the humanists—Francke regarding the Greek and Roman pagan writers with the old traditional dislike, as immoral, while Thomasius looked upon them with contempt, as antiquated and representing only a standpoint which had been long left behind; both again agreed as to the desirability of including the elements of modern culture in the education of the young. But here their agreement ceased. It was the aim of Thomasius, as far as possible, to secularize education, and to introduce among his countrymen French habits and French modes of thought; his own attire was gay and fashionable, and he was in the habit of taking his seat in the professorial chair adorned with gold chain and rings, and with his dagger by his side. Francke, who became the leader of the Pietists, regarded all this with even greater aversion than he did the lifeless orthodoxy traditional in the universities, and was shocked at the worldly tone and disregard for sacred things which characterized his brother professor. Both, however, commanded a considerable following among the students. Thomasius was professor in the faculty of jurisprudence, Francke in that of theology. And it was a common prediction in those days with respect to a student who proposed to pursue his academic career at Halle, that he would infallibly become either an atheist or a Pietist. But the services rendered by Thomasius to learning were genuine and lasting. He was the first to set the example, soon after followed by all the universities of Germany, of lecturing in the vernacular instead of in the customary Latin; and the discourse in which he first departed from the traditional method was devoted to the consideration of how far the German nation might with advantage imitate the French in matters of social life and intercourse. His more general views, as a disciple of the Cartesian philosophy and founder of the modern Rationalismus, exposed him to incessant attacks; but by the establishment of a monthly journal (at that time an original idea) he obtained a channel for expounding his views and refuting his antagonists which gave him a great advantage. On the influence of Francke, as the founder of that Pietistic school with which the reputation of Halle afterwards became especially identified, it is unnecessary here to dilate.[1] J. C. Wolf, who followed Thomasius as an assertor of the new culture, was driven from Halle by the accusations of the Pietists, who declared that his teaching was fraught with atheistical principles. In 1740, however, he was recalled by Frederick II., and reinstated in high office with every mark of consideration and respect. Throughout the whole of the 18th century Halle was the leader of academic thought and culture in Protestant Germany, although sharing that leadership, after the middle of the century, with Göttingen.

Göttingen.

The university of Göttingen (named after its founder "Georgia Augusta") was endowed with the amplest privileges as a university by George II. of England, elector of Hanover, 7th December 1736. The imperial sanction of the scheme had been given three years before (13th January 1733) and the university was formally opened 17th September 1737. The king himself assumed the office of "rector magnificentissimus," and the liberality of the royal endowments (doubling those of Halle), and the not less liberal character of the spirit that pervaded its organization, soon raised it to a foremost place among the schools of Germany. Halle had just expelled Wolf; and Göttingen, modelled on the same lines as Halle, but rejecting its Pietism and disclaiming its intolerance, appealed with remarkable success to the most enlightened feeling of the time. It included all the faculties, and two of its first professors—Mosheim, the eminent theologian, from Helmstädt, and Böhmer, the no less distinguished jurist, from Halle—together with Gesner, the man of letters, at once established its reputation. Much of its early success was also due to the supervision of its chief curator (there were two),—Baron Münchausen, himself a man of considerable attainments, who by his sagacious superintendence did much to promote the general efficiency of the whole professoriate. Not least among its attractions was also its splendid library, located in an ancient monastery, and now containing over 200,000 volumes and 5000 MSS. In addition to its general influence as a distinguished seat of learning, Göttingen may claim to have been mainly instrumental in diffusing a more adequate conception of the importance of the study of history. Before the latter half of the 18th century the mode of treatment adopted by university lecturers was singularly wanting in breadth of view. Profane history was held of but little account, excepting so far as it served to illustrate ecclesiastical and sacred history, while this, again, was invariably treated in the narrow spirit of the polemic, intent mainly on the defence of his own confession, according as he represented the Lutheran or the Reformed Church. The labours of the professors at Göttingen, especially Putter, Gatterer, Schlözer, and Spittler, combined with those of Mascov at Leipsic, did much towards promoting both a more catholic treatment and a wider scope. Not less beneficial was the example set at Göttingen of securing the appointment of its professors by a less prejudiced and partial body than a university board is only too likely to become. "'The great Münchausen,' says an illustrious professor of that seminary, 'allowed our university the right of presentation, of designation, or of recommendation, as little as the right of free election; for he was taught by experience that, although the faculties of universities may know the individuals best qualified to supply their vacant chairs, *they are seldom or never disposed to propose for appointment the worthiest within their knowledge.*'"[1] The system of patronage adopted at Göttingen was, in fact, identical with that which had already been instituted in the universities of the Netherlands by Douza (see *infra*, p. 850).

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[1] See Paulsen, *Gesch. des gelehrten Unterrichts*, &c., pp. 348-358.

Erlangen.

The university of Erlangen, a Lutheran centre, was founded by Frederick, margrave of Baireuth. Its charter was granted by the emperor Charles VII., 21st February 1743, and the university was formally constituted, 4th November. From its special guardian, Alexander, the last margrave of Ansbach, it was styled "Academia Alexandrina." In 1791, Ansbach and Baireuth having passed into the possession of Prussia, Erlangen became subject to the Prussian Government. The number of the students, which at the commencement of the century was under 300, was 880 in 1887.

The English and German universities compared.

On comparison with the great English universities, the universities of Germany must be pronounced inferior both in point of discipline and of moral control over the students. The superiority of the former in these respects is partly to be attributed to the more systematic care which they took, from a very early date, for the supervision of each student, by requiring that within a certain specified time after his entry into the university he should be registered as a pupil of some master of arts, who was responsible for his conduct, and represented him generally in his relations to the academic authorities. Marburg in its earliest statutes (those of 1529) endeavoured to establish a similar rule, but without success.[2] The development of the collegiate system at Oxford and Cambridge materially assisted the carrying out of this discipline. Although again, as in the German universities, feuds were not unfrequent, especially those between "north" and "south" (the natives of the northern and southern counties), the fact that in elections to fellowships and scholarships only a certain proportion were allowed to be taken from either of these divisions acted as a considerable check upon the possibility of any one college representing either element exclusively. In the German universities, on the other hand, the ancient division into nations, which died out with the 15th century, was revived under another form by the institution of national colleges, which largely served to foster the spirit of rivalry and contention. The demoralization induced by the Thirty Years' War and the increase of duelling intensified these tendencies, which, together with the tyranny of the older over the younger students, known as "Pennalismus," were evils against which the authorities contended, but ineffectually, by various ordinances. The institution of "Burschenthum," having for its design the encouragement of good fellowship and social feeling irrespective of nationality, served only as a partial check upon these excesses, which again received fresh stimulus by the rival institution of "Landsmannschaften," or societies of the same nationality. The latter proved singularly provocative of duelling, while the arrogant and even tyrannical demeanour of their members towards the unassociated students gave rise to a general combination of the latter for the purposes of self-defence and organized resistance. At all the great German universities both these forms of association are to be found existing at the present day.

Extinction of German universities during 1798–1815.

The political storms which marked the close of the last and the commencement of the present century gave the death-blow to not a few of the ancient universities of Germany. Mainz and Cologne ceased to exist in 1798; Bamberg, Dillingen, and Duisberg in 1804; Rinteln and Helmstädt in 1809; Salzburg in 1810; Erfurt in 1816. Altdorf was united to Erlangen in 1807, Frankfort-on-the-Oder to Breslau in 1809, and Wittenberg to Halle in 1815.

Munich.

The university of Ingolstadt was first moved in 1802 to Landshut, and from thence in 1826 to Munich, where it was united to the academy of sciences which was founded in the Bavarian capital in 1759. Of those of the above centres which altogether ceased to exist but few, however, were much missed or regretted,—that at Mainz, which had numbered some six hundred students, being the one notable exception. The others had for the most part fallen into a perfunctory and lifeless mode of teaching, and, with wasted or diminished revenues and declining numbers, had long ceased worthily to represent the functions of a university. Whatever loss may have attended their suppression has been far more than compensated by the activity and influence of the three great German universities which have risen in the present century. Munich has become a distinguished centre of study in all the faculties; and its numbers, allowing for the two great wars, have been continuously on the increase. The number of its professors in 1887 was over ninety, and that of its students at the commencement of the session 1886–87 3209.

Berlin.

The university of Berlin, known as the Royal Friedrich Wilhelm university, was founded in 1809, immediately after the peace of Tilsit, when Prussia had been reduced to the level of a third-rate power. Under the guiding influence of Wilhelm von Humboldt, however, the principles which were adopted in connexion with the new seat of learning not only raised it to a foremost place among the universities of Europe, but also largely conduced to the regeneration of Germany. A notable characteristic in the university of Berlin at the time of its foundation was its entire repudiation of attachment to any particular creed or school of thought, and professed subservience only to the interests of science and learning. "Each of the eminent teachers with whom the university began its life—F. A. Wolf, Fichte, Savigny, Reil—represented only himself, the path of inquiry or the completed theory which he had himself propounded. Its subsequent growth was astonishing. In 1813 Berlin had only 36 teachers altogether; in 1860 there were 173 in all,—97 professors, 66 privatdocenten, and 7 lecturers." In 1886 there were 296 teachers and 5357 students; and among the former a large proportion of the names are already of world-wide reputation, while its classical school stands unrivalled in Europe.

Bonn.

The university of Bonn, founded in 1818, and known as the Rhenish Friedrich Wilhelm university, has 88 professors and 1125 students. Equally distinguished as a school of philosophy and a school of theology, it is notable for the manner in which it combines the opposed schools of theological doctrine,—that of the Evangelical (or Lutheran) Church and that of the Roman Catholic Church here standing side by side, and both adorned by eminent names. This combination (which also exists at Tübingen and at Breslau) has been attended with complete success and (according to Dr Döllinger) with unmistakable advantages. When tried, however, a generation before, at Erfurt and at Heidelberg, its failure was not less conspicuous, and Erfurt was ruined by the experiment.

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[1] Hamilton, *Discussions*, p. 381.

[2] "Volumus neminem in hanc nostram Academiam admitti, aut per rectorem in album recipi, qui non habeat privatum atque domesticum preceptorem, qui ejus discipulum agnoscat, ad cujus judicium quisque pro sua ingenii capacitate atque Marte lecturas et publicas et privatas audiat, a cujus latere aut raro aut nunquam discedat." Koch expressly compares this provision with the discipline of Oxford and Cambridge, which, down to the commencement of the present century, was very much of the same character (Koch. *Gesch. des academischen Pädagogiums in Marburg*, p. 11).

Statistics of German and British universities compared.

Dr Conrad professor of political science at Halle, has recently made the statistics relating to the German universities the subject of a careful investigation and analysis, which offer some interesting results. The total cost of the universities of the German empire is shown to be much smaller than the total revenues of the English universities and colleges, although the number both of professors and students is much larger, and although 42 per cent. of the total expenditure is upon establishments, such as hospitals, museums, and so forth. But in Germany 72 per cent. of the cost of the universities is defrayed by the state, the students paying, in the shape of fees, only 9·3 per cent. To a great extent, however, the German universities are to be looked upon as professional schools, giving an education which directly fits a man to earn his bread as a clergyman, a lawyer, a judge, a physician, a schoolmaster, a chemist, an engineer, or an agriculturist. Notwithstanding the rapid growth in the numbers of the students, the growth of the professoriate has fully kept pace with it. In 1880 there were 1809 teachers at work in the German universities, more than half of whom (967) were full professors ("ordinarii"),—the proportion of teachers to students being 1 to 11. This is a much higher proportion than that of Oxford and Cambridge, although in them there is a large staff of college lecturers, which is practically more important than the university staff. It is higher again than the proportion of the Scottish universities, where there are only some 105 professors to between 5000 and 6000 students, a proportion of 1 to between 50 and 60 students. The increase in Germany has taken place partly by adding on fresh teachers for the old subjects, such as Latin and Greek, but still more by founding new chairs for new subjects, such as Oriental and Romance languages, geography, and archæology, and by subdividing departments which have been recently developed, such as those connected with political economy, political science, physiology, and biology. Owing to the great development of natural science, the faculty of philosophy has at some centres increased to such an extent as to equal in numbers all the other faculties put together. This inconvenience has been differently met at different universities. In those of Switzerland, no further remedy has been devised than that of appointing separate syndicates or boards of management for the two main divisions,—the philosophico-historic and the mathematical and natural-scientific; at Dorpat, Tübingen, and Strasburg, on the other hand, these divisions have been represented by the formation of two distinct faculties; while Tübingen, Munich, and Würzburg have created, in addition, a third faculty under which are grouped the several subjects of political economy, statistics, and finance.

Averages of students at German universities.

The following table (taken from Conrad) exhibits the average of the total number of matriculated students at the German universities for every five years from 1831 to 1884; it brings the tendency to form large centres very forcibly before the view. The three largest centres—Berlin, Leipsic, Munich—even in the first quinquennium appear as absorbing no less than 35 per cent. of the students, and in the last as many as 42 per cent. At the same time, there has lately been a no less notable increase among the centres of second magnitude. A quarter of a century ago only two universities had more than a thousand students; at present there are nine.

	1831-36.	1836-41.	1841-46.	1846-51.	1851-56.	1856-61.	1861-66.	1866-71.	1871-76.	1876-81.	1883-84.
Berlin	1820	1762	1715	1461	1599	1593	1972	2218	1948	3142	4867
Breslau	902	681	707	766	822	851	957	927	1037	1275	1479
Halle	810	655	712	671	629	710	768	838	968	1017	1544
Greifswald	208	198	218	190	214	273	345	420	508	538	725
Königsberg	421	391	347	323	358	390	445	460	606	723	969
Bonn	795	647	632	666	807	813	896	866	776	944	1037
Münster	261	213	238	284	348	473	521	453	400	289	280
Göttingen	865	774	670	676	684	657	721	772	1067	1092	1064
Marburg	331	273	263	265	245	254	264	332	401	510	720
Kiel	275	244	208	151	141	149	194	172	175	262	352
Munich	1556	1392	1529	1695	1700	1292	1245	1215	1142	1582	2468
Würzburg	445	449	472	582	743	648	635	613	890	930	1167
Erlangen	278	297	316	396	475	528	474	369	404	452	730
Tübingen	805	745	849	832	764	697	777	755	662	1076	1217
Heidelberg	661	570	727	661	684	584	742	652	621	643	782
Freiburg	474	433	245	291	331	313	301	277	289	424	615
Leipsic	1145	1002	917	970	843	854	991	1453	2686	3044	3433
Jena	500	433	421	402	396	417	482	384	423	491	566
Giessen	355	367	494	476	383	356	378	294	318	350	497
Rostock	95	95	88	87	98	121	144	152	141	176	232
Strasburg	...	..	...	...	...	...	...	...	687	713	844

Table of professors and students.

The following table, taken from Ascherson's *Deutscher Universitäts-Kalender*, 1887, supplies the most recent statistics respecting both the teaching and the student bodies in the different faculties of the German-speaking universities on the Continent.

Universities	Professors, &c.						Students.					
	Ordinary Professors.	Extra-ordinary Professors.	Honorary Professors.	Privat-docenten, Assistant Teachers, &c.	Teachers of Languages, &c.	Total.	Theology.		Juris-prudence, Political Economy, Forestry.	Medicine, Surgery, Pharmacy.	Philosophy, Philology, Mathematics, &c.	Total of Matriculated Students.
							Evangelical.	Catholic.				
German Empire—												
Berlin	75	83	7	124	7	296	794	...	1262	1297	1984	5337
Bonn	57	31	2	27	5	122	122	86	226	292	395	1121
Breslau	57	33	3	31	7	131	166	165	221	362	433	1347
Erlangen	39	7	1	9	5	61	386	...	118	267	105	880
Freiburg	36	15	1	24	4	80	...	116	147	428	305	996
Giessen	38	9	...	9	3	59	94	...	125	138	127	484
Göttingen	65	27	2	21	6	121	239	...	145	233	424	1041
Greifswald	41	23	...	13	5	82	306	...	55	441	121	923
Halle	50	30	1	18	11	110	598	...	115	315	499	1527
Heidelberg	43	28	6	20	9	106	72	...	198	202	305	772
Jena	35	24	8	15	5	87	126	...	80	210	191	607
Kiel	41	11	...	20	6	78	55	...	22	234	169	480
Königsberg	44	24	...	19	7	94	235	...	112	237	231	815
Leipsic	67	38	12	58	5	180	672	...	738	781	1040	3231
Marburg	44	15	..	17	6	82	188	...	74	271	360	894
Munich	75	15	5	65	5	165	...	146	1136	1350	544	3176
Münster	22	10	1	4	3	40	...	312	...	...	163	475
Rostock	29	3	...	5	2	39	87	...	35	100	105	327
Strasburg	59	20	1	19	3	102	89	...	195	233	331	848
Tübingen	52	16	...	17	8	93	354	160	348	235	150	1247
Würzburg	38	10	1	19	3	71	...	179	218	935	179	1511
Switzerland—												
Basel	37	13	...	29	4	83	95	...	42	131	86	354
Bern	41	6	4	36	...	87	44	8	164	227	96	539
Geneva	41	...	...	29	...	70	?	...	?	?	?	?
Lausanne	22	23	1	2	...	48	?	...	?	?	?	?
Neuchatel	25	3	11	3	...	42	?	...	?	?	?	?
Zurich	38	13	...	40	...	91	41	...	56	24	143	481
Russia (Baltic Provinces)—												
Dorpat	42	5	...	16	10	73	275	...	264	868	367	1734
Austria and Hungary—												
Czernowitz	26	6	...	6	3	41	...	60	123	...	30	213
Graz	60	17	...	43	4	114	...	80	459	548	70	1193
Innsbruck	41	11	1	19	2	74	...	221	252	231	65	769
Cracow	39	14	...	31	1	85	...	77	?	?	}	?
Prague (German university)	54	20	...	43	3	120	...	?	?	?		?
Vienna	83	55	4	147	12	301	...	204	1911	2318	460	4898

Fluctuations of numbers. In 1878 a comparison of the numbers of the students in the different faculties in the Prussian universities with those for the year 1867 showed a remarkable diminution in the faculty of theology, amounting in Lutheran centres to more than one-half, and in Catholic centres to nearly three-fourths. In jurisprudence there was an increase of nearly two-fifths, in medicine a decline of a third, and in philosophy an increase of one-fourth. During the last few years, however, the faculties of theology have made some progress towards regaining their former numbers.

Universities of United Provinces. The universities of the United Provinces, like those of Protestant Germany, were founded by the state as schools for the maintenance of the principles of the Reformation and the education of the clergy, and afforded in the 16th and 17th centuries a grateful refuge to not a few of those Huguenot or Port-Royalist scholars whom persecution compelled to flee beyond the boundaries of France, as well as to the Puritan clergy who were driven from England. **Leyden.** The earliest, that of Leyden, founded in 1575, commemorated the gallant and successful resistance of the citizens to the Spanish fleet under Requesens. Throughout the 17th century Leyden was distinguished by its learning, the ability of its professors, and the shelter it afforded to the more liberal thought associated at that period with Arminianism. Much of its early success was owing to the wise provisions and the influence of the celebrated James Douza:—"Douza's principles," says Hamilton, "were those which ought to regulate the practice of all academical patrons; and they were those of his successors. He knew that at the rate learning was seen prized by the state in the academy would it be valued by the nation at large. . . . He knew that professors wrought more even by example and influence than by teaching, that it was theirs to pitch high or low the standard of learning in a country, and that, as it proved easy or arduous to come up with them, they awoke either a restless endeavour after an even loftier attainment, or lulled into a self-satisfied conceit." Douza was, for Leyden and the Dutch, what Münchausen afterwards was for Göttingen and the German universities. "But with this difference: Leyden was the model on which the younger universities of the republic were constructed; Göttingen the model on which the older universities of the empire were reformed. Both Münchausen and Douza proposed a high ideal for the schools founded under their auspices; and both, as first curators, laboured with paramount influence in realizing this ideal for the same long period of thirty-two years. Under their patronage Leyden and Göttingen took the highest place among the universities of Europe; and both have only lost their relative supremacy by the application in other seminaries of the same measures which had at first determined their superiority." The appointment of the professors at Leyden was vested in three (afterwards five) curators, one of whom was selected from the body of the nobles, while the other two were appointed by the states of the province,—the office being held for nine years, and eventually for life. With these was associated the mayor of Leyden for the time being. **Franeker.** The university of Franeker was founded in 1585 on a somewhat less liberal basis than Leyden, the professors being required to declare their assent to the rule of faith embodied in the Heidelberg Catechism and the confession of the "Belgian Church." Its four faculties were those of theology, jurisprudence, medicine, and "the three languages and the liberal arts."[1] For a period of twelve years (*circ.* 1610-1622) the reputation of the university was enhanced by the able teaching of William Ames ("Amesius"), a Puritan divine and moralist who had been driven by Bancroft from Cambridge and from England. His fame and ability are said to have attracted to Franeker students from Hungary, Poland, and Russia.

Harderwijk. Groningen. Utrecht. With like organization were founded—in 1600 the university of Harderwijk, in 1614 that of Groningen, and in 1634 that of Utrecht. The restoration of the House of Orange, and establishment of the kingdom of the Netherlands (23d March 1815), was followed by important changes in connexion with the whole kingdom. The universities of Franeker and Harderwijk were suppressed, while their place was taken by the newly-founded centres at Ghent (1816) and Liége (1816). **Ghent. Liége.** A uniform constitution was given both to the Dutch and Belgian universities. It was also provided that there should be attached to each a board of curators, consisting of five persons, "distinguished by their love of literature and science and by their rank in society." These curators were to be nominated by the king, and at least three of them chosen from the province in which the university was situated, while the other two were to be chosen from adjacent provinces. After the redivision of the kingdom in 1831, Ghent and Liége were constituted state universities, and each received a subsidy from the Government (see BELGIUM). **Brussels.** The university of Brussels, on the other hand, founded in 1834, is an independent institution, supported by the liberal party; while the reconstituted university at Louvain represents the party of Roman Catholicism, and is almost exclusively a theological school for the education of the Catholic clergy. The universities of Belgium are, however, somewhat heterogeneous bodies, and present in their organization a singular combination of French and German institutions. **Amsterdam.** In Holland, the foundation of the university of Amsterdam (1877) has more than repaired the loss of Franeker and Harderwijk, and the progress of this new centre during the ten years of its existence has been remarkably rapid, so that it bids fair to rival, if not to outstrip, both Utrecht and Leyden. The higher education of women has made some progress in the Netherlands; and in 1882-83 there were eighteen women studying at Amsterdam, eleven at Groningen, four at Leyden, and seven at Utrecht.

Universities of Sweden and Norway. Lund. Upsala. In Sweden the university of Lund, founded in 1668 and modelled on the same plan as its predecessor at Upsala, has adhered to its antiquated constitution with remarkable tenacity. At both these universities the mediæval division into "nations" is still in force among the students, the number at Upsala being no less than thirteen. The professoriate at both centres is much below the modern requirements in point of numbers. **Christiania.** The university of Christiania in Norway, founded in 1811, and the Swedish universities are strongly Lutheran in character; and all alike are closely associated with the ecclesiastical institutions of the Scandinavian kingdoms. The same observation applies to Copenhagen,—where, however, the labours of Rask and Madvig have done much to sustain the reputation of the university for learning. **Kiel.** The university of Kiel (1665), on the other hand, has come much more under Teutonic influences, and is now a distinguished centre of scientific teaching.

University of Paris from the 17th century. In France the fortunes of academic learning were even less happy than in Germany. The university of Paris was distracted, throughout the 17th century, by theological dissensions,—in the first instance owing to the struggle that ensued after the Jesuits had effected a footing at the Collége de Clermont, and subsequently by the strife occasioned by the teaching of the Jansenists. Its studies, discipline, and numbers alike suffered. Towards the close of the century a certain revival took place, and a succession of illustrious names—Pourchot, Rollin, Grenan, Coffin, Demontempuys, Crevier, Lebeau—appear on the roll of its teachers. But this improvement was soon interrupted by the controversies excited by the promulgation

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[1] *Statuta et Leges*, Franeker, 1647, p. 3

Universities suppressed throughout France.

University of France created.

Creation of new centres.

Great French schools.

Lille and Angers.

Strasburg.

of the bull Unigenitus in 1713, condemning the tenets of Quesnel, when Rollin himself, although a man of singularly pacific disposition, deemed it his duty to head the opposition to Clement XI. and the French episcopate. At last, in 1762, the parlement of Paris issued a decree (August 6) placing the colleges of the Jesuits at the disposal of the university, and this was immediately followed by another for the expulsion of the order from Paris. Concurrently with this measure the prospects of the university assumed a more favourable character, the curriculum of its studies was extended, and both history and natural science began to be cultivated with a certain success. These better prospects were, however, soon obscured by the outbreak of the Revolution; and on the 15th September 1793 the universities and colleges throughout France, together with the faculties of theology, medicine, jurisprudence, and arts, were abolished by a decree of the Convention The Collége de France, when restored in 1831, was reconstituted mainly as a school of adult instruction, for the most part of a popular character, and entirely dissociated from the university. It now numbers thirty-nine chairs, among which is one of the Slavonic languages and literature. The university of France (which succeeded to that of Paris) is at present little more than an abstract term, signifying the whole of the professional body under state control, and comprising various faculties at different centres—Paris, Montpellier, Nancy, &c., together with twenty-seven academical rectorates. Each of these rectors presides over a local "conseil d'enseignement," in conjunction with which he elects the professors of lycées and the communal schoolmasters, whose formal appointment is then made by the minister of public instruction. There are ecclesiastics in some of the conseils d'enseignement, but the rectors are all laymen who have graduated in one of the faculties. The great schools have also in no small measure supplemented the work of the universities by their advance in the direction of scientific instruction. Among the number the "École Pratique des Hautes Études" in Paris (31st July, 1868) and the "École Polytechnique," which traces its origin as far back as the year 1794, are especially distinguished. The course of instruction at the former is divided into five sections—(1) mathematics, (2) physics and chemistry, (3) natural history and physiology, (4) history and philology, (5) economic science. At the latter the instruction is conceived solely with regard to the application of scientific principles to all branches of the public service, but more especially the military and mercantile. In 1875 the National Assembly passed an Act which enabled the Roman Catholic body to establish free universities of their own, and to confer degrees which should be of the same validity as those of the state university. At Lille and Angers such centres have been already organized. The university of Strasburg, which in the latter part of the last century had been distinguished by an intellectual activity which became associated with the names of Goethe, Herder, and others, was also swept away by the Revolution. It was, however, restored 1st May 1872, after the city had reverted to Germany, and was remodelled entirely on German principles. Since then its success has been marked and continuous.

Universities of Switzerland. Basel. Bern. Zurich.

In Switzerland all the higher education is supported mainly by the German and Protestant cantons. The four universities of Basel, Bern, Zurich, and Geneva have an aggregate of some 1400 or 1500 students, and all possess faculties of philosophy, jurisprudence, theology, and medicine. Basel is, however, the chief centre for theology, as is Bern for jurisprudence and Zurich for philosophy. At Geneva the famous academy of the 16th and 17th centuries, long distinguished as a centre of Calvinistic teaching, is now represented by a university (first formed in 1876), where the instruction is given (mainly in the French language) by a staff of forty-one professors, and where there is a rising school of science. Switzerland almost takes the lead in connexion with female education on the Continent, and in 1882-83 there were 52 women at the university of Geneva, 36 at Bern, and 24 at Zurich.

Universities of Spain and Portugal.

In Spain the universities at present existing are those of Barcelona, Granada, Madrid (transferred in 1837 from Alcala), Oviedo, Salamanca, Santiago, Seville, Valencia, Valladolid, and Zaragoza. They are all, with the exception perhaps of Madrid, in a lamentably depressed condition, and mainly under the influence of French ideas and modelled on French examples. But in Portugal, Coimbra, which narrowly escaped suppression in the 16th century as a suspected centre of political disaffection, is now a flourishing school. Its instruction is given gratis; but, as all members of the higher courts of judicature and administration in the realm are required to have graduated at the university, it is at the same time one of the most aristocratic schools in Europe. There are five faculties, viz., theology, jurisprudence, medicine, mathematics, and philosophy. Of these, that of law is by far the most flourishing, the number of students in this faculty nearly equalling the aggregate of all the rest. There is a valuable library, largely composed of collections formerly belonging to suppressed convents. As a school of theology Coimbra is distinctly anti-ultramontane, and the progressive spirit of the university is shown by the fact that the rector has been instructed by the government to devise a scheme for the admission of women.

of Italy.

In Italy the universities are numerically much in excess of the requirements of the population, there being no less than sixteen state universities and four free universities. Very few of these possess theological faculties, and in no country are theological studies less valued. Education for the church is almost entirely given at the numerous "seminaries," where it is of an almost entirely elementary character. In 1875 a laudable effort was made by Bonghi, the minister of education, to introduce reforms and to assimilate the universities in their organization and methods to the German type. His plans were, however, to a great extent reversed by his successor, Coppino.

of Austria-Hungary. Vienna.

Olmütz.

Graz.

Salzburg.

Lemberg.

In Austria the universities, being modelled on the same system as that of Prussia, present no especially noteworthy features. Vienna is chiefly distinguished for its school of medicine, which enjoyed in the last century a reputation almost unrivalled in Europe. The other faculties were, however, suffered to languish, and throughout the first half of the present century the whole university was in an extremely depressed state. From this condition it was in a great measure restored by the exertions of Count Thun. The number of the matriculated students in 1887 was 1893, and that of the professors 138; among the latter the names of Zschokke, Maassen, Sickel, Jellinek, and Büdinger are some of the most widely known. The university of Olmütz, founded in 1581, was formerly in possession of what is now the imperial library, and contained also a valuable collection of Slavonic works which were carried off by the Swedes and ultimately dispersed. It was suppressed in 1853, and is now represented only by a theological faculty. The university of Graz, the capital of Styria, was founded in 1586, and is now one of the most flourishing centres, containing some 1200 students. The university of Salzburg, founded in 1623, was suppressed in 1810; that of Lemberg, founded in 1784 by the emperor Joseph II., was removed in 1805 to Cracow and united to that university. In 1816 it was opened on an independent basis. In the bombardment of the town in 1848 the university buildings were burnt down, and the site was changed to what was formerly a Jesuit convent. The fine library and natural history museum were at the same time

Czernowitz. Budapest. Klausenburg. Agram. Debreczin.

almost entirely destroyed. The university at the present time numbers over a thousand students. The most recent foundation is that of Czernowitz, founded in 1875, and numbering about 300 students. The universities of the Hungarian kingdom are three in number:—Budapest, originally founded at Tyrnau in 1635, now possessing four faculties—theology, jurisprudence, medicine, and philosophy (number of professors in 1885 180, students 3117); Kolozsvar (Klausenburg), now the chief Magyar centre, founded in 1872 and also comprising four faculties, but where mathematics and natural science supply the place of theology (number of professors in 1877 64, students 391); Zágráb (Agram), the Slovack university, in Croatia, founded in 1869 but not opened until 1874, with three faculties, viz., jurisprudence, theology, and philosophy. The chief centre of Protestant education is the college at Debreczin, founded in 1531, which in past times was not unfrequently subsidized from England. It now numbers over 2000 students, and possesses a fine library.

Russian universities. Helsingfors. Moscow. Kieff. Kazan. Kharkoff. St Petersburg. Odessa.

Russia possesses, besides Dorpat (*supra*, p. 845), seven other universities. (1) Helsingfors, in Finland, was originally established by Queen Christina in Åbo (1640), and removed in 1826 to Helsingfors, where the original charter, signed by the celebrated Oxenstierna, is still preserved. It has four faculties, 38 professors, and 700 students. (2) Moscow is really the oldest Russian university, having been founded in 1755; it includes the faculties of history, physics, jurisprudence, and medicine; the professors are 69 in number, the students about 1660. (3) The university of St Vladimir at Kieff, originally founded at Vilna in 1803, was removed from thence to Kieff in 1833; the students number about 900, and the library contains 107,000 volumes. (4) Kazan (1804) includes the same faculties as Moscow; the students are about 450 in number, and it has a library containing 80,000 volumes. (5) Kharkoff (1804) numbers 600 students, and its library 55,000 volumes. (6) St Petersburg (1819) includes the four faculties of history, physics, jurisprudence, and Oriental languages, and numbers 1500 students. (7) Odessa, founded in 1865, represents the university of New Russia. Generally speaking, the universities of Russia are not frequented by the aristocratic classes; they are largely subsidized by the Government, and the annual fees payable by students are less than £7 a head. In 1863 the statutes of all the universities were remodelled; and since that time there has been a tendency to impress upon them a more national character, as distinguished from mere imitation of those in Germany.

Athens.

The university of Athens (founded 22d May 1837) is modelled on the university systems of northern Germany, on a plan originally devised by Professor Brandis. It includes four faculties, viz., theology, jurisprudence, medicine, and philosophy. The professors (ordinary and extraordinary) are upwards of 60 in number, the students about 1500. There is also a school of pharmacy, chemistry, and anatomy, and a library of 130,000 volumes, with 800 manuscripts.

The English universities since the mediæval period.

The history of the two English universities during the 16th and following centuries has presented, for the most part, features which contrast strongly with those of the Continental seats of learning. Both suffered severely from confiscation of their lands and revenues during the period of the Reformation, but otherwise have generally enjoyed a remarkable immunity from the worst consequences of civil and political strife and actual warfare. Both long remained centres chiefly of theological teaching, but their intimate connexion at once with the state and with the Church of England, as "by law established," and the modifications introduced into their constitutions, prevented their becoming arenas of fierce polemical contentions like those which distracted the Protestant universities of Germany.

Influence of the Renaissance. The Reformation at Cambridge.

The influence of the Renaissance, and the teaching of Erasmus, who resided for some time at both universities, exercised a notable effect alike at Oxford and at Cambridge. The names of Colet, Grocyn, and Linacre illustrate this influence at the former centre; those of Bishop Fisher, Sir John Cheke, and Sir Thomas Smith at the latter. The labours of Erasmus at Cambridge, as the author of a new Latin version of the New Testament, with the design of placing in the hands of students a text free from the errors of the Vulgate, were productive of important effects, and the university became a centre of Reformation doctrine some years before the writings of Luther became known in England. The foundation of Christ's College (1505) and St John's College (1511), through the influence of Fisher with the countess of Richmond, also materially aided the general progress of learning at Cambridge. The Royal Injunctions of 1535, embodying the views and designs of Thomas Cromwell, mark the downfall of the old scholastic methods of study at both universities; and the foundation of Trinity College, Cambridge, in 1546 (partly by an amalgamation of two older societies), represents the earliest conception of such an institution in England in complete independence of Roman Catholic traditions. Trinity (1554) and St John's (1555) at Oxford, on the other hand, founded during the reactionary reign of Mary, serve rather as examples of a transitional period.

Puritanism at Cambridge. Elizabethan statutes of 1570. Laudian statutes of 1636.

In the reign of Elizabeth Cambridge became the centre of another great movement—that of the earlier Puritanism, St John's and Queens' being the strongholds of the party led by Cartwright, Walter Travers, and others. Whitaker, the eminent master of St John's, although he sympathized to some extent with these views, strove to keep their expression within limits compatible with conformity to the Church of England. But the movement continued to gather strength; and Emmanuel College, founded in 1584, owed much of its early prosperity to the fact that it was a known school of Puritan doctrine. Most of the Puritans objected to the discipline enforced by the university and ordinary college statutes—especially the wearing of the cap and the surplice and the conferring of degrees in divinity. The Anglican party, headed by such men as Whitgift and Bancroft, resorted in defence to a repressive policy, of which subscription to the Acts of Supremacy and Uniformity, and the Elizabethan statutes of 1570 (investing the "caput" with larger powers, and thereby creating a more oligarchical form of government), were the most notable results. Oxford, although the Puritans were there headed by Leicester, the chancellor, devised at the same time a similar scheme, the rigid discipline of which was further developed in the Laudian or Caroline statutes of 1636. It was under these respective codes—the Elizabethan statutes of 1570 and the Laudian statutes of 1636—that the two universities were governed until the introduction of the new codes of 1858. During the Commonwealth the Puritan occupation and administration, at either university, were accompanied by little injury to the colleges, and were far less prejudicial to learning than the Royalist writers of the Restoration would lead us to suppose. William Dell, who was master of Caius College from 1649 to 1660, advocated the formation of schools of higher instruction in the large towns, a proposal which was then looked upon as one of but faintly masked hostility to the older centres.

The Cambridge Platonist movement.

During the 17th century Cambridge became the centre of another movement, a reflex of the influence of the Cartesian philosophy, which attracted for a time considerable attention. Its leaders, known as the Cambridge

Platonists, among whom Henry More, Cudworth, and Whichcote were especially conspicuous, were men of high character and great learning, although too much under the influence of an ill-restrained enthusiasm and purely speculative doctrines. The spread of the Baconian philosophy, and the example of a succession of eminent scientific thinkers, among whom were Isaac Barrow, master of Trinity (1673–77), the two Lucasian professors, Isaac Newton (prof. 1669–1702) and his successor William Whiston (prof. 1702–11), and Roger Cotes (Plumian prof. 1707–16), began to render the exact sciences more and more an object of study, and the institution of the tripos examinations in the course of the first half of the 18th century established the reputation of Cambridge as a school of mathematical science. At Oxford, where no similar development took place, and where the statutable requirements with respect to study and exercises were suffered to fall into neglect, the degeneracy of the whole community as a school of academic culture is attested by evidence too emphatic to be gainsaid. The moral tone at both universities was at this time singularly low; and the rise of Methodism, as associated with the names of the two Wesleys and Whitefield at Oxford and that of Berridge at Cambridge, operated with greater effect upon the nation at large than on either of the two centres where it had its origin. With the advance of the present century, however, a perceptible change took place. The labours of Simeon at Cambridge, in connexion with the Evangelical party, and the far more celebrated movement known as Tractarianism, at Oxford, exercised considerable influence in developing a more thoughtful spirit at either university. At both centres, also, the range of studies was extended: written examinations took the place of the often merely formal *viva voce* ceremonies; at Cambridge classics were raised in 1824 to the dignity of a new tripos. The number of the students at both universities was largely augmented. Further schemes of improvement were put forward and discussed. And in 1850 it was decided by the Government to appoint commissioners to inquire what additional reforms might advantageously be introduced. Their recommendations were not all carried into effect, but the main results were as follows:—"The professoriate was considerably increased, reorganized, and re-endowed, by means of contributions from colleges. The colleges were emancipated from their mediæval statutes, were invested with new constitutions, and acquired new legislative powers. The fellowships were almost universally thrown open to merit, and the effect of this was not merely to provide ample rewards for the highest academical attainments, but to place the governing power within colleges in the hands of able men, likely to promote further improvements. The number and value of scholarships was largely augmented, and many, though not all, of the restrictions upon them were abolished. The great mass of vexatious and obsolete oaths was swept away; and, though candidates for the M.A. degree and persons elected to fellowships were still required to make the old subscriptions and declarations, it was enacted that no religious test should be imposed at matriculation or on taking a bachelor's degree."[1]

In 1869 a statute was enacted at Cambridge admitting students as members of the university without making it imperative that they should be entered at any hall or college, but simply be resident either with their parents or in duly licensed lodgings.

The entire abolition of tests followed next. After several rejections in parliament it was eventually carried as a Government measure, and passed the House of Lords in 1871.

Reforms of 1877. In 1877 the reports of two new commissions were followed by further changes, the chief features of which were the diversion of a certain proportion of the revenues of the colleges to the uses of the university, especially with a view to the encouragement of studies in natural science; the enforcement of general and uniform regulations with respect to the salaries, selection, and duties of professors, lecturers, and examiners; the abolition (with a few exceptions) of all clerical restrictions on headships or fellowships; and the limitation of fellowships to a uniform amount.

Increase in numbers. That these successive and fundamental changes have, on the whole, been in unison with the national wishes and requirements may fairly be inferred from the remarkable increase in numbers during the last quarter of a century, and especially at Cambridge, where the number of undergraduates, which in 1862 was 1526, was in 1887 no less than 2979. In the academic year 1862–63 the number of matriculations was 448, and in 1886–87 1009.

Local examinations and university extension lectures. Scarcely less influential, as a means of recovering for the two universities a truly national character, has been the work which both have been carrying on and aiding by the institution of local examinations and of university extension lectures. Of these two schemes, the former was initiated by both Oxford and Cambridge in the year 1858; the latter had its origin at Cambridge, having been suggested by the success attending a course of lectures to women delivered by Mr (now Professor) James Stuart, in 1867, in Liverpool, Manchester, Sheffield, and Leeds. By the former the standard of education throughout the country has been raised, both in public and in private schools. By the latter, instruction of the character and method which characterize university teaching has been brought within the reach of students of all classes and ages throughout the land.

Durham. So long ago as the year 1640 an endeavour had been made to bring about the foundation of a northern university for the benefit of the counties remote from Oxford and Cambridge. Manchester and York both petitioned to be made the seat of the new centre. Cromwell, however, rejected both petitions, and decided in favour of Durham. Here he founded the university of Durham (1657), endowing it with the sequestered revenues of the dean and chapter of the cathedral, and entitling the society "The Mentor or Provost, Fellows, and Scholars of the College of Durham, of the foundation of Oliver, &c." This scheme was cancelled at the Restoration, and not revived until the present century; but on the 4th July 1832 a bill for the foundation of a university at Durham received the royal assent, the dean and chapter being thereby empowered to appropriate an estate at South Shields for the establishment and maintenance of a university for the advancement of learning. The foundation was to be directly connected with the cathedral church, the bishop of the diocese being appointed visitor, and the dean and chapter governors; while the direct control was vested in a warden, a senate, and a convocation. A college, modelled on the plan of those at the older universities, and designated University College, Durham, was founded in 1837, Bishop Hatfield's Hall in 1846, and Bishop Cosin's Hall (which no longer exists) in 1851. The university includes all the faculties, and in 1865 there was added to the faculty of arts a school of physical science, including pure and applied mathematics, chemistry, geology, mining, engineering, &c. In 1871 the corporation of the university, in conjunction with some of the leading landed proprietors in the adjacent counties, gave further extension to this design by the foundation of a college of physical science at Newcastle-upon-Tyne, designed to teach scientific principles in their application to engineering, mining, manufactures, and agriculture.

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[1] Brodrick, *University of Oxford*, pp. 136, 137.

Students who had passed the required examinations were made admissible as associates in physical science of the university. There is also a medical college which stands in similar relations to Durham, of which university Codrington College, Barbados, and Fourah Bay College, Sierra Leone, are likewise affiliated colleges.

University of London.

The university of London had its origin in a movement initiated in the year 1825 by Thomas Campbell, the poet, in conjunction with Henry (afterwards Lord) Brougham, Mr (afterwards Sir) Isaac Lyon Goldsmid, Joseph Hume, and some influential Dissenters, most of them connected with the congregation of Dr Cox of Hackney. The scheme was originally suggested by the fact that Dissenters were practically excluded from the older universities; but the conception, as it took shape, was distinctly non-theological. The first council, appointed December 1825, comprised names representative of nearly all the religious denominations, including (besides those above mentioned) Zachary Macaulay, George Grote, James Mill, William Tooke, Lord Dudley and Ward, Dr Olinthus Gregory, Lord Lansdowne, Lord John Russell, and the duke of Norfolk. On 11th February 1826 the deed of settlement was drawn up; and in the course of the year seven acres, constituting the site of University College, were purchased, the foundation stone of the new buildings being laid by the duke of Sussex 30th April 1827. The course of instruction was designed to include "languages, mathematics, physics, the mental and the moral sciences, together with the laws of England, history, and political economy, and the various branches of knowledge which are the objects of medical education." In October 1828 the college was opened as the university of London. But in the meantime a certain section of the supporters of the movement, while satisfied as to the essential soundness of the primary design as a development of national education, entertained considerable scruples as to the propriety of altogether dissociating such an institution from the national church. This feeling found expression in the foundation and incorporation of King's College (14th August 1829), opened 8th October 1831, and designed to combine with the original plan instruction in "the doctrines and duties of Christianity, as the same are inculcated by the United Church of England and Ireland." This new phase of the movement was so far successful that in 1836 it was deemed expedient to dissociate the university of London from University College as a "teaching body," and to limit its action simply to the institution of examinations and the conferring of degrees,—the college itself receiving a new charter, and being thenceforth designated as University College, London, while the rival institution was also incorporated with the university, and was thenceforth known as King's College, London. In the charter now given to the university it was stated that the king "deems it to be the duty of his royal office to hold forth to all classes and denominations of his faithful subjects, without any distinction whatsoever, an encouragement for pursuing a regular and liberal course of education." The charters of the university of London and of University College, London, were signed on the same day, 28th November 1836. In 1869 both the colleges gave their adhesion to the movement for the higher education of women which had been initiated elsewhere, and in 1880 ladies were for the first time admitted to degrees.

King's College.

University College.

Victoria.

The Victoria University took its origin in the institution known as the Owens College, Manchester,—so called after a wealthy citizen of that name to whom it owed its foundation. The college was founded 12th March 1851, for the purpose of affording to students who were unable, on the ground of expense, to resort to Oxford or Cambridge an education of an equally high class with that given at those centres. The institution was, from the first, unsectarian in character. In July 1877 a memorial was presented to the privy council praying for the grant of a charter to the college, conferring on it the rank of a university, to be called the "university of Manchester." The localization implied in this title having met with opposition from the Yorkshire College at Leeds, it was resolved that the university should be called the "Victoria University." Under this name the foundation received its charter 20th April 1880. "The characteristic features of the Victoria University, as compared with other British universities, are these:—(*a*) it does not, like London, confer its degrees on candidates who have passed certain examinations only, but it also requires attendance on prescribed courses of academic study in a college of the university; (*b*) the constitution of the university contemplates its (ultimately) becoming a federation of colleges; but these colleges will not be situated, like those of Oxford and Cambridge, in one town, but wherever a college of adequate efficiency and stability shall have arisen. University College, Liverpool, and the Yorkshire College, Leeds, having fulfilled these requirements, have become affiliated with the university. The university, like the older bodies in England and Scotland, is at once a teaching and an examining body, and there is an intimate *rapport* between the teaching and the examining functions. To give it a general or national character, the governing body consists partly of persons nominated by the crown and partly of representatives of the governing and teaching bodies of the colleges and of the graduates of the university. External examiners are appointed, who conduct the examinations in conjunction with examiners representing the teaching body. The graduates of the university meet its teachers in convocation to discuss the affairs of the university. Convocation will elect future chancellors, and a certain number of representatives on the court" (Thompson, *The Owens College*, &c., p. 548). Like the Johns Hopkins University in America, the Victoria University has instituted certain fellowships (styled the Berkeley fellowships) for the encouragement of research.

In Scotland the chief change to be noted in connexion with the university of St Andrews is the appropriation in 1579 of the two colleges of St Salvator and St Leonard to the faculty of philosophy, and that of St Mary to theology. In 1747 an Act of Parliament was obtained for the union of the two former colleges into one. Glasgow, in the year 1577, received a new charter, and its history from that date down to the Restoration was one of almost continuous progress. The restoration of Episcopacy, however, involved the alienation of a considerable portion of its revenues, and the consequent suspension of several of its chairs. In 1864 the old university buildings were sold, and, a Government grant having been obtained, together with private subscriptions, the present new buildings were erected from the joint fund. The faculties now recognized at Glasgow are those of arts, theology, jurisprudence, and medicine. At Aberdeen an amalgamation, similar to that at St Andrews, took place, by virtue of the Universities Act of 1858, of the two universities of King's College and Marischal College. In conjunction with Glasgow, this university returns a member to parliament. The peculiar constitution of the college at Edinburgh, as defined by its charter (the government being vested entirely in the lord provost, magistrates, and council, as patrons and guardians), involved the senate in frequent collisions with the town council. The latter, being a strictly representative body, included elements with which the senate of the university sometimes found it difficult to work harmoniously, and its disposition to dictate was strongly resented by the distinguished metaphysician and professor Sir William Hamilton. On the other hand, the council sometimes exercised a beneficial discretion by appointing professors of ability whom the senate might have regarded as ineligible on the ground of their religious tenets. The Disruption of 1843 emancipated the lay professors from subscription to the Established Church of Scotland, and resulted in many of the important changes which were subsequently introduced in the Universities Act of 1858. On the 28th October 1859 the town council, notwithstanding that their powers were already terminated by the provisions of the Act, availed themselves of a technical right to appoint a principal,—their choice falling upon Sir David Brewster. The great landmark in the history of the Scottish as in that of the English universities is represented by the remodelling of the several constitutions of these bodies in the year 1858. The commissioners of 1858–62 left the university of Edinburgh in the possession of constitutional autonomy, with its studies and degrees regulated by ordinances. The students also received the rectorial franchise, but were not, as at Glasgow and Aberdeen, divided into nations. In arts the B.A. degree was abolished, the M.A. representing the only degree in this faculty, as at the other Scottish universities. The course of study was divided into three departments:—(1) classics; (2) mathematics, including natural philosophy; (3) mental science and English literature. In each department it was required that there should be an additional examiner besides the professor, so that the candidates should not be entirely examined by their own teachers. It was also provided that, instead of one examination for the degree at the end of a student's course, examinations in each of the departments might be passed separately. In the twenty years beginning with 1863, 1400 M.A. degrees have been conferred, as against 250 in the twenty years preceding. In the faculty of medicine, the original single degree of doctor of medicine gave place to three classes—bachelor of medicine (M.B.), master in surgery (C.M.), and doctor of medicine (M.D.). In 1866 it was further laid down that theses should no longer be demanded from candidates for the lower degrees of M.B. and C.M., and, on the other hand, that the degree of M.D. should not be conferred on persons not showing any evidence of medical study after leaving the university, but that a thesis should be invariably required. Since the enactment of these ordinances the number of the medical students has increased from about 500 to over 1700. In the faculty of law the title of the degree was to be LL.B., and it was to be conferred only on those who had already graduated as M.A. But the minor degree, that of "bachelor of law" (B.L.), might be conferred if the candidate had attended one course of lectures in the faculty of arts, and passed a preliminary examination in (1) Latin, (2) Greek, French or German, and (3) any two of the three subjects—logic, moral philosophy, and mathematics. The chair of public law, which had fallen into abeyance in 1832, was reconstituted, and the chair of universal civil history was converted into a professorship of history and constitutional law. The degree of doctor of laws was left, as before, a purely honorary degree. Chairs of Sanskrit, engineering, geology, commercial and political economy, education, fine art, and the Celtic languages have also been founded. By the Representation of the People (Scotland) Act, 1868, the universities of Edinburgh and St Andrews were empowered to return jointly a member to the House of Commons.

Parliamentary grants to Scottish universities.

A parliamentary return for the ten years ending 30th March 1883 showed that the sums voted annually by parliament or chargeable on the consolidated fund to the four universities had amounted during that period to £65,821 for Aberdeen, £85,906 for Edinburgh, £66,182 for Glasgow, and £38,111 for St Andrews. In addition to these sums Edinburgh had received £80,000 and Glasgow £20,000 in the form of special grants in aid

Trinity College, Dublin.

Trinity College, Dublin, was founded in 1591, under the auspices of Sir John Perrot, the Irish viceroy. A royal charter nominated a provost and a minimum number of three fellows and three scholars as a body corporate, empowered to establish among themselves "whatever laws of either of the universities of Cambridge or Oxford they may judge to be apt and suitable; and especially that no other persons should teach or profess the liberal arts in Ireland without the queen's special licence." The first five provosts of Trinity College were all Cambridge men, and under the influence of Archbishop Loftus, the first provost, and his successors, the foundation received a strongly Puritan bias. Prior to the year 1873 the provostship, fellowships, and foundation scholarships could be held only by members of the Church of Ireland; but all such restrictions were abolished by Act 36 Vict. c. 21, whereby the requirement of subscription to any article or formulary of faith was finally abrogated. As at present constituted, the ordinary government is in the hands of the provost and senior fellows in conjunction with the visitors and council,—the supreme authority being the crown, except so far as limited by Act of Parliament.

Queen's University.

The first departure in Ireland from the exclusive system of education formerly represented by the foundation at Dublin, dates from the creation of the Queen's University, incorporated by royal charter 3d September 1850. By this charter the general legislation of the university, together with its government and administration, was vested in the university senate. In 1864 the charter of 1850 was superseded by a supplementary charter, and the university reconstituted "in order to render more complete and satisfactory the courses of education to be followed by students in the colleges"; and finally, in 1880, by virtue of the Act of Parliament known as the University Education (Ireland) Act, 1879, the Queen's University gave place to the Royal University of Ireland, which was practically a reconstitution of the former foundation, the dissolution of the Queen's University being decreed so soon as the newly constituted body should be in a position to confer degrees; at the same time all graduates of the Queen's University were recognized as graduates of the new university with corresponding degrees, and all matriculated students of the former as entitled to the same status in the latter. The university confers degrees in arts (B.A., M.A., D.Litt.), science, engineering, music, medicine, surgery, obstetrics, and law. The preliminary pass examinations in arts are held at annually selected centres,—those chosen in 1885 being Dublin, Belfast, Carlow, Cork, Galway, Limerick, and Londonderry. All honour examinations and all examinations in other faculties are held in Dublin. The Queen's Colleges at Belfast, Cork, and Galway were founded in December 1845, under an Act of Parliament "to enable Her Majesty to endow new colleges for the advancement of learning in Ireland," and were subsequently incorporated as colleges of the university. Their professors were at the same time constituted professors in the university, and conducted the examinations. But in the reconstruction of 1880 the chief share in the conduct of the examinations and advising the senate with respect to them was vested in a board of fellows, elected by the senate in equal numbers from the non-denominational colleges and the purely Catholic institutions. The colleges retain, however, their independence, being in no way subject to the control of the university senate except in the regulations with respect to the requirements for degrees and other academic distinctions. On the other hand, the obligation formerly imposed of a preliminary course of study at one or other of the colleges before admission to degrees was abolished at the foundation of the Royal University, the examinations being now open, like those of the university

Royal University of Ireland.

Colleges at Belfast, Cork, and Galway.

of London, to all matriculated students on payment of certain fees.

Colleges in Wales:—St David's, There is at present no university of Wales, although the bestowal of a royal charter before long is confidently anticipated. The oldest college, that of St David's at Lampeter, possesses the right of conferring degrees. It was founded in 1822 for the purpose of educating clergy men in the principles of the Established Church of England and Wales, mainly for the supply of the Welsh dioceses. The number of the professors in 1887 was 8, and the number of the students 120. Aberystwith, The next college in order of foundation is Aberystwith. It was founded 9th October 1872, but possesses no charter, and is mainly supported by the Dissenting bodies. The staff of professors numbers 13, and the students number 150. South Wales, The University College of South Wales and Monmouthshire at Cardiff was founded in 1883. The number of professors in 1887 was 9, lecturers 4, demonstrators 2; number of students 140. North Wales. The University College of North Wales at Bangor received its charter 4th June 1885, its object being to "provide instruction in all the branches of a liberal education except theology." Its staff consists of a principal, 8 professors or lecturers, and 2 demonstrators; the number of the students is 127. There is also a hall of residence for women students. At each of these three last-named colleges students proceeding to degrees have to go through either a London, Edinburgh, Glasgow, or Dublin course of study, but at Edinburgh, Glasgow, and Dublin a certain proportion of the term of residence ordinarily required is remitted in their favour.

Calcutta. Bombay. Madras. In India, the three older universities all date from 1857,—that of Calcutta having been incorporated January 24, Bombay July 18, Madras September 5, in that year. At these three universities the instruction is mainly in English. "A university in India is a body for examining candidates for degrees, and for conferring degrees. It has the power of prescribing text-books, standards of instruction, and rules of procedure, but is not an institution for teaching. Its governance and management are vested in a body of fellows, some of whom are *ex officio*, being the chief European functionaries of the state. The remainder are appointed by the Government, being generally chosen as representative men in respect of eminent learning, scientific attainment, official position, social status, or personal worth. Being a mixed body of Europeans and natives, they thus comprise all that is best and wisest in that division of the empire to which the university belongs, and fairly represent most of the phases of thought and philosophic tendencies observable in the country. The fellows in their corporate capacity form the senate. The affairs of the university are conducted by the syndicate, consisting of a limited number of members elected from among the fellows. The faculties comprise arts and philosophy, law, medicine, and civil engineering. A degree in natural and physical science has more recently been added" (Sir R. Temple, *India in 1880*, p. 145). Punjab university. The Punjab university was incorporated in 1883,—the Punjab University College, prior to that date, having conferred titles only and not degrees. The main object of this university is the encouragement of the study of the Oriental languages and literature, and the rendering accessible to native students the results of European scientific teaching through the medium of their own vernacular. The Oriental faculty is here the oldest, and the degree of B.O.L. (bachelor of Oriental literature) is given as the result of its examinations. At the Oriental College the instruction is given wholly in the native languages. In 1887 the senate at Cambridge (mainly on the representations of Mr C. P. Ilbert, formerly vice-chancellor of the university of Calcutta) adopted resolutions whereby some forty-nine collegiate institutions already affiliated to the latter body were affiliated to the university of Cambridge, their students thus becoming entitled to the remission of one year in the ordinary statutable requirements with respect to residence at Cambridge. It is at these institutions, and the colleges of the first or second grade in the other presidencies, that the instruction is given.

Sydney. In Australia, the university of Sydney was incorporated by an Act of the colonial legislature which received the royal assent 9th December 1851, and on 27th February 1858 a royal charter was granted conferring on graduates of the university the same rank, style, and precedence as are enjoyed by graduates of universities within the United Kingdom. Sydney is also one of the institutions associated with the university of London from which certificates of having received a due course of instruction may be received with a view to admission to degrees. There are four faculties, viz., arts, law, medicine, and science. The design of the university is to supply the means of a liberal education to all orders and denominations, without any distinction whatever. An Act for the purpose of facilitating the erection of colleges in connexion with different religious bodies was, however, passed by the legislature during the session of 1884, and since that time colleges representing the Episcopalian, Presbyterian, and Roman Catholic Churches have been founded. In 1885 the total number of students attending lectures in the university was 206. Melbourne. The university of Melbourne, in the colony of Victoria, was incorporated and endowed by royal Act 22d January 1853. This Act was amended 7th June 1881. Here also no religious tests are imposed on admission to any degree or election to any office. The council is empowered, after due examination, to confer degrees in all the faculties (excepting divinity) which can be conferred in any university within the British dominions. It is also authorized to affiliate colleges; and Trinity College (Church of England) was accordingly founded in 1870 and Ormond College (Presbyterian) in 1879. The founding of a university for Queensland is at the present time in contemplation. Adelaide. The university of Adelaide in South Australia (founded mainly by the exertions and munificence of Sir Walter Watson Hughes) was incorporated by an Act of the colonial legislature in 1874, in which year it was further endowed by Sir Thomas Elder. In 1881 letters patent were granted by the English crown whereby degrees conferred by the university were constituted of equal validity with those of any university of the United Kingdom. The faculties in the university are those of arts, medicine, law, science, and music. The number of matriculations since the foundation amounted in 1886 to 284, the number of undergraduates in that year being 90.

New Zealand. The university of New Zealand, founded in 1870, and reconstituted in 1874 and 1875, is empowered by royal charter to grant the several degrees of bachelor and master of arts, and bachelor and doctor in law, medicine, and music. Women are admitted to degrees. To this the Auckland University College, Nelson College, Canterbury College, and the university of Otago stand in the relation of affiliated institutions. Otago. This last-named institution was founded in 1869 by an order of the provincial council, with the power of conferring degrees in arts, medicine, and law, and received as an endowment 100,000 acres of pastoral land. It was opened in 1871 with a staff of three professors, all in the faculty of arts. In 1872 the provincial council further subsidized it by a grant of a second 100,000 acres of land, and the university was now enabled to make considerable additions to the staff of professors and lecturers, to establish a lectureship in law, and to lay the foundations of a medical school. In 1874 an agreement was made between the university of New Zealand and that of Otago, whereby the functions of the former were restricted to the examination of candidates for matriculation, for scholarships, and for degrees; while the latter bound itself to become affiliated to the university of New Zealand, to hold in abeyance its power of granting degrees, and to waive the claim which it had advanced to a royal charter. As the result of this arrangement, the university of Otago became possessed of 10,000 acres of land which had been set apart for university purposes in the former province of Southland. In 1877 a school of mines was established in connexion with the university.

Montreal. In Canada the M'Gill College and University at Montreal was founded by royal charter in 1821 (amended in 1852) on the foundation of the Honourable James M'Gill, who died at Montreal 19th December 1813. A number of colleges and schools throughout the province stand in the relation of affiliated institutions. The university is Protestant but undenominational. It includes the faculties of arts, applied sciences, medicine, and law. In 1885 the total number of students, including women, was 526. Toronto. The university of Toronto was originally established by royal charter in 1827, under the title of King's College, with certain religious restrictions, resembling those at that time in force at the English universities, but in 1834 these restrictions were abolished, and in 1849 the designation of the university was changed into that of the university of Toronto. In 1873 further amendments were made in the constitution of the university. The chancellor was made elective for a period of three years by convocation, which was at the same time reorganized so as to include all graduates in law, medicine, and surgery, all masters of arts, and bachelors of arts of three years standing, all doctors of science, and bachelors of science of three years standing. The powers of the senate were also extended to all branches of literature, science, and the arts, to granting certificates of proficiency to women, and to affiliating colleges. The work of instruction is performed by University College, which is maintained out of the endowment of the provincial university, and governed by a council composed of the residents and the professors. Its several chairs include classical literature, logic and rhetoric, mathematics and natural philosophy, chemistry and experimental philosophy, history and English literature, mineralogy and geology, metaphysics and ethics, meteorology and natural history, and lectureships on Oriental literature, German, and French. Other universities and colleges with power to confer

Other Canadian universities. degrees are the Victoria University at Cobourg (1836), supported by the Methodist Church of Canada; Queen's University, Kingston (1841), representing the Presbyterian body, and the university of Trinity College, Toronto, founded in 1851 on the suppression of the faculty of divinity in King's College. Lennoxville is a centre for university instruction in conformity with Church of England principles.

Cape of Good Hope. In Africa, an Act for the incorporation of the university of the Cape of Good Hope received the royal assent 26th June 1873, the council being empowered to grant degrees in arts, law, and medicine.

Universities of the United States. In the United States of America university education has received a great extension, without, however, exercising in Europe that reflex influence discernible in so many other relations. The report of the commissioners of education for 1883-84 gives a list of no less than 370 degree-giving universities or colleges; but of these a large proportion are sectarian, others represent only a single faculty, and nearly nine-tenths have been founded within the last thirty-five years. Although a higher education has unquestionably been thus very widely diffused, the undue multiplication of centres has, in some provinces, lowered the standard of attainment and led to a consequent depreciation in the value of university degrees. This tendency it was sought to counteract in the State of Ohio, some twenty-five years ago, by an organization of the different colleges. The instruction given is, in most cases, almost gratuitous, the charge to each student being less than 30 dollars a year. This cheapening of a higher education is not, however, attended with quite the same results as in Germany (where lads with little aptitude for a professional career are thus attracted to the professions), the rapidly increasing population and the wider scope for mechanical or agricultural pursuits probably exercising a beneficial counteracting influence. The distinguishing characteristics which belong to these numerous centres are described by the president of the Johns Hopkins University, in an address delivered at Harvard in 1886, as suggestive of four different classes of colleges,—(1) those which proceed from the original historic colleges, (2) those established in the name of the State, (3) those avowedly ecclesiastical, (4) those founded by private benefactions. **Harvard College. Yale College.** To the first class belong Harvard College and Yale College with their offshoots. Of these two, the former was founded in 1638 at Cambridge, Massachusetts, by a former fellow of Emmanuel College at Cambridge in England, and represented the Puritan tenets for which the parent society was at that time noted; the latter was founded in 1701 by the combined action of a few of the ministers of the State, a charter being given in the same year by the colonial legislature. It was for a long time chiefly supported by the Congregationalists, but is now unsectarian. The total number of students at Harvard in 1882 was 988, at Yale 692. **University of Pennsylvania.** The university of Pennsylvania was founded in 1751 by Thomas Penn and Richard Penn, on the lines of a scheme drawn up by Benjamin Franklin, and was from the first placed on a basis comprising all denominations. It is distinguished by the liberality with which it has opened its courses of instruction to the inhabitants of the city generally; the degree of Ph.D. is conferred on all comers after due examination. At Haverford and Lafayette Colleges, and also at the Lehigh university, "advanced degrees" are offered "only for higher study, prolonged beyond the collegiate course," instead of being conferred as a matter of routine after a certain term of years. **Johns Hopkins University.** The Johns Hopkins University, also an unsectarian body, was founded at Baltimore in 1867, and is already a school of established reputation, and especially resorted to by those designing to follow the profession of teachers. It is also distinguished by the possession of fellowships, to be held only by students intending to pursue some especial line of original research. Other steadily growing centres are Columbia College in New York, founded in 1754; the Cornell University, also unsectarian, recently enriched by the acquisition of a considerable endowment; Brown's University in Providence; and those of Princeton, Michigan, Virginia, and California. **Amherst College.** At Amherst College, where the number of students in 1882 was 339, the experiment has recently been made of partially dispensing with examinations during the course of

States and Territories.	No. of Colleges.	Preparatory Department.		Collegiate Department.		Income from Productive Funds.	Receipts in 1883 from Tuition Fees.	Volumes in College Libraries.	Value of Grounds, Buildings, and Apparatus.
		No. of Instructors.	No. of Students.	No. of Instructors.	No. of Students.				
Alabama	[illegible]	1	169	46	382	$24,000	...	16,500	$300,000
Arkansas	5	18	655	21	230	750	$5,320	2,820	109,000
California	11	33	1,311	135	933	109,500	46,200	63,100	1,921,000
Colorado	3	10	295	26	86	4,472	2,007	9,400	340,000
Connecticut	3	...	...	76	968	84,991	119,393	175,000	1,409,630
Delaware	1	...	...	6	48	4,060	...	8,000	30,000
Florida	1	...	...	...		...	...	...	...
Georgia	6	6	176	55	439	17,500	500	10,800	380,000
Illinois	29	83	2,795	252	1,998	98,724	139,477	145,649	2,601,000
Indiana	13	31	1,577	131	1,615	52,717	23,350	80,694	1,120,000
Iowa	19	87	2,369	188	1,266	59,455	75,786	61,581	1,378,000
Kansas	8	50	1,304	78	469	18,650	10,168	38,300	500,000
Kentucky	15	27	836	114	1,182	50,925	64,292	42,290	920,600
Louisiana	10	26	1,418	86	372	14,556	36,504	39,073	707,000
Maine	3	...	...	35	389	42,953	21,450	61,050	818,000
Maryland	10	29	393	118	821	228,734	48,275	74,100	819,500
Massachusetts	7	...	209	168	2,010	864,552	162,438	311,561	2,261,027
Michigan	9	29	1,604	117	1,029	84,525	76,586	80,865	1,380,984
Minnesota	5	7	449	73	499	51,054	33,422	26,037	820,765
Mississippi	3	5	500	24	241	1,200	7,976	10,800	480,000
Missouri	20	34	1,742	180	2,057	81,773	124,359	94,707	2,794,006
Nebraska	5	20	750	46	127	3,260	6,864	17,067	267,000
New Hampshire	1	...	...	15	232	50,000	14,000	65,000	100,000
New Jersey	4	2	68	76	602	71,500	16,410	68,000	810,000
New York	29	76	2,289	446	3,641	619,911	544,580	274,334	7,959,163
North Carolina	9	18	473	66	758	20,750	20,500	38,000	540,500
Ohio	33	106	4,002	327	2,001	170,713	110,368	169,052	2,809,234
Oregon	6	9	689	34	248	19,200	10,100	16,540	279,950
Pennsylvania	26	59	1,828	295	2,195	344,574	137,533	196,718	4,535,000
Rhode Island	1	...	...	17	270	40,157	33,756	68,522	1,250,000
South Carolina	9	17	478	46	371	19,600	10,530	21,000	320,000
Tennessee	[illegible]	34	1,712	151	1,264	89,000	83,293	60,384	1,568,749
Texas	11	25	1,274	97	1,161	1,300	60,346	12,948	342,000
Vermont	2	...	...	20	102	15,200	6,179	34,855	300,000
Virginia	7	5	71	78	603	80,050	21,629	92,100	1,650,000
West Virginia	2	8	49	15	210	6,400	5,200	7,000	200,000
Wisconsin	8	78	926	98	681	62,627	19,310	64,685	948,700
Dakota	2	[illegible]	32	7	160	...	...	133	35,000
District of Columbia	5	1	59	63	442	60,648	10,580	44,000	1,200,000
Utah	1	9	259	.	...	...	6,530	2,913	70,000
Washington	2	5	285	14	10	...	6,300	2,330	180,000
Total	370	829	37,755	3,815	32,767	$8,018,624	$2,106,565	2,541,782	$46,339,301

study, where the students give evidence of having made satisfactory progress. Considerable modifications have also taken place in the courses of study, nearly all the colleges having now adopted the system of "parallel courses," and the principle of selection between these. Female education has received in America an extension which it has attained in no other country, and one of the colleges (that of Wellesley) numbers several hundred students. Since the war of 1861 a greatly increased attention has been given throughout the universities to physical training and athletic exercises, and excellent gymnasia, constructed on German models, have been erected.

The accompanying table (p. 857), prepared by the council of education for the year 1883-84, shows the distribution of these centres in the different States, together with their numbers, revenues, libraries, and the estimated value of their endowments.

Authorities.—On the earlier history and organization of the mediæval universities, the student should consult F. C. von Savigny, *Gesch. d. römischen Rechts im Mittelalter*, 7 vols., 1826–31; for the university of Paris, Du Boulay, *Historia Universitatis Parisiensis*, 6 vols., Paris, 1665, Crevier, *Hist. de l'Université de Paris*, 7 vols., Paris, 1761, and C. Jourdain, *Hist. de l'Université de Paris au XVIIme et au XVIIIme Siècle*, Paris, 1862; of these the work of Du Boulay (Bulæus) is one of great research and labour, but wanting in critical judgment, while that of Crevier is little more than a readable outline drawn from the former. The views of Du Boulay have been challenged on many important points by P. H. Denifle in the first volume of his *Die Universitäten des Mittelalters bis 1400* (1885), and more particularly on those relating to the organization of the early universities. The work of Meiners, *Gesch. d. Entstehung u. Entwickelung der hohen Schulen unsers Erdtheils*, 4 vols (1802–5), must be regarded as almost superseded as a general history, and the same may be said of Huber's work on the English universities, *Die englischen Universitäten* (Cassel, 1839-40), translated by F. W. Newman, 3 vols. (1843). Much useful criticism on both the English and the Continental universities will be found in Sir W. Hamilton's *Discussions, &c.*, 1853. For the German universities the works of Zarncke, *Die deutschen Universitäten im Mittelalter* (Leipsic, 1857), and Paulsen, *Gesch. d. gelehrten Unterrichts auf den deutschen Schulen und Universitäten* (Leipsic, 1885), will be found the most trustworthy,—the former for the mediæval, the latter for the modern period. To these may be added two articles by Paulsen in vol. xlv. of Von Sybel's *Historische Zeitschrift*:—(1) "Gründung" and (2) "Organisation u. Lebensordnungen d. deutschen Universitäten im Mittelalter"; Tholuck, *Das akademische Leben des 17 Jahrhunderts*, 2 vols. (Halle, 1853-54); Von Raumer, *Gesch. d. Pädagogik*, vol. iv. (4th ed., 1872); Dolch, *Gesch. d. deutschen Studententhums* (1858); Sybel, *Die deutschen Universitäten* (2d ed., 1874); and Dr J. Conrad, *The German Universities for the last Fifty Years*, translated by Hutchinson, with preface by James Bryce, M.P. (Glasgow, 1885). For Oxford, there are the laborious collections by Anthony Wood,—*History and Antiquities of the University and of the Colleges and Halls of Oxford*, edited with continuation by Rev. J. Gutch, 5 vols. (1786–96), and *Athenæ* and *Fasti Oxonienses*, edited by Dr P. Bliss, 4 vols. (1813-20); also the publications of the Oxford Historical Society; *A History of the University of Oxford from the Earliest Times to 1530*, by H. C. Maxwell Lyte (1886); and *Statutes of the University of Oxford compiled in 1636 under Authority of Archbishop Laud*, ed. Griffiths (Oxford, 1888). For Cambridge, the researches of C. H. Cooper, greatly surpassing those of Wood in thoroughness and impartiality, are comprised in three series: (1) *Annals of Cambridge*, 4 vols. (1842–52); (2) *Athenæ Cantabrigienses, 1500-1609*, 2 vols. (1858-61); (3) *Memorials of Cambridge*, 3 vols. (new ed., 1884). The *Architectural History of the University of Cambridge and of the Colleges*, by the late Robert Willis, edited and continued by J. Willis Clark, 4 vols. (1886), is a work of admirable thoroughness and completeness. To these may be added *Cambridge in the Seventeenth Century; Lives of Nicholas Ferrar and Matthew Robinson*, by Prof. John E. B. Mayor, 2 vols. (1855, 1856); and Baker's *History of the College of St John the Evangelist, Cambridge*, edited by Mayor, 2 vols. (1869); also J. B. Mullinger, *History of the University of Cambridge from the Earliest Times to Accession of Charles I.*, 2 vols. (1873-85). For both universities see the *Documents* issued by the Oxford and Cambridge Commissions of 1858; also the Wood, Hearne, Tanner, and Rawlinson MSS., and the Cottonian, Harleian, Lansdowne (especially Kennett and Strype), Baker, and Cole collections. (J. B. M.)

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UNTERWALDEN is one of the Forest cantons of Switzerland, ranking as sixth in the Confederation. It is composed of two valleys through which run two streams both called the Aa, and which are called Obwald and Nidwald from their position with regard to the great forest of the Kernwald in which they are situated. In old documents the inhabitants are always described as "homines intramontani," whether "vallis superioris" (Obwald) or "vallis inferioris" (Nidwald). The total area of Obwald is 183·3 square miles, 154·2 of which are classed as productive (forests 37·6), while of the remainder 3·8 are covered by glaciers and 4·3 by lakes. The area of Nidwald is 112·1 square miles, 84·1 being productive (forests 27·7); of the rest the cantonal bit of the Lake of Lucerne covers 12·8. The highest point in the canton is the Titlis (10,627 feet) in Obwald.

The census of 1880 returned the population of Obwald as 15,356, an increase of 941 on 1870, and that of Nidwald as 11,992, an increase of 291. In both the women have a small majority over the men. The native tongue of practically the whole population is German (15,254 in Obwald, 11,869 in Nidwald), and they are nearly all Roman Catholics (15,078 in Obwald, 11,901 in Nidwald). Till 1814 the canton was in the diocese of Constance; since that time it has (like Uri) formed legally part of no diocese, though it is provisionally administered by the bishop of Chur. The capital of Obwald is Sarnen (4039 inhabitants), Kerns (2500) being the only other place which is more than a village; that of Nidwald is Stanz (2210). The population is purely agricultural and pastoral. In Obwald the forests are remarkable, in Nidwald the fiery energy of the inhabitants. In educational matters the standard is not very high, but is being gradually raised. At the head of the Nidwald valley (but legally in Obwald) stands the great Benedictine monastery of Engelberg, founded in 1121. There are no railways, but one is being made from Lucerne through Obwald over the Brünig Pass to Meyringen in Bern.

Historically Obwald was part of the Aargau, and Nidwald of the Zürichgau. In both there were many great landowners (specially the abbey of Murbach and the Hapsburgs) and few free men; while the fact that the Hapsburgs were counts of the Aargau and the Zürichgau further delayed the development of political freedom. Both took part in the risings of 1245–47, and in 1248 Sarnen was threatened by the pope with excommunication for opposing its hereditary lord, the count of Hapsburg. The alleged cruelties committed by the Hapsburgs do not, however, appear in history till

Justinger's *Chronicle*, 1420 (see TELL). On April 16, 1291, Rudolph the future emperor bought from Murbach all its estates in Unterwalden and thus ruled this district as the chief landowner, as count, and as emperor. On 1st August 1291 Nidwald formed the "Everlasting League" with Uri and Schwyz (this being the first known case in which its common seal is used), Obwald joining a little later on. In 1304 the two valleys were joined together under the same imperial bailiff, and in 1309 Henry VII. confirmed to them all the liberties granted by his predecessor—though none are known to have been granted. However, this placed Unterwalden on an equal political footing with Uri and Schwyz; and as such it took part in Morgarten fight (also driving back an invasion over the Brünig Pass) and in the renewal of the Everlasting League at Brunuen (1315), as well as at Sempach (1386), and in driving back the Gugler or English freebooters (1375). For physical reasons, it was difficult for Unterwalden to enlarge its territories. Yet in 1368 it acquired Alpnach, and in 1378 Hergiswyl. So too Obwald shared with Uri in the conquest of the Val Leventina (1403), and in the purchase of Bellinzona (1419), as well as in the loss of both (1426). It was Nidwald that, with Schwyz and Uri, finally won (1500) and ruled (till 1798) Bellinzona, Riviera, and Val Blegno; while both shared in conquests of Aargau (1415), Thurgau (1460), and Locarno, &c. (1512), and in the temporary occupation of the Val d'Ossola (1410–14 to 1417–22). In the Burgundian war Unterwalden, like the other Forest cantons, long hung back through jealousy of Bern, but came to the rescue in time of need. In 1481 it was at Stans that the Confederates nearly broke up the League for various reasons, and it was only by the intervention then of the holy hermit Nicholas von der Flüe (of Sachseln in Obwald) that peace was restored, and the great federal agreement known as the compact of Stans concluded. Like the other Forest cantons, Unterwalden clung to the old faith at the time of the Reformation, being a member of the "Christliche Vereinigung" (1529) and of the Golden League (1586).

In 1798 Unterwalden resisted the Helvetic republic, but, having formed part of the short-lived Tellgau, became a district of the canton of the Waldstätten. Obwald submitted at an early date, but Nidwald, refusing to accept the oath of fidelity to the constitution mainly on religious grounds, rose in desperate revolt (September 1798), and was only put down by the arrival of 15,000 armed men and by the storming of Stanz. In 1803 its independence as a canton was restored, but in 1815 Nidwald refused to accept the new constitution, and federal troops had to be employed to put down its resistance, the punishment inflicted being the transfer to Obwald of the jurisdiction over the abbey lands of Engelberg (since 1421 "protected" by both valleys), which in 1798 had fallen to the lot of Nidwald. Since that time the history of Unterwalden has been like that of the other Forest cantons. It was a member of the "League of Sarnen" (1832), to oppose the reforming wishes of other cantons, and of the "Sonderbund" (1843); it was defeated in the war of 1847; and it voted against the acceptance of the federal constitution both in 1848 and in 1874. It forms at present two half cantons, each sending one representative to the federal "assembly of states." In local matters the two valleys are independent. In each the supreme authority is the "landsgemeinde" (meeting on the last Sunday in April), composed of all male citizens of twenty (Obwald) or eighteen (Nidwald) years of age, while the cantonal council, which drafts measures and sanctions the expenditure of sums below certain fixed small amounts, is composed in Obwald of 80 members (including the executive council) elected by the people for 4 years, and in Nidwald of 48 (besides the executive council) chosen in the same way for 6 years. The executive council is in both cases elected by the "landsgemeinde"; in Obwald it consists of 3 officials and 4 ordinary members, and in Nidwald of 6 officials and 5 ordinary members,—the official members being chosen every year, the ordinary every 4 or 8 years respectively. The existing constitution of Obwald is that of 1867; that of Nidwald is dated 1850, and was amended in 1877–78.

It is very remarkable that in both valleys the old "common lands" are still in the hands of the old guilds, and "gemeinden" consist of natives, not merely residents, though in Obwald these contribute to the expenses of the new "political communes" of residents, while in Nidwald the latter have to raise special taxes. In Engelberg (which still retains some independence) the poor are greatly favoured in the division of the common lands and their proceeds, and unmarried persons (or widowers and widows) receive only half the share of those who are married.

See J. Businger, *Die Geschichten des Volkes von Unterwalden*, 2 vols., 1827–28.

UNYORO, a kingdom of Central Africa, bounded on the N. and E. by the Nile, on the W. by the Albert Nyanza, and on the S.E. by the kingdom of Uganda. Its area is about 1600 square miles. The country is very fertile, well-watered, and thickly wooded; for the most part it is hilly in character, especially on the borders of the Albert Lake and in the neighbourhood of Massindi and Kiroto, where the mountains have an altitude of from 5000 to 6000 feet. The population is about 1,500,000. The Wanyoro are of a dark reddish-brown colour, and are fully clothed, but are not so fine in physique, nor so high in intellectual development as their neighbours the Waganda, to whom, however, they appear to be very nearly related. The reigning family in Unyoro belongs to the Wahuma tribe, and is probably the oldest reigning Wahuma family in this part of Africa. The country is governed on the feudal system. Numerous tribes to the east and north of the Nile, and also on the western side of the Albert Nyanza, pay a small tribute to the Wanyoro. The latter possess large herds of cattle, and are very good herdsmen. The land, too, is cultivated to a considerable extent,—bananas, sweet potatoes, and dhurra being grown in large quantities. Coffee and tobacco are cultivated to a small extent. The people are very superstitious, and the numerous medicine men and women reap a rich harvest from their credulity. The Wanyoro huts are dome-shaped, small, and extremely filthy and full of vermin, although the people themselves are cleanly. Polygamy is universal, even the poorest man possessing two or three wives. Notwithstanding this, the people are fairly moral; but Unyoro is remarkable amongst Central African tribes for the existence of a definite class of courtesans. The Wanyoro are moderately skilful workmen, and their iron-work, pottery, and wood-work are both neat and tasteful. The only article they export is salt, which is obtained in considerable quantities at Kibiro on the shores of Lake Albert.

See Baker's *Albert Nyanza*, Felkin and Wilson's *Uganda and the Egyptian Soudan*, and various papers in *Petermann's Mittheilungen* by Emin Pasha.

UPANISHADS. See SANSKRIT, vol. xxi. p. 280, and BRAHMANISM.

UPAS, a Javanese word meaning poison, and specially applied by the Malays and people of western Java to the poison derived from the gum of the anchar tree (*Antiaris toxicaria*), one of the *Artocarpeæ*, which was commonly used in Celebes to envenom the bamboo darts of the natives. The name of the upas tree has become famous from the mendacious account (professedly by one Foersch, who was a surgeon at Samarang in 1773) published in the *London Magazine*, December 1783, and popularized by Erasmus Darwin in "Loves of the Plants" (*Botanic Garden*, pt. ii.). The tree was said to destroy all animal life within a radius of 15 miles or more. The poison was fetched by condemned malefactors, of whom scarcely two out of twenty returned. All this is pure fable, and in good part not even traditional fable, but mere invention.

For a scientific account of the *Antiaris*, see Horsfield's *Plantæ Javanicæ Rariores* (1838–52) and Blume's *Rumphia* (Brussels, 1839), and for the legend Yule, *Anglo-Indian Glossary*, p. 726 *sq.*

UPPER SIND FRONTIER, a district of British India, forming the northernmost portion of the province of Sind, in the Bombay presidency. It comprises an area of 2139 square miles, and lies between 27° 56′ and 28° 27′ N. lat. and between 68° and 69° 44′ E. long. It is bounded on the N. and W. by the Derajat districts of the Punjab and the territory of Khelat, on the S. by Shikarpur district, and on the E. by the Indus. In the north-east the country is hilly; the remainder consists of a narrow strip of level plain, one half being covered with jungle and subject to inundation, from which it is protected by artificial embankments. The land is watered by canals from the Indus, of which the chief is the Begári (85 miles in length), navigable throughout by large boats, and the Desert Canal, which irrigates the country west of Kashmor. The district contains several thriving timber plantations. The wild animals comprise an occasional tiger and hyænas; wild hogs and jackals abound; foxes are occasionally met with; and antelopes, hog-deer, and a species of *sámbhar* deer are found in the dense jungle tracts adjoining the Indus. The climate is remarkable for its dryness and for its extraordinary variations of temperature. The average annual rainfall at Jacobabad is less than 5 inches. There are numerous roads of all descriptions, and the Frontier Military Railway from Sukkur *via* Jacobabad to Sibi crosses the district.

The census of 1881 returned the population as 124,181 (males 70,166, females 54,015),—Hindus numbering 9894, Mohammedans 109,183, and Christians 230. The chief town is Jacobabad, with a population of 7365. In 1885-86 the cultivated area was estimated at 361,415 acres, of which 137,149 were cropped, and of these again 8163 were cropped more than once. The principal crops are wheat, joar, bajra, rice, barley, mustard-seed, and a little cotton and gram. Salt, lacquered work, leathern jars, embroidered shoes, woollen carpets, and saddle-bags are the principal manufactures. The internal trade is principally in grain, the greater part of which is sent to the Punjab, and the transit trade from Central Asia into Sind crosses the district, bringing wool and woollen goods, fruits, carpets, and horses.

UPSALA, a city of Sweden, the seat of its oldest university and residence of the archbishop of Sweden, is situated on the small river Fyris, 42 miles north of Stockholm. In spite of its position in a vast and fertile plain, Upsala was a rather insignificant little town till the opening of railway communication in 1866. The population, which in 1840 was only 5100, had at the end of 1885 increased to more than 20,000 (with students, scholars, and others, 23,000). The industries of the place are still unimportant, but its trade by sea (navigation being open for six or seven months of the year) and by rail is somewhat livelier. Upsala owes its fame to its university, which was founded in 1477. In 1624 Gustavus Adolphus endowed it with 300 farms, the revenue of which formed its entire income for more than two hundred years. Parliament now contributes nearly the half of its whole revenue (393,300 crowns, or about £21,800, in 1885). The professors numbered 58 in 1887, with 61 "docents" and assistant teachers, and there were 1928 students. The last-named are divided into 13 "nations" (based on the old ecclesiastical division of the country), almost every one of which possesses a house of its own, with a hall, reading-rooms, and library. About £7200 is distributed yearly in "stipendia" or scholarships. The new university house, above the cathedral, on the site of the former archbishop's castle, is in the Renaissance style, and was built in 1879-87. It has a great hall capable of holding 2000 persons, eleven lecture-rooms, &c. The vestibule, lighted from above by three large cupolas, and surrounded by open galleries, is particularly fine. The library building (called Carolina Rediviva, in remembrance of the Carolina which formerly existed near the cathedral) was erected in 1819-41. The library, which has a right to a copy of every book printed in Sweden, at present (1887) contains 250,000 volumes and 11,000 MSS., among which is the famous *Codex Argenteus* of Ulfilas's translation of the Gospels. The "Gustavianum," built by order of Gustavus Adolphus for a university house, is now wholly occupied by the zoological institution. The botanical garden (which formerly belonged to the castle) was presented by Gustavus III. to the university in 1787,—the former garden (in the northern part of the city), where Rudbeck and Linnæus worked, and where the residence of the latter is still to be seen, having been found too small and inconvenient. The medical faculty possesses a hospital and anatomical, chemical, and pathologico-physiological institutions; and about a mile from the town there is a magnificent lunatic asylum. The astronomical and meteorological institutions, as well as those of chemistry and physics, have also special buildings, all of recent date. The Royal Society of Sciences, established in 1710 by Eric Benzelius, the younger, occupies a house of its own, and has a valuable library. Of the buildings the cathedral, founded in the latter part of the 13th century and completed in 1435, is the most remarkable. The material is brick, but the proportions are uncommonly noble and harmonious; the length is 390 feet, and the height inside 88. It has suffered considerably from repeated fires, but since 1886 an extensive restoration has been going on. The castle, on the summit of a long ridge above the town, was founded in 1548 by Gustavus I., but not finished till a century later, when it was often used as a royal residence. It was destroyed by fire in 1702, and for more than forty years remained a ruin. At present only a small part of it is habitable, and that part is chiefly used by the provincial government, and as a residence of the governor. Apart from the cathedral and a few insignificant houses, there are no remains from the mediæval period, the city formerly having consisted almost entirely of wooden houses.

The name of Upsala originally belonged to a place nearly 2 miles to the north of the present city, which is still called Old Upsala. This Upsala, mentioned as early as the 9th century, was famous throughout Scandinavia for its splendid heathen temple, which, gleaming with gold, made it the centre of Svithiod, then divided into a great number of kingdoms; three huge grave mounds or barrows still commemorate old times. In the same place the first cathedral of the bishops of Upsala was also erected (about 1100). On the destruction of this building by fire, the inconvenient situation caused the removal in 1273 of the archiepiscopal see to the present city, then called Ostra Aros,[1] but within a comparatively short time it came to be generally called Upsala. During the Middle Ages the cathedral and the see of the archbishop made Upsala a kind of ecclesiastical capital. There the kings were crowned, after the election had taken place at the Mora stones, 10 miles south-east of Upsala. As early as the 14th century, however, Stockholm became the proper residence of the king. In 1567 Erik XIV. murdered in the castle five of the most eminent men of the kingdom, three of them belonging to the family of Sture. In 1593 was held the great synod which marks the final victory of Protestantism in Sweden; in the same year the university was restored by Charles IX. In the castle Christina, daughter of Gustavus Adolphus, resigned her crown to Charles X. in 1654. In 1702 nearly the whole city, with the castle and the cathedral, was burnt down. Among the teachers of the university who have carried its name beyond the boundaries of their own country, the following (besides Linnæus) deserve to be mentioned:—Olof Rudbeck the elder, the author of the *Atlantica* (1630-1702); Torbern Bergman (1735-1784), the celebrated chemist; and Erik Gustaf Geijer (1783-1847), the historian.

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[1] The name first occurs in Snorro Sturluson in connexion with the events of the year 1018; it signifies "the mouth of the eastern river."

END OF VOLUME TWENTY THIRD

AMERICAN

REVISIONS AND ADDITIONS

TO THE

ENCYCLOPÆDIA BRITANNICA

(NINTH EDITION.)

A DICTIONARY OF

ARTS, SCIENCES AND GENERAL LITERATURE

BY

W. H. DE PUY, DD., LL.D.,

ASSISTED BY A CORPS OF TRAINED WRITERS.

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TAAFFE, COUNT EDWARD FRANCIS JOSEPH, in the Austrian peerage, and Viscount Taaffe of Corren, and baron of Ballymote, Sligo, in the Irish peerage, born in the city of Prague in 1833. He was brought up in companionship with the present Emperor Francis Joseph. The count is a descendant of that powerful nobleman of the same name who proceeded from Ireland and made a great name in the Germanic Empire. He was appointed governor of Salzburg in 1863. In 1867 he became Austrian minister of the interior and vice-president of the Cisleithan ministry. At the latter end of 1869 he served as minister president. In 1871 he accepted the office of governor of the Tyrol and Vorarlberg. In 1880 he was summoned to form a new cabinet, over which he still presides.

TABBY, or TABBYING, another name for watering fabrics. It is usually applied to stuffs or worsted cloths instead of silks.

TABERNACLES, FEAST OF (Vulg. *Feriæ Tabernaculorum*), a Hebrew feast of seven days' duration, beginning on the 15th day of the 7th month (Tishri), and instituted principally in memory of the nomad life of the people in the desert, and the booths or tents used on their march. Besides this signification it also had an agricultural one, like the other two pilgrimage festivals, the Passah and the Feast of Weeks. It was emphatically the Feast of "Ingathering;" that is, the close of the labors of the field—the harvest of all the fruits, of the corn, the wine, and the oil. During this feast, the great bulk of the people were enjoined to dwell in booths, which were made of olive, pine, myrtle, palm and other branches, and were erected on the roofs of houses, and in the courts and streets.

TABLEAUX VIVANTS (living pictures), representations of works of painting and sculpture, or of scenes from history or fiction, by living persons. They are said to have been invented by Madam de Genlis when she had charge of the education of the children of the duke of Orleans. They have long been common in theaters, and have more recently become an amusement of private circles.

TACAHOUT, the native name of the small gall formed on the Indian tamarisk (*Tamarix gallica*, var. *Indica*). Since the discovery of photography, this gall has become of considerable importance as a source of gallic acid, of which it contains a large proportion.

TACITURNITY, in the law of Scotland, a mode of extinguishing an obligation by mere silence, and making no claim upon it for a long time. It is a distinct ground, and embraces a shorter period than the ordinary prescription or limitation; for if a creditor never apply for payment or performance of the obligation, a presumption arises either that there never was such an obligation, or that he has abandoned it.

TACONIC SYSTEM, an extensive series of rocks in the United States, described by Dr. Emmons. They consist of two divisions, the upper having a thickness of 25,000 feet, and containing lower Silurian fossils; and the lower, with 5,000 feet of thickness, in which, as yet, no fossils have been found, but which is generally considered to be the equivalent of the Cambrian rocks of Britain.

TAILZIE, the ancient term in the law of Scotland to denote a deed creating an entailed estate.

TAJ MAHAL, a costly tomb built in Agra, India, by the Emperor Shah Jehan, as a burial place for his favorite wife. It is said to have taken 20,000 workmen seventeen years to complete the structure, and its cost was estimated at $15,000,000. A tourist who saw it in 1891, wrote: "To describe the 'Taj' is an impossibility. You are dazzled, surprised, bewildered and inspired to think that such work could ever have been done by human hands. It is like a glimpse of paradise, something never to be forgotten, and, as you leave this tomb of tombs and this palace of palaces, and go out once more into the bright sunshine, it seems that you have witnessed some beautiful vision, or taken a trip to the so-called 'fairyland.'"

TALBOT, perhaps originally a name equivalent to bloodhound, but afterward applied to a race of hounds, now extinct, or nearly so, which seem to have been kept for show rather than for use. The talbot was of a pure white color, with large head, very broad muzzle, long pendulous ears, and rough hair on the belly. The white St. Hubert dog was either the talbot or a nearly allied breed. The talbot is the badge of the ancient House of Shrewsbury (surname Talbot), and the crest of some of the princely houses of Germany.

TALLADEGA, a prosperous town of Alabama, the seat of the Institution for the Deaf, Dumb and Blind.

TALLAHASSEE, a city, the capital of Florida, and the county-seat of Leon county, pleasantly situated on the Jacksonville, Pensacola and Mobile Railroad, in Northern Florida. The city is regularly laid out, and is the center of a considerable local trade. It has several excellent private schools. Population in 1890, 2,933.

TALLOW TREE, the name given in different parts of the world to trees of different kinds which produce a thick oil or vegetable tallow, or a somewhat resinous substance, which, like tallow, is capable of being used for making candles. The Tallow Tree of Malabar *(Vateria Indica)* is a very large tree of the natural order *Dipterocarpaceæ*. It has leathery leaves four to ten feet long, and panicles of white, fragrant flowers, with five petals. The stem is often sixteen feet in circumference. By incisions in the stem, East Indian copal is obtained; and by boiling its seeds, there is extracted a firm, white, vegetable tallow, which, as it has no unpleasant smell, is particularly suitable for making both candles and soap.—The Tallow Tree of China *(Stillingia sebifera)* belongs to the natural order *Euphorbiaceæ*. The candles made of it are beautifully white. This tree has been introduced into North America, is cultivated about Charleston and Savannah, and is almost naturalized in the maritime parts of Carolina. It presents a very beautiful and remarkable appearance at the approach of winter, when the leaves become bright red, and the pericarps falling off, leave the white seeds suspended by threads.

TALLY, the name given to the notched sticks which, till a recent period, were used in England for keeping accounts in Exchequer, answering the double purpose of receipts and public records. They were well seasoned rods of hazel or willow, inscribed on one side with notches indicating the sum for which the tally was an acknowledgment, and on two opposite sides with the same sum in Roman characters, along with the name of the payer and the date of the transaction.

TALMAGE, THOMAS DE WITT, born in New Jersey in 1832. He entered the legal profession, but, after a short period, prepared for the ministry at the New Brunswick Theological Seminary. His first pastorate was at Belleville, N. J.; he afterward removed to Philadelphia, where his rising fame induced the church at Brooklyn to make strenuous efforts to obtain his services as their minister, and he preached his first sermon there in March, 1869. The great success which attended Dr. Talmage's preaching necessitated the enlargement of the Tabernacle in 1871, but it was burned a year later. However, a still larger and finer structure was soon built, but this was also burnt down in 1889. A new church was built, at a cost of about $400,000, and dedicated in 1891. Dr. Talmage visited England in 1889, and afterward made a tour in Palestine and on the Continent. He is the author of several volumes of sermons and other religious works. *From Manger to Throne* was published after his return from the Holy Land.

TALUS, a term employed in geology to designate the sloping heap which accumulates at the base of a rock or precipice, from fragments broken off by the weather, or materials in any way carried over it. The term is also applied to the slope of a wall which diminishes in thickness as it rises.

TAMAQUA, a city of Pennsylvania. Population in 1890, 4,672. See Britannica, Vol. XXIII, p. 40.

TAMARA SPICE, a favorite mixture of condiments used by the Italians. It consists of powdered cinnamon, cloves, and coriander seeds in equal parts, and half the same quantity of aniseed and fennel-seed powdered.

TAMARIN *(Midas)*, a genus of South American monkeys, small and beautiful, with short muzzle, prominent forehead, long nails, which, except on the hinder thumbs, are formed like claws, the tail longer than the body, not prehensile, and covered with hair so as to resemble the tail of a squirrel. The SILKY TAMARIN, or MARAKINA *(M. rosalia)*, is the best known of the genus. It is of a golden yellow color, with fine, silky hair, which it is exceedingly careful to keep free from stain. It is often brought to Europe, but is very tender, and seldom lives long. It is a very gentle and playful creature.

TAMBOUR, a frame originally made round, upon which muslin or other material is stretched for embroidering. Tambour-work was extensively employed for the decoration of large surfaces of muslin, etc., for curtains and similar purposes; but pattern-weaving has been brought to resemble it so closely that it is being rapidly superseded.

TAMBOURINE, a very ancient musical instrument of the drum species, much used by the Biscayan and Italian peasants at their festivities, and sometimes introduced into orchestral music where the subject of the piece is connected with a people who use it, as the Basques, gypsies, or peasants of the Abruzzi.

TAMMANY SOCIETY, a noted political organization of the Democratic party in New York. The society in New York city was organized in 1789. Early in its history it began to be used as a political engine, and in time became the most effective instrument in the hands of the leaders of the Democratic party of the city and state of New York. Much reproach was brought upon the society by the famous "Ring," which for some years ruled in its councils, and which nearly proved its ruin; but a reorganization was afterward effected, and the regular meetings of the association continue to be held in Tammany Hall. See POLITICAL PARTIES in these Revisions and Additions; also Britannica, Vol. XVII, p. 463.

TAMPA, a town and an important shipping port of Florida, on the Gulf coast. It is interested in the manufacture of lumber.

TAMPICO, or SANTA ANNA DE TAMAULIPAS, a seaport of Mexico, in the state of Tamaulipas, on the Panuco, five miles from its mouth, in the Gulf of Mexico. At the mouth of the river is a dangerous bar, and the harbor is unsafe. Hides, tallow, bones and salted meat are exported to Great Britain and the United States.

TAMPION, the wooden plug placed in the mouth of a piece of ordnance to preserve it from dust and damp. In naval gunnery, the tampion is the wooden bottom for a charge of grapeshot.

TAM-TAM, an Indian musical instrument, resembling the tambourine, but larger and more powerful, and oval instead of round. It has been occasionally introduced into orchestral bands.

TAN-BALLS, tan-bark pressed into balls or lumps, which harden on drying, and serve for fuel in many parts of England.

TANEY, ROGER BROOKE, chief-justice of the United States, born in Calvert county, Md., in 1777, died in Baltimore, Md., in 1864. After studying law he was admitted to the bar in 1799, and soon obtained a large practice. He removed to Baltimore in 1823. In 1831 President Jackson made him United States attorney-general, and in December, 1835, Jackson nominated him chief-justice of the United States. In the *Dred Scott* decision (see Britannica, Vol. XXIII, p. 772) Chief-Justice Taney decided that a negro slave had no standing in a United States court, and that he had "no rights which a white man was bound to respect." This decision, rendered in March, 1857, roused in the North a fierce and determined antagonism to the domination of the slave power. Taney died on the same day on which the State of Maryland abolished slavery, Oct. 12, 1864.

TANK-WORMS. The mud in Indian tanks has been found to abound in *Filariæ*, some of which closely resemble the guinea-worm infesting the human body. Although there is no positive evidence, there is extreme probability that these tank-worms are the origin of the guinea-worm. Dr. Carter, who has had much personal observation of the guinea-worm in India, "argues, and apparently with good reason, *No tank-worm, no guinea-worm*. Persons who bathe in water in which the former is found may expect to have the latter." Mr. Bastian, who has written an excellent paper on the anatomy of the guinea-worm, states that there is an undoubted anatomical relation between it and the tank-worm. The real difficulty in the theory is that these tank-worms are widely diffused, while the guinea-worm is restricted in its localization.

TANTUM ERGO, the hymn uniformly sung in the Roman Catholic Church, at benediction with the Holy Sacrament. These are the first words of the penultimate strophe of the hymn Pange Lingua. The Tantum Ergo is the most popular of all the Eucharistic hymns of the Roman Catholic Church.

TANZIMAT, or TANSIMAT, the plural of the Arab word *tansim*, generally signifying "regulations," but in a special sense denoting the organic laws established by the Hatti-Sherif of Gulhane, in accordance with which the administration of the Turkish empire is carried on. These organic laws, the first attempt at constitutional government in Turkey, were published by Sultan Abdul-Medjid in 1844. But the tanzimat was a dead letter, or nearly so, except in connection with the army; so that on Sept. 7, 1854, the sultan found it necessary to publish a new ordinance, in which the complete carrying out of the tanzimat in all respects was commanded; and a commission was appointed to see that this was done.

TAPPAN, ARTHUR, a New York merchant and abolitionist, born at Northampton, Mass., in 1786, died at New Haven, Conn., in 1865. He was widely known as a patron of religious and patriotic organizations, tract, bible and other societies, endowed Lane Seminary at Cincinnati, a professorship at Auburn Theological Seminary, and built Tappan Hall at Oberlin; assisted in founding the "Journal of Commerce" and the "Emancipator," and was first president of the Anti-Slavery Society.

TAR. For general information on this subject see Britannica, Vol. XXIII, pp. 57-59. In the United States nearly all the wood-tar comes from North Carolina. It is there produced by the smothered burning of the wood and dead limbs of the pitch pine. A tar-kiln is commenced by scooping out of the ground a saucer-shaped foundation, making a hole in the middle, and thence running a wooden spout outside the rim of the foundation. The wood is split into billets three or four feet long and about three inches in diameter. The billets are stacked in the center hole and piled upward, each upper stick lapping a little over, thus giving the finished pile the appearance of an inverted cone. Logs of wood and green twigs are then piled around, and the whole covered with earth. The fire is lighted at the top eaves, and the distilled tar runs out through the spout. A kiln yields 50, 100, or more barrels of tar, according to its size. Large iron retorts have been used, but the product is not sufficiently greater or more cleanly to pay for increased cost.

Coal-tar was for a long time a troublesome product of gas-works, no useful application of it being known to any great extent. Later it was used as a covering to protect iron-work exposed to the weather; and the pitch obtained by distillation was found, when mixed with earthy matters, to be a good substitute for the natural product, asphaltum, used for artificial pavement, water-tight covering for roofs, etc. Finally tar distillers learned to extract from it crude naphtha, and also light oily fluids. The pitch, by continued distillation, was made to yield more oily matters. Crude naphtha is now purified with it; by taking one-tenth its bulk with concentrated sulphuric acid, adding when cold 5 per cent. of peroxide of manganese, and distilling off the upper portion a rectified naphtha is obtained, which easily dissolves India rubber. Mixed with wood-naphtha it produces a powerful solvent of various resinous substances useful in making varnishes. Still further purified, the liquid benzole is obtained, used extensively as an illuminating agent. The light essential oils, as well as the heavier ones, possess antiseptic properties, which render them valuable for preserving wood from decay. Among the other products obtained from coal-tar are carbolic acid and the aniline colors.

TARASCON, a town of France, whose inhabitants Alphonse Daudet made the subjects of his charming extravaganza, *Tartarin de Tarascon*, a most amusing satire on the characteristics of the natives of the south of France, which he followed up with a second part, *Tartarin sur les Alpes*, and a third, *Port Tarascon*, published in 1890. See Britannica, Vol. XXIII, p. 60.

TARAZONA, a town of Spain, in the province of Zaragoza, fifty-two miles northwest of the city of that name, on the Queyles, a tributary of the Ebro. It is the see of a bishop, and contains a cathedral, a bishop's palace, and a Moorish *Alcasar*. Population upward of 6,000, mainly engaged in agriculture.

TARBAGATAI, a frontier town of Chinese Turkestan, 170 miles east of the eastern extremity of Lake Balkash, at the foot of the mountains of the same name, in a plain watered by the Imil, with extensive meadows and pasture-grounds in the vicinity. The inhabitants consist of 3,000 exiled Chinese, 1,000 of a Chinese garrison, and a number of Mongolian merchants. The trade with Russia is important.

TARGOWITZ, or TARGOWICZA, in Russia, a small town in the government of Kiev, on the borders of Kherson, the scene (May, 1792) of a confederation of the five Polish nobles who were adverse to the constitution of May 3, 1791. They were incited to this traitorous conduct toward their country by Catharine II., and after their conduct had been fully unveiled, they were declared traitors to their country, and only escaped death by precipitate flight to Russia, where they were munificently rewarded for the treason which had given the czarina a pretext for executing the second partition of Poland.

TARIFF LEGISLATION IN THE UNITED STATES. The first tariff act was signed by President Washington on July 4, 1789. The new government had just been established, and the object of the law was to put money into the empty treasury of the republic. Alexander Hamilton was the author of the measure, which was modeled on the 5 per cent. import duty that the Congress of the Confederation had tried in vain to impose. This first law imposed specific duties on forty-seven articles and ad valorem rates of 7½, 10, 12½ and 15 per cent. on four commodities or small groups. The unenumerated goods were compelled to pay 5 per cent.

The second tariff act passed the House by a vote of 39 to 13, and passed the Senate without a division. It was approved by the President on Aug. 10, 1790. This act was longer than its predecessor, and the scale of duties was higher. Then followed the act of May 2, 1792, which became operative in the following July. It raised the duty on unenumerated merchandise to 7½ per cent. and that on many articles paying 7½ to 10 per cent. Another tariff bill was passed on June 7, 1794, going into effect on July 1. It imposed numerous rates in addition to those already payable, some of them specific and others 2½ and 5 per cent. ad valorem. Additional tariff measures were enacted on March 3 and July 8, 1797, and on May 13, 1800. These acts imposed additional rates, and there was a further increase of 2½ per cent. on March 26, 1804, on all imports then paying ad valorem rates.

The whole industrial situation of the country was changed suddenly and radically in 1807–8. Napoleon's Berlin and Milan decrees were followed by the English orders in council, and Mr. Jefferson's administration retaliated for the outrages on our commerce by the celebrated embargo in December, 1807. This was followed by the non-intercourse act in 1809, and by the declaration of war against England in 1812. During the progress of hostilities all commercial intercourse with Great Britain was, of course, suspended, and all import duties were doubled as a war measure.

This is known as the "Tariff of 1812." It passed the House of Representatives by a vote of 76 to 48, and received the sanction of the Senate by 20 votes in its favor to 9 against it. Amendments to it were adopted on Feb. 25, and again on July 29, 1813. On Feb. 15, 1816, the additional duties imposed by the act of 1812 were repealed, and additional duties of 42 per cent., to take effect on July 1, were substituted, but the law did not go into operation. From 1812 to 1816 the average rate on all imports was 32.73 per cent., the range being from 6.84 per cent. in 1815 to 69.03 in 1813.

THE LOWNDES-CALHOUN BILL.

The next great tariff measure is known as the Lowndes-Calhoun bill of 1816. The desire to protect the industries that had sprung up during the period of restriction and war was very strong in the country, and they were granted clear concessions in the measure bearing the name of the great South Carolinian. It was approved April 27, 1816, took effect the following July, and may be said to be the first of the protective tariffs. It was not wholly set aside until 1842, under the administration of Mr. Polk. The ad valorem duties under it ranged from 7½ to 33 per cent. The unenumerated goods paid 15 per cent., the manufacturers of iron and other metals generally 15 per cent., the majority of woolen goods 25 per cent., cotton goods 25 per cent., "with clauses establishing 'minimums'"—that is, in reckoning duties, 25 cents per square yard was to be deemed the minimum cost of cotton cloth; unbleached and uncolored yarn, 60 cents, and bleached or colored yarn, 75 cents per pound. These rates became practically prohibitory on the cheaper goods. The law was amended April 20 1818, and again on March 3, 1819. It had the support of New England and the Middle States, but the South was opposed to it. From 1817 to 1820 the average rate on imports was 26.52 per cent.; from 1821 to 1824, 35.02 per cent., and from 1821 to 1824, on dutiable goods only, 36.88 per cent. This general increase of duties was due to the necessity of providing for the interest on the heavy debt incurred by the second war with England.

The **CLAY TARIFF** followed in 1824. The vote in the House was close — 107 to 102; and there was a majority of only 4 in the Senate — 25 for to 21 against it. New England and the South voted against the measure, while on the other side were ranged the West and Middle States. It received the president's signature on May 22, 1824, and went into effect July 1. It remained in force in almost its entirety until 1842. It raised the duty on woolen goods from 25 to 30 per cent. for one year, and then to 33⅓ per cent. There was a "minimum" of 30 cents per square yard on cotton cloth. Wool over 10 cents a pound was rated at 20 per cent. until June 1, 1825, then 25 per cent. for one year, and then 30 per cent. The average rate on all imports from 1825 to 1828 was 47.17 per cent. and on dutiable goods 50.29 per cent.

THE "TARIFF OF ABOMINATIONS."

The "Tariff of Abominations," as it is called, was approved May 19, 1828, and went into operation part the following July and part in September. In the House 105 members voted for it and 94 members, mostly from New England and the South, against it. In the Senate the vote was 26 to 21. It had special reference to iron, wool and manufactures of wool. The duty on wool was 4 cents per pound and 40 per cent. for one year; then 4 cents and 45 per cent. for a year; then 4 cents and 50 per cent. Somewhat lower duties were provided for in an act passed on May 24, 1828, again in May, 1830, and still again on July 13, 1832. The average duty on all goods from 1829 to 1832 was 47.81 per cent., and on all dutiable articles 51.55 per cent.

The Modifying Tariff of 1832 was intended "to correct the inequalities of that of 1828." It was passed by the Whigs, or National Republicans, and levied high duties on cotton and woolen goods and other articles to which protection was meant to be applied. The vote in the House was 132 to 65 and in the Senate 32 to 16, the votes in favor of it coming from all sections of the country. The New England vote in the House was a tie. It was approved on July 14, and took effect on March 3, 1833. The existing duties were superseded by the act, some of them reduced and a few raised. In a separate act of the same date, railroad iron was made free. Under its operation, the average rate on imports in 1832-33, during the ten months it was in force, was 28.99 per cent., and dutiable articles 38.25 per cent.

The Compromise Tariff of 1833 provided for taking off one-third of the duties each year, until a uniform rate on all of 20 per cent. should be reached. It passed the House by 119 to 85, and the Senate by 29 to 16. New England then joined the Middle States in voting for high protective duties. It was approved on March 2, 1833, the day before the Tariff of 1832 went into operation, and took effect on Jan. 1, 1834. The terms of the compromise were that all duties which in the Tariff of 1832 exceeded 20 per cent., should have one-tenth of the excess over 20 per cent. taken off on Jan. 1, 1834; one-tenth more on Jan. 1, 1836; again one-tenth in 1838, and another one-tenth in 1840; so that by 1840, four-tenths of the excess over 20 per cent. would be disposed of. Then on Jan. 1, 1842, one-half of this remaining excess was to be taken off, and on July 1, 1842, the other half of the remaining excess was to go. There would, therefore, after July 1, 1842, have been a uniform rate of 20 per cent. on all articles, The average duty on all imports from 1834 to 1842 was 19.25 per cent., and on dutiable articles 34.73 per cent.

THE TARIFF OF 1842.

The Tariff of 1842 was passed by the Whigs as a party measure, and was avowedly a protective measure. It took effect at once, on August 30, 1842, changed all existing rates, was amended in March, 1843, and died December 1, 1846. New England and the Middle States gave it strong support. The South was earnest in opposition and the West was a tie. The average rate on all imports under it was 26.92 per cent. and on dutiable articles 33.47 per cent.

The Polk-Walker Tariff of 1846 is one of the most noteworthy acts in the fiscal history of the country. In his inaugural address President Polk said: "In the general proposition that no more money shall be collected than the necessities of an economical administration shall require all parties seem to acquiesce. I have heretofore declared to my fellow-citizens that in my judgment it is the duty of the government to extend, as far as it may be practicable to do so, by its revenue laws and all other means within its power, fair and just protection to all the great interests of the Union, embracing agriculture, manufactures, the mechanic arts, commerce and navigation. I have also declared my opinion to be in favor of a tariff for revenue; and that, in adjusting the details of such a tariff, I have sanctioned such moderate discriminating duties as would produce the amount of revenue needed, and at the same time afford reasonable protection to our home industries."

The following table gives the averages of the tariff duties since 1791:

TARIFF AVERAGES.

	PER CENT.
From 1791 to 1812	19.58
From 1812 to 1817	32.73
From 1817 to 1825	26.52
From 1825 to 1829	47.17
From 1829 to 1832	47.81
From 1832 to 1834	28.99
From 1834 to 1843	19.25
From 1843 to 1847	26.92
From 1847 to 1858	23.20
From 1858 to 1862	15.66
From 1862 to 1884	34.16
From 1884 to 1890	45.50
From 1890 to ——	about 66.00

Robert J. Walker, of Mississippi, who was President Polk's Secretary of the Treasury, laid down these principles as a basis for revenue reform in his celebrated report of 1845:

"No more money shall be collected than is needed for economical administration.

"The duty on no article should exceed the lowest rate which will yield the largest revenue.

"Below such rate discrimination may be made, or for imperative reasons an article may be made free.

"Luxuries should be taxed at the minimum rate for revenue.

"Duties should be all ad valorem, and never specific.

"Duties should be so imposed as to operate as equally as possible throughout the Union, without respect to class or section."

The bill framed on this basis was approved by Mr. Polk on July 30, 1846. It passed the House by 114 to 95, the East being in opposition and the West and South in support. The vote in the Senate on a third reading was a tie, and Vice-President Dallas gave the casting vote in the affirmative. The Senate on the final passage stood 28 to 27. This act superseded the Whig tariff, and remained in force until 1861. It swept away specific and compound duties. It divided all dutiable merchandise into eight classes, which introduced greater simplicity into the whole system of customs regulations. The average duty on all imports was, from 1847 to 1857, 23.20 per cent., and on dutiable articles 26.22 per cent.

The tariff of 1857, which was the next in order, made a still further reduction in duties. It was approved on March 3, 1857, took effect on July 1, and remained in force until April 1, 1861. New England united with the South in giving it 123 votes to 72 in the House, and in the Senate 33 to 12. The average duty on all goods, from 1858 to 1861, was 15.66 per cent., and on dutiable articles 20.12 per cent.

THE MORRILL TARIFF.

The Morrill Tariff of 1861 differed from all its predecessors in that it provided for a general system of compound and differential duties, specific and ad valorem, and also made a distinction between goods imported from different parts of the world. It passed the House on May 11, 1860, by a vote of 105 to 64, and the Senate on February 20, 1861, by a vote of 25 to 14. From the first, through all the cumbrous legislation that has followed in its wake, it has been avowedly protective. It was frequently changed during the War of the Rebellion, ostensibly for purposes of revenue. At an early period in its history the number of rates ran up to over two thousand. From 1861 to 1869 every year produced some enlargement of the original scheme. In 1870 there was some modification of rates, generally in the line of reduction. Tea and coffee, taxed since 1861, were then put on the free list, and the duties on cotton and woolen goods, wool, iron, paper, glass and leather were lowered about 10 per cent. The free list was somewhat enlarged, but the reduction was rescinded in the act of March 3, 1875. The duty on quinine was abolished on July 1, 1879. The average duty on all imports, from 1862 to 1883, was 34.16 per cent., and on dutiable articles 42.74 per cent.

THE "COMMISSION TARIFF."

This was passed by the House on March 3, 1883, by a vote of 152 to 116, and passed the Senate on March 2, the vote being 32 to 31. This was the tariff which was in force until October 6, 1890, when it was superseded, except as to tobacco and tin plate.

THE M'KINLEY TARIFF.

The present tariff, familiarly called "The McKinley Tariff" (from the name of the chairman of the congressional committee having the matter in charge in the House of Representatives), passed the House in October, 1890, by a vote of 152 to 81, and the Senate by a vote of 33 to 27, and was approved by President Harrison, 1890.

The following table gives the leading articles of merchandise and the import duties on them by the McKinley tariff:

Alcohol, 10 per cent. ad valorem.
Aluminium, unmanufactured, 15c. per lb.
Aniline Colors or Dyes, 35 per cent.
Animals for breeding purposes, free.
Bagging for cotton, 1 6-10 and 1 8-10c. per lb.
Bags, grain, 2c. per lb.
Barley, 30c. per bushel.
Beads, ornamental, 10 per cent.
Beef, Mutton and Pork, 2c. per lb.
Beer, Ale, not in bottles, 20c. per gallon.
Beer, Porter and Ale, in bottles, 40c. per gallon.
Bindings, cotton, 40 per cent.
Bindings, flax, 50 per cent.
Bindings, wool, 60c. per lb. and 60 per cent.
Blankets, value not over 30c. per lb., 16 1-2c. per lb. and 30 per cent.
Blankets, value 30c. and not over 40c., 22c. per lb. and 35 per cent.
Blankets, value 40c. and not over 60c., 33c. per lb. and 35 per cent.
Blankets, value 60c. and not over 80c., 38 1-2c. per lb. and 40 per cent.
Blankets, value over 80c. per lb., 38 1-2c. per lb. and 40 per cent.
Bonnets, silk, 60 per cent.
Bonnets, straw, 30 per cent.
Books, Charts, Maps, 25 per cent.
Books, over 20 years old, or for public libraries, free.
Bronze, manufactures of, 45 per cent.
Brushes, 40 per cent.
Building Stone, rough, 11c per cubic foot.
Building Stone, dressed, 40 per cent.
Butter and substitutes for, 6c. per lb.
Buttons, pearl, 2 1-2c. per line and 25 per cent.
Buttons, sleeve and collar, gilt, 50 per cent.
Buttons, wool, hair, etc., 60c. per lb. and 60 per cent.
Canvas for sails, 50 per cent.
Caps, cotton, 50 per cent.
Caps, fur and leather, 35 per cent.
Carpets, treble ingrain, 19c. per sq. yd. and 40 per cent.
Carpets, two ply, 14c. per sq. yd. and 40 per cent.
Carpets, tapestry Brussels, 28c. per sq. yd. and 40 per cent.
Carpets, Wilton and Axminster, 60c. per sq. yd. and 40 per cent.
Carpets, Brussels, 44c. per sq. yd. and 40 per cent.
Carpets, velvet, 40c. per sq. yd. and 40 per cent.
Cheese, all kinds, 6c. per lb.
Cigars and Cigarettes, $4.50 per lb. and 25 per cent.
Clocks, n. o. p., 45 per cent.
Clothing, ready-made, cotton n. o. p., 50 per cent.
Clothing, ready made, linen, 55 per cent.
Clothing, ready made, silk, 60 per cent.
Clothing, ready-made, woolen, 49 1-2c. per lb. and 60 per cent.
Coal, anthracite, free.
Coal, bituminous, 75c. per ton.
Coffee, free.
Confectionery, all sugar, 5c. per lb.
Copper, manufactures of, 45 per cent.
Cotton Trimmings, 60 per cent.
Cotton Galloons and Gimps, 40 per cent
Cotton Gloves, 50 per cent.
Cotton Handkerchiefs, 50 per cent.
Cotton Hosiery valued at more than 60c. and not more than $2 per dozen pairs, 50c. per doz. and 30 per cent.
Cotton Hosiery, $2 to $4 per dozen, 75c. per doz. and 40 per cent.
Cotton Hosiery, more than $4 per dozen, $1 per doz. and 40 per cent.
Cotton Shirts and Drawers, value $3 to $5, $1.25 per doz. and 40 per cent.
Cotton Plushes, Velvet, etc., 10c. per sq. yd. and 20 per cent.
Cotton Swiss Muslin, 60 per cent.
Cotton Webbing, 40 per cent.
Cotton Curtains, 60 per cent.
Cutlery, Pocket-Knives, etc., valued at not more than 50c. per doz., 12c. per doz. and 50 per cent.
Cutlery, 50c. to $2 per doz., 50c. per doz. and 50 per cent.
Cutlery, $1.50 to $3 per doz., $1 per doz. and 50 per cent.
Cutlery, more than $3 per doz., $2 per doz. and 50 per cent.
Cutlery, Razors, less than $4 per doz., $1 per doz. and 30 per cent.
Cutlery, Razors, more than $4 per doz., $1.75 per doz. and 30 per cent.
Cutlery, Table-Knives, not more than $1 per doz., 10c. per doz. and 30 per cent.
Cutlery, Table-Knives, $1 to $2 per doz., 35c. per doz. and 30 per cent.
Cutlery, Table-Knives, $2 to $3 per doz., 40c. per doz. and 30 per cent.
Cutlery, Table-Knives, $3 to $8 per doz., $1 per doz. and 30 per cent.
Cutlery, Table-Knives, more than $8 per doz., $2 per doz. and 30 per cent.
Diamonds, uncut (free); cut and set, 50 per cent.
Diamonds, cut but not set, 10 per cent.
Drugs, crude, free.
Drugs, not crude, 10 per cent.
Earthenware, common, 25 per cent.
Earthenware, China, Porcelain, plain, 55 per cent.
Earthenware, decorated, 60 per cent.
Eggs, 5c. per doz.
Engravings, 25 per cent.
Extracts, Dyewood, Logwood, 7-8c. per lb.
Extracts, meat, 35c. per lb.
Fans, palm leaf, with handles, 30 per cent.
Felt, hats, 55 per cent.
Felt, shoes, 49 1-2c. per lb. and 60 per cent.
Fertilizers, guanos, manures, free.
Firearms, double-barreled, breech-loading, value not over $6, $1.50 each and 35 per cent.
Firearms, value $6 to $12, $4 each and 35 per cent.
Firearms, value over $12, $6 each and 35 per cent.
Firearms, single-barreled, $1 each and 35 per cent.
Firearms, Pistols, value over $1.50, $1 each and 35 per cent.
Fish, American fisheries, free.
Fish, smoked, dried, salted, pickled, 3-4c. per lb.
Flannels, value not over 30c. per lb., 16 1-2c. per lb. and 30 per cent.
Flannels, 30c. to 40c., 22c. per lb. and 35 per cent.
Flannels, value 40c. to 50c., 33c. per lb. and 35 per cent.
Flax, manufactures of, 50 per cent.
Flowers, artificial, 50 per cent.
Fruits, preserved in their own juice, 30 per cent.
Fruits, apples, 25c. per bushel.
Fruits, oranges and lemons, n. o. p., 13c. per box and 30 per cent.
Fur manufactures, 35 per cent.
Furniture, wood, 35 per cent.
Glassware, plain and cut, 60 per cent.
Glass, lamp chimneys, 60 per cent.
Glass, polished plate, not over 16x24, 5c. per sq. foot.
Glass, silvered, not over 16x24, 6c. per sq. foot.
Glass, Bohemian, 60 per cent.
Glass, disks for optical instruments, 60 per cent.
Gloves, kid, men's plain, $1 doz., not less than 50 per cent.

Gloves, embroidered, $1.50 doz., not less than 50 per cent.
Gloves, lined, $2.50 doz., not less than 50 per cent.
Gloves, pique lined $2.50 doz., not less than 50 per cent.
Gloves, pique lined and embroidered, $3 doz., not less than 50 per cent.
Gloves, ladies' and children's, plain, $1.75 doz., not less than 50 per cent.
Gloves, ladies' lined, $2.75 doz., not less than 50 per cent.
Gloves, lined and embroidered, $3.25 doz., not less than 50 per cent.
Gloves, suedes and schmaschen, embroidered, 50c. doz., not less than 50 per cent.
Gloves, suedes, lined, $1 doz., not less than 50 per cent.
Gloves, suedes, lined and embroidered, $1.50 doz., not less than 50 per cent.
Glucose, 3-4c. per lb.
Glue, value not over 7c. per lb., 1 1-2c. per lb.
Gold, manufactures of, not jewelry, 45 per cent
Hair of hogs, curled for mattresses, 15 per cent.
Hair manufactures n. o. p., 33c. per lb. and 40 per cent
Hair Braids and ornaments, 60c. per lb. and 60 per cent
Hair, human, unmanufactured, 20 per cent.
Hams, 5c. per lb.
Handkerchiefs, linen, 55 per cent.
Handkerchiefs, silk, 60 per cent.
Hay, $4 per ton.
Hemp Cordage, untarred. 2 1-2c. per lb.
Hemp Cordage, tarred. 3c. per lb.
Hides, raw, dried, salted, pickled, free.
Hogs, $1.50 per head.
Honey, 20c. per gallon.
Hoops, iron or steel, for baling purposes, 1 3-10c. per lb
Hops, 15c. per lb
Horn, manufactures of, 30 per cent.
Horses, Mules, value under $150, $30 per head.
Horses, Mules, value over $150, 30 per cent.
India-rubber, manufactures, 30 per cent.
India-rubber, vulcanized, 35 per cent.
India rubber, wearing apparel, 50c. per lb. and 50 per cent
Instruments, philosophical, metal, 45 per cent.
Iron, manufactures of, n. o. sp., 45 per cent.
Iron Screws, 1 2 inch or less in length, 14c. per lb
Iron Tinned Plates, 2 2-10c. per lb.
Ivory manufactures, n. o. p., 40 per cent.
Jewelry, 50 per cent.
Jute, burlaps, 1 5-8c. per lb.
Jute, cotton bagging, 1 6-10 and 1 8-10c. per lb
Jute, other bagging, 2c. per lb
Knit Goods, wearing apparel, value not over 30c. lb., 33c per lb. and 40 per cent.
Knit Goods, wearing apparel, value 30c. and not over 40c., 38 1-2c. per lb. and 40 per cent.
Knit Goods, wearing apparel, value 40c. and not over 60c., 44c. per lb. and 50 per cent.
Knit Goods, wearing apparel, value 60c. and not over 80c., 44c. per lb. and 50 per cent
Knit Goods, wearing apparel, value over 80c. lb., 44c. per lb. and 50 per cent.
Knit Goods, silk, 60 per cent.
Knives, carving, $1 to $5 per doz. and 30 per cent.
Laces, cotton, 60 per cent.
Laces, linen, 60 per cent.
Lard, 2c. per lb.
Lead, pigs, bars, 2c. per lb.
Lead, type metal. 1 1-2c. per lb
Leather manufactures n. o. p., 35 per cent.
Lime, 6c. per 100 lbs.
Linen manufactures n. o. p., 50 per cent.
Linen, wearing apparel, 55 per cent.
Linen Thread, 45 per cent.
Linseed Oil, 32c. per gallon.
Macaroni, 2c. per lb.
Malt, 45c. per bushel.
Matches, friction, boxed, 10c. per gross
Mats, cocoa and rattan, 8c. per sq. ft.
Matting, jute, 6c. per sq. yd.
Mathematical Instruments, glass, 60 per cent.
Meerschaum Pipes, 70 per cent.
Mica, ground, 35 per cent.
Milk, fresh, 5c. per gallon.
Milk, condensed, 3c. per lb.
Molasses, free (after April 1, 1891).
Muffs, fur, 35 per cent.
Musical Instruments, metal, 45 per cent.
Music Boxes, 45 per cent.
Nails, cut, 1c. per lb.
Nails, horseshoe, 4c. per lb.
Needles, sewing, free.
Newspapers, Periodicals, free
Oat Meal, 1c. per lb.
Oil Cloths for floors, value over 25c. per sq. yd., 15c. per sq. yd. and 30 per cent
Oil, olive, 35c. per gallon.
Oil, whale and seal, 8c. per gallon.
Onions, 40c. per bushel.
Opium, liquid preparations, 40 per cent.
Organs, 45 per cent.
Paintings, by American artists, free.
Paintings, by foreign artists, 15 per cent.
Paper manufactures n. o. p., 25 per cent.
Paper Stock, crude, free.
Pepper, cayenne, unground, 2 1-2c. per lb.
Perfumery, alcoholic, $2.50 per gallon and 50 per cent.
Personal Effects (see note).
Phosphorus, 20c. per lb.
Photograph Albums, 35 per cent.
Photograph Slides, 60 per cent
Pianofortes, 45 per cent.
Pickles, 45 per cent.
Pins, metallic, 30 per cent.
Pipes of Clay, common (see Meerschaum), 15c. per gross.
Plants n. o. p., 20 per cent.
Poultry, dressed, 5c. per lb.
Potatoes, 25c. per bushel.
Pulp, wood, for paper-makers' use, ground, $2.50 per ton, dry weight.
Quicksilver, 10c. per lb.
Quilts, cotton, 45 per cent.
Quinine, Sulphate and Salts, free.
Railroad Ties, cedar, 20 per cent.
Robes, buffalo, made up, 35 per cent.
Roofing Tiles, plain, 25 per cent.
Rope, bale, of hemp, 50 per cent.
Rope, bale, of cotton, 40 per cent.
Rugs, Oriental, 60c. per sq. yd. and 40 per cent.
Salmon, dried or smoked, 1c. per lb.
Salmon, pickled and salted, 30 per cent.
Salt, in bulk, 8c. per 100 lbs.
Salt, in bags, 12c. per 100 lbs.
Sauces n. o. p., 45 per cent.
Sausages, Bologna, free.
Sausages, all others, 25 per cent.
Sealskin Sacques, 35 per cent.
Seeds, Garden, 20 per cent.
Sheetings, linen, 50 per cent.
Shirts, in whole or part linen, 55 per cent.
Shoe laces, cotton, 40 per cent.
Shoe laces, leather, 35 per cent.
Shoes, leather, 25 per cent.
Shoes, India rubber, 30 per cent.
Silk, raw, free.
Silk, spun in skeins, 35 per cent.
Silk, laces, embroideries, handkerchiefs, and all wearing apparel, 60 per cent.
Skins, uncured, raw, free.
Skins, tanned and dressed, 20 per cent.
Slates, porcelain, plain, 60 per cent.
Smokers' articles, except clay pipes, 70 per cent.
Snuff, 50c. per lb.
Soap, castile, 1 1-4c. per lb.
Spelter, in blocks, 1 3-4c. per lb
Spirits, except bay rum, $2.50 per proof gallon.
Statuary, marble, 15 per cent.
Steel Ingots, Slabs, etc., value 7c. to 10c. per lb., 2 8-10c per lb.
Steel Ingots, Slabs, etc., value 10c. to 13c. per lb., 3 1-2c per lb.
Steel Ingots, Slabs, etc., value 13c. to 16c. per lb., 4 2-10c. per lb.
Steel Ingots, Slabs, etc., value above 16c. per lb., 7c. per lb.
Stereoscopic Views, glass, 60 per cent.
Straw manufactures n. o. p., 30 per cent.
Sugars, not above 16 Dutch standard, free (after April 1, 1891).
Sugars, above 16 Dutch standard, 1-2c. per lb.
Sumac, ground, 4-10c. per lb.
Tea, free.
Telegraph-poles, cedar, 20 per cent.
Telescopes, 60 per cent.
Thermometers, 60 per cent.
Thread, cotton, value from 25c. to 40c. per lb., 18c. per lb.
Thread, 40c. to 50c. per lb., 23c. per lb.
Thread, 50c. to 60c. per lb., 28c. per lb.
Thread, flax or linen, value not over 13c. per lb., 6c. per lb
Thread, over 13c. per lb., 45 per cent

Tin, ore or metal (after July 1, 1893), 4c. per lb.

Tin Plates (after July 1, 1891), 2 2 10c. per lb.

Tobacco, cigar-wrappers, not stemmed, $2 per lb.

Tobacco, if stemmed, $2.75 per lb.

Tobacco, all other leaf, if stemmed, 50c. per lb.

Tobacco, unmanufactured, not stemmed, 35c. per lb.

Tooth-brushes, 40 per cent.

Trees, nursery stock, 20 per cent.

Trimmings, cotton, 60 per cent.

Trimmings, linen, 60 per cent.

Trimmings, lace, 60 per cent.

Trimmings, wool, worsted, etc., 60c. per lb. and 60 per cent.

Towels, linen damask, 50 per cent.

Umbrellas, silk or alpaca, 55 per cent.

Vegetables, natural n. o. p., 25 per cent.

Vegetables, prepared or preserved, 45 per cent.

Velvets, silk, $3.50 per lb. and 15 per cent., but not less than 50 per cent.

Violins, 35 per cent.

Watches, and parts of, 25 per cent.

Water-colors, for artists, 30 per cent.

Wearing Apparel (see note).

Whips, raw hide and leather, 35 per cent

Wheat, 25c. per bushel.

Wicks and Wicking, cotton, 40 per cent.

Willow for basketmakers, 30 per cent.

Willow Hats and Bonnets, 40 per cent.

Willow manufactures n. o. p., 40 per cent.

Wines, champagne, in 1 2 pint bottles or less, $2 per doz.

Wines, champagne, 1-2 pint and not over 1 pint, $4 per doz.

Wines, champagne, 1 pint and not over 1 quart, $8 per doz.

Wines, champagne, over 1 quart, $8 and $2 50 per gallon.

Wines, still, in casks, 50c. per gallon.

Woods, cabinet, sawed, 15 per cent.

Wool, first and second class, 11 and 12c. per lb.

Wool, third class, n. o. p., 50 per cent.

Wool or Worsted Yarns, value not over 30c. per lb., 27 1-2c. per lb. and 35 per cent.

Wool or Worsted Yarns, over 30c. and not over 40c., 33c. per lb. and 35 per cent.

Wool or Worsted Yarns, over 40c., 38 1-2c. per lb. and 40 per cent.

Woolen and Worsted Clothing, 49 1-2c. per lb. and 60 per cent.

Woolen manufactures, n. o. p., value not over 30c. per lb., 33c. per lb. and 40 per cent.

Woolen manufactures, value 30c. and not over 40c, 38 1-2c per lb and 40 per cent.

Woolen manufactures, value 40c. and not over 60c., 44c. per lb. and 50 per cent.

Woolen manufactures, value 60c. and not over 80c., 44c. per lb. and 50 per cent.

Woolen manufactures, value over 80c., 44c. per lb. and 50 per cent.

NOTE.—Personal or household effects of persons arriving in the United States, in use over one year, or of American citizens dying abroad, free. Duty must be paid on all watches but one. Articles and tools of trade, when in actual use, free.

RECIPROCITY SECTION OF THE TARIFF LAW.

In the present or McKinley tariff law, a special section (numbered section 3 in the tariff bill), was inserted, providing for the encouragement of "reciprocal trade" between the United States and other countries. The following is the text of the section relating to reciprocity:

Sec. 3. That with a view to secure reciprocal trade with countries producing the following articles, and for this purpose, on and after the first day of July, 1892, whenever, and so often as the president shall be satisfied that the government of any country producing and exporting sugars, molasses, coffee, tea and hides, raw and uncured, or any of such articles, imposes duties or other exactions upon the agricultural or other products of the United States, which in view of the free introduction of such sugar, molasses, coffee, tea and hides into the United States he may deem to be reciprocally unequal and unreasonable, he shall have the power and it shall be his duty to suspend, by proclamation to that effect, the provisions of this act relating to the free introduction of such sugar, molasses, coffee, tea and hides, the production of such country, for such time as he shall deem just, and in such case and during such suspension duties shall be levied, collected and paid upon sugar, molasses, coffee, tea and hides, the product of or exported from such designated country, as follows, namely:

All sugars not above number thirteen Dutch standard in color shall pay duty on their polariscopic tests as follows, namely:

All sugars not above number thirteen Dutch standard in color, all tank bottoms, syrups of cane juice or of beet juice, melada, concentrated melada, concrete and concentrated molasses, testing by the polariscope not above seventy-five degrees, seven tenths of one cent per pound; and for every additional degree or fraction of a degree shown by the polariscopic test, two hundredths of one cent per pound additional.

All sugars above number thirteen Dutch standard in color shall be classified by the Dutch standard of color, and pay duty as follows, namely:

All sugar above number thirteen and not above number sixteen Dutch standard of color, one and three-eighths cents per pound.

All sugar above number sixteen and not above number twenty Dutch standard of color, one and five-eighths cents per pound.

All sugars above number twenty Dutch standard of color, two cents per pound.

Molasses testing above fifty-six degrees, four cents per gallon.

Sugar drainings and sugar sweepings shall be subject to duty either as molasses or sugar, as the case may be, according to polariscopic test.

On coffee, three cents per pound.

On tea, ten cents per pound.

Hides, raw or uncured, whether dry, salted or pickled, Angora goat-skins, raw, without the wool, unmanufactured, asses' skins, raw or unmanufactured, and skins, except sheepskins with the wool on, one and one-half cents per pound.

TARIFF OR CUSTOMS RATES IN THE UNITED KINGDOM.

In former years the tariff rate list of Great Britain and Ireland embraced more than a thousand articles of merchandise. At present the list includes only *nineteen*, as follows:

	£	*s.*	*d.*
Beer, mum and spruce, the original specific gravity not exceeding 1215 deg., per barrel of 36 galls	1	6	0
Beer, exceeding 1215 deg., per barrel of 36 galls	1	10	6
Beer and Ale, worts of which were before fermentation of a specific gravity of 1055 deg., per barrel of 36 galls....................................	0	6	6
And so in proportion for any difference in gravity.			
Cards (Playing) ....per doz. packs	0	3	9
Chickory, raw or kiln-dried.........................cwt.	0	13	3
Chickory, roasted or ground ....lb.	0	0	2
Chickory and coffee mixed..........................lb.	0	0	2
Chloral hydrate ....lb.	0	1	3
Chloroform ....lb.	0	3	0
Cocoa...lb.	0	0	1
Cocoa husks and shells............................cwt.	0	2	0
Cocoa or Chocolate, ground, prepared or in any way manufactured.......................................lb.	0	0	2
Coffee (raw)..cwt.	0	14	0
Coffee (kiln-dried, roasted or ground)............lb.	0	0	2
Collodion ....gall.	1	4	0
Ether, acetic...lb.	0	1	9
Ether, butyric.......................................gall.	0	15	0
Ether, sulphuric.....................................gall.	1	5	0
Ethyl, Iodide of.....................................gall.	0	13	0
Fruit (almonds and dates free) dried ....cwt.	0	7	0
Naphtha or methylic alcohol (puri.) proof......gall.	0	10	4
Plate (gold).........................every oz. Troy	0	17	0
Plate (silver)..Troy	0	1	6
Soap, transparent, in the manufacture of which spirit has been used.................................lb.	0	0	3
Spirits, or strong waters.................proof gall.	0	10	4
Spirits, Perfumed spirits and Cologne water liquid gall.	0	16	6
Spirits, Liqueurs, Cordials, or other preparations containing spirit in bottle, if not to be tested for ascertaining the strength ....liquid gall.	0	14	0
Tea..lb.	0	0	6
Tobacco, unmanufactured, containing 10 per cent or more of moisture ....lb.	0	3	2
Tobacco, containing less than 10 per cent.........lb.	0	3	6
Tobacco, cigars ....lb.	0	5	6
Tobacco, Cavendish or Negrohead.................lb.	0	4	6
Snuff, not more than 13 lbs. (in 100 lbs.) moisture...lb.	0	4	6
Snuff, containing more than 13 lbs.................lb.	0	3	9
Tobacco, other manufactured ....lb.	0	4	6
Tobacco, Cavendish or Negrohead, manufactured in bond from unmanufactured tobacco............lb.	0	4	6

Varnish (cont. spirit), same as spirits.	£	s.	d.
Wine, not exceeding 30 deg., proof spirit......gall.	0	1	0
Wine, exceeding 30 deg., but not exceeding 42 deg.......gall.	0	2	6
Wine, for each additional degree of strength beyond 42 deg.......gall.	0	0	3
Sparkling Wine, imported in bottle.......gall.	0	2	6
Sparkling Wine, when the market value is proved not to exceed 15s. per gall.......gall.	0	1	0

These duties are in addition to the duty in respect of alcoholic strength.

TARNOW, a town of Austrian Galicia, near the right bank of the Dunajec, a navigable tributary of the Vistula, forty-nine miles east of Cracow by the Vienna and Lemberg Railway. It is the seat of a Catholic bishop, contains a theological college, and a beautiful cathedral, in which are numerous monuments of marble, surmounted by statues, enriched with *bassi rilievi*, and rising to from sixty to seventy feet in height. Several industries are actively carried on, and there is a good general trade Population (including suburbs), 16,400.

TARPEIAN ROCK (Lat. *Rupes Tarpeia*, or *Mons Tarpeius*), the name originally applied to the whole of the Capitoline Hill, but latterly confined to a portion of the southern part of the hill, the following being the legend commonly related in connection with it. In the time of Romulus, Tarpeia (a vestal virgin), the daughter of Sp. Tarpeius, governor of the Roman citadel on the Capitoline, covetous of the golden ornaments on the Sabine soldiery, and tempted by their offer to give her what they wore on their left arms, opened a gate of the fortress to the Sabine king, Titus Tatius, who had come to revenge the rape of the Sabine women. "Keeping their promise to the ear," the Sabines crushed Tarpeia to death beneath their shields, and she was buried in the part of the hill which bears her name. Subsequently, it was not unusual for persons condemned on the charge of aspiring to restore the monarchy, or of treason to the state generally, to be hurled from the Tarpeian Rock—e. g., the famous Manlius, the savior of the capitol during the invasion of the Gauls.

TARRYTOWN, a town of New York. Population in 1890, 3,901. See Britannica, Vol. XII, p. 331.

TARSNEY, JOHN C., member of Congress, born in Michigan in 1845. He attended the common schools until August, 1862, when he enlisted in the 4th Regiment Michigan Infantry, then serving in the Fifth Army Corps; joined the regiment in the field, near Antietam, immediately after the battle of that name; was slightly wounded at the battle of Fredericksburg, and was severely wounded and taken prisoner at the battle of Gettysburg; remained a prisoner of war at Belle Isle, Andersonville, and Millen until the latter part of November, 1864, when, being exchanged, he rejoined his command in front of Petersburg, and participated in the campaign which followed, ending in the surrender at Appomattox; was mustered out of the service in June, 1865, when he entered the High School at Hudson, Mich., and remained in that school until the fall of 1866, when he entered the Law Department of the University of Michigan, from which he graduated March, 1869; practiced law at Hudson, Mich., until 1872, when he removed to Kansas City, Mo.; was city attorney of Kansas City in 1874 and 1875, since which time he has followed the profession of law; was elected to Congress in 1889, and re-elected in 1891.

TASCHEREAU, ELZEAR ALEXANDER, cardinal and archbishop of Quebec, born in 1820, and educated at the Seminary of Quebec. He was ordained priest in 1842, and for twelve years filled the professorship of philosophy in Quebec Seminary, and studied the canon law in Rome for two years. He was made rector of Laval University in 1863. Eleven years later he became archbishop, and in 1887 was created first Canadian cardinal. He unsuccessfully opposed in 1887 the incorporation of the Jesuit Order in Canada.

TASMANIA, one of the Australian states. (For general article see Britannica, Vol. XXIII, pp. 72–75.) The accredited reports of 1889 placed the area at 26,215 square miles, or about 16,778,000 acres, of which 15,571,500 acres are the area of Tasmania proper, the rest being the area of a number of small islands which form two main groups, northeast and northwest. Population in 1889, 151,480, an increase for the year of 3.75 per cent. The population of Hobart, the capital, in 1881 was 21,118, and of Launceston 12,752. At this writing the new census (of 1891) had not been reported.

CONSTITUTION. The parliament of Tasmania, under the acts of 1871 and 1885, consists of a Legislative Council and a House of Assembly. The Council is composed of eighteen members, elected by all natural born or naturalized subjects of the Crown who possess either a freehold worth £20 a year, or a leasehold of £80, or are barristers or solicitors on roll of Supreme Court, medical practitioners duly qualified, and all subjects holding a commission or possessing a degree. Each member is elected for six years. The House of Assembly consists of thirty-six members, elected by all whose names appear on valuation rolls as owners or occupiers of property, or who are in receipt of income of £60 per annum (of which £30 must have been received during last six months before claim to vote is sent in), and who have continuously resided in Tasmania for over twelve months. The Assembly is elected for five years. The number of electors for the Legislative Council in 1889 was 6,420, or 4.31 of the total population, and for the House of Assembly 26,054, or 17.50 of the total population. The legislative authority vests in both Houses, while the executive is vested in a governor appointed by the Crown. The governor is, by virtue of his office, commander-in-chief of the troops in the colony; he has a salary of £5,000 per annum. He is aided in the exercise of the executive by a cabinet of responsible ministers, consisting of four members, as follows: Premier and Chief Secretary, Hon. Philip Oakley Fysh; Treasurer, Hon. Bolton Stafford Bird; Attorney-General, Hon. Andrew Inglis Clark; Minister of Lands and Works, Hon. Alfred Pillinger. Each of the ministers has a salary of £900 per annum. The position of premier has a salary of £200 per annum in addition. The ministers must have a seat in either of the two Houses. The present governor (1891) is Sir G. C. Hamilton, appointed in 1887.

EDUCATION. There were, in January, 1891, sixteen high schools or colleges in Tasmania, with an average attendance of 1,297; 229 public elementary schools, with 17,948 scholars on roll; and 88 private schools, with 3,542 scholars. Education is compulsory. There were also 596 children attending ragged schools. Two technical schools were started in 1888 at Hobart and Launceston. The higher education is under a university, who hold examinations and grant degrees, being at present merely an examining body. Elementary education is under the control of a director working under a ministerial head. There are several valuable scholarships from the lower to the higher schools.

REVENUE, EXPENDITURES, DEBT, AND TRADE. The revenue in 1891 was estimated at £808,346, and the expenditures at £793,206. The public debt on January 31, 1890, was £5,019.050 (raised, chiefly, for the construction of public works), consisting of 3½ and 4 per cent. debentures. There are large customs duties, those in 1889 amounting to £309,762, or over 19 per cent. of the imports. The imports of 1889 were valued at £1,611,035, the exports £1,459,857. In 1889, 842 vessels (of 458,247 tons) were entered. For Religion and Railways see those topics in these Revisions and Additions.

TASMAN SEA, the new name adopted by the Australasian Association (at their third annual meeting held in Christchurch, New Zealand, Jan. 15, 1891) for the sea between Australia and New Zealand

TASSISUDON, the capital of Bhotan, on the right bank of the Godadda, an affluent of the Brahmaputra. Many of the inhabitants, whose number has not been ascertained, are employed in manufacturing paper, and in making brass images and ornaments for their places of worship.

TATTA, a town of Sinde, on the right bank of the Indus, and at the head of the delta of that river, sixty-four miles east of Kurrachi. In former times Tatta was a most flourishing town, and manufactured fabrics of silk and cotton—a branch of industry that has almost wholly disappeared. The only noticeable structure is the mosque of Shah-Jehan, built of brick, and is now falling into decay; but the vast cemetery of Tatta deserves mention. It has an area of six square miles, contains, it is calculated, at least a million tombs, and has room for not less than four millions. Population of Tatta, about 10,000.

TAUCHNITZ, KARL CHRISTOPH TRAUGOTT, a famous German printer and bookseller, born at Grosspardau, near Leipzig, in 1761, died in 1836. In 1809 he began the issue of a series of editions of the classic authors, the elegance and cheapness of which gave them a European circulation. By offering a prize of a ducat for every error pointed out, he was able to bring out, in 1828, an edition of Homer of extraordinary correctness. He was the first to introduce (1816) stereotyping into Germany; and he also applied it to music, which had not been attempted before. In the latter years of his busy life he stereotyped the Hebrew Bible, and the Koran in the original Arabic. On his death the business was continued by his son, KARL CHRISTIAN PHIL. TAUCHNITZ.—A nephew of the elder Tauchnitz, CHRISTIAN BERNH. TAUCHNITZ, also set up a publishing establishment in Leipzig, combined with printing. Among the most noted of his undertakings is the issue of "British Authors" (begun 1842), so well known to all English travelers on the continent, of which upward of 1,000 volumes had appeared in 1870.

TAUNTON, a city of Massachusetts. Population in 1890, 25,448. See Britannica, Vol. XXIII, p. 83.

TAXICORNES, a family of coleopterous insects, of the section Heteromera, having the body generally square; the thorax either concealing or receiving the head; the antennæ short; and the legs adapted for running. Most of them are found in fungi and beneath the bark of trees. They are widely distributed over the world.

TAYLOR, ABNER, member of Congress from Illinois, born in Maine. He has been in active business all his life, as contractor, builder, and merchant; the only office he ever held was that of member of the State Legislature for one term; was a delegate to the national Republican convention in 1884; was elected to Congress in 1889, and re-elected in 1891.

TAYLOR, ALFRED ALEXANDER, member of Congress, born in Tennessee in 1849. He was educated at Pennington, N. J.; read law, and was admitted to the bar in 1870; was elected to the Legislature in 1875; was nominated for governor of Tennessee in 1886, and was defeated by his brother, Robert L. Taylor; was elected to Congress in 1889, and re-elected in 1891.

TAYLOR, COL. CHARLES H., an American journalist, born in Charlestown, Mass., July 14, 1846. He began industrial life doing chores and learning to set type on the *Massachusetts Ploughman*, at a salary of $2 per week. Later he changed to the office of the *Boston Traveler*, remaining there until 1861, when he enlisted in the 38th Massachusetts Union Regiment. A year and a half later he was wounded in battle and discharged, returning to the office of the *Traveler* where he was placed on the reportorial staff. By diligent application and overtime work he soon succeeded in mastering shorthand as well as becoming a more facile writer for the press In 1866 he was sent to report a meeting of the Anti-Slavery Society. Believing that the speeches would prove to be of special interest to the public he reported them in full, including that of William Lloyd Garrison. His report being declined by the Boston press, Mr. Taylor forwarded it to the *New York Tribune*, where it was accepted, and a check for it returned by the next mail, with an invitation to become the regular Boston correspondent of the *Tribune*. His articles in the *Tribune* awakened notable attention and brought him the ensuing year a return of $4,000. In 1872 he was a member of the House of Representatives, and in 1873 was elected Clerk of the House, a position which he held for eleven years. During this time he became manager of the Boston *Globe*, the paper having, when he took charge of it, a circulation of 12,000 copies. Under his management and enterprise the circulation rapidly increased, and in 1890 reported a guaranteed daily issue of 155,937 copies, with a Sunday issue of 147,707 copies. Colonel Taylor's son, C. H. Taylor, jr., a graduate of Harvard University, inherits his father's talent for journalism, and gives promise, in that line, of a most successful future.

TAYLOR, EZRA B., member of Congress, born at Nelson, Ohio, July 9, 1823. He was admitted to the bar in 1845; except while on the bench and in the army has practiced his profession ever since; was elected to fill a vacancy in Congress in 1879, and has since been continuously re-elected; his present term expires in 1893.

TEKELI, EMERIC, COUNT, a celebrated Hun-

garian patriot, descended from a noble Lutheran family, born at the castle of Kasmark, in the county of Zips, in 1656, died at Constantinople in 1705. His wife, Helena, the widow of Ragotsky, was celebrated all over Europe for her beauty, but was no less distinguished for her heroic gallantry, as was proved by her obstinate defense of her castle of Mongatz against an army of Imperialists.

TELEGRAPHS IN THE UNITED STATES.

Lines.	Miles of Wire.	Miles of Poles and Cables.	No. of Offices.	No. of Employes.
Western Union	678,997	183,917	19,382	30,000
Postal	29,500	6,200	1,598	5,300
United States Government	3,000	3,000	55	90
Deseret	1,092	963	56	57
Smaller Lines	95,000	60,000	4,500	7,000
Total	807,589	254,180	25,591	42,447

THE WESTERN UNION TELEGRAPH COMPANY.

Statement exhibiting the mileage of lines operated, number of offices, number of messages sent, receipts, expenses and profits, for each year since 1868.

Year	Miles of Poles & Cables	Miles of Wire.	Offices	Messages	Receipts	Expenses	Profits
1868	50,183	97,594	3,219	6,404,595	$7,004,560	$4,362,849	$2,641,711
1869	52,099	104,584	3,607	7,934,933	7,316,918	4,568,117	2,748,801
1870	54,109	112,191	3,972	9,157,646	7,138,737	4,910,772	2,227,965
1871	56,032	121,151	4,606	10,646,077	7,637,448	5,104,787	2,532,661
1872	62,033	137,190	5,237	12,444,499	8,457,095	5,666,863	2,790,232
1873	65,757	154,472	5,740	14,456,832	9,333,018	6,575,056	2,757,962
1874	71,585	175,735	6,188	16,329,256	9,262,653	6,755,733	2,506,920
1875	72,833	179,496	6,565	17,153,710	9,564,574	6,335,414	3,229,157
1876	73,532	183,832	7,072	18,729,567	10,034,983	6,635,473	3,399,510
1877	76,955	194,323	7,500	21,158,941	9,812,352	6,672,224	3,140,128
1878	81,002	206,202	8,014	23,918,894	9,861,355	6,309,812	3,551,543
1879	82,987	211,566	8,534	25,070,106	10,960,640	6,160,200	4,800,440
1880	85,645	233,534	9,077	29,215,509	12,782,894	6,948,957	5,833,937
1881	110,340	327,171	10,737	32,500,000	14,393,543	8,485,264	5,908,279
1882	131,060	374,368	12,068	38,842,247	17,114,165	9,996,095	7,118,070
1883	144,294	432,726	12,917	41,181,177	19,454,903	11,794,553	7,660,350
1884	145,037	450,571	13,761	42,076,226	19,632,939	13,022,504	6,610,435
1885	147,500	462,283	14,184	42,096,583	17,706,833	12,005,909	5,700,924
1886	151,832	489,607	15,142	43,289,807	16,298,639	12,378,783	3,919,855
1887	156,814	524,641	15,658	47,394,530	17,191,910	13,154,628	4,037,281
1888	171,375	616,248	17,241	51,463,955	19,711,164	14,640,592	5,070,572
1889	178,754	647,697	18,470	54,108,326	20,783,194	14,565,152	6,218,041
1890	183,917	678,997	19,382	55,878,762	22,387,029	15,074,304	7,312,725

The average toll per message in 1868 was 104.7, in 1880 was 31.2, in 1890 was 32.4. The average cost per message to the company in 1868 was 63.4, in 1880 was 22.1, in 1890 was 22.7.

TELEGRAPH STATISTICS OF THE WORLD.

Countries.	Year.	Miles of Lines.	Miles of Wires.	Number of Messages.
Algeria	1888	7,000	16,000	
Argentine Republic	1889	14,700	28,550	3,511,426
Austria-Hungary	1888	38,159	111,532	13,240,642
Belgium	1889	4,013	19,030	7,266,634
Bolivia	1889	180		16,127
Brazil	1889	6,300	11,190	567,935
Bulgaria	1888	2,750		6?0,695
Canada	1889	29,460	61,219	4,061,381
Cape of Good Hope	1889	4,339		1,053,949
Chili	1889	10,600		572,333
Columbia	1888	2,800		......
Costa Rica	1888	600		112,653
Cuba	1889	2,810		......
Denmark	1889	3,674	10,280	
Dutch East Indies	1887	6,556	......	396,966
Ecuador	1889	1,200		
Egypt	1889	3,172	5,423	666,869
France	1889	51,560	241,800	29,511,000
Germany	1888	57,763	186,733	17,782,323

TELEGRAPH STATISTICS — CONTINUED.

Countries.	Year.	Miles of Lines.	Miles of Wires.	Number of Messages.
Great Britain and Ireland	1889	30,726	183,502	57,765,347
Greece	1889	4,362	5,062	936,636
Guatemala	1888	1,925	......	457,009
Hawaii	1888	250	......	......
Honduras	1889	1,800	......	......
India, British	1888	31,894	91,517	2,807,617
Italy	1889	19,460	73,160	8,572,671
Japan	1888	6,164	......	2,564,514
Luxemburg	1889	1,653	......	......
Mexico	1889	27,861	......	......
Montenegro	1889	280	......	......
Netherlands	1889	3,100	10,850	4,059,674
New South Wales	1889	12,000	22,219	3,410,417
New Zealand	1889	4,962	11,617	1,765,860
Nicaragua	1888	1,700	......	
Norway	1889	5,638	10,289	1,314,583
Orange Free State	1889	1,120	......	......
Paraguay	1889	100	......	......
Persia	1889	3,624	6,123	......
Peru	1878	1,382	......	......
Philippine Islands	1889	720	......	......
Porto Rico	1889	470	......	......
Portugal	1885	3,210	7,168	1,730,107
Queensland	1889	9,167	16,648	1,284,438
Roumania	1883	3,271	8,084	1,317,689
Russia	1888	88,280	172,300	10,477,049
Salvador	1888	1,440	......	......
Servia	1889	1,510	3,000	471,126
Siam	1889	1,000	......	......
South Australia	1889	5,500	11,448	......
Spain	1887	11,512	28,870	3,549,860
Sweden	1889	5,120	13,346	1,430,481
Switzerland	1888	4,340	10,540	3,000,000
Tasmania	1889	1,894	2,505	271,769
Transvaal	1889	1,250	......	......
Tunis	1889	2,000		......
Turkey	1889	15,000	......	......
United States	1890	254,110	807,589	80,000,000
Uruguay	1889	2,234	......	148,166
Venezuela	1888	3,000		408,514
Victoria	1889	4,194	10,360	2,743,338
Western Australia	1889	2,385	2,659	180,735
Total		842,812	...	......

The number of telegraphic messages annually transmitted may be estimated at 300,000,000.

The greatly increased mileage since 1880 is principally due to the fact that in 1881 the Western Union Telegraph Company absorbed by purchase all the lines of the American Union and the Atlantic and Pacific Telegraph Company, the former having previously in operation over 12,000 miles of line, and the latter 8,706 miles. Capital stock of the Western Union $86,200,000.

The Western Union has exclusive contracts with several International Cable Companies, operating eight Atlantic cables, and guarantees 5 per cent. annual dividends on the stock of the American Cable Company; amount, $14,000,000.

Besides the above, there are many new lines of Telegraph, which have complied with the United States Telegraph Act of 1866, and are operating wires with or without connection with railway companies.

The Mutual Union Telegraph Company, of the United States, established in 1881, has about 8,000 miles of line, 60,000 miles of wire, 1,200 offices, and has extended its lines north and south, operating already from Boston to Chicago, St Louis, Washington, etc. Capital stock, $2,500,000. This line is now leased and operated by the Western Union Telegraph Company.

The Baltimore and Ohio Railroad Telegraph, having lines coëxtensive with its railway system and branches, besides many newly extended wires south and west, constituting 6,711 miles of line and 54,087 miles of wire, was purchased for $5,000,000 in 1887 by the Western Union Company, which now owns and operates it.

The Bankers and Merchants' Telegraph Company, New York, organized March 23, 1881, has about 4,000 miles of line, 28,300 miles of wire, and is in operation to many leading points. Capital authorized, $3,000,000. Debt about $7,500,000, as stated in August, 1884. Sold in foreclosure, July 31, 1885, and now operated by the United Lines of Telegraph.

The American Rapid Telegraph Company, New York to Boston, Philadelphia, Baltimore, Washington, Buffalo, etc., with capital stock of $4,000,000. Has been leased by the Western Union Company.

The Postal Telegraph and Cable Company, of New York, organized June 21, 1881, has about 1,500 miles of line, and 4,500 miles of wire in operation, from New York to Chicago, etc., and owns what are claimed to be very valuable patents in improved wires and telegraphy. Authorized capital stock, $21,000,000, of which about $7,000,000 has been issued. Now operated by the United Lines of Telegraph.

The aggregate mileage of telegraph lines in the United State open for public business exceeds 190,000 miles, besides railway, government, private, and telephonic lines, length not ascertainable.

TELEOSAURUS, a genus of fossil crocodiles, whose remains occur in the oölitic rocks. They are found associated with marine fossils, and the peculiar modification of their skeleton seems to have specially fitted them for an aquatic life. Both surfaces of the vertebræ were slightly concave, the hind legs were large and strong, and the anterior portion of the body gradually tapered into the long and slender jaws, which were armed with numerous equal and slender teeth, slightly recurved, and admirably adapted for the capture f fishes, with which the oölitic seas abounded. No less than twenty species have been described.

TELEPHONES, IN THE UNITED STATES. The following are the latest statistics made public by the American Bell Telephone Company, which practically monopolizes the telephone business in the United States:

	1888.	1889.	1890.
Exchanges	739	742	757
Branch offices	452	452	471
Miles of wire on poles	127,839	142,631	154,009
Miles of wire on buildings	10,225	10,266	11,484
Miles of wire underground	8,009	17,038	27,117
Miles of wire submarine	365	536	603
Total miles of wire	146,438	170,471	193,213
Total circuits	132,004	143,687	156,780
Total employes	6,183	6,310	6,758
Total subscribers	158,712	171,454	185,003

The number of instruments in the hands of licensees under rental at the beginning of 1890 was 444,861. The number of exchange connections daily in the United States is 1,240,147, or a total per year of over 400,000,000. The average number of daily calls per subscriber is 6.13. The company received in rental of telephones in 1889, $2,657,361. It paid its stockholders in dividends in 1889, $1,838,913.

The Bell Company and its subsidiary companies represent about $80,000,000 of capital; the Long-Distance Telephone Company about $5,000,000.

TELEPHONING LONG DISTANCES. In April, 1891, a telephone line was opened for public use between Paris and London, a distance of 297 miles. There has been telephoning over much greater distances in the United States since 1883, when conversation was carried on between New York and Cleveland, a distance of 650 miles, and since then communication has been obtained between Boston and Chicago (1,000 miles). At the time of the great blizzard of 1888, the only direct means of communication between Boston and New York for several days was over along distance telephone wire, which withstood the storm that prostrated all the other lines. A charge of two dollars is made for three minutes' use of the wire between the English and French capitals. For general article on the telephone see Britannica, Vol. XXIII, pp. 127, 135.

TELESCOPES. For general subject see illustrated article in Britannica, Vol. XXII, pp. 135-154. Alvan Clark & Sons, of Cambridgeport, Mass., constructed in 1860 a telescope of eighteen and one-half-inch aperture, then the largest refractor known. It was originally intended for the University of Mississippi, but, being prevented by the Civil War from reaching its destination, it was purchased by the Chicago Astronomical Society and mounted at the Dearborn Observatory. In 1873, the Clarks completed a twenty-six-inch refractor for the U. S. Naval Observatory at Washington, the contract price for which was $46,000. At the same time they made for Mr. Leander McCormick an objective of a slightly larger aperture, which they mounted in 1883 at the University of Virginia. In 1879 the Clarks entered into a contract with the Russian government to furnish an objective glass of thirty inches, and in 1880 with the trustees of the Lick Observatory for one of thirty-six inches. The glass for these large lenses comes either from Birmingham, England, or from Paris, France. The makers experienced great difficulties in obtaining disks of the requisite degree of purity, particularly in the case of the thirty-six-inch crown-glass disk, which involved nearly three years' labor and nineteen failures, before a suitable piece was obtained. Of smaller objectives the Clarks have made a great number, some sixty or more, between the apertures six and twelve inches.

The mounting for the thirty-inch Pulkowa (Russian) objective was made by a firm of Hamburg, Germany, and that for the Lick lens by Warner & Swasey, of Cleveland, Ohio. The eye end of the Lick telescope is provided with a fine position micrometer made by Tauth & Co., and a stellar spectroscope made by Brashear. For use as a photographic telescope, a third (crown) lens of thirty-three-inch clear aperture is mounted in front of the objective, its application shortening the focal length of the telescope by ten feet. It i very desirable to have means by which the ordinar visual objective can be readily transformed into photographic objective, in order to correct th chromatic aberration. The third (photographic) lens is removed when direct observations are to be made.

Following is a list of the largest reflecting telescopes, and another list of the largest refracting telescopes of the world:

LIST OF THE LARGEST REFLECTORS IN THE WORLD.

Observatory or Owner.	Aperture.		Constructed by
	Centimeters.	In.	
Lord Rosse, Birr Castle, Ireland	183	72	Lord Rosse, 1844.
Bessemer, London	128	50½	Bessemer.
Sir W. Herschel, Slough	122	48	Herschel.
Lassell, Liverpool	122	48	Lassell, 1860 (destr'd).
Melbourne Observatory	122	48	Grubb, 1870.
Paris Observatory	120	47	Martin. Eichens, 1876.
Common, Ealing	94	37	Calver and Common, 1879.
Lord Rosse, Birr Castle	91½	36	Lord Rosse.
Toulouse Observatory	85	33½	Henry. Secretan.
Marseilles Observatory	80	31½	Foucault, Eichens.
Harvard College Observatory	71	28	H. Draper.

LIST OF THE LARGEST REFRACTORS IN THE WORLD.

Observatory or Owner.	Aperture.		Constructed by
	Centimeters.	In.	
Lick Observatory, Mt. Hamilton, Cal	91½	36	Clark, Warner and Swasey, 1887.
Pulkowa	76	30	Clark, Repsold, 1884.
Nice	76	30	Henry, Gautier, 1886.
Greenwich	71	28	Grubb.
Paris	73½	27	Martin (Eichens)
Vienna	68½	27	Grubb.
McCormick Observatory	66	26	Clark, 1883.
Washington	66	26	Clark, 1873.
Newell, Gateshead, Eng.	63½	25	Cooke, 1868.
Princeton	58½	23	Clark, 1881.
Strasburg	48½	18	Merz, Repsold, 1879.
Milan	48½	18	Merz, 1879.
Dearborn Observatory (near Chicago)	47	18½	Clark, 1863.
Dr. Van Duzee, Buffalo.	40½	16	Fitz.
Warner Observatory, Rochester	40½	16	Clark, 1880.
Carleton College Observatory, Minn	40½	16	Brashear.
Washburn Observatory, Madison, Wis	39½	15½	Clark, 1879.
Dun Echt Observatory, (Lord Lindsay)	38½	15$\frac{1}{16}$	Grubb, 1875.
Harvard College Observatory	38	14	Merz, 1843.
Pulkowa Observatory	38	14	Merz, 1840.
Paris Observatory	38	14	Lerebours, Brunner, 1854.
Lisbon Observatory	38	14	Merz, Repsold, 1861.
Huggins, London	38	15	Grubb, 1871.
Brussels Observatory	38	14	Merz, Cooke, 1880.
Bordeaux Observatory	38	14	Merz, Eichens, 1880.
Litchfield Observatory, Clinton, N. Y	34	13½	Spencer and Eaton.
Markree Castle, Ireland.	34	13½	Cauchoix, Grubb, 1834.
Columbia College, New York	33	13	Rutherfurd.
Dubley Observatory, Albany	33	13	Fitz.
Harvard College Observatory	33	13	Clark.
Catania-Etna	32½	12	Merz, 1877.
Greenwich	32½	12¾	Merz, Trouton and Simms, 1860.
Ann Arbor, Mich	32	12½	Fitz.
Vassar College, Poughkeepsie, N. Y	31½	12¼	Fitz (reworked by Clark).
Morrison Observatory	31	12¼	Clark, 1876.
Oxford, England	31	12⅛	Grubb, 1875.
Cambridge, England	30½	12	Cauchoix.
Dublin, Ireland	30½	12	Cauchoix.
Radcliffe Observatory, Oxford	30½	12	Cauchoix.
Middletown, Conn	30½	12	Clark, 1869.
S. V. White, Brooklyn, N. Y	30½	12	Clark (reworked, 1867).
Alleghany, Pa	30½	12	Fitz (reworked by Clark, 1874).
Harvard College Observatory	30½	12	Clark, 1888.
U. S. Military Academy, West Point	30½	12	Clark, 1884.
Lick Observatory, Cal	30½	12	Clark, 1881.
Vienna	30½	12	Clark, 1876.

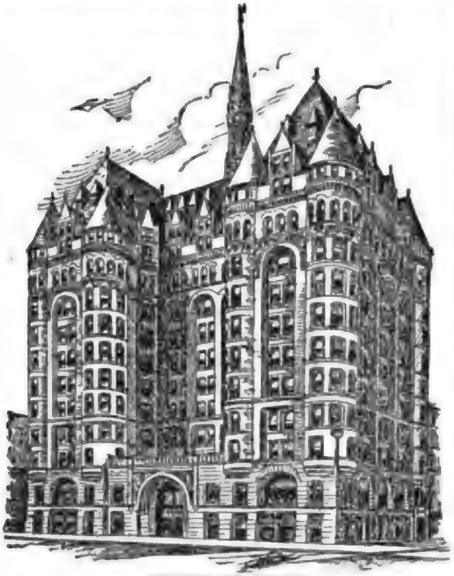
TELLER, HENRY M., United States senator, born in Alleghany county, N. Y., May 23, 1830. He studied law, was admitted to the bar in New York, and has since practiced; removed to Illinois in 1858, and thence to Colorado in 1861; was elected to the United States Senate (on the admission of Colorado as a state), and took his seat Dec. 4, 1876; was re-elected Dec. 11, 1876, and served until April 17, 1882, when he was appointed Secretary of the Interior by President Arthur, and served until March 3, 1885; was again elected to the United States Senate, and took his seat March 4, 1885. His present term expires in 1897.

TEMBU, ABATEMBU, or TAMBOOKIE, the name of an important tribe of Kaffirs, occupying the region east of the present boundary of the Cape Colony, where it forms the eastern limit of the district of Queenstown, formed by Sir Harry Smith, in 1849, 1850, a rather elevated plateau, from which flow the headwaters of the Kei, Bashee, Tsomo, and other important rivers. They number about 90,000 souls, and are of a less warlike and predatory nature than the adjoining tribes of the Amaxosa and Amagaleka Kaffirs. They have located themselves in the unoccupied country east of the White Kei and Tsomo Rivers, a good pastoral region, but rather bare of wood.

TEMPERANCE REFORM. See TEMPERANCE SOCIETIES, in Britannica, Vol. XXII, pp. 158–160.

TEMPERANCE TEMPLE. This temple, now approaching completion, is one of the notable buildings of Chicago. The corner-stone was laid in the presence of a large audience Nov. 1, 1890, with imposing ceremonies, conducted by Miss Frances Willard, president of the Women's National Christian Temperance Union, and her associates in the executive administration of that society. The edifice is to cost $1,100,000, and is to be completed by May 1, 1892. Its foundation measures 190 feet on LaSalle street, and 96 feet on

Monroe street. The edifice is thirteen stories high, including ten stories from the ground level to the cornice, and three stories above that line. The subjoined accredited description has been kindly furnished for insertion:



TEMPERANCE TEMPLE.

It will be a steel, fire-proof building, the first two stories being faced with a rich, dark red granite, and the remaining stories to the cornice with a fine pressed brick, made to order, of a new and corresponding tint. The architecture is described as French Gothic. The LaSaile street front bears a very striking resemblance to the Adams street front of the Pullman Building. Its general ground plat is somewhat in the shape of the letter H. The building consists of two immense wings united by a narrower middle portion, called a vinculum. In this wing there will be a central court, 70 feet long and 30 feet deep, on the LaSalle street front, and a similar court 18 feet deep on the west side of the building, designed to admit light and promote ventilation, as well as a feature of beauty. The LaSalle street front will be made continuous by a lofty stone arch, which will span the court and form the main entrance. The four corners presented to LaSalle street will receive a rounded turret treatment, and the intermediate windows in the front of each wing will be grouped under a broad arch on the next story. The steep roof is broken into terraces, marking the three stories above the cornice, each of which has its strikingly beautiful gothic windows. From the roof of the vinculum rises a graceful gold bronze fleche to the height of 70 additional feet, surmounted with a symbolical figure of a woman with face upturned and arm outstretched, as if in prayer. The architectural effect of the whole design, therefore, is not a little temple-like.

In the interior this great building will be fully as much like a temple of mammon as a temple of temperance. The basement will probably contain a restaurant. The first floor has already been rented to three banks, with the exception of a large room at the southwest corner of the building and a broad hall leading to it from an entrance on Monroe street, near the northern corner of the building. This reserved room is to be called Willard Hall. It is to be the trysting place of the temperance advocates of the world. It is to be beautified with fountains, statuary, paintings and relics, and from it is to ascend daily for all time to come the incense of prayer for the abatement of the liquor evil. Even the broad hallway leading to it is to be lined with marble and emblazoned with memorials of the temperance conflict. A considerable portion of the upper floors, not yet selected, will be used for the other work of the Women's Christian Temperance Union; but, with these exceptions, everything, from cellar to garret, is to be rented for business purposes. To add to its eligibility, every conceivable modern convenience will be provided, and, among other things, eight great elevators.

This enterprise, under the auspices of the Women's National Christian Union, was specially conducted by the Women's Building Association, of which Mrs. Matilda B. Carse was the head. The association proposes to raise the money, or, as it claims, has already raised it, by the sale of $600,000 worth of stock, and a loan of $500,000, for which bonds have been issued, secured on the property. But the stockholders are under obligations to sell their stock to the association at any time within twelve years, and in this way the women intend to own the whole outfit in a short time. The process of raising money for this purpose is going on incessantly through the "Union Signal," which is pressing into service many women and children in the United States as collectors and contributors. There is no doubt of ultimate success in this colossal financial venture. The building, when completed, is expected to bring a revenue of $250,000 per annum.

TEMPLATE, a mold in wood or metal, showing the outline or profile of moldings, from which mold the workmen execute the molding.

TEMPLEMORE, a market town of the county of Tipperary, province of Munster, Ireland, situated on the right bank of the River Suir, nine miles north of Thurles. Although without manufactories of any note, Templemore has some considerable share of inland traffic. It is a station on the Great Southern and Western Railway, seventy-nine miles distant from Dublin. The public buildings, one of which is an extensive barrack, are substantial, but without any noteworthy architectural character. The population in 1871 was 3,443, of whom almost all were Roman Catholics.

TENDA COL DE, a pass over the maritime Alps.

TENDER, in naval language, a small vessel appointed for the service of a larger one. Steam gunboats are most commonly employed as tenders.

TENEDOS (Turk. *Bogdsha-Adassi*), an island belonging to Turkey, in the northeast of the Ægean Sea, off the coast of the Troad, about seventeen miles south of the western entrance to the Strait of the Dardanelles. It is about five miles long by two broad, rocky, but not unproductive, with a population of more than 6,000, who are partly Greeks and partly Turks. The chief town, also called Tenedos, or Bogdsha, on the northeast coast, is the seat of a Greek bishop and Turkish aga, and carries on an active trade in wine.

TENES, a rising seaport of Algeria, 100 miles west of the city of Algiers. It is happily situated for commerce, is the entrepot for Orléansville, and the depot for the supply of the army with provisions. It is at once fortunate in the agricultural resources of its territory, in its mineral wealth, and its position in respect to transit-trade. The population of the commune is about 8,000.

TENNESSEE, State of. For general article on Tennessee, see Britannica, Vol. XXIII, pp. 176–179. The census of 1890 reports the area and population as follows: Area, 42,050; population, 1,767,518, an increase during the decade of 225,159. Capital, Nashville, with a population of 76,168. The following table gives the population of the cities and towns of the State. which in 1890 had each over 8,000 inhabitants; also their population in 1880, and their ratio of increase:

CITIES AND TOWNS.	1890.	1880.	Increase	Per Cent.
Chattanooga	29,100	12,892	16,208	125.72
Jackson	10,039	5,377	4,662	86.70
Knoxville	22,535	9,693	12,842	132.49
Memphis	64,495	33,592	30,903	92.00
Nashville	76,168	43,350	32,818	75.70

AREAS AND POPULATION BY COUNTIES. The land areas in square miles, and the population, severally, of the counties of the state were as follows in 1890:

COUNTIES.	Area sq. m.	Population 1890.	Population 1880.
Anderson	360	15,128	10,820
Bedford	520	24,739	26,025
Benton	412	11,230	9,780
Bledsoe	300	6,134	5,617
Blount	614	17,589	15,985
Bradley	280	13,607	12,124
Campbell	488	13,486	10,005
Cannon	280	12,197	11,859
Carroll	600	23,630	22,103
Carter	298	13,389	10,019
Cheatham	400	8,845	7,956
Chester	288	9,069	......
Claiborne	472	15,103	13,373
Clay	260	7,260	6,987
Cocke	458	16,523	14,808
Coffee	360	13,827	12,894
Crockett	260	15,146	14,109
Cumberland	275	5,376	4,538
Davidson	508	108,174	79,026
Decatur	310	8,995	8,498
De Kalb	310	15,650	14,813
Dickson	620	13,645	12,460
Dyer	495	19,878	15,118
Fayette	630	28,878	31,871
Fentress	510	5,226	5,941
Franklin	570	18,929	17,178
Gibson	610	35,859	32,685
Giles	656	34,957	36,014
Grainger	294	13,196	12,384
Greene	580	26,614	24,005
Grundy	410	6,345	4,592
Hamblen	150	11,418	10,187
Hamilton	440	53,482	23,642
Hancock	260	10,342	9,098
Hardeman	640	21,029	22,921
Hardin	560	17,698	14,793
Hawkins	490	22,246	20,610
Haywood	570	23,558	26,053

AREA AND POPULATION — continued.

COUNTIES.	Area sq. m.	Population 1890.	Population 1880.
Henderson	530	16,336	17,430
Henry	580	21,070	22,142
Hickman	648	14,499	12,095
Houston	210	5,390	4,295
Humphreys	420	11,720	11,379
Jackson	280	13,325	12,008
James	210	4,903	5,187
Jefferson	310	16,478	15,846
Johnson	340	8,858	7,766
Knox	520	59,557	39,124
Lake	210	5,304	3,968
Lauderdale	450	18,756	14,918
Lawrence	676	12,286	10,383
Lewis	280	2,555	2,181
Lincoln	540	27,382	26,960
Loudon	256	9,273	9,148
McMinn	452	17,890	15,064
McNairy	550	15,510	17,271
Macon	332	10,878	9,321
Madison	520	30,497	30,874
Marion	500	15,411	10,910
Marshall	350	18,906	19,259
Maury	600	38,112	39,904
Meigs	200	6,930	7,117
Monroe	580	15,329	14,283
Montgomery	540	29,697	28,481
Moore	170	5,975	6,233
Morgan	448	7,639	5,156
Obion	540	27,273	22,912
Overton	360	12,039	12,153
Perry	420	7,785	7,174
Pickett	240	4,736	......
Polk	400	8,361	7,269
Putnam	430	13,683	11,501
Rhea	360	12,647	7,073
Roane	450	17,418	15,237
Robertson	538	20,078	18,861
Rutherford	580	35,097	36,741
Scott	620	9,794	6,021
Sequatchie	252	3,027	2,565
Sevier	560	18,761	15,541
Shelby	728	112,740	78,430
Smith	368	18,404	17,799
Stewart	500	12,193	12,690
Sullivan	410	20,879	18,321
Sumner	536	23,668	23,625
Tipton	404	24,271	21,033
Trousdale	166	5,850	6,646
Unicoi	196	4,619	3,645
Union	220	11,459	10,260
Van Buren	322	2,863	2,933
Warren	446	14,413	14,079
Washington	344	20,354	16,181
Wayne	720	11,471	11,301
Weakley	620	28,955	24,538
White	390	12,348	11,176
Williamson	550	26,321	28,313
Wilson	536	27,148	28,747

GOVERNORS OF TENNESSEE. The following is a complete list of the governors of the state, with the periods and dates of service:

"STATE OF FRANKLIN."
John Sevier, 1785–1788.

TERRITORY OF TENNESSEE.
William Blount, 1790–1796.

STATE OF TENNESSEE.

John Sevier, 1796–1801.
Archibald Roane, 1801–03.
John Sevier, 1803–09.
William Blount, 1809–15.
Joseph McMinn, 1815–21.
William Carroll, 1821–27.
Samuel Houston, 1827–29.
William Carroll, 1829–35.
Newton Cannon, 1835–39.
James K. Polk, 1839–41.
James C. Jones, 1841–45.
Aaron V. Brown, 1845–47.
Neill S. Brown, 1847–49.
William Trousdale, 1849–51.
William B. Campbell, 1851–53.
Andrew Johnson, 1853–57.
Isham G. Harris, 1857–62.
Andrew Johnson, 1862–65.
Wm. G. Brownlow, 1865–69.
De Witt C. Senter, 1869–71.
John C. Brown, 1871–75.
James D. Porter, 1875–79.
Albert S. Marks, 1879–81.
Alvin Hawkins, 1881–83.
Wm. B. Bate, 1883–87.
Robert L. Taylor, 1887–91.
John P. Buchanan, 1891–93.

The governor's salary is $4,000.

Brief Historic Outline. Tennessee was early claimed by North Carolina as a part of her territory. In 1757 Fort Loudon was erected on the Tennessee River. The North Carolina people settled in the Holston River region. Other early settlers came from Virginia and South Carolina. In the Revolutionary War the settlers joined the patriots, and in 1776 fought with and signally defeated the Indians. Early in 1785 the settlers in East Tennessee formed a state government of their own, naming their new state Franklin or Frankland, and holding their first legislature later in the same year. On June 1, 1796, a state constitution was adopted, and the new state was admitted into the Union. Knoxville became the capital. An ordinance of secession was adopted. Numerous severe battles were fought during the Civil War. In April, 1865, the legislature ratified the Thirteenth Amendment, and July 15th the Fourteenth Amendment.

Progress of population in Tennessee by decades: In 1790, 35,691; 1800, 105,602; 1810, 261,727; 1820, 422,771; 1830, 681,904; 1840, 829,210; 1850, 1,002,717; 1860, 1,109,801; 1870, 1,258,520; 1880, 1,542,359; 1890, 1,767,518.

For numerous other items of interest relating to the State of Tennessee, see the article United States in these Revisions and Additions.

TENNIEL, John, artist, born in 1820. Showing the possession of artistic taste at an early age, he may be considered as entirely self-taught. He was a successful candidate in one of the cartoon competitions for the decoration of Westminster Hall, and painted a fresco for the Palace at Westminster. His illustrations of books, although not comprising many, have always been characterized by great taste. When *Alice in Wonderland* made its appearance, some portion of the notice it obtained may fairly be attributed to his illustrations of the book. In 1851 he joined the staff of "Punch," with which newspaper he has since been connected, and for which he draws the cartoon. Many of his sketches have obtained world-wide notice by this means, among the most famous of his recent cartoons being one that appeared in March, 1890, entitled *Dropping the Pilot.* The original of this sketch, which had reference to the resignation of Prince Bismarck, was purchased by the Earl of Rosebery and presented to the ex-chancellor.

TENNYSON, Alfred, Baron (creat. 1884), the son of Rev. George Clayton Tennyson, rector of Somersby, Lincolnshire; born at Somersby, England, in 1809. He was educated at Cambridge, where he gained the Chancellor's medal for his poem in blank verse, *Timbuctoo;* married Emily, daughter of Henry Selwood, of Peasmore, and niece of Sir John Franklin; has been Poet Laureate since 1850. He published in 1830 his first volume, *Poems Chiefly Lyrical;* followed by *Poems; The Princess*—which contains what many consider the finest of his lyrics; *Tears, Idle Tears; May Queen,* and *Locksley Hall; In Memoriam*—a tribute to the memory of Arthur Hallam, son of the historian; this fine poem was at first published anonymously. His other chief works being *Maud; Idylls of the King; Enoch Arden; The Holy Grail; The Window, or the Songs of the Wren; Gareth and Lynette; Queen Mary; Harold; The Cup; The Promise of May; The Cup and the Falcon; Becket; Tiresias; Locksley Hall; Sixty Years After*—which attracted a great deal of attention; *Jubilee Ode,* published in 1887. Lord Tennyson has for many years resided at Freshwater, in the Isle of Wight; Aldworth; or at Rundhurst, Sussex. Almost simultaneously with the publication, in 1889, of *Asolando,* by Robert Browning, a volume of poetry by Lord Tennyson was issued, entitled *Demeter,* and containing some very choice poems. Among its contents was *Crossing the Bar,* which, by its exquisite music, excited great admiration.

TENTACULITES, a genus of obscure annulated tapering shells, found abundantly in some strata of Silurian age. They are generally referred to annelids, but the structure of the shell seems to exhibit greater affinities to recent pteropodous molluscs.

TENTERDEN, a municipal borough and market-town in the Weald of Kent, eighteen miles south-east of Maidstone. The church, which contains portions of Early English, is surmounted by a massive and lofty perpendicular tower. Tradition asserts, that a quantity of stones, which had been got together for the purpose of strengthening the sea-wall of the Goodwin Sands, were employed in the building of this tower, and that when the next storm came, the district of Goodwin Sands, which had formerly belonged to the mainland, was submerged. Thus arose the popular saying, that "Tenterden steeple was the cause of the Goodwin Sands." Population in 1871, 3,669.

TERCE (Lat. *tertia*—i. e., *hora,* the third hour), one of the "Lesser Hours" of the Roman Breviary, so called from the time of the day for which it is fixed.

TERCE, in the law of Scotland, the interest or estate which a widow has in the land of her deceased husband at common law. This amounts to a life rent of one-third of such estates.

TERENTIUS AFER, Publius, the comic poet, born at Carthage, 195 B.C. By birth or purchase, he became the slave of the Roman senator, P. Terentius Lucanus, who, out of regard to his handsome person and unusual talents, educated him highly, and finely manumitted him. On his manumission, he assumed, of course, his patron's *nomen* Terentius. His first play was the *Andria,* written in his twenty-seventh year, but not acted till 166 B.C. Its success was immediate. He is supposed to have died in his thirty-sixth or thirty-seventh year, leaving one daughter. Six comedies are extant under the name of Terentius, which are perhaps all he produced, namely: *Andria, Hecyra, Heauton-timoroumenos, Eunuchus, Phormio* and *Adelphi.* In conjunction with Plautus, Terentius, on the revival of letters, was studied as a model by the most accomplished play-writers. His language is pure and almost immaculate.

TERHUNE, Mary Virginia, an American authoress, known by her pen name as Marion Harland, daughter of Samuel Hawes, a merchant of Virginia, and wife of Edward Terhune, D.D., of Brooklyn, born in Amelia county, Va., about 1830. She began to write for the newspapers at the age of fourteen, and at sixteen published in a magazine a sketch entitled *Marrying from Prudential Motives,* which was copied in England, translated for a French magazine, retranslated for a London periodical, and copied again in its altered form in the United States. Besides many novels, she has written a number of popular works on housekeeping; was for some time editor of "Babyhood"; has edited special departments of "Saint Nicholas" and "Wide Awake"; and was the founder, in 1888, of the "Home-Maker."

TERMINUS, a Roman divinity, supposed to preside over public and private boundaries. Originally, he appears to have been the same as Jupiter himself, but gradually he was recognized as a separate and distinct god. Hardly any religious conception is more thoroughly characteristic of the Romans, that land-loving, law-reverencing people, than the conception of Terminus, whose worship was practiced down to a late period.

TERRA-FIRMA, a term frequently employed to denote continental land as distinguished from islands. But it was at one time more specially applied — first, to all the mainland of Italy which acknowledged the supremacy of Venice; and secondly, to the extensive tract of South America, bounded by the Pacific Ocean, Peru, the Silvas of the Amazon, the Atlantic Ocean, and the Isthmus of Panama, which mostly belonged to the Spaniards during the last century. In a still more restricted sense, the term was applied by the Spaniards to the Isthmus of Panama itself.

TERRE HAUTE, a city of Indiana. Population in 1890, 30,217. See Britannica, Vol. XXIII, p. 195.

TERRELL, a town of Texas, in Kaufman county, a thriving trading and shipping point.

TERRY, MISS ELLEN, an English actress, born at Coventry in 1848. She made her first appearance on the stage during Charles Kean's Shakespearian revivals in 1858, playing the parts of Mamillius in *The Winter's Tale* and Prince Arthur in *King John*. When only fourteen she was a member of Mr. Chute's Bristol company, which included Mrs. Kendal, Mrs. Labouchere, Kate Bishop, and several other now prominent members of the profession. She made her debut in London, in 1863, as Gertrude in *The Little Treasure*, and until 1864, played Hero in *Much Ado About Nothing*, Mary Meredith in *Our American Cousin*, and other secondary parts. In that year she married and left the stage, but reappeared again in 1867, in *The Double Marriage* at the New Queen's Theater, London. She afterward joined Mr. and Mrs. Bancroft at the Prince of Wales' Theater, where she acted the part of Portia. In 1878 she made her first appearance at the Lyceum, and has since, in conjunction with Mr. Irving, played in the longest runs ever known of *Hamlet*, *The Merchant of Venice*, *Romeo and Juliet*, and *Much Ado About Nothing*. She has also appeared as Viola in *Twelfth Night*, Henrietta Maria in *Charles I.*, Camma in Tennyson's tragedy of *The Cup*, and Ruth Meadows in *Eugene Aram*. She achieved immense success as Marguerite in W. G. Wills' play of *Faust*. She accompanied Mr. Irving on his American tour in 1887, and afterward reappeared at the Lyceum in *Faust*, and at the same theater played as *Lady Macbeth* and in *Dead Heart*. In 1890 she appeared as Lucy Ashton in *Ravenswood*, with great success.

TERRY, WILLIAM L., member of Congress, born in Anson county, N. C., Sept. 27, 1850. He removed, with his parents, to Mississippi in 1857, and to Arkansas in 1861; was educated at Bingham's Military Academy, North Carolina, and Trinity College, North Carolina, graduating in 1872; entered the profession of law in November, 1873; was an officer of Arkansas state troops in 1874; was elected a member of the City Council of Little Rock in 1877, and a state senator in 1878, serving as president of the Senate; was city attorney of Little Rock eight terms. Was a delegate to the Democratic National Conventions of 1884 and 1888. In 1890 was elected a representative from the Fourth Congressional District of Arkansas to the LII. Congress.

TEWFIK, MOHAMMED TEWFIK PASHA, KHEDIVE OF EGYPT, eldest son of Ismail Pasha, born in 1852. He was made president of council by his father upon dismissal of Nubar, in 1878, and worked for a few weeks loyally with his colleagues, Sir Rivers Wilson and M. de Blignieres, but resigned rather than be party to the *coup d'etat*. On deposition of Ismail he was proclaimed Khedive by Sultan's firman, in 1879; gave loyal support to Dual Control, 1879–82. He was unable to resist rebellion of Arabi, but refused to take refuge in British ships. After bombardment of Alexandria he entered into negotiations with the English, and proclaimed amnesty to all who would return to obedience. This being ineffectual, after Tel-el-Kebir Tewfik returned to Cairo. He behaved with great courage during the outbreak of cholera in 1883, when, accompanied by his wife, he visited the sick in spite of the remonstrances of ministers. After 1884 he usually acted under the influence of Sir E. Baring. Though a Mohammedan, Tewfik was strongly opposed to the Moslem institutions of polygamy and slavery. He died in 1892.

TEXARKANA, a town, the county seat of Miller county, Ark., an important railway center, situated about one-half in Arkansas, and the rest in Texas. It is an important point on the southern line to the Pacific coast. The post-office is in the state of Arkansas. Population in 1890, 3,486.

TEXAS, STATE OF. For general article on Texas, see Britannica, Vol. XXIII, pp. 202–206. The census of 1890 reports the area and population as follows: Area 265,780; population, 2,235,523, an increase during the decade of 643,774. Capital, Austin, with a population of 14,476. The following table gives the population of the cities and towns of the state, which in 1890 had each over 8,000 inhabitants; also their population in 1880, and their rate of increase:

CITIES AND TOWNS.	1890.	1880.	Increase	Per Cent.
Austin	14,476	11,013	3,463	31.44
Dallas	38,067	10,358	27,709	267.51
Denison	10,958	3,975	6,983	175.67
El Paso	10,338	763	9,602	1,304.62
Fort Worth	23,076	6,663	16,413	246.33
Galveston	29,084	22,248	6,836	30.73
Houston	27,557	16,513	11,044	66.88
Laredo	11,319	3,521	7,798	221.47
Paris	8,254	3,980	4,274	107.39
San Antonio	37,673	20,550	17,123	83.32
Waco	14,445	7,295	7,150	98.0

The census report of several other cities and towns are as follows: Brenham, 4,683; Corpus Christi, 4,378; Corsicana, 8,278; Gainesville, 6,563; Marshall, 7,196; Palestine, 5,834; Sherman, 7,322; Tyler, 6,908; Navasota, 3,610.

AREAS AND POPULATION BY COUNTIES. The land areas in square miles, and the population, severally, of the counties of the state were as follows, in 1890:

COUNTIES.	Area sq. miles.	Pop. 1890.	Pop. 1880.
Anderson	1 000	20.923	17.395
Andrews	1.500	24	......
Angelina	880	6.306	5,239
Aransas	400	1,824	996
Archer	900	2,101	596
Armstrong	900	944	31
Atascosa	1.200	6.459	4,217
Austin	700	17.859	14.429
Bailey	900	......	......
Bandera	970	3,782	2,158
Bastrop	960	20.736	17,215
Baylor	900	2 595	715
Bee	980	3,720	2,298
Bell	1,000	33 297	20,518
Bexar	1,180	49 266	30,470
Blanco	710	4,635	3,583
Borden	940	222	35
Bosque	980	14,157	11.217
Bowie	920	20 267	10,965
Brazoria	1,440	11,506	9,774
Brazos	510	16,650	13.576
Brewster	2,640	710	......
Briscoe	900	......	12
Brown	900	11,359	8,414
Buchel	1,440	307	......
Burleson	640	13,001	9.243
Burnet	1,000	10,721	6,855
Caldwell	500	15,769	11,757
Calhoun	500	815	1,739
Callahan	900	5 434	3,453
Cameron	1,960	14.424	14.959
Camp	200	6,624	5 931
Carson	900	356	......
Cass	950	22 554	16,724
Castro	840	9	..
Chambers	840	2 241	2 187
Cherokee	1,000	22,975	16.723
Childress	750	1,175	25
Clay	1,100	7.503	5.045
Cochran	840	......	......
Coke	900	2.059	......
Coleman	1,290	6.088	3,603
Collin	880	36,736	25,983
Collingsworth	900	357	6
Colorado	900	19,512	16,673
Comal	580	6,398	5,546
Comanche	960	16,393	8,608
Concho	1,010	1,059	800
Cooke	920	24.696	20.391
Coryell	1,000	16.816	10.924
Cottle	1,080	240	24
Crane	1 000	15	......
Crockett	5 510	194	127
Crosby	900	346	82
Dallam	1 400	75	......
Dallas	900	67,042	33,488
Dawson	900	29	24
Deaf Smith	1,380	179	38
Delta	260	9,117	5,597
Denton	900	21 289	18 143
De Witt	880	14 307	10 082
Dickens	840	295	28
Dimmit	1,080	1,049	665
Donley	900	1 056	160
Duval	1 750	7 598	5,732
Eastland	900	10,373	4,855
Ector	900	224	......
Edwards	2 620	1 962	266
Ellis	950	31 774	21,294
El Paso	9.750	15 678	3,845
Encinal	1.700	1,022	1 902
Erath	1 090	21,535	11 796
Falls	770	20,706	16,240
Fannin	1,080	38,709	25 501
Fayette	930	31 481	27,996
Fisher	900	2 996	136
Floyd	1.100	529	3
Foley	2 160	76	......
Fort Bend	880	10,586	9,380
Franklin	300	6,481	5,280
Freestone	870	15.987	14,921
Frio	1.010	3,112	2 130
Gaines	1,500	68	8
Galveston	640	31 476	24 121
Garza	900	14	36
Gillespie	960	7.028	5.228
Glasscock	900	208	......
Goliad	820	5,910	5.832
Gonzales	980	18,016	14.840
Gray	900	203	56
Grayson	960	53,211	38,108
Gregg	260	9.402	8,530
Grimes	720	21,312	18,603
Guadalupe	710	15.217	12,202
Hale	1,100	721	......
Hall	900	703	36
Hamilton	900	9.279	6,365
Hansford	910	133	18
Hardeman	1,180	3,904	50
Hardin	940	3 956	1,870
Harris	1,800	37.249	27.985
Harrison	880	26.721	25.177
Hartley	1.480	252	100
Haskell	900	1.665	48
Hays	680	11.352	7.555
Hemphill	900	519	149
Henderson	960	12 285	9.735
Hidalgo	2,970	6 534	4 347
Hill	1.000	27,583	16,554
Hockley	940	......	......
Hood	460	7,581	6,125
Hopkins	750	20 572	15.461
Houston	1.200	19,360	16.702
Howard	840	1,210	50
Hunt	870	31.885	17.230
Hutchinson	900	58	50
Irion	970	870	......
Jack	1.000	9.740	6,626
Jackson	880	3 281	2,723
Jasper	840	5,592	5.779
Jeff Davis	2.390	1,394	......
Jefferson	960	5 857	3,489
Johnson	720	22.313	17,911
Jones	900	3,797	546
Karnes	730	3,637	3,270
Kaufman	800	21,598	15,448
Kendall	620	3,809	2,763
Kent	840	324	92
Kerr	1.100	4,445	2 168
Kimble	1.300	2,234	1.343
King	900	173	40
Kinney	1.700	3,781	4 487
Knox	900	1.134	77
Lamar	900	37,302	27,193
Lamb	1.010	4	......
Lampasas	800	7.565	5 421
La Salle	1.400	2.139	789
Lavaca	1 000	21,887	13 641
Lee	640	11.952	8,937
Leon	1 000	13 841	12.817
Liberty	1.170	4 230	4.999
Limestone	960	21 678	16 246
Lipscomb	900	632	69
Live Oak	1,100	2.055	1.994
Llano	900	6.759	4 962
Loving	900	3	......
Lubbock	900	33	25
Lynn	900	24	9
McCulloch	1,000	3,205	1 533
McLennan	1.040	39.204	26 934
McMullen	1 200	1,038	701
Madison	450	8.512	5,395
Marion	420	10,862	10.983
Martin	900	264	12
Mason	960	5,168	2.655
Matagorda	1 150	3,985	3,940
Maverick	1.320	3,698	2.967
Medina	1.270	5 730	4.492
Menard	880	1 207	1.239
Midland	900	1,033	......
Milam	1 000	24.773	18,659
Mills	640	5,480	......

AREA AND POPULATION — continued

Counties.	Area, sq. miles.	Pop. 1890.	Pop. 1880.
Mitchell	900	2,059	117
Montague	890	18,863	11,257
Montgomery	1,100	11,765	10,154
Moore	900	15	....
Morris	260	6,580	5,032
Motley	1,080	139	24
Nacogdoches	960	15,984	11,590
Navarro	1,020	26,373	21,702
Newton	970	4,650	4,359
Nolan	900	1,573	640
Nueces	2,432	8,093	7,673
Ochiltree	900	198	....
Oldham	1,460	270	287
Orange	390	4,770	2.938
Palo Pinto	960	8.320	5.885
Panola	800	14,328	12.219
Parker	900	21,682	15,870
Parmer	850	7	....
Pecos	6,700	1,326	1,807
Polk	1,200	10,332	7,189
Potter	900	849	28
Presidio	3,470	1,698	2,873
Rains	270	3,909	3,035
Randall	900	187	3
Red River	1,060	21,452	17,194
Reeves	2,390	1,247	....
Refugio	760	1,239	1,585
Roberts	900	326	32
Robertson	850	26,506	22,383
Rockwall	150	5,972	2,984
Runnels	910	3,182	980
Rusk	930	18,559	18,986
Sabine	580	4,969	4.161
San Augustine	560	6,688	5.084
San Jacinto	640	7,360	6,186
San Patricio	930	1,312	1,010
San Saba	1,180	6,621	5,324
Schleicher	1,500	155	....
Scurry	900	1,415	102
Shackelford	900	2,012	2,037
Shelby	800	14,365	9,523
Sherman	900	71	....
Smith	930	28,324	21,863
Somervell	200	3,411	2.649
Starr	2,570	10,052	8,304
Stephens	900	4,926	4,725
Stonewall	900	1,024	104
Sutton	1,620	658	....
Swisher	900	100	4
Tarrant	900	41,142	24,671
Taylor	900	6.946	1,736
Terry	900	21	....
Throckmorton	900	902	711
Titus	400	8,190	6,959
Tom Green	2,940	5.152	3.615
Travis	1,040	37.019	27,028
Trinity	710	7.648	4.915
Tyler	930	10,877	5,825
Upshur	520	12,695	10,266
Upton	1,140	52	....
Uvalde	1,420	3.804	2,541
Val Verde	2,890	2,874	....
Van Zandt	840	16,225	12,619
Victoria	850	8,737	6,289
Walker	740	12 874	12,024
Waller	500	10,888	9,024
Ward	1,160	77	....
Washington	600	29.161	27,565
Webb	1,680	16,564	5,273
Wharton	1,100	7,584	4,549
Wheeler	900	778	512
Wichita	600	4,831	433
Wilbarger	940	7,092	126
Williamson	1,070	25,878	15,155
Wilson	800	10,655	7,118
Winkler	900	18	....
Wise	700	24,134	16,601
Wood	......	13,932	11,212
Yoakum	840	4	....
Young	900	5,049	4,726
Zapata	1,370	3,562	3,636
Zavalla	1,200	1,097	410

Governors of Texas. The following is a complete list of the governors of the state, with the periods and dates of service:

PROVISIONAL GOVERNOR BEFORE THE DECLARATION OF INDEPENDENCE OF MEXICAN CONTROL.

Henry Smith, 1835-36.

PRESIDENTS UNDER THE REPUBLIC.

David G. Burnet, 1836-36.
Sam Houston, 1836-38.
Mirabeau B. Lamar, 1838-40.
David J. Burnet, 1840-41.
Sam Houston, 1841-44.
Anson Jones, 1844-46.

GOVERNORS OF THE STATE.

J. P. Henderson, 1846-47.
Geo. T. Wood, 1847-49.
P. Hansborough Bell, 1849-53.
Edward M. Pease, 1853-57.
H. G. Runnels, 1857-59.
Sam Houston, 1859-61.
Edward Clark, 1861-61.
Francis R. Lubbock,1861-63.
Pendleton Murray, 1863-65.
A. J. Hamilton, 1865-66
J. W. Throckmorton, 1866-67.
Edward M. Pease, 1867-70.
Edmund J. Davis, 1870-74.
Richard Coke, 1874-76.
Richard Hubbard, 1876-79.
Oran M. Roberts, 1879-83.
John Ireland, 1883-87.
Lawrence S. Ross, 1887-91.
James S. Hogg, 1891-93.

The governor's salary is $4,000.

Brief Historic Chronology. De La Salle, a Frenchman, landed at Matagorda Bay in 1687, and erected Fort St. Louis. He was soon after murdered by some of his own men, and his colony failed. Capt. Alonzo de Leon, a Spaniard, established a mission and trading post on the site of the fort in 1690. This settlement was also abandoned. In 1714 Capt. de St. Denis succeeded in establishing three missions on the Rio Grande. In 1735 a French colony was established on Red River, against the protest of the Spaniards. After the Louisiana purchase by the United States a controversy with respect to the boundary line took place with Texas, Spain claiming land east of the Sabine River, and the United States claiming the land west of the Rio Grande. In the treaty of 1819, in which Spain ceded Florida to the United States, the latter guaranteed to Spain her territory west of the Rio Grande. Mexico became independent of Spain in 1820. The Texan war with Mexico began Oct. 2, 1835, and, on Nov. 12, 1835, a provisional government was formed. Several bloody battles followed. On March 17th the Texans adopted a republican constitution, and elected David G. Burnet president of the Republic of Texas. The decisive battle was fought at San Jacinto, April 21st, Gen. Sam Houston leading the Texans to success. The United States acknowledged the independence of Texas in March, 1837. Annexation of Texas to the United States was voted by Congress, Dec. 27, 1845, and accepted by Texas, Feb. 19, 1846. Texas followed the rest of the South in the Civil War of 1860-65. In March, 1870, Texas was formally restored to the Union. In February, 1876, a new state constitution was adopted.

Progress of population in Texas by decades: In 1850, 212,592; 1860, 604,215; 1870, 818,579; 1880, 1,591,749; 1890, 2,235,523.

For numerous other items of interest relating to Texas, see the article United States in these Revisions and Additions.

THALLOGENOUS PLANTS, those acotyledonous plants which exhibit the greatest simplicity of structure, consisting of a mere thallus with reproductive organs. Of this description are *Algæ*, *Characeæ*, *Fungi* and *Lichens*.

THANN, a town of Alsace, in the former French department of Haut-Rhin, prettily situated at the foot of a hill, crowned by the ruins of the castle of Engelburg, thirteen miles northwest of Mulhouse. It contains a superb Gothic church, surmounted by a spire of delicate open work upward of 300 feet high. Cotton cloths, chemicals and machinery are manufactured. Population in 1871, 8,052.

THEOLOGICAL SEMINARIES IN THE UNITED STATES. According to the latest report of the U. S. commissioner of education the theological schools in the United States were, in 1887, as follows:

Religious Denominations.	No. of Schools.	No. of Instructors.	No. of Students
Baptist	19	107	1,014
Free Baptist	2	11	78
Roman Catholic	17	150	663
Lutheran	17	69	1,057
Methodist Episcopal	16	107	645
Methodist Protestant	2	10	[illegible]
Methodist Episcopal, South	2	20	207
German Methodist Episcopal	1	3	39
Wesleyan Methodist	1	5	20
Presbyterian	14	81	749
Cumberland Presbyterian	2	19	327
United Presbyterian	2	19	65
Reformed Presbyterian	1	3	22
Protestant Episcopal	12	68	286
Congregational	11	66	378
Universalist	3	22	61
Unitarian	1	7	[illegible]
Christian	6	18	236
Reformed	5	15	73
Reformed (Dutch)	1	6	22
Associate Reformed	1	6	....
Unsectarian	4	30	152
United Brethren	2	9	65
Jewish	1	9	....
Evangelical Association	1	4	9
German Evangelical	1	3	82
Total	145	867	6,306

In the following list we give the names and locations of these schools, together with the dates of their organizations.

THE BAPTIST THEOLOGICAL SCHOOLS are (The dates tell when founded):

1. Hamilton Theological Seminary, at Hamilton, N. Y., 1820.
2. Newton Theological Institution, at Newton Centre, Mass., 1825.
3. Rochester Theological Seminary, at Rochester, N. Y., 1850.
4. The Southern Baptist Theological Seminary, at Greenville, S. C., 1859.
5. The Baptist Union Theological Seminary, at Morgan Park, Ill., 1866.
6. The Atlanta Theological Seminary, at Atlanta, Ga., 1867.
7. Richmond Theological Seminary, at Richmond, Va., 1867.
8. Crozer Theological Seminary, at Upland, Delaware county, Pa., 1867.
9. Shurtleff College, at Upper Alton, Ill., 1827.
10. Wayland Seminary, at Washington, D. C., 1865.
11. Shaw University, at Raleigh, N. C., 1865.
12. Roger Williams University, at Nashville, Tenn., 1865.
13. William Jewell College, at Liberty, Mo., 1868.
14. The Benedict Institute, at Columbia, S. C., 1871.
15. Jackson College, at Jackson, Miss., 1877.
16. Indian University, at Muskogee, Indian Territory, 1880.
17. The Selma University, at Selma, Ala., 1877.
18. Bishop College, at Marshall, Texas, 1881.
19. Leland University, at New Orleans, La.

FREE-WILL BAPTISTS.

1. Hillsdale College, at Hillsdale, Mich., 1852.
2. Bates College Theological Seminary, at Lewiston, Me., 1870.

ROMAN CATHOLIC THEOLOGICAL SCHOOLS.

1. Theological Department of St. Sulpice and St. Mary's University, Baltimore, 1791.
2. Theological Department of Mount St. Mary's College, Emmittsburg, Md., 1808
3. Theological Department of Viateur's College, Bourbonnais Grove, Ill.
4. St. Vincent Seminary, Germantown, Philadelphia, 1818.
5. Theological Seminary of St. Charles Borromeo, at Overbrook, Pa., 1832.
6. St. Vincent's Theological Seminary, at Cape Girardeau, Mo., 1843.
7. St. Mary's Theological Seminary, at Cleveland, Ohio, 1849.
8. St. Meinrad's Theological Seminary, at St. Meinrad, Ind., 1854.
9. St. Joseph's Theological Seminary, at Troy, N. Y., 1864.
10. St. Charles Borromeo Theological Seminary, at Carthagena, Ohio, 1864.
11. Seminary of St. Francis of Sales, at St. Francis, Wis., 1855.
12. Diocesan Seminary of the Immaculate Conception, at South Orange, N. J., 1856.
13. College and Seminary of our Lady of Angels, at Suspension Bridge, N. Y., 1856.
14. St. Bonaventure's Seminary, at Alleghany, N. Y., 1859.
15. St. John's University, Collegeville, Minn., formerly St. John's Seminary, St. Joseph, Minn., 1857.
16. Ecclesiastical Department of the Monastery of St. Thomas Villanova, at Villanova, Pa., 1842,
17. Preston Park Theological Seminary, at Louisville, Ky., 1870.

LUTHERAN THEOLOGICAL SEMINARIES.

1. The Theological Seminary of the general Synod, at Gettysburg, Pa., 1826.
2. The Theological Seminary of the Synod of Ohio, at Columbus, Ohio, 1830.
3. The Theological Seminary of the South, at Newberry, S. C., 1830.
4. The Theological Seminary of the Evangelical Lutheran Church, at Philadelphia, 1864.
5. Concordia Seminary, at St. Louis, Mo., 1830.
6. Wittenberg College, at Springfield, Ohio, 1845.
7. Wartburg Seminary, at Mendota, Ill., 1856.
8. The Missionary Institute, at Selinsgrove, Pa., 1858.
9. Augustana Seminary, at Rock Island, Ill., 1860.
10. Hartwick Seminary, in Otsego county, N. Y., 1815.
11. Augsburg Seminary, at Minneapolis, Minn., 1862.
12. Luther Seminary, at Madison, Wis., 1876.
13. The Evangelical Lutheran Theological Seminary, at Milwaukee, Wis., 1878.

14. The Red Wing, at Red Wing, Minn.

15. The Theological Seminary at Afton, Minn., 1881.

16. Concordia College, at Conover, N. C., 1883.

17. The Theological Seminary at Saginaw, Mich.

METHODIST EPISCOPAL SEMINARIES.

1. De Pauw University, at Greencastle, Ind., 1837.

2. The Theological Department of Boston University, at Boston, Mass., 1876.

3. Garrett Biblical Institute, at Evanston, Ill., 1856.

4. Wallace College (German), at Berea, Ohio, 1864.

5. Central Tennessee College, at Nashville, Tenn., 1866.

6. The Gilbert-Haven School of Theology, at New Orleans, La., 1866.

7. The Drew Theological Seminary, at Madison, N. J., 1867.

8. The Centenary Biblical Institute, at Baltimore, Md., 1867.

9. The German-English College, at Galena, Ill., 1868.

10. A Swedish Theological Seminary, at Evanston, Ill., 1870.

11. A German College, at Mount Pleasant, Iowa, 1873.

12. The Gammon School of Theology of Clark University, at Atlanta, Ga., 1883.

13. McKendree College, at Lebanon, Ill.

14. Central Wesleyan College (German), at Warrenton, Mo., 1864.

15. Vanderbilt University, at Nashville, Tenn., 1872.

16. Trinity College of M. E. Church South.

17. Wilberforce University (African), at Wilberforce, Ohio, 1853.

18. Livingstone College (African), at Salisbury, N. C.

WESLEYAN METHODIST SCHOOL.

The Wheaton Theological Seminary, at Wheaton, Ill., 1881.

PRESBYTERIAN THEOLOGICAL SEMINARIES.

1. Princeton Theological Seminary, at Princeton, N. J., 1812.

2. Union Theological Seminary, at Hampden Sidney College, Va., 1812.

3. Auburn Theological Seminary, at Auburn, N. Y., 1819.

4. The Western Theological Seminary, at Alleghany, Pa., 1827.

5. Lane Theological Seminary, at Cincinnati, Ohio, 1829.

6. Union Theological Seminary, at New York city, 1836.

7. Danville Theological Seminary, at Danville, Ky., 1853.

8. The German Theological Seminary of the Northwest, at Dubuque, Iowa, 1852.

9. The McCormick Theological Seminary, No. 1060 N. Halsted st., Chicago, Ill., 1856.

10. The German Theological Seminary of Newark, at Bloomfield, N. J., 1868.

11. San Francisco Theological Seminary, at San Francisco, Cal , 1871.

12. Biddle University, for colored students, at Charlotte, N. C., 1868.

13. Lincoln University, near Oxford, Pa., 1871.

14. An Institute for Training Colored Ministers, at Tuscaloosa, Ala , 1877.

CUMBERLAND PRESBYTERIANS.

1. The Cumberland University, at Lebanon, Tenn., 1852.

2. Trinity University, at Tehuacana, Texas, 1871.

UNITED PRESBYTERIANS.

1. The U. P. Theological Seminary, at Xenia, Ohio, 1860.

2. The Theological Seminary of the U. P. Church, at Alleghany City, Pa., 1825.

PROTESTANT EPISCOPAL SEMINARIES.

1. The General Theological Seminary, in New York City, 1819.

2. The Prot. E. Theological Seminary of Virginia, near Alexandria, Va., 1823.

3. The Theological Seminary of the P. E. Church in the Diocese of Ohio, at Gambier, Ohio, 1824.

4. The Episcopal Theological School of Massachusetts, at Cambridge, 1867.

5. The Kansas Theological School, at Topeka, Kans., 1874.

6. The Berkeley Divinity School, at Middletown, Conn., 1850.

7. The Seabury Divinity School, at Faribault, Minn., 1860.

8. St. Andrew's Divinity School, at Syracuse, N. Y., 1876.

9. The Divinity School of the P. E. Church, in Philadelphia, Pa., 1862.

10. Griswold College, at Davenport, Iowa, 1859.

11. The Theological Department of the University of the South, at Suwanee, Tenn., 1856.

12. Wheeler Hall, Chicago, Ill., 1885.

CONGREGATIONAL THEOLOGICAL SEMINARIES.

1. Andover Theological Seminary, at Andover, Mass., 1808.

2. Bangor Theological Seminary, at Bangor, Me., 1819.

3. Yale Theological Seminary (department of Yale University), New Haven, Conn., 1755.

4. The Theological Institute of Connecticut, at Hartford, Conn., 1834.

5. Oberlin Theological Seminary (department of Oberlin College), at Oberlin, Ohio, 1834.

6. The Chicago Theological Seminary, at Chicago, Ill., 1854.

7. The Pacific Theological Seminary, at Oakland, Cal., 1869.

8. Fisk University, at Nashville, Tenn., 1869.

9. Straight University, at New Orleans, La. 1869.

10. Talladega College, at Talledaga, Ala., 1869.

11. The German Theological Seminary, at Crete, Neb., 1878.

UNIVERSALIST SCHOOLS.

1. Canton Theological School, at Canton, N. Y., 1858.

2. Divinity School of Tufts College, at College Hill, Mass., 1869.

3. Theological Department of Lombard University, at Galesburg, Ill., 1881.

A UNITARIAN SEMINARY.

The Meadville Theological School, at Meadville, Pa., 1844.

CHRISTIAN (DISCIPLES OF CHRIST) SCHOOLS.

1. Eureka College, Eureka, Ill., 1855.
2. Oskaloosa College, Oskaloosa, Iowa, 1856.
3. The Christian Biblical Institute, at Stanfordville, N. Y., 1869.
4. The College of the Bible, at Lexington, Ky., 1865.
5. Drake University, at Des Moines, Iowa, 1881.
6. Union Christian College, at Merom, Ind., 1862.

REFORMED (GERMAN AND DUTCH) THEOLOGICAL SCHOOLS.

1. The Theological Seminary of the Reformed Church, at Lancaster, Pa., 1871.
2. Heidelberg Theological Seminary, at Tiffin, Ohio, 1851.
3. Mission House, at Franklin, Wis., 1860.
4. Ursinus College, at Freeland, Pa., 1870.
5. Dutch Reformed School of Rutgers College, at New Brunswick, N. J., 1810.
6. The Western Seminary, at Holland, Mich., 1866.

The United Brethren (in Christ) have a Union Biblical Seminary, at Dayton, Ohio, since 1881; and

The United Brethren, otherwise called **Moravians**, have a Theological Seminary, at Bethlehem, Pa., 1838.

The Swedenborgians have a Theological School, at Waltham, Mass., since 1866; and

The Jews have the Hebrew Union College, at Cincinnati, Ohio, since 1875.

Undenominational is the Theological Department of the Howard University, at Washington, D. C., opened 1870.

METHODIST PROTESTANT SEMINARIES.

1. The Theological Department of Adrian College, Mich., opened 1878; and
2. Westminster Theological Seminary, at Westminster, Md., opened 1882.

THEOSOPHY, an assumed knowledge of things divine, directly obtained from God through spiritual intercommunion. It claims a special insight into the divine nature. While mysticism and other theological doctrines start from known phenomena and deduce therefrom certain conclusions concerning God, theosophy, on the other hand, starts with a supposed or pretended insight into the nature of God, directly revealed to its adherents, and explains from this standpoint the phenomena of the outer world. We find claims of such direct inspiration among the Hindus, Persians, Arabs, Greeks (the later Neo-Platonists), Jews (the Cabbalists), and Christians. It was widely proclaimed in the twelfth century, and held to in some form by many so-called Christians. In later times we had Paracelsus, Jacob Boehme, Schelling, Franz von Baader and others (about these see the article Theosophy in Britannica, Vol. XXIII, pp. 278–9).

The Theosophical Society of New York was started in 1877 by Madame Helene P. Blavatsky (née Hahn), born in St. Petersburg, Russia. She was married to a man named Blavatsky while she was a school-girl, but left her husband a few weeks afterward. She came to New York about 1873, after she had traveled widely, as she claimed, from 1850 till 1870, among the priests in the East who professed to hold, and eventually revealed to her, the secret of theosophy. In New York City she joined Col. Henry S. Olcott, a former spiritualist and successful lawyer; with his assistance she founded the Theosophical Society of New York. William Q. Judge, who was for years before that time a mystic, joined the two partners in 1877. Blavatsky performed some things which are said to be wonderful. Gen. Abner A. Doubleday, U. S. A.; Charles Lotheran, the journalist; Mitchell, of the New York "Sun;" Curtis, of the New York "World;" Prof. Alexander Wilder, the anthropologist; Donovan, the sculptor; half a dozen Catholic priests, and a score of other well-educated people, are ready to-day to testify to certain wonderful happenings in the flat occupied by Mme. Blavatsky and Col. Olcott. These people assert that Blavatsky's performances there transcended all the recognized laws of nature. No one present could explain the phenomena displayed before his eyes. Newspaper articles attracted the attention of the whole country to her doings, especially in 1878, when her society became an accomplished fact.

A curious thing about Mme. Blavatsky was the fact that she would look old one day and young the next. Nobody knew her exact age. But sometimes in the forenoons she appeared like a woman of seventy, while in the evenings she never looked older than thirty-five.

It is said that the Theosophical Society numbered about 2,000 members in the United States, in May, 1891, and it is also said that these members are admitted for money, and that the society is kept alive by means of dues and compulsory subscriptions.

In 1879 Mme. Blavatsky broke up her household and started for India to revive theosophy among the Hindus. Some respectable people in India accused her of imposture. Dr. Hodgson had been sent out some years previous by the London Society for Psychic Research. He spent three months in finding out whether Mme. Blavatsky was a humbug or not. Information obtained from her housekeeper with regard to evident impostures convinced him that she was a humbug, and he stated so publicly. Upon this the woman left India and turned up in London, England, where she was instrumental in reviving theosophy considerably. Being a woman of very unusual education, she succeeded in convincing people who did not belief in supernaturalism that she had powers which they were unable to explain, and her system of wonderful performances or displays she called theosophy. She died in London, May 8, 1891.

THERAPIA, or **Tarapia**, a village of European Turkey, province of Rumili, situated on the Bosporus, twenty-one miles northeast of Constantinople, at the head of a large and beautiful bay of the same name. It is one of the most charmingly picturesque spots in the neighborhood of the Turkish capital, and all summer has a climate deliciously cool. Therapia is the residence of the French and English embassies, and many of the Frankish merchants have villas here.

THERMOMETER. See Britannica, Vol. XXII, pp. 288–293.

THERSITES, son of Agrius, whom Homer, in the Iliad, makes the ugliest and most impudent talker of the Greeks before Troy. His name in antiquity was a synonym for dastardly and malevolent impudence. The later poets say that he was slain by Achilles for calumniating him.

THESSALONIANS, Epistles to the. See Britannica, Vol. XXII, pp. 297–298.

THIRTY TYRANTS OF THE ROMAN EMPIRE, the collective title given to a set of military usurpers who sprung up in different parts of the empire during the fifteen years (A.D. 253–268) occupied by the reigns of Valerian and Gallienus, and amid the wretched confusions of the time, endeavored to establish themselves as independent princes. The name is borrowed from the Thirty Tyrants at Athens, but in reality historians can only reckon nineteen.

THOLEN, an island in the Netherlands, province of Zeeland, bounded on the south by the Easter Scheldt. It contains about 34,000 acres of rich land, and is defended from floods by strong dykes, whose borders are planted with trees. Population, 14,078. Wheat, rye, barley, oats, beans and potatoes are extensively grown. The annual produce of madder reaches a million of pounds weight, and of flax, 400,000. Horses, cattle, sheep and swine are kept in large numbers. Tholen, the chief town, with a population of 2,540, is situated in the southeast corner of the island.

THOMAS, Ormsby B., member of Congress, born in Vermont in 1832. He removed to Wisconsin in childhood, was admitted to the bar in 1856; was a member of the Wisconsin Assembly in 1862, 1865 and 1867, of the state Senate in 1880–81, and member of Congress from 1885 to 1891.

THOMAS, William L., born in 1830. In early life he studied engraving in Parisand Rome, under his brother, the late Mr. G. H. Thomas. He visited America and started the first illustrated American paper. On returning to England he entered into business as a wood-engraver. In 1869 the "Graphic" was launched under Mr. Thomas' direction, and he is managing director and art editor of it. He is a member of the Royal Institute of Painters in Water Colors. The foundation of the "Daily Graphic," under the artistic management of Mr. Thomas, took place in 1890.

THOMASTON, a town and port of Maine, on the St. George River, fifteen miles from the coast, and eighty miles northeast of Portland. Its extensive granite quarries are worked by the convicts of the state prison; 300,000 casks of lime are exported annually. There are five churches and two public libraries. Population in 1870, 3,092.

THOMPSON, Albert, member of Congress, born at Brookville, Pa., Jan. 23, 1842. He studied law, was admitted to the bar in 1864, and has since practiced; was elected probate judge of Scioto county, Ohio, in 1869; was elected common pleas judge of the Seventh Judicial District of Ohio in 1881; served in the Union army as a lieutenant of volunteers; was promoted to captain, and served until 1863, when he was discharged for wounds received in battle; was a member of Congress from 1885 to 1891.

THOMSON, Sir William, was born at Belfast in 1824. He was educated at Glasgow and Cambridge, where he graduated as second wrangler, and was elected to a fellowship. He was appointed professor of natural philosophy in the University of Glasgow in 1846. Was editor of the "Cambridge and Dublin Mathematical Journal" in 1846, to which he contributed valuable additions to the mathematical theory of electricity. It is in connection with submarine telegraphy that Sir William Thomson's labors in electrical science are best known. He has also made important additions to the science of magnetism. His mathematical insight is seen to the greatest advantage in his investigation of the nature of heat. He was made president of the British Association in 1871; and was knighted in 1866. He is joint author with Professor Tait of the well-known treatise on *Natural Philosophy*. He was created grand officier of the Legion d'Honneur in 1889.

THORN, Conference of. One of those efforts to explain away the differences between the several bodies of Christians, with a view to religious reunion, of which the seventeenth century furnishes more than one example. The originator of this movement was the king of Poland, Ladislaus IV., who proposed his project for the consideration of a synod of the bishops of his kingdom, held at Warsaw in 1643. The conference met in October, 1645, and was opened in a spirit of moderation; but it soon lapsed into disputation and controversy, and at length broke up without any result, Nov. 21, 1645.

THORN-APPLE (*Datura*), a genus of plants of the natural order *Solanaceæ*, having a tubular five-cleft calyx, a large funnel-shaped five-lobed flower, a two-laminated stigma, and an imperfectly four-celled, prickly, or unarmed capsule. The species of this genus are annual herbaceous plants, rarely shrubs or trees; and are in general very narcotic, and productive of excitement or delirium. The common Thorn-apple, or Jamestown Weed (*D. stramonium*), is an annual plant, with smooth stem and leaves, white flowers, and erect prickly capsules, a native of the East Indies, brought by the gypsies to Europe, where it is now very generally to be met with, as also in Asia, the north of Africa, and North America. It contains a peculiar narcotic alkaloid, *daturine*, and is one of the most powerful narcotic acrid poisons; but its leaves and seeds are employed, although rarely, in medicine.

THREE KINGS, Feast of the, a famous mediæval festival, identical with *Epiphany* or *Twelfth Night*, and designed to commemorate the visit of the three magi or wise men of the East (transformed by the mingled ignorance and reverence of the middle ages into great kings) to the infant Savior. But the name is more particularly given to a kind of dramatic or spectacular representation of the incidents recorded in the second chapter of Matthew—as, the appearance of the wise men in splendid pomp at the court of Herod, the miraculous star, the manger at Bethlehem, the solemn and costly worship of the Babe—which was long very popular. In 1336, a peculiarly gorgeous representation was got up at Milan by the Preaching Friars.

THREE RIVERS, a town of Michigan, in St. Joseph county. It has an extensive water power, and produces a variety of manufactures. Population in 1890, 3,122.

THROW, the term applied in mining to amount of dislocation in a vertical direction, produced by a fault in the strata.

THUNDERING LEGION, **The**, a legion of the Roman army which is the subject of a well-known miraculous legend, stating that, during Marcus Aurelius' war with the Marcomanni (A. D. 174), his army was supplied with water in answer to the prayer of Christian soldiers; this rain being also turned upon the enemy in the shape of a fearful thunder-storm, under cover of which the Romans attacked and utterly routed them.

THURIFER, the ministering attendant in the Roman Catholic Church, at solemn mass, vespers, and other solemn ceremonies, whose duty it is to carry the *thurible*, or incense-vessel, and either to minister incense himself, or to present the thurible to be used for that purpose by the officiating priest. The office of thurifer is one of those which belong to the so-called "Minor Order" of *Acolyte*.

THURMAN, **Allen G.**, an American statesman, born in Virginia in 1813. He was admitted to the bar in 1835; was judge of the Supreme Court of Ohio, in 1851; was chief justice from 1854 to 1856; and United States senator from 1869 to 1881.

THURSDAY (Swed. *Thorsday*, Ger. *Donnerstag*), the fifth day of the week, so called from Donar or Thor, who as god of the air, had much in common with the Roman Jupiter, to whom the same day was dedicated (Lat. *Jovis deis*, Rf. *Jeudi*).

THURSTON, **Sir John Bates**, governor of Fiji, high commissioner and consul-general for the Western Pacific, born in 1836. He spent the early part of his life at sea; became consul at Fiji and Tonga in 1866, and acquired the confidence and good-will of the native king and chiefs of Fiji; was their "chosen and special" adviser to confer with the British commissioners as to the cession of Fiji; was colonial secretary and auditor-general of Fiji in 1874, and five years later became the secretary to the high commissioner for the Western Pacific. Has administered the government on various occasions, and has been appointed on several commissions requiring tact and knowledge of the natives. He was governor of Fiji and high commissioner in 1887.

THYMELEACEÆ, a natural order of exogenous plants, of which the Mezereon and Spurge Laurel are familiar examples. This order consists chiefly of shrubs, with a few herbaceous plants, and contains about 300 species, natives chiefly of the warm and temperate climates. Poisonous properties prevail in the order. The bark is in general very caustic, and that of some species is used as a vesicatory, and for other medicinal purposes.

THYRSUS, in botany, a panicle, in which the flower-stalks are short, and the flowers are thus close together, so that the panicle is dense. It is a very common form in inflorescence. The use of the term is, however, somewhat vague.

TICHVIN, a town of Great Russia, in the government of Novgorod, 468 miles southeast of St. Petersburg, on the Tichvinka, which, together with the canal of the same name, connects the Volga with the Baltic. It contains numerous churches, but is best known for its monastery, which contains a "thaumaturgical," or miracle-working machine of the Virgin. The inhabitants are chiefly employed in the transit-trade by land and water. Population, 6,387.

TICKING, a strong cloth used chiefly for making beds, mattresses and paillasses. Formerly it was always manufactured of linen, but cotton is now largely used for this purpose. A very general character of ticking is that it is woven in stripes of two colors, blue and white.

TICONDEROGA, a town of New York. See Britannica, Vol. XXIII, p. 352.

TIE, in music, an arch drawn over two notes on the same degree, uniting them so that they are played or sung in one single note of the same value.

TIEL, the seat of an arrondissement in the Netherlands, province of Gelderland, picturesquely situated on the right bank of the Waal. The fortifications have been demolished and formed into beautiful walks. The principal buildings are the town house, court house, chamber of trade and the great Reformed Church of St. Martin. Tiel has a good haven and large trade in agricultural produce and cattle. In 1864, 319 ships discharged grain, earthenware, lime, wood, coal, bricks, salt, etc. The principal industries are copper founding, brick making, tanning, book printing, paper making, beer brewing, etc. Population, 7,748.

TIEN-TE (celestial virtue), the name given to the Tae Ping-Wang (king of universal peace), the pretender to imperial authority in China, and the head of the mighty insurrection which for sixteen years convulsed that country. The insurrection was under the direction of five chiefs, independent of each other, but all acknowledging the supremacy of Tien-te; and as, according to the plan of the rebellion, China, after being delivered from its Manchoo rulers, was to be divided among those chiefs; each of them assumed beforehand the title and insignia of "king."

TIERS ÉTAT (Fr. third estate), the third branch of the French estates, which consisted of representatives of the trading inhabitants of the towns, and of the peasantry in the country. The *tiers etat* played an important part in the opening scene of the Revolution.

TIFFIN, a city of Ohio. Population in 1890, 10,801. See Britannica, Vol. XXIII, p. 385.

TIGER-FLOWER (*Tigridia pavonia*), a plant of the natural order *Iridaceæ*, the only known species of its genus, which is distinguished by the three outer segments of the perianth being larger, and by the filaments being united into a long cylinder. It is a native of Mexico, but hardy enough to endure the climate of Britain, and is much cultivated in flower gardens for the singularity and great beauty of its flowers, which are, however, very evanescent. The root is a scaly bulb.

TILBURY FORT, in Essex, situated on the north bank of the Thames, opposite Gravesend. Originally erected in the time of Henry VIII. as a block-house, it was converted (1667) into a regular fortification after the bold expedition of De Ruyter into the Thames and Medway. It is of a rectangular form, built chiefly of brick, with a massive stone portal, and is surrounded by a deep and wide fosse, which can easily be filled with water. Batteries of heavy ordnance are placed so as to command the river and the reach below; there are also piers for the landing of troops, stores, etc. The banks of the Thames being here very flat, the ground around the fort is during floods and high tides laid under water, and the atmosphere of the place is in consequence far from salubrious.

TILESTONES, the uppermost group of the Silurian period, consisting of a reddish, thin-bedded, slightly micaceous sandstone, which in some places attains a thickness of 1,000 feet. It is now ascertained that the fossils agree in great part specifically, and in general character entirely, with those of the underlying Upper Ludlow Rocks, and they are accordingly considered to be the newest group of the Upper Silurian division. The Tilestones are well seen at Kington in Herefordshire, and at Downton Castle near Ludlow, where they are quarried for building purposes.

TILLETT, BENJAMIN, one of the leaders of the great Dock Strike in England, and general secretary of the Dock, Wharf, Riverside and General Laborers' Union, born in Bristol in 1859. Before he was eight he worked in a brickyard, and at twelve served six months on a fishing-smack. He was then apprenticed to a bootmaker, but ran away and joined the navy, from which he was discharged invalided after a short service. After several voyages in merchant vessels he settled at the docks, and gradually formed the Dockers' Union, which has now some 23,000 members. He gave valuable evidence before the Parliamentary Commission on Pauper Immigration, and before the Lords' Committee on the Sweating System. He is a ready speaker, and during the strike showed much talent in the organization of labor. Was invited to speak at the Church Congress of 1890, but, owing to his not being a member of the Established Church, he withdrew from the appointment.

TIMBREL (Spanish *tamburil*), a small musical instrument, of the drum species, in use in ancient times, which was carried in the hand, and was apparently not unlike the modern tambourine, with or without bells.

TIME, STANDARD, is explained in the article on HOROLOGY in these Revisions and Additions.

TINCTURES, solutions of vegetable and animal drugs, and sometimes of mineral substances in spirituous liquids. The spirit most commonly employed is proof-spirit; sometimes rectified spirit is used; and occasionally ether.

TINEIDÆ, a family of small moths, the smallest insects of the lepidopterous order. The body is long and slender, the wings entire, often narrow, mostly convoluted in repose. Many of them are very brilliantly colored. Many deposit their eggs in animal substances, on which the larvæ feed, making cases for themselves out of the substance they feed on. The clothes moths are a familiar example.

TINKER'S ROOT *(Triosteum perfoliatum)*, a shrubby plant of the natural order *Caprifoliaceæ*, a native of North America, the root of which is used as an emetic and mild cathartic. It derives its name from Dr. Tinker, who first brought it into notice.

TINNITUS AURIUM, the Latin translation of, and the ordinary medical term for, ringing in the ears. In most cases it is an unimportant symptom, depending on some local temporary affection of the ear, or on some disturbance of the digestive system with which the part of the brain, from which the auditory nerve springs, sympathizes, or which excites the cerebral circulation; but as it is also a common symptom of organic disease of the auditory nerve, it may indicate a dangerous condition, or may be a prelude to complete deafness. Hence, although commonly of no consequence, it is a symptom that, especially if permanent, must be carefully watched.

TINOS, or **TINO** (anc. *Tenos*), an island in the Grecian Archipelago, belonging to the group of the Cyclades, and lying southeast of the island of Andros, fifty-three miles off the coast of Bœotia. It is eighteen miles long, eight miles in extreme breadth, has an area of eighty-one square miles, and a population of 21,171. The Tenians were conspicuous among the ancient Greeks for their industry, and they still maintain their preëminence in that respect. The island is carefully cultivated, well watered, has a delightful climate, and is very productive in silk, wine, barley and fruits. Silk gloves and stockings are manufactured; and the inhabitants have made themselves famous as workers in marble, which is found in the island. In the modern town of Tinos, or St. Nicholas, is a cathedral built of white marble, and famous as a resort for pilgrims.

TINSEL OF THE FEU, in the law of Scotland, an irritancy or forfeiture of a feu-right caused by the failure to pay the feu-duty for two whole years. A statute of 1597 authorized, in such a case, the superior to take steps to obtain a decree of declarator that the feu was forfeited; but the vassal might, any time before decree, purge the irritancy by paying the arrear. Tinsel of the Superiority is a similar remedy which a vassal has against the superior who has not got himself infeft, so as to be in a position to complete the vassal's title. In such a case, the tenant may under the statute 1474, charge the superior, that if he do not within forty days obtain infeftment, he shall lose the tenant or vassal for his (the superior's) lifetime, and thereby all the casualties that may fall to the superior from the act or delinquency of such vassal.

TIREE, one of the Inner Hebrides, included in Argyleshire, twenty miles northwest of Iona. It is thirteen miles long, and over six miles in extreme breadth. The surface is low, rising in the north to little more than twenty feet, and in the south to about 400 feet above sea-level. The absence of trees and shrubs gives to the island a bleak appearance. Upward of 5,000 acres are under tillage, while 10,700 acres are in pasture or waste-land. Some interest attaches to the island from the number of Scandinavian forts which dot the shores, and from the standing-stones, ruined churches, and ancient graves which occur in the interior. Population, in 1871, 2,834, who support themselves by rearing cattle, fishing, and exporting poultry.

TIRNOVA, a town of European Turkey, in Bulgaria, on the Jantra, thirty-five miles southeast of Sistova. There are numerous mosques, churches, and synagogues; dyeing is carried on, and silk and coarse cloth are manufactured. Population variously stated at from 12,000 to 16,000.

TISANE, TISAN, or **PTISAN**, an infusion made of certain herbs, leaves, or flowers, used as tea for medicinal purposes. It is a very favorite form of remedy in the domestic medicine of France.

TITULAR, one who enjoys the bare title of an office, without the actual possession of that office. Thus, the English kings styled themselves kings of France from the time of Henry IV. down to the year 1800; and previous to the recent changes in Italy, the king of Sardinia, as well as the king of Naples, was titular king of Jerusalem. In English Ecclesiastical Law, a titular is a person invested with a title, in virtue of which he holds a benefice, whether he performs its duties or not. In the law of Scotland the term has received another acceptation. There are many titular dignities in the Roman Catholic Church; but the class of them which is chiefly noticeable is that which has grown out of the separation between the eastern and western churches.

TITUSVILLE, a city of Pennsylvania. Population in 1890, 8,073. See Vol. XXIII, p. 420, and XVIII, p. 713.

TOAD. See Britannica, Vol. XXII, pp. 422–423.

TOAST, the name given to bread dried or scorched before the fire. So early as the sixteenth century toasted bread formed a favorite addition to English drinks. Sack was drunk with toast, and so was punch. The practice of drinking healths is one so natural that it is impossible to say when it began. Certain it is, however, that it received an artificial development owing to the prevalence of convivial habits in the seventeenth century. It became the custom to describe a woman whose health was so drunk as herself "a toast." Whatever may be the origin of the use of the word "toast" in this sense, we now apply it not only to any person, but also to any sentiment mentioned with honor before drinking. The French have adopted the word "toast," making it masculine when applied to a man or a sentiment, but feminine when applied to a woman.

TOCHER, in the law of Scotland, an ancient name for the marriage-portion given by a father on the marriage of his daughter. It is settled according to the wish of the father, or as may be agreed with the intended husband of the daughter.

TOD (derivation unknown), a weight of wool, now unused; it was fixed at twenty-eight pounds avoirdupois in 1671.

TODDY, the name given in the East Indies to the fermented juice of various palms from which arrack is distilled. The name has been adopted in Britain for a mixture of whisky, sugar and hot water, which forms the national drink of Scotland and Ireland.

TOLEDO, a city of Ohio. Population in 1890, 81,434. See Britannica, Vol. XXIII, p. 436.

TOLSTOÏ, COUNT LYOF NIKOLAIVITCH, usually called Count Leo Tolstoï, the most eminent living Russian novelist; born in 1828, at Yasnaia Poliana, in the government of Toula, where he still lives. He entered the army at the age of twenty-three, and served in the Caucasus and at Sebastopol. He first made literary reputation by his vivid sketches from Sebastopol. Leaving the army soon after the close of the Crimean war, he devoted himself to literature. His *War and Peace*, a tale of the invasion of Russia by Napoleon in 1812, is regarded by Russians as his masterpiece; but his *Anna Karenina*, which appeared in 1876, is better appreciated abroad. Matthew Arnold reviewed it enthusiastically a few months before his death; and George Meredith says that Anna, the beautiful but unfaithful wife, who ends her guilty passion by suicide, is the most perfectly depicted female character in all fiction. *The Cossacks* is his only other novel. He wrote much on education, and published many short tales and reminiscences of childhood and youth. The last six years of his life he has devoted to religious teaching. He makes "Resist not evil" the keystone of the Christian faith, and insists that the literal interpretation of the Sermon on the Mount is the only rule of the Christian life. His religious views are set forth in *Christ's Christianity;* Count Tolstoï married in 1861, and has nine children living. Published in 1889 *My Religion*. Translations of his *Kreutzer Sonata* appeared in 1890, and the views contained therein on the social question were the subject of much attention.

TOMAHAWK, a light war-hatchet of the North American Indians. The early ones were rudely made of stone, ingeniously fastened to their handles by animal sinews, or cords of skin. European traders supplied hatchets of steel, the heads of which were made hollow, for a tobacco-pipe; the handle of ash, with the pith removed, being the stem. These hatchets are used in the chase and in battle, not only in close combat, but by being thrown with a wonderful skill, so as always to strike the object aimed at with the edge of the instrument. The handles are curiously ornamented. In the figurative language of the Indians, to make peace, is to bury the tomahawk; to make war, is to dig it up.

TOMATO (*Lycopersicum esculentum*), a plant of the natural order *Solanaceæ*, formerly ranked in the genus *Solanum*, and known as *S. Lycopersicum*. The genus *Lycopersicum* is distinguished by a 5-6-parted calyx, a wheel-shaped, 5-6-cleft corolla, five stamens, and a 2-3-celled berry with hairy seeds. The tomato is an annual, from 2 to 6 feet in height, requiring support when tall. The leaves are unequally pinnate, the leaflets cut; the flowers numerous, followed by berries, which are various in shape and color—generally red and yellow—in different varieties. The plant is a native of the tropical parts of America, but is now much cultivated in all parts of the world suitable for it, as the South of Europe and the United States. The fruit is much used for sauces, catsup, preserves, confectionery and pickles. The unripe fruit makes one of the best of pickles. Tomatoes appear with almost every dish in Italy. The use of them is rapidly increasing in different countries.

TON, a suffix of frequent occurrence in the names of Anglo-Saxon settlements It seems to be from the same root as the Gothic *tains*, meaning a twig, the Ang-Sax. *tynan*, to hedge, and the Ger. *zaun*, a hedge. Hence, a *tun* or *ton* was a place surrounded by a hedge, or rudely fortified by a palisade. Originally, it meant only a single homestead or farm, and this use of it is still common in Scotland. In modern English, in the form of *town*, it is applied to a collection of houses.

TONGA BAY, a small inlet on the east coast of Africa, bounded on the north by Cape Delgado, and extending inland in a north direction. Coconut trees and jungle line the shores of the bay, and at its head is the village of Tonga, important from its frontier position. Cape Delgado was the northern limit of the Portuguese colonial possession of Mozambique; and the village of Tonga, which is situated north of the parallel of latitude of the Cape, was long possessed by the seyyid of Zanzibar. In 1887 it was forcibly occupied by the Portuguese.

TONGA, Kingdom of. For general article on Tonga, see Friendly Isles in Britannica. The Tonga Archipelago includes three adjacent groups of Islands, namely, Tonga, Haapai and Vavau; total area, 374 square miles; population, about 21,000, including 400 foreigners. Present king, George Tubau. The heir presumptive is Taupa Hau, great-grandson of the king. There is a legislative assembly, composed one-half of nobles nominated by the king, and the other half of representatives elected by the people.

TONICITY, Muscular. The contractility of muscles shows itself under two distinct forms—*Irritability* and *Tonicity*, which are alike distinct in the mode of their action and in the conditions requisite for their exhibition. Irritability is most manifest in the voluntary muscles and in the heart, which, when in activity, exhibit powerful contractions, alternating with relaxation; while Tonicity is shown in a moderate and permanent contraction, which, instead of being consequent upon stimulation through the nerves, as in irritability, is especially excited by change of temperature in the tissue itself, and is mainly shown in the involuntary or nonstriated muscles.

TONQUIN. For general article on Tonquin, see Britannica, Vol. XXIII, pp. 439–443. The territory was annexed to France in 1884. It is divided into fourteen provinces, with 8,000 villages, and a population estimated at 9,000,000. There are 400,000 Roman Catholics. Chief town, Hanoï, an agglomeration of many villages, with a population of 150,000. Revenue (1888) of Tonquin and Annam 17,321,000 francs, expenditure 17,034,620 francs. There were 11,475 French troops in 1889, besides 6,500 native soldiers. The chief cultures are rice, sugar-cane, silk-tree, cotton and various fruit trees and tobacco. There are copper and iron mines of good quality. The chief industries are silk, cotton, sugar, pepper and oils. The imports were valued in 1888 at 23,881,012 francs, and the exports at 6,988,249 francs. The expenditure of France for Annam and Tonquin in the budget of 1891 was 10,450,000 francs.

TOOMBUDRA (correctly, Tunga-Bhadro), an important tributary of the Kistnah or Krishna, rising in the southwest of Maisur (Mysore), and, after a northeast course of from 350 to 400 miles, joining the Kistnah twenty-five miles below Karnul.

TOON, or **Toona** (*Cedrela Toona*), a tree of the natural order *Cedrelaceæ*, one of the largest timber trees of India. Dr. Hooker measured one which was thirty feet in girth at five feet above the ground. The leaves are pinnate, the flowers small, in panicles, with a honey-like smell, the petals erect, and approaching each other so as to form a sort of tube. The tree ascends to the height of 4,000 feet on the Himalaya Mountains, and is found to the furthest south of the East Indies. It is sometimes called *Bastard Cedar*. The wood is soft, but is used for furniture. The bark is a powerful astringent, and is used in dysentery, diarrhœa, etc.

TOP, in a ship, the platform at the head of each lower-mast. It is supported on the trestle-trees and cross-trees, and serves to give a wider base to the top-mast shrouds. It is also used for working the upper sails.

TOPEKA, a city of Kansas. Population in 1890, 31,007. See Britannica, Vol. XXIII, p. 446.

TOPHANE (correctly *Top-haneh*), a suburb of Constantinople, forming a continuation of Galatea along the northern shore of the Bosporus.

TOR (Celtic, "a projecting rock"), a word "found in the names of Mount Taurus and the Tors of Devonshire (Yes Tor, Brent Tor, etc.), and Derbyshire (Mam Tor, Chee Tor, etc.) The higher summits of the *Tyr*-(ol) are called *Die Taur-en.*"

TORGET, a small island off the northwest coast of Norway. It serves as a landmark to sailors, is the haunt of numerous water-fowl, but is chiefly noteworthy for its lofty rock called Torghatten (the Hat of Torget), which rises to the height of 756 feet above sea-level, and is pierced through, near the top, by a cave or passage 80 feet wide and 1,300 feet long.

TORLONIA, a princely Roman family, remarkable for their wealth, and for their extraordinarily sudden rise from the very lowest condition. They trace their origin to a poor "cicerone," called Giovanni Torlonia, born in 1754, who gained a reputation in his profession, and became afterward an agent of the French emissaries who were sent to excite the Roman populace to revolution, and on the failure of this project was left with considerable funds in his hands: he afterward became a merchant, gradually rising to the position of a stock-broker, usurer, and money-dealer; and by acquiring mortgages over the properties of the impoverished Roman princes, and by various other ventures, amassed an immense fortune. He was made a grandee of Spain, and duke of Bracciano by the pope. His three sons have allied themselves with princely families of the highest rank.

TORNADOES and cyclones are both whirlwinds of violent gyrations. In the tornado the movement is principally vertical, and the ground area of the storm is comparatively small. Tornadoes range from the water spout of the ocean, and the whirling sand-storm of the desert down to the little dust-whirls which are so common in our streets. Cyclones move with great velocity in a horizontal direction, whereas, the horizontal motion of tornadoes is slow. But their circular and upward motion is very fast, so that their gyrations produce funnels of water, sand, dust, etc., often of great height. In the United States these whirling funnels are sometimes seen pendent from a mass of black clouds. Their whirling motion is always from right to left, and often maintained for several hours. Tornadoes generally arise just after the hottest part of the day, when the atmosphere has its greatest instability. The months of greatest frequency are April, May, June and July. The destruction in a tornado may be caused either by the surface wind, which is forced in on all sides to feed the ascending current in the tornado-funnel, or by the gyrating winds of the funnel itself when sufficiently low to come within the reach of buildings and trees. In the latter case no structure, however strongly built, is able to withstand the enormous force of a good-sized tornado.

In the United States some 3,000 persons have been killed, and as many injured, by these storms during the last century. The loss of property by this destructive agency reaches scores of millions of dollars. They occur most frequently in the states bordering the northern Mississippi and the lower Missouri. Here the warm and very moist winds from the Gulf meet with currents of cold air from the north, and this produces very unstable atmospheric conditions. Tornadoes never occur west of the one hundredth meridian.

Gen. Greeley's list of destructive tornadoes is given, in part, in the following table, some of the less destructive ones being omitted:

STATE.	Date.	Persons		Houses Destroyed.	Value of Loss.
		Killed.	Injured.		
Mississippi	May 7, 1840....	317	109	...	$1,260,000
Mississippi	June 16, 1842..	500	...	...	....
Connecticut	Aug. 9, 1878 ...	34	28	...	2,000,000
Missouri........	April 18, 1880..	101	600	...	1,000,000
Iowa	June 17, 1882..	100	300	200	1,000,000
Mississippi	April 22, 1883..	51	200	100	300,000
Wisconsin......	May 18, 1883...	16	100	52	175,000
Minnesota	Aug. 21, 1883 ..	26	80	400	700,000
Arkansas	Nov. 21, 1883 ..	5	102	60	300,000
North Carolina..	Feb. 19, 1884 ..	18	125	55	....
Dakota	July 28, 1884 ..	15	18	100	....
Wisconsin	Sept. 9, 1884 ...	6	75	305	4,000,000
New Jersey.....	Aug. 3, 1885 ...	6	100	500	500,000
Ohio	Sept. 8, 1885...	6	100	300	500,000
Minnesota	April 14, 1886..	74	136	138	385,000
Ohio	May 12, 1886...	57	...	85	....
Kansas	April 21, 1887..	20	217	330	1,000,000

Many of these tornadoes extended through several states, that of April 14, 1886, for instance, traveled 350 miles, from Council Bluffs, Iowa, to Sauk Rapids, Minn., which town it destroyed. That of April 18, 1880, utterly wrecked the town of Marshfield, Mo. Many other towns and villages have been partly or wholly destroyed. The forests of the Mississippi Valley often present great lanes of broken-down and torn-up trees, indicating the tracks of tornadoes in the past. The Atlantic States, while less frequently visited by this destructive agent, are by no means exempt from its visitations. Several examples given in the above table were in the east, that of Aug. 3, 1885, passing through the city of Camden, N. J., where it made frightful havoc. A more recent disaster of this kind was that of Jan. 9, 1889, in which a violent tornado struck the city of Reading, Pa., fortunately only on its outskirt, utterly wrecking a silk-mill and a railroad paint-shop, with a loss of twenty-four persons killed and ninety-eight injured. An accompanying tornado passed over Western Pennsylvania on the same day, and did great damage in the oil-fields, tore down the suspension bridge at Niagara, and wrecked an unfinished building at Pittsburgh, with considerable loss of life.

TORNEA, a river, important as forming part of the boundary line between Russia and Sweden. It rises in Lake Tornea, in Sweden, and flows southeast and south between Russia and Sweden, entering the Gulf of Bothnia at its northern extremity, after a course of 250 miles. At its mouth is the small town of Tornea.

TORNEA, a town in Finland, situated on the peninsula of Svensar, at the mouth of the Tornea, in the government of Uleaborg. The population, which is about 800, is principally engaged in the exchange-trade with the more northern and scantily-inhabited districts of Finland and Sweden, of which Tornea is the active center, as the most northerly town in the Russian Empire; deals, salt-fish, tar, hemp, reindeer skins and other peltries being brought to Tornea to be exchanged for tobacco, spirits, manufactured goods, etc. Tornea is often visited in summer by travelers anxious to witness the singular spectacle of the sun remaining above the horizon both night and day at the summer solstice. Tornea was several times taken by the Russians from Sweden before its final cession at the peace of Frederikshamn, in 1809, when it was ceded, together with the whole of Western Finland, to Russia.

TORO, or **TORRO**, an ancient but decayed town of Spain, in the modern province of Zamora, standing on the right bank of the Douro, twenty-one miles east of Zamora. It contains numerous religious houses, most of which have been allowed to fall into a state of decay; and has brandy distilleries and brick and tile works. Population, 7,000.

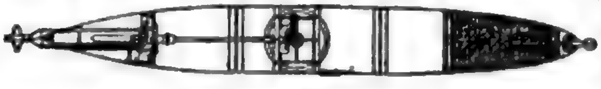
TORONTO, a city of Canada. Population in 1891, 181,200. See Britannica, Vol. XXIII, pp. 447–49.

TORPEDO WARFARE. For general article on torpedoes and the use of torpedoes in naval warfare, see Britannica, Vol. XXIII, pp. 449–51. It is only required that attention should here be called to such new types of torpedoes as are now engaging the attention of naval experts, and which seem likely to prove of practical value hereafter.

In the United States, Secretary Tracy, of the navy, appointed in 1891, a naval torpedo board for experimenting with, and superintending the construction of, such types, automobile or fish torpedoes, as may give promise of fulfilling all the requirements of the navy. The competitive tests of the various patterns are to be made at Newport, and hence that station, in this respect, promises for some time to be one of more than usual interest. The development of torpedo appliance in this country may be said to have just commenced.

Of explosives in general they all belong to one of two classes—mechanical mixtures or chemical compounds. Of the many kinds of high explosives there are gun-cotton, dynamite No. 1, explosive gelatine and forcite gelatine. But the vessels from which it is proposed to send these to kill and to destroy are of various patterns. The expenditure of liberal appropriations, both in this country and abroad, have resulted in a large series of experiments, more or less successful, with air torpedoes—including rockets and dynamite shells; ground and buoyant mines; spar, towing and submarine shells; controllable torpedoes, and automatic, automobile and fish torpedoes. One of the results is that all of the ships which constitute the cavalry of the sea, are fitted with torpedoes, and also with torpedo nettings to protect them from the torpedoes of an enemy. And to-day we have torpedo boats of the first and second classes, torpedo dispatch vessels, torpedo cruisers, etc., and many more about to be constructed. Those of the automobile type which have been extensively experimented with are the Whitehead, the Brennan, the one invented by Capt. John A. Howell of the navy, the one invented by Lieutenant Hall of the navy, the Sims-Edison and the Patrick. There are several others, but those mentioned have attained the best results and most prominence.

The Howell torpedo is one of the most complete submarine, or automobile torpedoes yet perfected. In fact it is considered the ideal torpedo, with a capacity for a charge sufficient to insure the disabling or annihilation of the ship attacked, and send every soul on board before his Maker. It is self-contained, and so simple in its mechanism that the ordinary enlisted men readily become familiar with its method of operation. It is easy to repair and overhaul without special tools or appliances—although it is less liable than almost any of the others to become disabled or get out of order; it possesses a motive power easily applied and always available, and it is easily adapted for frequent exercises. In fact, it can be fitted and effectively employed from every type of ship. The speed, size, charge and accuracy of action are equal to the best results that have been obtained with the Whitehead torpedo. In fact, no other automatic torpedo, of the same size, has reached so great a speed. Its initial speed is now twenty-three knots for the 8-foot pattern, weighing 325 pounds, including seventy pounds of explosive, or greater than that carried by any but the largest Whitehead.

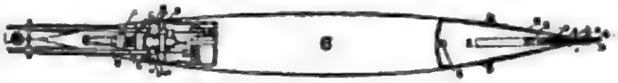

THE HOWELL TORPEDO.

The general form of the Howell torpedo is that of a spindle, the central portion being cylindrical. The shell is constructed entirely of brass or bronze, a material which is not corroded by contact with sea water. Its characteristic feature is the heavy fly-wheel by which it is propelled, and by which, at the same time, it gives a directive force that renders unnecessary any device for steering the torpedo in the horizontal plane. The fly-wheel is of steel and weighs about 130 pounds, and rotates on frictional wheels. It is geared to two shafts, one on each side of the torpedo, which carry the propellers; and when set to revolving at a considerable speed it will continue to rotate for several hours, if no additional load is applied. The propellers revolve in opposite directions, thus preventing the rolling motion of the torpedo. This forms the whole driving mechanism of the torpedo, which is, in principle, the same as that of the Whitehead.

To control the submersion recourse is had to a horizontal rudder, which is operated automatically by mechanism whose action is controlled by a combined pendulum and hydro-pneumatic cylinder, the piston of which moves with the varying external pressures at various depths. The discharging gear for sending the torpedo from the ship toward the enemy, consists of a frame or derrick extending from the ship's side, under which the torpedo is hung by clutches and studs on its shell. The torpedo is so arranged that it can be conveniently slung from the deck, and on being detached from the derrick, it does not drop vertically into the water, but is swung outward in the arc of a circle, being detached automatically by a checkline and trigger on reaching the vertical below the pivot. This gives it an impulse without changing the angle of its longitudinal axis with the surface of the water. The mechanical success of the weapon seems assured. In the last few years it has been subjected to trial before several naval boards, whose reports summed up maintain the following elements of superiority for it over some other types: It is a much cheaper weapon; for the same size and weight it carries a heavier charge; it does not possess the element of danger contained in the air flash, the rupture of which (by accident or hostile shot) has already been shown to be destructive to life and property; its track is not betrayed, in day-time and clear weather, by air bubbles. The explosive charge, which is of gun-cotton, is placed in the forward end of the torpedo, and is fired by a detonating cap placed under a percussion firing-pin. The outer end of the firing-pin is provided with fan-shaped corrugated horns, which receive the impact blow, and are so shaped and arranged as to prevent glancing or sliding along on the object struck. The force of the blow shears off the soft metal-pin and thus permits the firing-pin to be driven down on the detonator by the spring.

The navy department recently ordered thirty of the Howell torpedoes to be made, together with their launching carriages. Since then the principal improvements made in the torpedo are mechanical, and, though the form is the same as that before used, the body of the torpedo, of spun brass, is much improved in workmanship. It is made in four sections, and motion is communicated to the fly-wheel by means of a clutch coupling driven by a steam turbine motor. The following are the dimensions agreed upon after a series of tests: Length of body of torpedo, 9 feet; length over all, including propeller, 9½ feet; extreme diameter, 14.2 inches; displacement, 410 pounds; weight of explosive charge, at least, 72 pounds; minimum speed, 22½ knots. The effective working range of the torpedo will not be less than 400 yards, and the mean speed for that range not less than 22½ knots per hour. The torpedoes are to be of good material, so as to be easily handled and manipulated, as would be necessary in actual naval service, and this without undue risk or injury; and it must be so fitted as to be readily used for practice and exercise, and recovered at the end of the run, and be made ready for another run speedily and without elaborate preparation.

Like other fish torpedoes, that designed by Lieut. M. E. Hall, of the navy, has the shape of a spindle of revolution, carrying the charge in the nose, with a percussion apparatus. The principal features of this torpedo are its diving mechanism, the pectoral fins, the device for overcoming the net-defenses of vessels of war, and a special automatic engine that utilizes the full expansion force of the motive power. The pattern of the torpedo shown in the cut has the following weights, dimensions, etc.: Length, 15 feet; extreme diameter, 14¼ inches; weight, 575 pounds; diameter of engines, 4 inches; length of stroke, 4 inches; diameter of propellers, 10 inches; revolutions a minute, 2,100; gun-cotton charge, 80 pounds.



THE LIEUTENANT HALL TORPEDO.

The cut shows a side view of the torpedo and its three sections—the forward cone (A), the air-flask

(B) attaching the buoyant grapnel (L). At the end of the forward cone or compartment (A) the firing-rod (a) is fitted loosely into the sleeve (b), and actuated by a spring connected with the trigger (c) upon contact with the object of attack. The rib of the trigger is broken off by impact. Should the torpedo graze a vessel's bilge the trigger would be tripped, and the firing-rod would be impelled by the spring against the plunger (d), detonating the gun-cotton charge, as before, by means of the primer and detonator. When attacking a vessel protected by netting, the float (L) is drawn aft by the resistance of the water, and tows aft and above the torpedo until it fouls the net that the torpedo passes under. Then the pull upon the tow-line (e) trips the trigger (c), and explodes the torpedo in close proximity to the ship.

The magazine E contains eighty pounds of gun-cotton in a copper case, which is pivoted at its after end (g) and suspended by hangers (g g) at its forward end, permitting a slight swinging movement, which automatically steers the torpedo. It has been well proved that when a ship heels over to a brisk wind the lee bow becomes buried, and has a greater displacement than the weather one. This pressure under the lee bow throws her into the wind unless counteracted by the helm. This force is utilized in the Hall torpedo in the following manner: A sea striking the torpedo in launching drives it to leeward, at the same time, owing to its slight stability it causes her to roll. As the torpedo is symmetrical and circular in section there would be no unbalanced pressure under the lee bow, hence the pectoral fins have been introduced. These are actuated by lugs upon the swinging magazine (E) which take against flexible brass plates and act upon the torpedo so as to bring her upon an even keel, so to speak. For instance, if a wave should strike the torpedo on the port bow, she rolls to starboard, and being deflected in this direction the starboard pectoral fin is forced out by the swinging magazine, causing an unbalanced pressure under the lee bow and forcing the torpedo back to her course. In other words, the torpedo has a flexible bow which is automatically distended on one side or the other, as required to keep her on her course. As soon as the torpedo regains an upright position the magazine is centered by the springs (K).

The air-flask (B) has a capacity of nine cubic feet and contains air under a pressure of 1,200 pounds a square inch. The throttle (l) is automatically opened as the torpedo is discharged, permitting air to reach the engine.

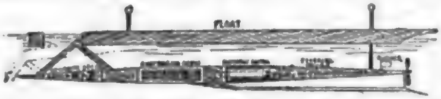
The engine chamber and the immersion chamber are in the after cone. An automatic two-cylinder double-cating trunk-engine actuates the screws by means of the lever gears (n, n, n, n,) the exhaust air escaping through the hollow screw-shafts, which are provided with check-valves (p p) to prevent the entrance of sea-water at the end of the run. Abaft the engine-case is the immersion chamber containing the diving mechanism. The diving-valve is actuated by a float, the position of which depends upon the amount of water in the chamber. Water enters freely until it reaches the bottom of the telescopic tube, after which it can only enter by compressing the imprisoned atmospheric air within the chamber. By extending the tube a greater pressure will be required to fill the chamber than when the tube is contracted; hence, in the former case the torpedo will dive deeper than in the latter case. The reaction of the air upon the water raises or depresses the tail of the torpedo, causing it to dive or to rise to the surface. The motive-power is steam, which, together with a suitable quantity of water heated to 550 degrees, is stored in a flask or generator. As the pressure is reduced by the consumption of the steam, the heated water gradually vaporizes, furnishing a continuous supply.

The Patrick torpedo is an invention of J. N. H. Patrick, and has been thoroughly tested, to the satisfaction of both the United States and the French governments. It has reached a stage which, in the judgment of experts, renders it a valuable weapon for use in actual warfare. It consists of two fourteen-foot copper cylinders, held by bars three feet apart. The upper cylinder is filled with lampblack and carries signal flags. The lower cylinder is filled with the firing charge. The machinery is propelled by carbonic acid gas. Recent experiments with it by the Navy Torpedo Board at Newport were reported as eminently successful. The conditions of the test were that the torpedo should make a speed of twenty knots for one mile, maneuvering and firing under the conditions of service, to be readily, certainly and completely accomplished by the manipulator of the operating apparatus, the center of the explosive charge to be at least three feet below the surface of the water when exploded.

When the torpedo was in motion only the two flags and the foaming water, turned up by the rapidly revolving propeller, could be seen. The torpedo was first headed for the training-ship Jamestown, then turned to the north, and run for a quarter of a mile in that direction. A sharp turn was then made in toward shore and the torpedo returned to the starting point, forming a course the shape of an ellipse, and about a third of a mile in its largest diameter. Several trials of the torpedo were made, to test the efficiency of its motive power. The torpedo is shaped like a spindle, tapering at each end. It is about forty feet in length, and its greatest diameter is twenty-four inches. Its displacement is 5,163 pounds, and the magazine charge of dynamite is 200 pounds. The torpedo proper is sustained by a float which is practically indestructible by mechanical gun-fire during the short time that it would be exposed. The float is also of the fusiform, and is made of sheet-copper, one-eighth of an inch thick, filled with lampblack. The propeller and rudder work in solid water, and the former cannot easily be fouled nor the cable grappled. The explosion also takes place about three feet under the water.

In the application of the motive power, as in many other details, the torpedo differs from other models. The propeller is two-bladed, and is fixed on a hollow shaft through which the governing cable is paid out, the controlling battery being 100 cells of bichromate. The acid, drawn in liquid form from the bottom of the flask, is taken through copper piping in the bottoms of the heaters. These heaters are copper cylinders which contain the diluted sulphuric acid, each having a cylindrical trough in the top holding the lime. This trough is divided into two parts, kept closed by a series of hooks on a common rod, the rod being connected with a piston in a cylinder outside the heater. The cable performs the functions of starting, stopping, starboarding and porting the helm, and firing the charge.

In considering the problem of the transmission of power, the electric current has long occupied attention, and has been in use for controlling and directing torpedoes about twenty years. The first application of electricity for propelling torpedoes was in 1877 by Mr. Sims, and after some preliminary experimenting with a small pulling boat, he completed a cigar-shaped torpedo propelled and controlled by electricity. It not being successful in point of speed, a larger boat was built, since when the perfection of the torpedo, or rather the efficient generation of application of power, by the dynamos on shore and the motor on board, has been completed. A great increase in speed is claimed for the Sims-Edison torpedo. As will be seen by the illustration, the apparatus consists of two parts, the "float" and the submerged "fish," a steel frame connects the two, being inclined at the bow and very sharp, so as either to cut through obstructions, or dive under them, as indicated by the dotted lines in the cut. Both the float and fish are of sheet copper. The former is about thirty feet long and filled with cotton, which renders it impervious to the water, and even if struck repeatedly by small projectiles it would still sustain its burden. It is broad at the top and narrow at the bottom, so that the bouyancy increases rapidly with immersion. The fish, which carries a 200-pound charge of explosive, is submerged about three and three-quarter feet, and can be exploded at will or by concussion against the object of attack. The fish, or torpedo hull, is cylindrical, with conical ends.

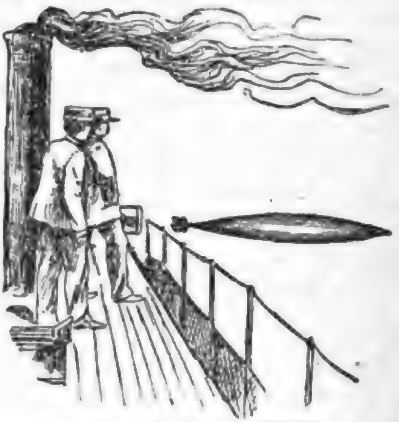


THE SIMS-EDISON TORPEDO.

As may be seen in the cut the fish has four compartments with water-tight bulkheads, and, as each compartment is separate from the other, it can be taken apart when necessary for storage, and can be put together again in fifteen minutes ready for immediate service. The forward compartment carries the explosive, the next compartment is empty, the third carries the cable and the fourth carries the electric motor and steering gear. Its total weight, including a forty horse-power motor and 6,000 feet of cable, is 4,364 pounds. The motor is two-pole, series-wound and its resistance at rest is 6.53 ohms. The Edison generator is capable of 1,500 to 1,600 revolutions, with 1,300 volts at terminals and twenty-five ampères normal capacity. On the official trial the motor drove the boat at a speed of over twenty-one miles an hour and on a short run reached twenty-two miles an hour. The cable is compound, having a small insulated conductor in the center for the steering current produced by a battery on shore, and an annular conductor for the motor current. Steering is effected by a powerful electro-magnet, into which is switched the main current by means of a strong polarized relay actuated by the current of the shore battery through the central conductor of the cable. Two keys, or one pole-changing key and switch, under the hand of the officer on shore, control the relay of the fish, and the rudder is thus thrown to one side or the other at will at any moment. The result is that while at full speed the boat may have its course changed in any desired direction at any moment.

The charge is exploded electrically, hence there is no probability of premature discharge. The moment that the torpedo has reached and is pushing against the object of attack can be exactly determined day or night by a simple ammeter in the circuit showing by its great change of reading when the motor is affected by the stoppage of the boat. Besides the many advantages possessed by such a torpedo for coast and harbor defense, it has a special value as an instrument of offensive warfare on the high seas, as nearly all the war vessels are fitted with dynamos and engines for them. By carrying a generator for torpedo service, each vessel in commission can have one or more of the Sims-Edison torpedoes fastened by 100-foot hawsers furnished with electro-magnetic snap-hooks, the electric cable communication being then maintained permanently with the generator. The torpedo can thus travel along within a convenient distance controlled by the navigator of the war-ship. In action the war-vessel could approach the enemy within a distance of two miles, stop and send the torpedo on ahead, guiding it to the certain destruction of the hostile vessel.

Another recent invention of a torpedo controlled by electricity is that of Lieutenant N. T. Halpine, of the navy. It has a very noticeable feature not possessed by any other. In all other torpedoes of the "controlled" types it has been impossible to have experimental drills without destroying the fish or hull; and as this was a matter of much expense, the drills have been conducted without using an explosive charge. In Lieutenant Halpine's torpedo this difficulty has been overcome. The forward part of the torpedo has a bell-mouth opening, into which the explosive charge is fitted in its own case, and is there held until the object of



DISCHARGING AN AERIAL TORPEDO.

attack is reached, when it is detached and that part of the hull which contains the mechanism is left at a safe distance. The explosive charge can then be fired at will and the torpedo proper, or the hull, can be run to the starting point. The power used can be either compressed air, electric or other motor, working on a screw propeller.

There are other automobile or fish torpedoes, especially the Whitehead, Brennan, Victoria, Schwartzkopff, that possess much merit; but they are so nearly like the Howell, the Hall, the Patrick and the Halpine that it is not necessary to describe them here. John L. Lay, the inventor of the first controllable torpedo that reached the phase of an actual service weapon, has recently produced a new weapon in England and he claims for it a speed of sixteen knots with a range of two miles.

A new invention of a submarine torpedo boat, or as this sort of weapon is frequently referred to, the controllable torpedo, has recently appeared at Detroit, and if it accomplishes all that the inventor maintains for it, Jules Verne's dream of the *Nautilus* promises to be realized. The boat is, in appearance, like a double-pointed cigar. It is forty feet in length, sixteen feet deep from top to bottom, and its extreme breadth, from the midship point, is nine feet. The motive power is to be a storage battery of electricity, connected with a screw propeller on each side; and the vessel can be submerged by simply turning a switch at the shore station. The inventor of this "devilish weapon" declares that the machinery can be so adjusted as to sink the boat to any depth and send her along at a speed of ten miles an hour with ease. And should any of the machinery become deranged the torpedo would immediately rise to the surface by the stopping of the propeller, which alone keeps her submerged. The inventor has an air chamber provided, the capacity of which is sufficient, with the aid of chemicals, to purify the air for two men for twenty-four hours.

TORQUES, a species of gold ornament, worn around the neck, and much in use in ancient times, both among Asiatic and North European nations. It consisted of a spirally-twisted bar of gold, bent round nearly into a circle, with the ends free, and terminating in hooks, or sometimes in serpents.

TORRINGTON, a municipal borough and market-town of the county of Devon, on an eminence sloping to the Torridge, ten miles southwest of Barnstaple. The inhabitants are for the most part employed in agriculture and glove-making. The name of Torrington emerges frequently during the great Civil War; and the capture of the town by Fairfax in 1646, on which occasion the church, with 200 prisoners, and those who guarded them, were blown into the air by gunpowder, proved fatal to the king's cause in the west. Population in 1871, 3,529.

TORRINGTON, a township of Connecticut, on the Naugatuck River. It has important manufactories of woolen goods, plated goods, hardware, machinery and needles. Population in 1890, 6,000.

TORSO (Ital.), strictly, a trunk, such as the trunk of a tree, but specially applied to an ancient statue of which only the body remains. Of such imperfect relics of classic art, the most famous is the *Torso of Hercules*, a masterpiece of manly beauty discovered in the Campo del Fiore, at the beginning of the sixteenth century, and placed, by order of Pope Julius II., in the Vatican.

TORTOISE, Turtle. See Britannica, Vol. XXII, pp. 455–460.

TORTUGAS (Sp. Turtles), a group of ten low coral islets or keys, also called the Dry Tortugas, belonging to the United States, at the entrance of the Gulf of Mexico, 120 miles southwest of Cape Sable, the southern point of Florida. There has been a lighthouse erected on Bush Key; and refractory soldiers, and prisoners connected with the War of Secession, have been employed in erecting a fort, called Fort Jefferson.

TORULA CEREVISIÆ, or the Yeast Plant, one of those fungi which are connected with the process of fermentation. This plant, which is also known under the names of *Saccharomyces*, *Mycoderma cerevisiæ*, and *Cryptococcus fermentum*, may be readily observed by examining a little yeast under the microscope, when it will be seen in the form of round or oval corpuscles, varying in diameter from the 800th to the 400th of a line, and many having smaller corpuscles in their interior. They grow by protrusion of gemmules, and germinate sometimes on one, and sometimes on several spots of the primitive fungus cells. These shoots throwing off new gemmules, the yeast-plant gradually forms single or branching rows of oblong cells, connected together like beads. This peculiar arrangement of the cells, and the fact that they are not acted on by acetic acid, is characteristic of the plant.

TOSHACH, the name given among Celtic nations to the military leader of a clan or tribe, whose functions were in early times separated from those of the supreme judicial officer. When the office of toshach, originally elective, became hereditary, according to the principle of divided authority characteristic of Celtic communities, it remained permanently in the eldest cadet of the clan.

TOTIPALMÆ, Cuvier's name for a group of birds, of the order *Palmipedes*, having the hind toe connected with the other toes by a web. Pelicans, cormorants, frigate-birds, gannets, and darters belong to this group. All the *Totipalmæ* are marine; they feed on fishes, molluscs and other marine animals, and are excellent swimmers and divers. Many of them have long wings, and are birds of powerful flight.

TOTNES, or Totness, a municipal and formerly a parliamentary borough and market-town of Devonshire, situated on the slope of a steep hill, on the right bank of the River Dart, about ten miles from its mouth. It is a place of great antiquity, has an interesting church of the fifteenth century, and some curious antique houses. The River Dart is navigable for vessels of 200 tons up to the town, which has some little shipping trade. The borough, which comprised also the suburb of Bridgetown, was disfranchised for corrupt practices by the Reform Bill of 1867. Steamers ply during the summer months between Totnes and Dartmouth. It is a station on the South Devon railway. Population in 1871, 4,073.

TOUCH-WOOD, the wood of willows and some other trees softened by decay. It is sometimes used as tinder for obtaining fire, from the readiness with which a spark ignites it.

TOULA, or Tula, an important manufacturing town of Great Russia, capital of the government of the same name, on the Upa, an affluent of the Oka, 110 miles south of Moscow. Its churches, arsenal, theater, industrial museum, cathedral and the ancient Kreml are the principal buildings. Toula is an ancient town, and has suffered severely from Tartar invasion, and during the wars of the commencement of the seventeenth century. Iron works founded here under Czar Alexis Michailovitch have acquired a well-merited reputation. Cutlery, locks, tea-urns and bells are made in great perfection; and bristles are prepared in large quantities both for home consumption and export. Population, 56,496.

TOURAINE, one of the former provinces of France, of which the capital was Tours, and which was bounded on the north by the province of Orleannais, on the east by Berri, on the south by Poitou, and on the west by Anjou. It was about sixty miles in length, and nearly the same number of miles in breadth; it now appears on the map as the department of Indre-et-Loire.

TOURGÉE, Albion W., an American lawyer and novelist, born in Ohio, in 1838. He served with credit throughout the Civil War, being twice wounded; practiced law in North Carolina; became judge of the North Carolina Superior Court in 1868, and assisted in the preparation of a *Code of Civil Procedure for North Carolina*. He has written a number of novels, including *A Fool's Errand*.

TOWN-ADJUTANT, Town-Major, officers on the staff of a garrison. They are often veteran officers, too much worn for field-service. The pay depends on the magnitude of the trust. The town-major ranks as a captain; the adjutant as a lieutenant. The duties of these officers consist in maintaining discipline, and looking after the finding of the batteries, etc.

TOWNSEND, Charles Champlin, member of Congress, born at Allegheny City, Pa., in 1841. He received a common-school education; is a manufacturer; served two years in the army during the rebellion as a private, and afterward as adjutant; and was elected to Congress, 1889.

TOWNSEND, Hosea, member of Congress; born in Ohio, in 1840. He entered Western Reserve College, Ohio, in 1860; left school to enter the army in 1861; was promoted to lieutenant, and resigned in 1863, on account of disability; was admitted to the bar, and commenced the practice of law in Tennessee in 1865; was elected to the Legislature of that state in 1869, and served one term; removed to Colorado in 1879, and was elected to Congress in 1889, and re-elected in 1891.

TRACHOMA (derived from the Greek *trachus*, rough), the term employed in ophthalmic surgery to designate a granular condition of the mucous covering of the eyelids, often accompanied with haziness and vascularity of the cornea. It is one of the most serious *sequelæ* of purulent ophthalmia.

TRACY, Benjamin F., secretary of the navy, born at Owego, N. Y., in 1830. He studied law; was elected to the New York Assembly in 1861; was a colonel of volunteers; was in the battle of the Wilderness, and was brevetted brigadier-general; became United States district attorney for the eastern district of New York in 1866; judge of the New York Court of Appeals in 1881; secretary of the navy in 1889. In February, 1890, Mrs. Tracy and Miss Mary Tracy, the wife and youngest daughter of the secretary, lost their lives by a fire which destroyed their Washington residence.

TRADUCIANISM, one of the theories adopted for the purpose of explaining the production of the soul in the procreation of the human species. The theory known as traducianism, is ascribed to Tertullian as its first author. He taught that souls are propagated by souls, as bodies by bodies, and by the same or a simultaneous process. The discussion of these theories in the fourth and fifth centuries, was much promoted by the controversies on Manichæism.

TRAMMEL-NET. A kind of net resembling the drift-net used in the herring-fishery, but anchored and buoyed at each end, the back-rope supported by small cork-floats, and the foot-rope kept close to the ground by weights. The length varies from 20 to 300 yards.

TRANS-ANDINE RAILWAY, the first railway across the continent of South America. It runs from Buenos Ayres to Valparaiso, some 870 miles. In 1890 there were 640 miles finished at the Buenos Ayres and 82 at the Valparaiso end, while about a third of the rest was practically complete. The Andes range is crossed at Cumbre Pass, which is 13,045 feet above the sea level, and at this point the railway follows a tunnel about three miles long at an elevation of 10,450 feet, the grades for a considerable distance being 1 in 12½, so that a rack rail is employed. The opening of the whole route is expected to take place in 1892. Eight tunnels are being bored through the Andes in connection with the line, of a total length of nearly ten miles. Electricity and water are employed in novel fashion, and work on the tunnel goes on at twenty-six points.

TRANSITION, a term employed at first by Werner to designate rocks having a mineral character intermediate between the highly crystal line, or metamorphic rocks and ordinary sedimentary deposits.

TRANSITORY ACTION, in the law of England, is used, in contradistinction to local action, to denote that the particular action may be tried in another county than that in which the occurrence arose.

TRANSKEIAN TERRITORIES. For these countries of South Africa, see Britannica, Vol. XXIII, pp. 516–519. The area of Cape Colony, in 1889, was estimated at 233,430 square miles. This includes an area of 15,283 square miles in the Transkeian Territories, and of Walfish Bay, in Damaraland.

The estimated population in 1889 of Cape Colony proper, including Griqualand West, was 1,048,628; and of its dependencies, Transkei, East Griqualand, and Tembuland, 410,195; total 1,458,823. In 1880 it was 1,136,986. The total white population is estimated at about 350,000. The colony is divided into seventy divisions, and its dependencies into sixteen districts.

The various Transkeian territories are grouped under their chief magistrates as follows, with population in January, 1889: Griqualand East, comprising Port St. John's, Noman's Land, and the Gatberg, with nine subordinate magistrates (area 7,511 square miles, population 121,138, of whom 3,921 Europeans): Tembuland, comprising Tembuland proper, Bomvanaland, and Emigrant Tembuland, with seven magistrates, including resident magistrate (area 4,055 square miles, population 159,325, of whom 5,515 Europeans); Transkei, comprising Fingoland, the Idutywa Reserve, and Gcalekaland, with six magistrates (area 2,535 square miles, population 136,395, of whom 1,000 Europeans). These districts are subject to the "Native Territories Penal Code." Pondoland, population 200,000, with a resident commissioner appointed by the Cape government Walfish Bay has an area of 430 square miles.

The capital of the colony, Cape Town, had a population in 1889 of 41,704, excluding military and shipping. The probable population of Cape Town and suburbs is 70,000. Port Elizabeth had a population of 13,049 in 1875, 15,926 in 1889; Kimberley, 13,590 in 1875, 28,663 in 1889; Beaconsfield, 21,619 in 1889; Graham's Town, 6,903 in 1875, 8,261 in 1889; King William's Town, 5,195 in 1875, 5,386 in 1889; Woodstock, 5,720; East London, 5,903; Graaff Reinet, 5,622; Stellenbosch, 5,055.

A large proportion of the white inhabitants are of Dutch, German, and French origin, mostly descendants of the original settlers.

TRANSLATION OF MINISTERS, in the law of Scotland, the removal of a minister from one parish benefice to another.

TRANSOMS, in artillery, the bars or bolts by which the two sides—technically called "cheeks"—of a gun-carriage are held together. In a ship, beams across the sternpost, at right angles to that timber fastened in the same way as the floors upon the keel.

TRANSPOSE, in music, to change a piece of music in performance from the key in which it is written to another key. To play at sight an accompaniment for such an instrument as the pianoforte or organ, transposed from one key to another, requires considerable artistic skill. To the singer, transposal presents no difficulties.

TRASS, a tufaceous deposit of the extinct volcanoes of the Eifel, near Coblenz, resembling the Puzzolana of Naples. Its base consists almost entirely of pumice, in which are imbedded fragments of basalt, burnt shale, slate, sandstone, etc., and even numerous trunks and branches of trees. Its formation is accounted for by supposing an eruption to have taken place, with copious evolution of gases, in a lake-basin, and a flood of the mud thus formed to have swept away whatever came before it. Large areas are covered by the trass, which has choked up valleys, now partially re-excavated.

TRAVERSING PLATFORM, an arrangement for the more rapid and easy movement of cannon in battery. The gun is either mounted on an ordinary truck-carriage, or on rollers under its trunnions. The truck or rollers work in and out on two parallel iron rails, which rails are mounted on the traversing carriage, and are sixteen feet or more in length. Wheels at each end of this platform, or more frequently if the weight of the gun be very great, are placed at right angles to the direction of the rails, and run on circular tramways, which have their center in the embrasure through which the gun is fired. The rails incline upward toward the rear, to moderate the gun's recoil. The advantages are, that the leverage for turning the gun is increased by the platform's length, while the circular rails diminish the resistance; that the gun is easily run out for firing on the upper rails; that by its own recoil it runs itself in again for loading; and that a much smaller embrasure is required to give a good compass to the muzzle.

TRAVESTY, a term applied in literature to denote a burlesque representation of something previously executed in a serious and lofty manner. It differs from Parody in, that while the latter changes the subject-matter and the *dramatis personæ*, but mockingly imitates the style of the original, the former leaves the subject-matter partially, and the *dramatis personæ* wholly, unaltered; producing a purely comic effect by the substitution of the mean, the frivolous, and the grotesque in action or speech, for the serious, the noble, or the heroic.

TRAVNIK, a town of European Turkey, capital of the province of Bosnia, on the Lasva River, forty-five miles northwest of Bosna-Serai. Its numerous mosques and the castle, which dates from the middle ages, are the principal edifices. It contains 12,000 inhabitants, almost all Mohammedans. The principal branch of industry is the manufacture of sword-blades.

TREASON. See Britannica, Vol. XXII, pp. 525–530.

TREASURY. The United States Treasury Department was established by act of Congress Sept. 2, 1789, and numerous amendments have since so augmented its business, that it is now the largest and most important of all the executive departments of our government. It is presided over by a Secretary who is nominated by the President and confirmed by the Senate. This officer has the duty of managing the United States revenues under the laws of Congress. Two Assistant Secretaries of the Treasury are also appointed by the President and confirmed by the Senate. There are also in the office of the secretary a Chief Clerk and nine Division Chiefs, upon whom devolves the general direction of the routine business and operations of the office.

In addition to the officers connected with the secretary's office proper, there are in the treasury department the following officers:

1. The First Comptroller examines all accounts settled by the first auditor, except those relating to receipts from customs. He also countersigns all warrants drawn by the secretary of the treasury.

2. The Second Comptroller examines all accounts settled by the second, third and fourth auditors. He also countersigns all requisitions drawn on the secretary of the treasury by the secretaries of war and of the navy.

3 The Commissioner of Customs examines all accounts settled by the first auditor relating to receipts from customs, and certifies to balances arising thereon to the register of the treasury

4 The First Auditor examines all accounts accruing in the treasury department (except those arising under the internal revenue laws), certifies the balance, and transmits the accounts to the first comptroller, or to the commissioner of customs, who have respectively the revision thereof.

5. The Second Auditor examines and settles the accounts relating to the pay and clothing of the

army, ordnance service, subsistence of officers, bounties to soldiers, hospital stores, and contingent expenses of the war department, and also those relating to Indian affairs.

6. The Third Auditor examines all accounts relating to the subsistence and transportation of the army, all accounts of the war department, other than those assigned to the second auditor, and all accounts relating to army pensions.

7. The Fourth Auditor receives and settles all accounts relating to navy pensions and accounts pertaining to the naval service.

8. The Fifth Auditor receives and examines all accounts relative to the diplomatic and consular service, accounts relating to the census, the national museum and the contingent expenses of the patent office.

9. The Sixth Auditor examines all accounts relating to the postal service, and reports to the postmaster-general all balances found on settlement of such accounts.

10. The Treasurer of the United States receives and disburses all public moneys that may be deposited in the treasury at Washington, and the sub-treasuries at New York, Boston, Philadelphia, Baltimore, New Orleans, San Francisco, St. Louis, Chicago and Cincinnati, and in the national bank United States depositories.

11. The Register of the Treasury is the official bookkeeper of the United States. He prepares a yearly statement which shows every receipt and disbursement of the public money; signs and issues all the United States bonds; registers all warrants drawn by the secretary of the treasury upon the United States treasurer and transmits statements of balances due to individuals after the settlement of their accounts by the first comptroller, or the commissioner of customs, upon which payment is made.

12. The Comptroller of the Currency has the control of the national banks.

13. The Director of the Mint has general supervision of all the mints and assay offices of the United States.

14. The Solicitor of the Treasury is the law officer of the department. He takes cognizance of all frauds or attempted frauds on the customs revenue, and has supervision over suits for the collection of moneys due to the United States, excepting those due under the internal revenue, and over all suits relating to national banks, in which the United States and its agents are parties.

15. The Commissioner of Internal Revenue has general superintendence of the collection of all internal revenue taxes, and the enforcement of all internal revenue laws.

16. The Superintendent of the Coast and Geodetic Survey is charged with the survey of the Atlantic, Gulf and Pacific coasts of the United States, including the coasts of Alaska; the survey of rivers to the head of tide-water or ship navigation; deep-sea soundings; temperature and current observations along the said coasts; magnetic observations and gravity research; determination of heights by geodetic leveling, and of geographical position by lines of transcontinental triangulation.

17. The Supervising Inspector-General of Steam Vessels superintends the administration of the steamboat inspection laws, presides at the meetings of the board of supervising inspectors, receives all reports, and examines all accounts of inspectors.

18. The Supervising Surgeon-General supervises the marine hospitals and other relief stations of the service; takes care of sick and disabled seamen, both from the merchant vessels of the United States, and from the revenue-marine and light-house services; purveys medical and other supplies; assigns medical officers to the United States hospitals, and examines requisitions, vouchers, property returns, and manages all matters pertaining to the United States hospital service.

19. The General Superintendent of the Life-Saving Service supervises the organization and government of the employés of the service; prepares regulations therefor; fixes the number and compensation of surfmen to be employed at the several stations; supervises the expenditure of all appropriations made for the service; examines the accounts of disbursements of the district superintendents, and the property returns of the keepers of the several stations; prepares estimates for the support of the service; compiles statistics of marine disasters, and makes an annual report of the expenditures for the maintenance of the life-saving service and of the operations of said service during the year.

20. The Chief of the Bureau of Statistics collects and publishes the statistics of our foreign commerce; makes monthly statements of imports and exports, especially of breadstuffs, provisions, petroleum, and cotton; makes annual reports on navigation, and monthly reports on immigration, and the total values of foreign commerce.

21. The Chief of the Bureau of Engraving and Printing designs, engraves, prints, and finishes all the securities and other similar work of the government printed from steel plates (except postage stamps and postal notes), embracing United States notes, bonds, and certificates, national bank notes, internal revenue and customs stamps, treasury drafts and checks, disbursing officers' checks, licenses, commissions, patent and pension certificates, and portraits of deceased members of Congress and other public officers authorized by law.

22. The Light-House Board is composed of two officers of the navy of high rank, two officers of the corps of engineers of the army, and two civilians of high scientific attainments, together with an officer of the navy and an officer of engineers of the army as secretaries. Under the superintendence of the secretary of the treasury this board discharges all administrative duties relating to the construction, illumination, inspection, and superintendence of light-houses, light-vessels, beacons, buoys, and their appendages.

It is seen from the foregoing details that the transaction of the immense and varied business of the United States treasury department is distributed among a series of responsible officers. The clerical and other forces employed in the various offices and bureaus number 15.697, of whom 2,852 are in bureaus in Washington, D.C., 4,450 in the customs service, 3.303 in the internal revenue service, 948 in the mints and assay offices, 225 in the several sub-treasuries, and 3.919 in the life-saving, marine hospital, steamboat inspection, and revenue marine bureaus, and in the various public buildings and other branches of the department located throughout the country.

TREATY. For information on the general subject of treaties, see Britannica, Vol. XXII, pp. 530-532. In the United States the treaties are negotiated by the executive department and confirmed by the Senate. When so confirmed, they are part of the law of the land. The principal treaties in which the United States are vitally interested are:

1819. Declaration of the rights of neutrals, as adopted by the United States and accepted by Great Britain.

1838. Maine boundary dispute, between Great Britain and the United States, settled by Lord Ashburton and Daniel Webster.

1842. Anglo-American Convention to check the slave trade.

1843. Arbitration on pecuniary disputes between the United States and Mexico (under the King of Prussia).

1846. Treaty between Great Britain and the United States, fixing the forty-ninth parallel as boundary, and confirming Vancouver Island to Great Britain.

1850. Clayton-Bulwer Treaty, Great Britain and United States (neutrality in Central America).

1853. Arbitration between Great Britain and the United States (Florida bonds).

1853. Arbitration between the United States and Mexico.

1854. Washington Treaty, between Great Britain and the United States (Fisheries and Commerce).

1858. Convention between the United States and Japan (opening certain ports).

1858. Arbitration between the United States and Chili (under the King of the Belgians).

1859. Arbitration between the United States and Paraguay, New Granada, and Costa Rica.

1863. A detailed Code of Instructions drawn up for the United States armies in the field, laying down valuable principles of international law.

1863. Arbitration between the United States and Peru.

1864. Convention of Geneva on behalf of the sick and wounded in war. Red cross adopted.

1864. Arbitration between Great Britain and the United States about Puget Sound.

1865-6. Slaves emancipated in the United States.

1869. International Telegraphic Conference and Treaty at Berne.

1871. Arbitration agreed to between Great Britain and the United States on the Alabama Claims. The award was made in June, 1872.

1871. Arbitration between the United States and Mexico.

1871. International Telegraph Conference at Rome.

1872. St. Juan Arbitration between Great Britain and the United States (under the emperor of Germany).

1874. Dispute between Switzerland and Italy referred to the United States minister at Rome.

1874. International Postal Treaty at Berne. Postal Union established.

1874. International Conference and Declaration of Brussels on the Laws and Customs of War.

1875. International Telegraph Conference at St. Petersburg.

1875. International Postal and Metric Conference at Paris.

1879. Telegraphic Convention in London.

1883. Convention at Paris on the protection of industrial property.

1885. International Telegraph Conference at Berlin.

1885. First International Congress on Inland Navigation at Brussels.

1885. African Conference at Berlin. The new Congo State sanctioned.

1886. Conference at Tokio for the revision of Japanese Treaties. New provisions in regard to foreign residents.

1887. Conventions between China and France, and China and the United States.

1887. Joint Commission at Washington to arrange the Fishery Disputes between the United States, Great Britain and Canada.

1888. Fisheries Treaty concluded by the Washington Commission; rejected by the United States Senate.

1888. Convention for the Neutralization of the Suez Canal signed at Constantinople by representatives of the powers.

1888. International Trades Union Congress in London.

Up to 1873 the United States government adjusted its relations to the North American Indians by means of treaties. Since 1873 this method has been discontinued, and acts of Congress have taken the place of treaties as means of adjusting such relations.

TREBLE, the highest part in harmonized music, which in general contains the melody, and is sung by a soprano voice. The treble or G clef is placed on the second line of the staff, indicating that the note G occupies the line encircled by its lower curve. It is one of the two clefs in use in music for keyed instruments.

TREE, the name given to those plants which live for many years, and have woody stems and branches, the stem being generally single, and bearing a head of branches and twigs; whereas shrubs have generally a number of stems springing from one root. The terms tree and shrub are not, however, of very exactly defined signification; and many shrubs, under certain circumstances, assume the form of trees, either naturally or by the help of art; while trees are, in other circumstances, converted into shrubs.

TREES OF LIBERTY. The custom, peculiar to almost all the nations of Europe, celebrating the beginning of spring and various festivals by setting up green boughs, led, during the War of Independence in the United States, to the habit of planting poplars and other trees as the symbol of growing freedom. This example was imitated during the French Revolution. These trees, crowned with the cap of liberty, were soon to be found in every village, while the people danced round them, singing revolutionary songs, and regarded them as the rendezvous of the patriots. This custom was regulated by a decree of the convention, and diffused over foreign countries by the republican armies. During the Reign of Terror, thousands lost their lives under the pretext of having injured a tree of liberty. During the empire, this custom, like all others that had originated during the republic, was completely suppressed. After most of the trees of liberty had fallen during the conflicts in the streets of Paris, in June, 1848, government issued an order for their removal from all places where they impeded traffic. Before the end of the year, they had entirely disappeared. Numerous trees of liberty were likewise erected in Italy during the revolution of 1848 and 1849, but fell again as the different insurrections were quelled.

TRENTON, a town, and the county-seat of Grundy county, Mo., on the Crooked Fork of Grand River. It contains a number of machine shops and flour and woolen mills. Population in 1890, 5,011.

TRENTON, a city of New Jersey. Population in 1890, 57.458. See Britannica, Vol. XXIII, p. 552.

TREVELYAN, Sir George Otto, born in 1838 He represented Tynemouth in 1865–68, and commenced his official parliamentary career in 1869 as lord of the admiralty; and, in Mr. Gladstone's ministry, became secretary to the admirality. After holding the office of chief secretary for Ireland, Sir George was appointed chancellor of the duchy of Lancaster (with a seat in the cabinet) in 1884, and held the office of secretary for Scotland for a month in 1886. Sir George, being unable to agree with Mr. Gladstone's Irish policy, resigned his position in the government, but on the conclusion of the Round Table Conference, at which he represented the Unionist party, he announced that his opposition to the points of disagreement with regard to the Home Rule movement had been overcome, and he rejoined his colleagues on the Front Opposition bench. Sir George has gained distinction in the world of letters by his *Life of Lord Macaulay*, his uncle. He is also the author of some humorous poetry, entitled *The Ladies in Parliament*.

TRÉVES, Holy Coat of. For general article on Tréves, see Britannica, Vol. XXIII, pp. 552–53. After an interval of forty-seven years another great pilgrimage was made in the midsummer of 1891, to Tréves, Prussia, to obtain a personal view of the alleged "seamless coat" of Jesus Christ, which, at the time of his crucifixion, passed into possession of the Roman soldiers, and which had last been exhibited in 1844 to pilgrims, estimated to number over 1,500,000. The story of this coat which at intervals has awakened excited attention for several centuries, is that it was discovered, or rather found, by St. Helena, the innkeeper's daughter, who became the wife of one Cæsar and the mother of another. On her return from Palestine, early in the fourth century, she deposited the garment in the basilica out of which grew the Cathedral of Tréves, a city which, in those days, was the capital of Belgic Gaul, and the residence of the later Roman emperors. In course of time this lordly church was so filled with relics that when the barbarians in the fifth century, and the Normans in the ninth, played havoc with the town, the treasures were concealed in crypts, and there they remained for so long a period that the existence of some of them was forgotten. This is the legend. More authentic records tell us that the holy coat was discovered, or rediscovered, in the year 1196, and then solemnly exhibited to the uncritical gaze of the pious. Contrary to the wont of most other treasures of a similar kind, which are exhibited pretty frequently—the "great relics" in Aix la-Chapelle being an exception—the holy coat was not seen again for more than three centuries, an interval that is full of suggestiveness in the case of a town crowded, as the archiepiscopal capital of Tréves then was, with crafty priests and skillful weavers.

At all events, it was not shown until 1512, when the multitudes flocking to venerate it were so great that Leo X. determined that it should be produced every seventh year. But, meantime, Tetzel and his sale of indulgences had made their mark, and the great festival of the holy coat ceased to be observed with any regularity, profitable though the occasion undoubtedly was to the church and townsmen of Tréves. In 1810 it was again exhibited, and in spite of the slowness of traveling, and notwithstanding Napoleon's prohibition against the working of miracles, 227,000 people went to the memorable sight. For thirty-four years nothing more was heard of the coat, and the secret of its hiding place was confided to so select a body of the cathedral clergy that it was feared that it had again been lost. Indeed, so silent were the authorities regarding this greatest of their relics that as late as 1841, there were doubts whether it really existed. All that the attendants of the church could say was that it was walled up in the high altar, and would appear once more on the centenary of its exhibition in 1744.

In 1844, accordingly, Bishop Arnoldi produced the coat. It was then a loose garment with wide sleeves, very simple in shape, of coarse material, dark brown in color, and entirely without seam or decoration. According to one of the many descriptions and figures of it published at the time it measured from the extremity of each sleeve five feet four inches, the length from the collar to the lowermost edge being five feet two inches. In parts it was tender or threadbare, and some stains on it were reputed to be those of the Redeemer's blood, though nothing was said as to the patchwork character of the tunic. On this, as on previous occasions, miracles were reported to have been wrought by it in the shape of cures, the nature of the best authenticated being closely akin to those known nowadays as faith healing. Since the Middle Ages no such pilgrimage had been known, and no mediæval shrine could have attracted the same number of people in the same space of time, for it is said that 1,500,000 devotees visited the high altar on which the coat was placed. They came from all quarters, many from long distances, traveling on foot, preceded by their village priests and by surpliced boys bearing banners. All the inns and lodging houses of the town were crammed, and not a vacant room which the owners were willing to let, could be had after the first week for either love or money. But it was summer, and there was little hardship in sleeping on staircases, in out-houses, or even in the streets and squares, with the pilgrim wallets for pillows. Every morning at early dawn, the eager sightseers took up their posts by the cathedral doors, until a line of more than a mile in length was formed, so that it was difficult for any, save the head of the procession, to reach the coat much under three hours. The heat, dust and fatigue exhausted many, who fainted by the way, while the pent-up excitement of others gave way to hysteria as they made their oblations before the sacred object.

At the close of the exhibition, among those who disapproved of the whole affair was Johann Ronge, a Roman Catholic priest, who, in October, 1844, made a vigorous attack on Bishop Arnoldi for encouraging those acts of adoration to what he declared was at best a relic of the most doubtful authenticity. As this declaration was against a canon of the church, and in contempt of more than one papal bull, the recalcitrant churchman was promptly excommunicated by the chapter of Breslau. The result, however, was a schism so wide that in six months there were twenty-seven congregations who professed themselves of Ronge's way of thinking.

In midsummer, 1891, a committee of experts, chosen by the Roman Catholic Bishop of Tréves, made a private examination of the garment and vouched for its genuineness, "though it is rather moldier and more mildewed than when last permitted to see the light of day." That is to say, they vouch that the coat is the same one which was exhibited in 1844, the seals still being intact. We need hardly observe that it was impossible for them, or for anybody else, to produce a scintilla of proof that it was the seamless coat for which the Roman soldiers cast lots on Calvary nearly nineteen centuries ago. Roman Catholic tradition affirms that the coat possesses a miraculous power, enabling it to defy the ravages of time. Unfortunately, however, the pious citizens who had been requested to examine it did not bear out this explanation by their report. On the contrary they declare that the garment shows traces of having been renewed, several patches on it being embedded in a piece of linen or cotton cloth of a later manufacture.

In 1891, after extensive preparations, the exhibition opened August 20th. A cable telegram received on that date describing the opening ceremonies, reads as follows:

"The garment known as the holy coat was exposed to view this morning in the cathedral at Tréves. Two Knights of Malta, in full costume, with drawn swords in their hands, stood on either side of the shrine inclosing the holy-coat case, which was surrounded by tall lighted candles in handsome candlesticks and surmounted by a large gold cross. There was an impressive scene in the sanctuary during the celebration of high mass, over a hundred priests assisted in the ceremonies.

"The bishop declares that the only aim of the exhibition is 'to revive the faith in and the love toward our Divine Saviour,' and fervently exhorts the Church to the end that the period of exhibition may be 'a season of grace for all.' This grace, he urges, is to be petitioned for 'through fervent prayer and works of Christian penance.' The feast should be celebrated in the spirit of our forefathers. 'Not out of curiosity, not for amusement, did they come to our cathedral; but they followed the impulse of grace, to profess their faith, to show to God their love and gratitude by venerating His holy coat.'

"The holy coat is distinctly visible in the body of the cathedral, and is much more plainly seen than upon the former occasion of its exhibition. The old silken covering being almost entirely worn away, it appears to-day to be of a brownish yellow color."

During the exhibition of the "Holy Coat," which closed in October, 1891, it was estimated that over 2,000,000 people visited Tréves.

TRIDACNIDÆ, a family of lamellibranchiate molluscs, having the shell open, the valves equal, the foot small, and furnished with a byssus. *Tridacna gigas* is remarkable for its great size, exceeding that of any other bivalve. The shell of a single specimen has been known to weigh more than 500 lbs. The valves are sometimes used in Roman Catholic churches for holy-water vessels. They are also used as an ornament for grottoes and fountains. They are deeply furrowed and beautifully grooved. This great mollusc is a native of the East Indies, and is used for food.

TRIDENT, in classic mythology, the symbol of Neptune's sovereignty over the sea. It consisted of a staff, armed at one end with three short prongs, with double barbs at the points, resembling the *fuscina* used by the Italians in catching large fish, particularly the sword-fish, from which we may perhaps infer that Neptunus was originally the god of fishermen.

TRIENNIAL PRESCRIPTION, in the law of Scotland, a limit of three years imposed on all creditors to bring their actions to recover a certain class of debts and damages, such as actions to recover merchants' accounts, servants' wages, house rents (where the lease is verbal), debts due to tradesmen, lawyers and doctors. So actions to recover damages for wrongous imprisonment must be brought within three years.

TRIGONOCARPON, a common fruit in the coal-measures, occurring in all the strata except the underclays and limestones. Some six or eight species have been established, which differ from one another in size and shape—some being as small as a pea, and others as large as a walnut. They are marked, when preserved in the round, with three longitudinal ridges, and from this character the name was derived. They have never been found attached to any plant. It was at first thought that they were palm fruits, but Dr. Hooker, from the examination of several specimens which exhibit structure, has shown that they are not unlike the structure of *Salisburia*, a drupe-bearing coniferous tree, a native of China and Japan.

TRIKHALA, or **TRIKALA**, a town of Europe, in Greece, thirty-three miles southwest of Larissa. It manufactures cotton and woolen stuffs, and has a large transit trade with Epirus and Albania. The neighboring plains, which are watered by the Salembria (ancient *Peneus*), are rich in all sorts of fruits. Population, (1889), 12,662. Trikhala is the *Trikka* of Homer, and was celebrated in the classic ages for its temple of Æsculapius.

TRILOGY, the name given by the Greeks to a group of three tragedies, either connected by a common subject, or each representing a distinct story. A satyric drama was customarily added as a termination, whence the whole was sometimes termed a *tetralogy*. Every tragic poet that wished to take part in a poetic contest had to produce a trilogy along with a satyric drama at the Dionysiac, Lenæan and Anthesteriac festivals. We possess only one perfect specimen of the classic trilogy, the *Oresteia* of Æschylus, which embraces the *Agamemnon*, the *Chœphoræ* and the *Eumenides*.

TRIMMER, a political term in use in the reigns of Charles II. and William III., originally applied to certain politicians of Charles' time, of whom the chief was Charles Montagu, earl of Halifax, who held opinions half-way between the extreme Whigs and Tories. Halifax adopted the name Trimmer as a title of honor, maintaining that everything good was a medium between extremes. The same term was applied more generally by Dryden and other writers of the same period to all who, professing to be friends to monarchy, were at the same time enemies to the duke of York, and who were equally obnoxious to the court and to the fanatical republicans.

TRIMURTI, the name of the Hindu triad, or the gods Brahma (masculine), Vishnu and Siva, when thought of as an inseparable unity, though three in form. When represented, the Trimurti is one body with three heads: the middle head, that of Brahma; at its right, that of Vishnu; and at its left, that of Siva.

TRINIDAD, a town, the county-seat of Las Animas county, Colorado; on Purgatory River. It is the seat of Rice Institute and other educational institutions, and exports large quantities of wool. Population in 1890, 5,500.

TRINITY, a river of Texas, formed by the union of two streams, West Fork and Elm Fork, which rise near the northern boundary of the state, and unite 150 miles southeast, the main stream flowing thence 550 miles in the same general direction to Galveston Bay, about forty miles north of the city of Galveston. It is navigable 300 to 500 miles.

TRINITY, a river of California, rising near the coast-range, and flowing through a country of rich gold-mines, into the Klamath River.

TRINODA NECESSITAS, three species of contributions, to which, in Anglo-Saxon times, all the lands of England, whatever their tenure, not excepting those of the church, were subject, namely, *Bryge-bot*, for keeping the bridges and highways in repair; and *Burg-bot*, for keeping the fortresses in repair; and *Fyrd*, for maintaining the military and naval force of the kingdom.

TRIO, in music, a composition for three voices or for three instruments. The same term is also applied to a movement in ¾ time in a different key, which follows a minuet or other movement, and always leads back to the previous movement in the original key.

TRIPLE ALLIANCE, the name first given in 1879, to a stipulation of mutual support between Germany, Austria and Italy. It was a defensive agreement of mutual support, for the ostensible pupose of preserving the peace of Europe, but for the real purpose of preventing Russia and France from making any efforts to encroach upon the present boundary allotment of the European states. The alliance was for a term of six years. In 1885 it was renewed for another term of six years; and it now (1891) has been extended for another six years' term.

The motive for this third alliance is obvious. Germany has nothing to gain and much to lose from another war. She does not care to add to her territories, and in the event of a great struggle there would probably be serious trouble in Alsace and Lorraine. On the other hand, both Russia and France have definite ends to be reached. Russia is always working in the Balkan region for additions to her territory, and always moving on patiently, but with unbroken determination, toward Constantinople. France is inspired with a determination to recover her lost territory or be revenged. It is believed that the arrangement between Russia and France involves a distinct understanding by which France is to be allowed supremacy in the Mediterranean, and Russia to have a perfectly free hand in the East. It must be remembered also that while the populations of Austria, Italy and Germany desire peace no less earnestly than their rulers, there is in France strong popular feeling against Germany, and in Russia a latent desire for war, which at any moment may be fanned into a flame. The war initiated by Germany or Austria would be a dynastic war, but a war initiated by either France or Russia might be a popular war. The practical bearing of this fact lies in the possibility of the war being precipitated by an outburst of popular feeling in either of these two countries. So far as the members of the Triple Alliance are concerned, war will not be precipitated save by the concurrent action of the sovereigns at the head of the states. What Italy has to gain from this alliance is not very clear. Her only apparant gain is in prestige; as a member of the alliance she ranks as a great power, and since the bold move of Cavour in sending Italian troops to the Crimea this has been part of her policy; a policy that has resulted in the autonomy of the Italian people.

The chief beneficent result of the Triple Alliance lies in the fact that in a way it insures for the time the peace of Europe. A war to-day would mean a struggle between two groups of powers who would divide all Europe between them. Not since the days of Napoleon has Europe witnessed so gigantic a strife as would follow the outbreak of hostilities; and this fact has a tendency to make statesmen and rulers sober by making them conscious of tremendous responsibilities. On the other hand, the Triple Alliance is the direct source of a number of very unfortunate influences. It involves a military force on all sides of nearly ten millions of men, and it represents the most frightful burden of taxation known in history. This enormous body of men must not only be supported and paid, but in great numbers they are taken out of every field of productive work, and the world loses just so much by their absence. The situation involves more loss of productive force and a heavier outgo to sustain unproductive hands, than any previous condition in the history of the world. This is a very serious fact in the economic situation. Moreover, the alliance, extended now for a third term of six years, makes it impossible to take the first step toward the disarmament of Europe. It fastens the *status quo* more heavily than ever upon all the great nations. There are apparently but two ways of escape from the appalling burdens which Europe is now bearing. A great war might so thoroughly weaken and disable one or two of the disputants as to destroy the present equilibrium and relieve the others of the dangers and fears which now surround them; or, by consensus of opinion, a reduction of the different armaments. Sooner or later the burden will be too heavy to be borne; it is already wearing into the hearts and souls of men; but the Triple Alliance makes it impossible to reduce the burden or to relieve the situation.

TRIPLET, in music. When a note is divided into three in place of two parts—as when a minim is divided into three crotchets, a crotchet into three quavers, etc.— the group is called a triplet, and it is usual to place the figure 3 over it.

TRIPOD, any article of furniture supported on three feet. Three-legged caldrons and bronze altars more especially came under this denomination in classical times; many of them are of exquisite workmanship, and richly decorated. The sacrificial tripod in its earliest form resembled the caldron, with the addition of three rings at the top to serve as handles. Of this description seems to have been the tripod at Delphi, from which the Pythian priestess delivered her oracles. Tripods of a similar form were given as prizes at the Pythian games; and at Athens, a tripod was considered an appropriate reward for a successful choragus. Some beautiful tripods were found at Pompeii; and there are several very interesting specimens in the British Museum.

TRIPOLI, a mineral substance employed in polishing metals, marble, glass, etc., so named because it was originally brought from Tripoli in Africa. It is a siliceous rock, composed of very minute particles, somewhat loosely held together, so as to yield readily to the nail, and to crumble down in water like rotten-stone.

TRITON, in Greek mythology, a son of Poseidon and Amphitrite, who dwells with his parents in a golden palace at the bottom of the sea. He usually figures as an attendant on his father, riding over the Mediterranean on a horse or other sea-monster, and soothing the turbulent waves by blowing his shell-trumpet—his "wreathed horn," as Wordsworth calls it. The later poets speak of Tritons, in the plural, as a race of subordinate sea-deities, who were frequently represented in works of art.

TROMSOE, a small island on the northwest coast of Norway, in Finmark, between the island Kvalö and the mainland. It is four miles long and about a mile and a half broad. On the eastern side of the island is the small but thriving town of the same name, the seat of a bishop. Russian vessels from Archangel and the White Sea visit this town, and bring corn, which they exchange for dried fish. Population, about 3,000.

TRON, or **TRONE WEIGHT**, the most ancient system of weight used in Scotland, so called from *trone*, a species of heavy beam or balance set up in the market-place, and employed for the weighing of heavy wares. The weights employed in the public markets formed the most convenient reference, and consequently tron weight became the standard. The tron pound contained twenty ounces, but from the custom of giving "one in" to the score, was always reckoned at twenty-one ounces; this was the most general value; but it varied in the different market-towns between this and twenty-eight ounces. The later tron stone or standard weight contains sixteen tron pounds, each pound sixteen tron ounces, and each tron ounce sixteen drops; the tron pound is estimated to be equivalent to 1.3747 pounds avoirdupois.

TROOP, in cavalry, the unit of formation, forming the command of a captain, consisting usually of sixty troopers, and corresponding to a company of infantry. The officers of a troop are the captain, lieutenant and cornet. Two troops form a squadron.

TROPE (Gr. *tropos*, a "change," a "turning"), the name of a figure of speech which does not appear to differ from metaphor.

TROPHY, a memorial of victory erected on the spot where the enemy had turned to flight. Among the Greeks (with the exception of the Macedonians, who erected no trophies), one or two shields and helmets of the routed enemy, placed upon the trunk of a tree, served as the sign and memorial of victory. After a sea-fight, the trophy consisted of the beaks and stern-ornaments of the captured vessels, set up on the nearest coast. In early times the Romans never erected trophies on the field, but decorated the buildings at Rome with the spoils of the vanquished. Of this practice we have a familiar instance in the *rostra* or beaks set up in the forum. In later times pillars and triumphal arches were employed to commemorate victories. Besides these, in modern times, the humiliation of an enemy is rendered lasting by such devices as the bridge of Jena, of Waterloo, and by the distribution of captured cannon.

TROUT, the popular name of many species of the genus *Salmo*, as characterized by Cuvier. The name is given to some of the silvery species migrating to the sea, and to all the yellow species, which constantly inhabit fresh waters. Trouts are found in almost all the lakes and rivers of the temperate and colder parts of the Northern hemisphere. The Common Trout (*Salmo fario* or *Salar Ausonii*) is widely diffused in the Eastern hemisphere. It is found even in very small streams, and almost to their mountain sources, but attains its largest size where there is considerable depth of water and abundance of food. The head of the Common Trout is large; the eye large; the general form symmetrical, stouter than that of the salmon, the convexity of the outline of the back nearly similar to that of the belly; the tail is slightly forked; the teeth numerous and curved. The color is yellow, but the tint varies much in the trout of different waters, sometimes passing into greenish-black or violet. On the back and upper part of the sides there are spots of black and red; the belly is silvery white. The fins are light-brown; the dorsal fin and tail with numerous darker brown spots. America has numerous species. One of them, the Common Brook Trout or Speckled Trout (*Salmo fontinalis*), is similar to the Common Trout. It abounds in the streams of Canada, and in the northern and middle parts of the United States. The North American Lake Trout (*Salmo confinis*) inhabits the deepest waters of the great lakes, and sometimes attains a weight of more than sixty pounds. It is dark-colored, mottled with grayish spots. The finest species in quality, as well as largest in size, is the Mackinaw Trout, or Namaycush (*Salmo amethystus*, or *namaycush*). It is found in Lake Huron, Lake Superior and the more northern lakes. The Red-bellied Trout (*Salmo*, or *Fario erythrogaster*) of the lakes of New York and Pennsylvania, sometimes two and one-half feet in length, is deep greenish on the back, lighter on the sides, which are spotted with red, the belly orange-red.

TROUVERE, the name given in Northern France to the same kind of courtly or polished poet who, in Southern France was called a Troubadour.

TROY, a city of New York. Population in 1890, 60,956. See Britannica, Vol. XXIII, p. 590.

TROY, a town, the county-seat of Miami county, Ohio, on Great Miami River and Miami Canal. It has abundant water-power, flour-mills, wagon-factories, and an extensive trade. Population in 1890, 4,590.

TRUCKEE, a village in Nevada county, Cal., near the crest of the Sierra, at an elevation of about 6,000 feet. It has extensive saw-mills and lumber manufactories, run by the water-power of the Truckee River. It is in the vicinity of Donner Lake and Lake Tahoe. In winter snow falls to a great depth.

TRUCK FARMING IN THE UNITED STATES. The United States census statistics taken in 1890, showed that over $100,000,000 was invested in truck farming, and that after paying all freights and commissions, trucking received about $75,000,000 for the produce of 1889. The total cost of labor, manures, seeds, etc., amounted to about $24,000,000, leaving about $52,000,000 as net profit. The acreage covered by the truck crops aggregated 535,000 acres. Over 200,000 men, about 10,000 women and 15,000 children were employed, receiving for their labor nearly $10,000,000. Seventy-six thousand horses and mules, and $9,000,000 worth of machines and other implements were required.

Truck farming is not market gardening as this special business is carried on, but it is ordinary farming devoted to the heavier class of products upon a much less extensive system than the truly garden culture of the grower of vegetables and fruits, who is especially a market gardener. Truck farming is market farming as distinguished from the higher culture of the gardener who confines himself to a few acres in the immediate vicinity, or within the actual bounds of a large town or a city. The market gardener works on land which costs $2,000 or $3,000 an acre, or for which he pays as annual rent a sum equal to the whole value of an acre of a suburban farm. The market farmer works on a farm and devotes only a part of his time and labor to the truck which he grows. He is usually a dairyman or a fruit grower, and devotes less or more of his available land to the heavier class of vegetables which can be grown in fields. The following list of products will give an idea of his crops:

	Acres.
Asparagus	37,970
Beans	12,707
Cabbage	77,094
Kale	2,962
Spinach	20,195
Irish potatoes	28,046
Beets	2,420
Celery	15,381
Cucumbers	4,721
Watermelons	114,381
Other melons	28,477
Peas	56,162
Sweet potatoes	28,621
Tomatoes	12,802
Miscellaneous vegetables	82,601
Total	324,540

Truck farming is carried on in the vicinity of every city, town and village of the whole United States. In some states, as in Florida, New Jersey, the eastern part of Pennsylvania, Illinois for the whole length of the state, in Maryland, North Carolina, and in New York, especially in Long Island, in Michigan and even in Kansas, whence celery is now shipped to New York City, this industry covers certainly a million acres of land. Sweet corn alone occupies around the city of New York at least 10,000 acres of land, and one small town near that city alone has sent out every evening for years past no less than 150 wagons loaded with this kind of truck in the height of the season. The list of the districts in which this business is carried on is thus given, with the annual value of the produce:

Districts.	Acres.	Value of Products.
New England	6,838	$ 3,184,218
New York and Philadelphia	108,135	21,102,521
Peninsular	25,714	2,413,648
Norfolk	45,375	4,692,859
Baltimore	37,181	3,784,696
South Atlantic	111,441	13,183,516
Mississippi Valley	36,180	4,982,567
Southwest	36,889	4,979,783
Central	107,414	15,432,223
Northwest	1,083	204,791
Mountain	3,833	531,976
Pacific Coast	14,357	2,024,345
Total	534,450	$76,517,148

Every village of two hundred or three hundred people offers a market for farm products of this kind and small fruits. In most of these small communities it is supposed that the villagers grow their own supplies in their own gardens. Experience in this direction has shown that this is far from being the exact case, and that on the contrary the village gardens are rarely productive enough to satisfy their owners; that the crops grown are late, and not of fine quality, and that if vegetables and fruits fresh from the farms are offered they will be eagerly taken. A case in point may be referred to. A farmer, whose land adjoined a village of about 500 people, had a surplus of strawberries in his garden which he wished to dispose of. He picked a dozen quarts and sent a boy into the village to sell them. In an hour the boy had returned, and wanted more. That day more than 100 quarts were sold. Some of the purchasers wanted cream, and the demand for this was supplied at a price equal to twice the value of the butter. The result was that a market was found for asparagus, early cabbages, cauliflowers (not one of which was grown in the village), tomatoes, and other truck, and gradually the farmer was obliged to put several acres of his land in these crops to meet the demands of this little village. The income from this source became larger than that from the rest of the farm, which had been previously wholly devoted to the dairy.

But it is not only the residents of villages who will purchase truck of this kind. A milk dairyman may sell to farmers along his route many products which they do not grow. Celery, asparagus, cauliflowers, early cabbages, and sweet corn may find many purchasers among farmers who think these trifles are beneath their notice, and give their attention to the large crops. Some of the most prosperous farmers belong to this class of truckers, giving their sole attention to potatoes, muskmelons, tomatoes, celery, onions, cabbages, etc., and thus make their small farms turn out from $200 upward per acre, and, becoming known for the excellence of their products, their honesty in dealing, and the certainty of supply, make permanent business connections, and sell their products without the least difficulty. This subject is well worth the attentive study of farmers who are complaining of the paucity of their profits.

TRULLAN, the name (derived from the hall—Gr. *troullos*—of the palace in which the Fathers assembled) given to the council, also called *Quinisext*.

TRUST COMPANIES, financial corporations which are authorized to receive money on deposit and pay interest thereon, and also to receive securities and other personal property from individuals or corporations, and loan money on real estate and collateral or personal securities. They may also act as the fiscal agents of states, municipalities or corporations, and in such capacity receive and disburse money, and transfer, register, and countersign certificates of stocks, bonds, or other evidence of indebtedness. They also act as trustees under mortgages given by corporations, and accept and execute any other municipal or corporate trusts not inconsistent with law. The charters of such companies are obtained through the state Legislature, and as a rule contain the broadest of powers. But in the state of New York, since 1887, they are organized under a general law, which, however, is not applicable to companies previously chartered by special acts of the Legislature. The affairs of trust companies are managed by directors or trustees, elected annually by their stockholders. These officials are generally forbidden from borrowing the moneys or securities of the corporation. The capital of these companies varies from $100,000 to $2,000,000, and must be invested in bonds and mortgages, or designated public securities.

TRUSTS. Organizations for the control of several corporations under one direction by the device of a transfer by the stockholders in each corporation of at least a majority of the stock to a central committee or board of trustees, which issues in return to such stockholders respectively, certificates showing in effect that, although they have parted with their stock and the consequent voting power, they are still entitled to dividends or to their share in the profits—the object being to enable the trustees to elect directors in all the corporations, to control and suspend at pleasure the work of any of them, and thus to economize expenses, regulate production, and defeat competition. In a looser sense, the term "trust" is applied to any combination of establishments in the same line of business for securing the same ends, by holding the individual interests of each subservient to a common authority for the common interests of all. It is against public policy for a stockholder to divest himself of his voting power; hence, such a transfer of stock, if made, is revocable at the pleasure of the maker. So far as the object of such a combination is shown to be the control of prices of, and the prevention of competition in, the necessaries or conveniences of life, it is held to be a criminal act upon the principles which rendered engrossing and forestalling punishable; and a corporation, which by corporate act, surrenders its powers to the control of a trust, thereby affords ground for a forfeiture of its charter by the state.

ANTI-TRUST LEGISLATION BY CONGRESS. The LI. Congress of the United States adopted an important Anti-Trust Act, as follows:

The act provides that every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several states, or with foreign nations, is hereby declared to be illegal. Every person who shall make any such contract or engage in any such combination or conspiracy shall be deemed guilty of a misdemeanor, and, on conviction thereof, shall be punished by fine not exceeding five thousand dollars, or by imprisonment not exceeding one year, or by both said punishments, in the discretion of the court.

Sec. 2. Every person who shall monopolize, or attempt to monopolize, or combine or conspire with any other person or persons, to monopolize any part of the trade or commerce among the several states, or with foreign nations, shall be deemed guilty of a misdemeanor, and, on conviction thereof, shall be punished by fine not exceeding five thousand dollars, or by imprisonment not exceeding one year, or by both said punishments, in the discretion of the court.

Sec. 3. Every contract, combination in form of trust or otherwise, or conspiracy, in restraint of trade or commerce in any territory of the United States or of the District of Columbia, or in restraint of trade or commerce between any such territory and another, or between any such territory or territories and any state or states or the District of Columbia, or with foreign nations, or between the District of Columbia and any state or states or foreign nations, is hereby declared illegal. Every person who shall make any such contract or engage in any such combination or conspiracy, shall be deemed guilty of a misdemeanor, and, on conviction thereof, shall be punished by fine not exceeding five thousand dollars, or by imprisonment not exceeding one year, or by both said punishments, in the discretion of the court.

Sec. 4. The several Circuit Courts of the United States are hereby invested with jurisdiction to prevent and restrain violations of this act; and it shall be the duties of the several district attorneys of the United States, in their respective districts, under the direction of the attorney general, to institute proceedings in equity to prevent and restrain such violations. Such proceedings may be by way of petition setting forth the case and praying that such violation shall be enjoined or otherwise prohibited. When the parties complained of shall have deen duly notified of such petition, the court shall proceed, as soon as may be, to the hearing and determination of the case; and pending such petition and before final decree, the court may at any time make such temporary restraining order or prohibition as shall be deemed just in the premises.

Sec. 5. Whenever it shall appear to the court before which any proceeding under Section 4 of this act may be pending, that the ends of justice require that other parties should be brought before the court, the court may cause them to be summoned, whether they reside in the district in which the court is held or not, and subpœnas to that end may be served in any district by the marshal thereof

Sec. 6. Any property owned under any contract or by any combination, or pursuant to any conspiracy (and being the subject thereof) mentioned in Section 1 of this act, and being in the course of transportation from one state to another, or to a foreign country, shall be forfeited to the United States, and may be seized and condemned by like proceedings as those provided by law for the forfeiture, seizure and condemnation of property imported into the United States contrary to law.

Sec. 7. Any person who shall be injured in his business or property by any other person or corporation by reason of anything forbidden or declared to be unlawful by this act may sue therefor in any Circuit Court of the United States in the district in which the defendant resides or is found, without respect to the amount in controversy, and shall recover threefold the damages by him sustained, and the costs of suit, including a reasonable attorney's fee.

Sec. 8. That the word "person," or "persons," wherever used in this act shall be deemed to include corporations and associations existing under or authorized by the laws of either the United States, the laws of any of the territories, the laws of any state, or the laws of any foreign country.

The above bill, when reported by a committee of conference, passed both houses without a division.

TRYSAIL, a small fore-and-aft sail, mounted by a cutter or schooner in a storm, when the wind is too violent for her to carry her ordinary canvas.

TUBICOLÆ, an order of *Annelida*, having a tubular shelly covering, into which the animal can retreat, but from which, when undisturbed and disposed to activity, it projects its head and gill-tufts. The genus *Serpula* is a good example.

TUCKER, HENRY ST. GEORGE, member of Congress, born in Virginia in 1853. He was educated at Washington and Lee University, graduating in 1875; has practiced law continuously since: was elected to Congress in 1889, and reelected in 1891.

TUCSON, a city of Arizona. Population in 1890, 5,095. See Britannica, Vol. XXIII, p. 604.

TUDOR STYLE, in architecture, a rather indefinite term applied to the late Perpendicular, and the transition from that to the Elizabethan.

TUESDAY, the third day of the week, so called from *Tiwesdæg*, the day of Tiw or Tiu, the old Saxon name for the god of war. The day bears a corresponding name in the other Germanic dialects

TUFTS COLLEGE. See COLLEGES AND UNIVERSITIES IN UNITED STATES in these Revisions and Additions.

TULIP TREE, often called TULIP POPLAR, *(Liriodendron tulipifera)*, a beautiful tree of the natural order *Magnoliaceæ*, a native of the United States, having a stem sometimes 100 to 140 feet high, and 3 feet thick, with a grayish-brown cracked bark, and many gnarled branches. The leaves are ovate, and three-lobed: the flowers solitary at the extremities of the branchlets. The bark has a bitter, aromatic taste, and in some parts of the basin of the Mississippi it forms considerable tracts of the forest.

TUNBRIDGE-WARE, a pretty kind of manufacture in wood, carried on at Tunbridge Wells. It consists of small articles, such as ladies' work-boxes, etc., which are covered with a veneer characteristic of this industry; it is formed by building up a geometric pattern with very small strips of wood of a triangular or square shape in transverse sections; these are carefully glued together so as to form a solid mass, from which thin transverse veneers are cut, and are used to cover the articles made. This trade was formerly of much greater importance than at present.

TUNIS, a country of northern Africa. For general article on Tunis see Britannica, Vol. XXIII, pp. 619-623. Tunis was acquired by France in 1881. It has an estimated area of 45,000 square miles, and a population of about 1,500,000.

TUNNELS IN AMERICA. Among the prominent tunnels in this country we mention the following:

1. The HOOSAC TUNNEL, on the railway from Boston, Mass., to Troy, N. Y., is four and three-fourths miles long, reaching through the Hoosac Mountain, which is a part of the Green Mountain Range. It was begun in 1862 and finished in 1880. This tunnel cost the state of Massachusetts about eighteen millions of dollars; but the state sold it in 1887, together with forty-four miles of railroad, to the Fitchburg Railroad Company for five millions of dollars in bonds and five millions of dollars in stock.

2. A TUNNEL THROUGH THE CASCADE RANGE, in the state of Washington, 9,850 feet long, was built from 1886 to 1888, for a single track railroad.

3. The BIG BEND TUNNEL of Butte county, Cal., is two miles long, and was built from 1882 to 1887, in order to reach some auriferous regions in the valley of the Feather River. It diverts the water of this river from its present channel and carries it through a mountain.

4. The CHICAGO TUNNEL, built from 1864 to 1876, runs from the foot of a land-shaft at Chicago two miles under Lake Michigan to the foot of a shaft in the lake. The lake-shaft is protected by a pentagonal crib or breakwater, forty feet high. This tunnel supplies the city of Chicago with water.

5. The SUTRO TUNNEL, built from 1869 to 1879, runs 20,000 feet into the mountain in which the Comstock mine is situated, near the town of Virginia City, Nev. It drains and ventilates a number of important mines.

6. A TUNNEL AT PORT HURON, Mich., some miles above Detroit, under the St. Clair River, is one and one-fourth miles in length, and large enough for a single track railroad.

7. A TUNNEL UNDER THE HUDSON RIVER, connecting New York City with New Jersey, is in the course of construction, and approaches completion now (October, 1891).

TUPELO (*Nyssa*), a genus of trees of the natural order *Cornaceæ*, natives of North America, chiefly of the middle and southern parts of the United States: having simple alternate leaves, mostly entire, greenish inconspicuous flowers at the extremity of long stalks, the fruit a drupe. *N. multiflora* attains a height of 60 to 70 feet. It is often called Sour Gum Tree. *N. tomentosa*, the Large Tupelo is a lofty and beautiful tree, remarkable for the extraordinary enlargement of the base of the trunk, which is sometimes 8 or 9 feet in diameter, while at no great height the diameter diminishes to 15 or 20 inches. The fruit resembles a small olive, and is preserved in the same way by the French settlers in America. *N. candicans* or *capitata*, the Ogechee Lime or Sour Gum Tree, is a small tree, of which the fruit is very acid, and is used like that of the lime. The wood of all the species is soft, that of the large tupelo remarkably so.

TUPELO, a prosperous and growing town of Mississippi, in the eastern part of the state, on the line of the Mobile and Ohio Railroad.

TUPPER, SIR CHARLES, high commissioner for Canada in London, born at Amherst, Nova Scotia, July, 1821. He was educated in Edinburgh for the medical profession, and was the first president of the Canadian Medical Association. He entered politics, and became prime minister of his native province in 1864; was a strong advocate of confederation, and wrote a "Letter to the Earl of Carnarvon on the Union question," in 1866; became cabinet minister of the Dominion in 1870, and held office with Sir John Macdonald till 1873: was one of the leaders of the Conservative opposition till 1878, when he was again appointed minister. As minister of railways he took the chief part in advocating throughout Canada the construction of the Canadian Pacific Railway, and took charge of the measure in parliament. He received his present appointment in 1884. Accompanied Mr. Chamberlain to Washington as Canadian representative during the fishery negotiation in 1888, and for his services was created a baronet.

TUPPER, MARTIN F., an English author, born in 1810, died in 1889. His principal work was *Proverbial Philosophy*.

TURKEY, EMPIRE OF. For general article on Turkey see Britannica, Vol. XXIII, pp. 648–657. The latest estimated area and population of Turkey are as follows: Area (including states nominally subject), 1,652,542 square miles; population, 32,360,000, viz.:

	Square Miles.	Population.
Turkey in Europe	63,850	4,790,000
Turkey in Asia	729,170	16,133,900
Turkey in Africa*	398,873	1,000,000
Bulgaria†	37,860	3,154,375
Bosnia‡	23,570	1,504,091
Samos	210	41,156
Egypt	400,000	6,817,265
Total	1,653,533	33,440,787

The estimated populations of the other largest towns are as follows: Adrianople, 100,000; Salonica, 60,000, Monastir, 45,000; Scutari, 30,000; Janina, 20,000; Smyrna, 200,000; Damascus, 200,000; Bagdad, 180,000; Aleppo, 120,000; Erzeroum, 60,000; Kaisarieh, 60,000; Mosul, 45,000; Sana, 50,000; Sivas, 48,000; Mecca, 45,000; Trebizond, 45,000; Adana, 45,000; Diarbekir, 40,000; Broussa, 35,700; Angora, 30,000; Van, 30,000; Jedda, 30,000; Jerusalem, 28,000; Konieh, 25,000; Chios, 25,000; Bitlis, 25,000; Canea, 15,000; Tripoli, 30,000.

ETHNOLOGICAL STATISTICS. In the European provinces under immediate Turkish rule, Turks (of Finno-Tataric race), Greeks and Albanians are almost equally numerous, and constitute 70 per cent. of the population. Other races represented are Serbs, Bulgarians, Roumanians, Armenians, Magyars, Gypsies, Jews, Circassians. In Asiatic Turkey there is a large Turkish element, with some four million Arabs, besides Greeks, Syrians, Kurds, Circassians, Armenians, Jews and numerous other races. The following are the returns for Constantinople, arranged in order of religious beliefs, viz.:

Mussulmans, 384,910; Greeks, 152,741; Armenians, 149,590; Bulgarians, 4,377, Roman Catholics (native), 6,442; Greek Latins, 1,082; Protestants (native), 819; Jews, 44,361; Foreigners, 129,243. Total, 873,565.

CONSTITUTION AND GOVERNMENT. The legislative and executive authority is, under the supreme authority of the Sultan, exercised by two high dignitaries, the "Sadr-azim," or Grand Vizier, the head of the temporal government, and the "Sheïk-ul-Islam," the head of the church. Both are appointed by the Sultan, the latter with the nominal concurrence of the "Ulema," a body comprising the clergy and chief functionaries of the law, over which the "Sheïk-ul-Islam" presides, although he himself does not exercise priestly functions. Connected with the "Ulema" are the "Mufti," the interpreters of the Koran. The Ulema comprise all the great judges, theologians and jurists, and the great teachers of literature and science who may be summoned by the Mufti. The principal civic functionaries bear the titles of Effendi, Bey or Pasha.

Forms of constitution, after the model of the West European States, were drawn up at various periods by successive Ottoman governments, the first of them embodied in the "Hatti-Humayoun" of Sultan Abdul-Medjid, proclaimed Feb. 18 1856, and the most recent in a decree of Sultan Abdul-Hamid II., of November, 1876. But the carrying out of these projects of reform appears entirely impossible in the present condition of the Ottoman empire.

The Grand Vizier, as head of the government and representative of the sovereign, is president of the Medjliss-i-Hass, or Privy Council, which corresponds to the British Cabinet. The Medjliss-i-Hass consists of the following members, besides the Prime Minister, namely: 1. The Sheïk-ul-Islam; 2. The Minister of the Interior; 3. The Minister of Foreign Affairs; 4. The Minister of War; 5. The Minister of Finance; 6. The Minister of Marine; 7. The Minister of Commerce; 8. The Minister of Public Works; 9. The Minister of Justice; 10. The Minister of Public Instruction; 11. The Minister of Evkaf (*fondations pieuses*); 12. The President of the Council of State; 13. The Grand Master of Artillery.

The whole of the empire is divided into vilayets, or governments, and subdivided into sanjaks, or provinces, and kazas, or districts. A vali, or governor-general, who is held to represent the sultan, and is assisted by a provincial council, is placed at the head of each vilayet. The provinces and districts are subjected to inferior authorities, under the superintendence of the principal governor. The division of the country into vilayets has been frequently modified of late for political reasons. All subjects, however humble their origin, are eligible to, and may fill, the highest offices in the state.

Under the capitulations, foreigners residing in Turkey are under the laws of their respective countries, and are amenable for trial (in cases in which Turkish subjects are not concerned), to a tribunal presided over by their consul. Foreigners who own real property, are amenable to the Ottoman civil courts in questions relative to their landed property.

PRESENT REIGNING SULTAN AND FAMILY. Abdul-Hamid II., born Sept. 22, 1842, the second son of Sultan Abdul-Medjid. He succeeded to the throne on the deposition of elder brother, Sultan Murad V., Aug. 31, 1876.

Children of the Sultan.—I. Mehemmed-Selim Effendi, born Jan. 11, 1870. II. Zekié Sultana, born Jan. 12, 1871. III. Naïmé Sultana, born Aug. 5, 1876. IV. Abdul-Kadir Effendi, born Feb. 23, 1878. V. Ahmed Effendi, born March 14, 1878. VI. Naïlé Sultana, born 1883. VII. Mehemmed Burhaneddin Effendi, born 1885.

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* Tripoli.

† Including Eastern Roumelia.

‡ Including Herzegovina and Novibazar, a tributary principality.

Brothers and Sisters of the Sultan.—I. Mohammed Murad Effendi, born Sept. 21, 1840; proclaimed Sultan of Turkey on the deposition of his uncle, Sultan Abdul-Aziz, May 30, 1876; declared by the council of ministers to be suffering from idiocy, and deposed from the throne Aug. 31, 1876. II. Djémilé Sultana, born Aug. 18, 1843; married, June 3, 1858, to Mahmoud-Djelal-Eddin Pasha, son of Ahmet Feti Pasha. III. Mehemmed-Reshad Effendi, born Nov. 3, 1844; heir-apparent to the throne. IV. Medihié Sultana, born Nov. 21, 1851; married to the late Mahmud Pasha, son of Halil Pasha. V. Suleiman Effendi, born Nov. 21, 1860. VI. Fehimé Sultana, born Jan. 26, 1861. VII. Wahieddin Effendi, born Jan. 12, 1862.

The present sovereign of Turkey is the thirty-fourth, in male descent, of the house of Othman, the founder of the empire, and the twenty-eighth sultan since the conquest of Constantinople. By the law of succession obeyed in the reigning family, the crown is inherited according to seniority by the male descendants of Othman, sprung from the Imperial Harem. The harem is considered a permanent state institution. All children born in the harem, whether offspring of free women or of slaves, are legitimate and of equal lineage. The sultan is succeeded by his eldest son, but only in case there are no uncles or cousins of greater age.

It has not been the custom of the sultans of Turkey for some centuries to contract regular marriages. The inmates of the harem come, by purchase or free will, mostly from districts beyond the limits of the empire, the majority from Circassia. From among these inmates the sultan designates a certain number, generally seven, to be "Kadyn," or ladies of the palace, the rest, called "Odalik," remaining under them as servants. The superintendent of the harem, always an aged lady of the palace, and bearing the title of "Haznadar-Kadyn," has to keep up intercourse with the outer world through the guard of eunuchs, whose chief, called "Kyzlar-Agassi," has the same rank as the grand vizier, but has the precedence if present on state occasions.

The civil list of the Sultan is variously reported at from one to two millions sterling. To the imperial family belong a great number of crown domains, the income from which contributes to the revenue. The finances of the civil list have of late been put into order, but are still reported to be insufficient to cover the expenditure of the court and harem, numbering altogether over five thousand individuals. The amount charged to the budget of 1880 was P. 62,747,116 for the palace, and P. 23,750,212 for the crown princes. Total, about £785,000, or $3,925,000.

REVENUES, EXPENDITURES AND NATIONAL DEBT. The revenue for 1889 was estimated at $92,500.000; expenditures, $107,000,000. The total national consolitated debt in 1888 was $450,543,900, drawing about 4 per cent. interest.

ARMY AND NAVY. The standing army in 1891 was composed of 264 battalions of infantry, 189 squadrons of cavalry, 104 batteries field artillery, 36 batteries mountain and 29 battalions garrison artillery, 4 battalions infantry train, 14 battalions of artificers, 3 battalions fire brigade, 22 companies of engineers, 2 sanitary companies, and 1 telegraph company, with a total numerical force of 9,810 officers and 149,000 men

According to the existing system, the army consists of the nizam or regular army, two bans of redif or landwehr, and the mustahfiz or landsturm. Non-Mahommedans are not liable to military service, but have to pay an exemption tax, about six shillings per head per annum, levied alike on males of all ages. Military service is compulsory on all able-bodied Mahommedans who have reached the age of twenty. By the recruiting law of 1887 military service is rendered obligatory for all the Mussulman population of the empire, excepting only Constantinople and its suburbs, which still retains its privilege of exemption from military service.

The conscripts are divided into two classes:

1. Those who can claim no reason for exemption.
2. Those who are infirm, sole supports of families, or who are exempt for various special reasons.

The first class is again divided into two classes, called first and second levies (tertib).

As many men as are required to fill the ranks of the standing army are taken for the first levy, and go through twenty years' service, six with the nizam and first reserve (Ikhtiyats), eight years in the redif, and six in the mustahfiz or landsturm.

The men of the second levy have to undergo six to nine months' drill with a nizam battalion in the first year of their service, and thirty days' drill at their homes in every subsequent year. They are also liable on emergency to be called to join the nizam. Thus all the able-bodied Mahommedan population will receive a fair amount of military training, and it is expected that when the system is in working order, the Ottoman government will be able to put at least 800,000 trained men into the field.

The navy on Jan. 1, 1891, consisted of fifteen large armor-clad ships, a river monitor, two river gun-boats, twenty-seven sea-going torpedo boats, two submarine boats, one torpedo school-ship, two frigates, one spardecked corvette, eleven dispatch vessels and yachts, and six dispatch boats.

The largest armor-clad ships of the Turkish navy are the two frigates, the Mésoudiyé and the Hamidieh. These two frigates were built on somewhat similar designs, but the Hamidieh is the smaller. The Mésoudiyé is 332 feet long, with extreme breadth of 59 feet. She is constructed on the central battery principle, and has on the main deck a 12-gun battery, 148 feet long, the armor-plates of which are 12 inches thick at, and 10 inches thick above, the water-line. The bow also is strongly fortified, and fitted with a ram of great strength, adapted to pierce an opponent below the armor in the most vulnerable part. Forward, under the forecastle, were two 6½-ton guns, firing ahead, and under the poop aft was one gun of the same caliber, but these have been removed for smaller Krupp guns.

For the navy of Turkey the crews are raised in the same manner as the land forces, partly by conscription, and partly by voluntary enlistment. The time of service in the navy is twelve years, five in active service, three in the reserve, and four in the redif. The nominal strength of the navy is 6 vice-admirals, 11 rear-admirals, 208 captains, 289 vice-captains, 228 lieutenants, 187 ensigns, and 30,000 sailors, besides 9.460 marines. The budget of 1880 estimates the expenses for the maintenance of the navy at $81.154,650 piastres.

CUSTOM DUTIES. All articles of import into Turkey are taxed 8 per cent. ad valorem, except tobacco and salt, which are monopolies; there is also an export duty of 1 per cent. on native produce if sent abroad, but of 8 per cent. if sent from one part of the empire to another.

Turkey negotiated in 1890 a new treaty of commerce with Great Britain and some of the other powers, and it proposed removing the export custom duty of 1 per cent., and building bonded warehouses in some of the principal seaport towns of the empire.

Articles destined for schools, churches, embassies, consulates, as well as agricultural machines and the plant for railways are free of duty.

The imports in 1889 aggregated $87,554,940; the exports, $61,539,595. The balance of trade, therefore, was against Turkey to the amount of $26,015,345.

COMMERCE AND SHIPPING. The mercantile navy of the Turkish empire, according to Lloyd's Register, in 1890 consisted of 94 steamers (each of 100 tons or upward) of 71,607 gross tons, and 813 sailing vessels of 158,170 tons.

In 1888–89 (March to February) the Ottoman ports of the Mediterranean and Black Sea were visited by 177,150 vessels of 31,319,354 tons, those of the Red Sea by 3,612 vessels of 435,309 tons, and those of the Persian Gulf by 1,261 vessels of 179,607 tons. Constantinople alone was visited by 36,057 vessels of 11,001,875 tons.

In 1888–89 (March 1 to February 28) 15,819 vessels of 10,460,363 tons entered the Dardanelles; of these 6,444 vessels of 7,034,837 tons were British.

In 1889, 554 vessels of 272,019 tons entered the port of Tripoli.

TURKMANSHAI, a village of Azerbijan, sixty-five miles southeast of Tabriz, the place where, on Feb. 22, 1828, was concluded the treaty between Persia and Russia, by which the former resigned to the latter the provinces of Erivan and Nakchevan.

TURNAU, a walled town of Bohemia, circle of Jung-Bunzlau, on the east bank of the Iser, fifty miles northeast of Prague. It has a church, built in 1825, which is reckoned one of the most beautiful in Bohemia. Turnau has manufactories of cotton, woolens, and more particularly of artificial gems, which are exported in great quantities to the United States. Population, 4,700. Here was fought (July, 1866) a battle between the Prussians and Austrians, in which the former were victorious.

TURNER, CHARLES H., member of Congress, born in New Hampshire in 1861. He removed to New York in 1879; was employed for six months on the elevated railroad; drove an ice-wagon for two years; entered the class of 1886 in Columbia College, and pursued a course of two years; after leaving college re-engaged in the ice business, and continued therein till he became a candidate in 1888 for state senator; was a member of Congress from 1889 to 1891.

TURNER, ERASTUS J., member of Congress, born in Pennsylvania in 1846. He attended college at Henry, Illinois, from 1856 to 1860; enlisted in a regiment of Iowa infantry in 1864, and remained till the close of the war; was a student at Adrian College, Michigan, from 1866 to 1868; was admitted to the bar in 1871; removed to Kansas in 1879; was elected a member of the Legislature in 1881 and re-elected in 1883; was elected secretary of the Kansas Board of Railroad Commissioners April 1, 1883, which position he resigned August 1, 1886, to accept the nomination for Congress; was a member of Congress from 1887 to 1891.

TURNER, HENRY G., born in North Carolina March 20, 1839. He was elected to Congress in 1881, and has been continuously re-elected; his present term expires in 1893.

TURNER, SHARON, the Anglo-Saxon historian, born in London, Sept. 24, 1768, died in 1847. After years of hard reading and patient collection of materials he published, 1799–1805, a *History of the Anglo-Saxons*, in three volumes, a work, with all its imperfections, that has given its author a permanent place in English literature. He also wrote numerous other historical works.

TURNPIKE STAIR, a turret stair revolving round a central newel.

TURPIE, DAVID, United States senator, born in Ohio in 1829. He studied law and was admitted to practice at Logansport, Ind., in 1849; was appointed by Governor Wright, whom he succeeded in the Senate, judge of the Court of Common Pleas in 1854, and was judge of the Circuit Court in 1856; in 1853, and also in 1858, he was a member of the Legislature of Indiana; in 1863 was elected a senator to Congress for the unexpired term of Jesse D. Bright, and immediately succeeding Joseph A. Wright, who served by appointment of the governor; was elected a member of the House of Representatives of the General Assembly of Indiana, and served as speaker of that body, 1874–5; in 1878 was appointed one of the three commissioners to revise the laws of Indiana, serving as such three years; in August, 1886, was appointed United States district attorney for the state of Indiana, and served as such until March 3, 1887; was elected to the United States Senate Feb. 2, 1887, and took his seat March 4, 1887. His term of service will expire March 3, 1893.

TURPIN, LOUIS W., member of Congress, was born in Charlottesville, Va.. Feb. 22 1849. He removed to Alabama in 1858; was self-educated; in politics is a Democrat, and was tax assessor of Hale county, Ala., seven years; was elected a representative from the Fourth Congressional District of Alabama to the Fifty-first Congress, but was unseated by the House of Representatives. In 1890, was elected from the same district to the Fifty-second Congress.

TURPIS CAUSA, a phrase in the law of Scotland borrowed from the Roman law, to express an immoral consideration on which some contract or obligation is founded. The rule is, that when an immoral contract is broken, no court of law will assist either party to enforce it.

TUSCALOOSA, a prosperous manufacturing city of Alabama. It has fine water-power, and is the seat of the State University, two female colleges, and several other excellent private schools. Population in 1890, 5,486.

TUSCAN ORDER OF ARCHITECTURE, one of the five classic orders, being a Roman modification of the Doric style with unfluted columns, and without triglyphs. It is the simplest of the orders.

TUSCARORAS, a tribe of North American Indians, who, at the settlement of North Carolina, had fifteen towns on the Tar and Neuse Rivers, and 1,200 warriors. In 1711 they began a war with the settlers, and after a series of savage encounters were defeated, and joined the Iroquois in New York, where they became allies of the English, and where about fifty families still reside on an Indian Reservation in the western part of the state.

TUSKEGEE, a prosperous town of Alabama, the seat of a female college, an orphans' home, and of the Alabama High School for boys; also of a normal school for colored teachers. Population in 1890, 2,600.

TUTTLINGEN, a town of Würtemberg, on the right bank of the Danube, twenty miles southwest of Sigmaringen. It has manufactories of knives, needles, cloth, cotton, hosiery, linen and silk, and carries on some trade in corn. Population, 7,031. Tuttlingen is historically notable as the scene of a battle in 1643, during the Thirty Years' War, in which an Austro-Bavarian force, under Hatzfeld and Mercy, defeated the French.

TUTTY-POWDER, an impure oxide of zinc, found in the chimneys of the furnaces in which the ores of that metal are roasted. It has some value in medicine.

TWILL, a woven fabric, whose warp is raised one thread and depressed two or more threads for the passage of the filling. This gives the structure a curious appearance of diagonal lines.

TWO RIVERS, a town of Wisconsin, on Lake Michigan. It produces a variety of manufactures, principally of wood. Population in 1890, 2,870.

TYBEE, an island and sound at the mouth of the Savannah River, Georgia. The sound is a bay of the Atlantic, extending from Tybee Island on the South to Hilton Head on the north, opening to Port Royal entrance by Cooper's River, Wall's Cut, Lazaretto Creek, and other channels. The island is six miles long by three wide, and was occupied in 1861 by General Sherman, who erected batteries for the reduction of Fort Pulaski, which capitulated April 11, 1862.

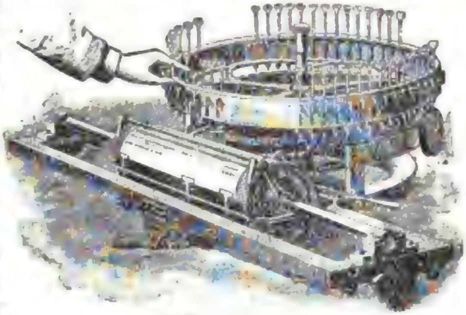
TYE, CHRISTOPHER, an English musician of note, born at Westminster in 1500. He was educated in the King's Chapel, and held the office of musical instructor to Edward VI. when Prince of Wales. He received the degree of Musical Doctor from the university of Cambridge in 1545, and from Oxford in 1548. Under Elizabeth, he was organist to the Chapel Royal, and produced various services and anthems, some of which are yet in repute among musicians. Dr. Tye's general scholarship was considerable.

TYLER, a growing town and railroad junction in Smith County, Texas, the seat of the United States and state courts for northeastern Texas. It is an important fruit market. Population in 1890, 6,908.

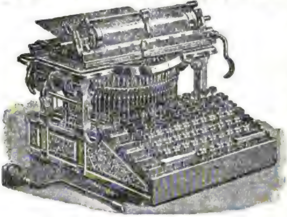
TYLOR, EDWARD BURNETT, president of the British Anthropological Society, and keeper of the Oxford University Museum, born at Camberwell, 1832, and educated at the school of the Society of Friends, Tottenham. He has greatly distinguished himself by his researches in the history of man and civilization. His best known works are his *Handbook on Anthropology*, and *Primitive Culture: Researches into the Development of Mythology, Philosophy, Religion, Art and Custom.*

TYNDALL, JOHN, born Aug. 21, 1820, at Leighlin Bridge, Carlow, Ireland. He was first educated at a national school. In 1839 he left school to join the Irish Ordnance Survey. In 1851 he went to Berlin, and continued his researches under Professor Magnus. He soon returned to England, and was elected F. R. S. in 1852. In 1853 he was invited to give a Friday evening discourse at the Royal Institution. He was appointed Professor of Natural Philosophy 1853, but resigned in 1888. It was in 1849 that Professor Tyndall first visited the Alps, purely for the sake of recreation. The result of these visits and his investigations are contained in the *Philosophical Transactions* for 1851, also in his *Glaciers of the Alps.* In 1863 his work, *Heat Considered as a Mode of Motion*, was published, and this at once put him in in the forefront as a physicist. In 1866 he relieved Professor Faraday at Trinity House, and on the latter's death succeeded him as superintendent of the Royal Institution. In 1874 he delivered the famous Belfast address as president of the annual meeting of the British Association. A political correspondence took place in the early part of 1890 between Professor Tyndall and Sir W. Harcourt.

TYPEWRITERS. For general article see Britannica, Vol. XXIV, pp. 697-8. The archives of the British Patent Office show that the first patent upon a writing machine was granted Jan. 7, 1714, to Henry Mill, a skilled engineer, who died about the year 1770. As no drawings accompanied the specification, the machine cannot now be described. It is believed that it was for embossing letters for the blind. The next invention in this field was a French device for stamping embossed letters upon paper for the use of the blind; it appeared about 1784. Until 1841 there is no record in the English Patent Office of any other writing machines. But from that date a number of devices, all more or less impracticable, made their appearance, and more than a hundred inventions of writing machines have been patented in England, not one of which has done its work in a satisfactory manner.

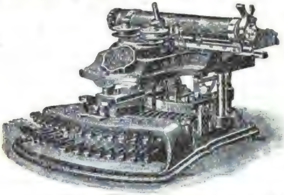

THE FIRST TYPEWRITER.

American records show that, in 1843, Charles Thurber, of Worcester, Mass., took out a patent for a writing machine, followed by an improvement two years later. The Thurber machine wrote, but so slowly that it remained a curiosity and nothing more. The accompanying cut shows its operation. The keys are small steel rods, four inches long, with common types inserted in the lower end, and bearing buttons on the top with the corresponding letters marked on them. The keys are placed in a vertical position around the rim of a horizontal brass wheel, sixteen inches across, which turns about a central post, and each key-rod is surrounded by a spiral spring, which raises it after it has been pressed down upon the paper.


SMITH PREMIER.

Mr. A. Ely Beach, now one of the proprietors of the "Scientific American," obtained a patent in 1856 for a machine intended to print embossed letters for the use of the blind. It covered a principle afterward developed into success. All the printing was done at one point, the center of a circle, and the machine was made with type-bars converging as the spokes of a wheel

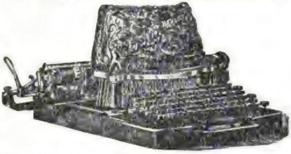
Soon afterward Dr. Samuel W. Francis adopted the pianoforte action and arranged his hammers, each with the face of a letter, in a circle, throwing them up as piano-hammers act, each one striking at a common center. A silk ribbon saturated with ink was made to pass under the paper very much as is now done, and was so adjusted as to move with each impression.


THE CRANDALL.

Several other early patents were issued, among them one to Fairbanks, in 1848, and another to Oliver T. Eddy, of Baltimore.

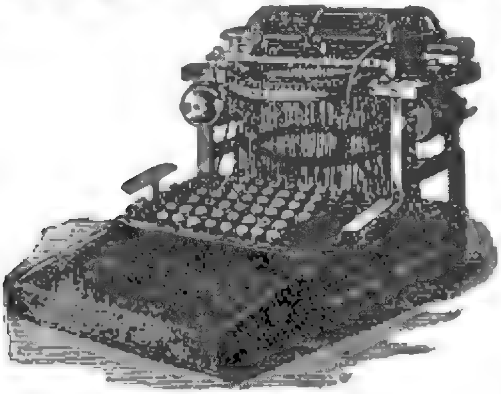
In 1867 a writing machine called "The Type Writer," was patented by C. Latham Sholes, Samuel W. Soulé, and Carlos Glidden, of Milwaukee, Wis. Neither of them knew what had previously been done in the same line, except that Mr. Sholes had seen an article in the "Scientific American," copied from "London Engineering," in which was described a writing machine called the "pterotype," invented by John Pratt of Centre, Ala., but then residing near London, England. The "Scientific American" article was followed by the suggestion that whoever would make a successful writing machine would not only secure a fortune, but would confer a blessing upon mankind. Sholes and Soulé were printers who had been engaged for some time in perfecting a machine for numbering the pages of blank books, and for printing serial numbers on bank notes. Mr. Glidden, who was a man of means, happened to be working at a patent plow in the machine shop frequented by Sholes and Soulé. He took great interest in the paging machine. One day he said to Sholes, "Why can't a machine be made that will write letters and words instead of simply figures?"

When the "Scientific American" article appeared, Mr. Glidden showed it to Sholes, and, Soulé having joined them, the three went to work upon the invention. Soulé suggested pivoted types set in a circle, and Sholes suggested the letter-spacing device. In September, 1867, the first machine was finished, and letters written with it were sent to acquaintances and friends.


THE BARLOCK.

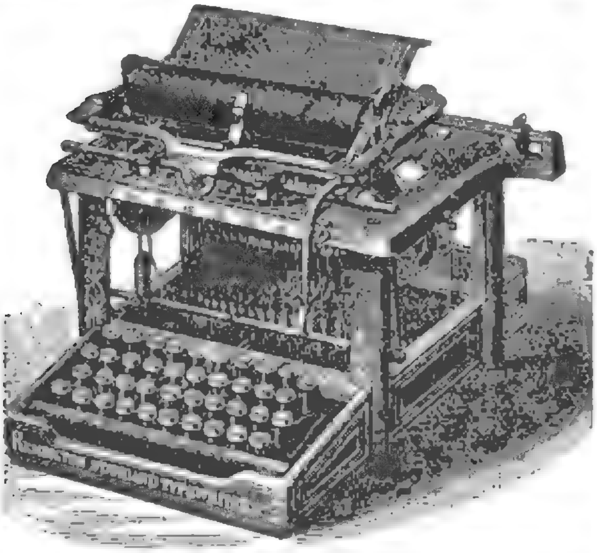
Mr. James Densmore, then of Meadville, Pa., who received one of these letters, was so impressed by it that by return mail he asked to become interested in the enterprise. In reply he was offered a quarter interest if he would pay all the expenses up to date. He accepted the offer, and when he saw the machine, in March, 1868, he pronounced it good for nothing except to show that the idea was feasible. His faith, however, was unshaken, and Soulé and Glidden having dropped out of the enterprise, he assumed all expenses, and urged Sholes to remedy certain defects which he pointed out. No less than twenty-five or thirty experimental typewriters were made, each one a little better than its predecessor. As fast as finished they were placed in the hands of different experts, among others James O. Clephane, a stenographer of Washington, D. C., who by hard use destroyed one after another till the patience of Sholes was exhausted. But Densmore insisted that as the machine must be made so that anybody could use it, such tests were a blessing and not a misfortune.

Progress was made slowly until in 1873 the machine was taken by E. Remington & Sons, of Ilion, N. Y., when it received the attention of a number of skilled machinists, who put into practical shape much that had been merely suggested by the original inventors. When the machine appeared upon the market, it was first offered chiefly to professional men—lawyers, clergymen and newspaper men; and apparently its greatest field of usefulness, the offices of mercantile houses, was almost overlooked. It was not until 1882 that its real possibilities became apparent; until then the machine had been, so to speak, on trial. There had been some defects that interfered with its rapid growth and favor. From 1882 until the present time, its history is one long record of successes, abroad as well as at home, and these successes are due perhaps not so much to the fading away of prejudices as to actual improvements in the machine itself.



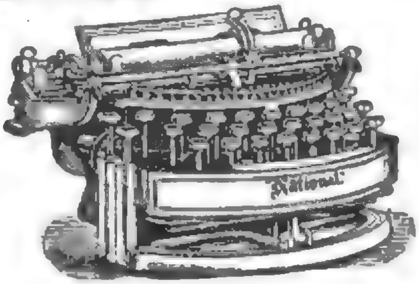
CALIGRAPH.

In the Remington Typewriter the type arms or bars, each bearing a lower-case letter and its corresponding capital, are thrown up by pianoforte lever action. Each impression causes the frame carrying the rollers which hold the paper sheet to move one space. The types are of tempered steel and are practically indestructible. The perfection of its mechanical construction is attested by the immense amount of daily work which the machine does without strain, and by the fact that experts can work the keys so fast as to give clear impressions of a letter at the rate of thirteen to a second. Among the improvements of recent years have been the introduction of capital and lower-case letters in the same machine without increasing the number of keys—a radical and vast improvement—the strengthening of the machine, the addition of some parts, the elimination of others. The noise made by the old machine has been greatly lessened, and its liability to get out of order reduced.



THE REMINGTON.

The most remarkable achievement of the typewriter, the chief reason of its success and popularity, has been the saving of time effected in business offices. According to innumerable tests and to the experience of nine out of ten of our active business houses, the typewriter, as compared with the pen, saves forty minutes an hour, or, to carry out the calculation, five hours and twenty minutes in a business day. In a country like ours, where time means money, it is very easy to estimate how many times the typewriter must pay for itself every year in a busy office. Last summer, in England, Miss Emiline S. Owen, who went over to show Englishmen what could be done with the Remington typewriter, wrote for three minutes at a speed of ninety-nine words a minute, the same matter having been previously written out in longhand by Mr. Thomas Allen Reed, one of the most rapid longhand writers in the world, at the unprecedented rate of sixty-five words per minute, the best that he could do.



THE NATIONAL.

Mr. E. D. Easton, one of the leading legal stenographers of Washington, in his summary of what the typewriter has done for him, says that in the Guiteau case two operators and machines answered for getting up the copy, one each for an associate reporter and himself. Something like 21,000 folios were transcribed, at a saving over the old method of about four cents per folio, or $840 in three months. In the Star Route cases, which lasted about a year, there were in the neighborhood of 70,000 folios written. The two machines and operators saved about three thousand dollars.

In a recorded test made in New York city some time ago, Miss M. E. Orr wrote an article containing 384 words from dictation, in the presence of witnesses, in four minutes and twenty-nine seconds, without error. The average was eighty-five words per minute. Others have written at the rate of more than one hundred words per minute. At many public institutions, in the United States, such as the Cooper Institute and the Young Women's Christian Association, in New York city, there are free classes in typewriting. There are over two hundred machines in use in the several business colleges and shorthand schools, for purposes of instruction, in New York city alone. Typewriting is now taught in some of the public schools, and it is, probably, only a question of time when it will be in many of them.

TYPH-FEVER, a term now coming into use to designate continued low fever. The best marked varieties of this affection are known as typhus and typhoid fevers, which in typical cases are easily distinguished from each other, but not infrequently it is difficult to decide whether the disease should be classed as typhus or typhoid fever; hence, the general term typh-fever is a very convenient one in doubtful cases. All the typh-fevers belong nosologically to the miasmatous order of zymotic diseases.

TYRNAU, a town of Hungary, county of Ober-Neutra, on the River Trna, about thirty miles northeast of Presburg. It has so many churches and convents that it has been nicknamed "Little Rome." Tyrnau has manufactories of cloth, linen, wood, etc., and a tolerably lively general trade, especially in wine.

U

UEA—ULULATION.

UEA, or **Uvea**, a circle of islets in the South Pacific Ocean. See Britannica, Vol. XV, p. 30.

UGANDA, or **Buganda**, the largest and most powerful of the East Africa equatorial states. See Britannica, Vol. XXIII, pp. 717–18.

The sovereign, who bears the official title of Kabakawa Buganda (Emperor of Uganda) and Overlord of Unyoro, Buzongora, Karagwe, Buzinza, Usoga, etc., is theoretically an autocrat, but his power is restricted by custom and by the Lukiko, a sort of privy council, composed of the Katikiro (chief judge) and the Aba-Saza (great chiefs), who, however, are all appointed by the king himself, as are also the Batongole (court officials), and even the under officers of the five great territorial lords of Lubiro (in the center about the capital), Kyagwe (in the east), Bulemezi (in the northwest), Budu (in the west), and Singo (in the north). Another important functionary is the Gabunga (head admiral), who commands a fleet of several hundred canoes on Lake Victoria. The territorial lords are hereditary feudal chiefs, enjoying almost royal privileges. The revenue is collected by the Basolonzi, or tax-gatherers, chiefly in the form of brass and copper wire, bark cloth, and cowrie shells. The capital, which was at Banda in 1862, has since then been shifted, with the royal caprice, to Rubaga, Nabulagala, and Mungo, which was the royal residence in 1891.

UHLANS, light cavalry of Asiatic origin, introduced into the north of Europe along with the colonies of Tartars who established themselves in Poland and Lithuania. They were mounted on light, active Tartar horses and armed with saber, lance, and, latterly, with pistols. The Prussian Uhlans won great renown in the Franco-German war of 1870-71 by their bravery and marvelous activity. The Prussians applied the term, rather loosely, however, including all their light cavalry, under the designation.

UJEIN, one of the seven sacred cities of Hindustan, in Sindia's dominions, of which it was formerly capital, on the right bank of the Sipra, thirty-five miles northwest of Indore. It is surrounded by walls with round towers, is six miles in circumference, contains the grand palace of the Sindia family, several mosques and mausoleums, an observatory, and an antique gate, supposed to date from before the Christian era. An active trade is carried on in cloths, opium, etc. The number of the inhabitants is not ascertained.

UJHELY-SATORALYA, a market town of Hungary, 105 miles northwest of Pesth. It stands on the Hagyalya Mountains, contains several churches and a gymnasium, and is noted for its wine culture. Population, 7,200.

UKASE, or **Ukas**, a term applied in Russia to all the orders or edicts, legislative or administrative, emanating from the government. The ukases either proceed directly from the emperor, and are then called imenny ukas, or are published as decisions of the directing senate. Both have the force of laws until they are annulled by subsequent decisions.

ULODENDRON, a singular genus of coal-plants, found on stems which occur chiefly in the roof-shales. The stems are covered with small rhomboidal scars, as in Lepidodendron, formed by the bases of leaves or scales; but they differ remarkably from that genus in having a double series of large oval or circular markings, arranged linearly on the opposite sides of the trunk. These markings are variously interpreted as representing the cicatrices produced by the bases of cones, by branches, or by leaf-stalks. It is, like many of the coal-fossils, an extremely enigmatical plant: and it is difficult to determine its position in the vegetable kingdom.

ULRIC, ST., bishop of Augsburg, venerated as one of the Fathers of the German Church, born at Augsburg about the year 890; died in 973. His father, Hupald, was one of those counts of Dillingen who play so important a part in mediaeval German history. He was educated at the celebrated Benedictine monastery of St. Gall in Switzerland, and returned to his native diocese of Augsburg, where he received holy orders. In accordance with the usage of his times, he made a pilgrimage to Rome, and soon after his return was consecrated bishop of Augsburg, on the death of Hiltine in the year 923. Bishop Ulric bore an important part in the public affairs of the empire during the reign of Henry I. and his son Otho; and he was the guiding spirit of the several councils in Germany which, in the tenth century, labored at the work of reformation.

ULSTER BADGE. On the institution of the order of baronets in England by James I., a sinister hand, erect, open and couped at the wrist gules, the armorial ensign of the province of Ulster, was made their distinguishing badge, in respect of the order having been intended for the encouragement of plantations in the province of Ulster.

ULTIMATUM, in diplomacy, the final conditions or terms offered by one government for the settlement of its disputes with another; the most favorable terms which a negotiator is prepared to offer, whose rejection will generally be considered to put an end to negotiation.

ULTIMUS HÆRES, in the law of Scotland, the crown which is the last heir after all the kin have become exhausted, and succeeds to the property of those who die without leaving next of kin, or who, being bastards, have no next of kin.

ULULATION, a howling, or loud lamentation: a wailing. It sometimes happens that articulate sounds or cries which resemble and perhaps imitate those of animals, or are a mere shrieking and howling, form the sole or chief symptom and ch acteristic of a morbid mental state. The act automatic, and may be regarded as indicative of grave changes in the physical and moral nature. In the Middle Ages, during great religious excitement, and those mental epidemics which involved large communities, such phenomena appear to have been of frequent occurrence. It appears that in the eighteenth century, a family of five sisters, in the county of Oxford, were affected with a modification of hysteria, during which they howled or barked like a dog; and that, about the same period, a large religious community of females in France, one and all, and at the same hours, shrieked or mewed like cats; and were only reduced to sobriety and to silence by the presence of military.

ULUNDA, or LUNDA, a native feudal state of Africa, the largest and most populous empire in the Congo basin, comprising most of the territory lying between the Kwango and Kasai. Its ruler bears the official title of Muata Yanvo, and is the fourteenth in descent from the founder of the dynasty in the seventeenth century. He is the suzerain of about 300 monas and muenes, that is, vassal chiefs and kinglets, who pay tribute in kind—ivory, lion and leopard skins, corn, cloth, salt, etc.—so long as the central power is strong enough to enforce it. Its present area cannot be estimated at much less than 100,000 square miles, with a population perhaps not exceeding 2,000,000.

The succession goes to one of the sons of the two chief wives, chosen by four official electors and confirmed by the Lukoshesha, or "Mother of the Kings and Peoples." The Lukoshesha, whose election is made in the same way from the daughters of the two chief wives, and ratified by the king, is exempt from his jurisdiction and "above all law," holding her own court, ruling over her own territories, and enjoying independent tribute.

The *Mussamba*, or royal residence, is displaced at every succession, within a certain limit. The dominant people in the empire are the Ka-Lunda, a negroid race of Bantu speech. They import woven goods and ironware from the south, and copperware from the southeast, and have also long had dealings with the Portuguese half-breeds from the west and the Arab slave-hunters from the east. The chief exports are ivory and slaves. But trade languishes, being regarded as a royal monopoly, and burdened with many restrictions.

ULUNDA, or LUNDA, a territory of Africa, in the Lake Moero district, which about the middle of this century was ruled over by the powerful Muata Kazembe, heir of the Morupwe dynasty, the most potent in South Central Africa during the sixteenth century. The present Muata Kazembe retains a mere semblance of authority, and is now the vassal of Msidi (Msiri), founder of the new kingdom of Garenganze (Katanga), in the region between the Luapula and Lualaba, head streams of the Congo within the limits of the Congo Free State, and continuous southward with British Zambesia (Barokeland and Mashukulumbweland).

UM, a Kaffir or Zulu word signifying river, and used as a prefix in the names of most of the rivers on the southeast coast of Africa, from the Great Kei, where the names of Hottentot origin appear to cease, nearly as far to the northeast as the Sofala coast, where the names Imhambane, Imhampoora, have the same prefix in a corrupted state. The Hottentot word Kei has the same meaning, and is still preserved in the Kei and Keiskamma rivers, and other streams on the east coast of the Cape Colony.

UMBILICAL CORD. In botany, the connecting link between the placenta of the ovary and the ovule, through which pass the vessels that nourish the ovule until it ripens into seed. In some plants the ovules are so closely connected with the placenta that no umbilical cord can be said to exist; in others it is of considerable length.

UMBRELLA TREE. A small magnolia tree (*Magnolia umbrella*), whose large leaves are crowded on the summit of the flowering branches in umbrella-like circles. Its range is from southeast Pennsylvania along the Alleghenies to central Alabama, and westward through Kentucky and Tennessee to northeast Mississippi. It also occurs in Arkansas. Like all the magnolias it is a handsome tree, bearing large, white, highly-scented flowers, and a rose-colored fruit.

UMPIRE. In law, a third person appointed by two arbitrators in the event of their differing in opinion. When the reference or arbitration has devolved upon the umpire, his award or umpirage becomes final and binding upon the parties.

UNALASHKA, an island belonging to the United States, in the North Pacific, one of the Fox Islands, in lat. 53° 52′ N., and 166° 32′ W. It is seventy-five miles long, and in some parts twenty miles broad, has a rugged, mountainous surface, and is thinly peopled. Ships are here supplied with all necessaries except wood.

UNDINES, the name given, in the fanciful system of the Paracelsists, to the elementary spirits of the water. They are of the female sex. Among all the different orders of elementary spirits, they intermarry most readily with human beings. Baron de la Motte Fouque has made this Paracelsist fancy the basis of an exquisite tale, entitled *Undine*.

UNION, or TOKELAU, a group of three clusters of islets in the Pacific Ocean. The principal are: Fakaapo or Bowditch, Mikuhimo or Duke of Clarence, and Atafu or Duke of York. They lie between 8° 30′ and 11′ S. lat., and 171° and 172° W. long. The group, which has been annexed to Great Britain, is of importance, chiefly, as a stage in the proposed telegraph route between British Columbia and Australia, and as a coaling station for steamers along the same route.

UNION CITY, a town of Pennsylvania, about twenty-two miles southeast of Erie. It has manufactories of leather, flour, barrels, furniture and carriages, and contains an extensive oil refinery. Population in 1890, 2,255.

UNION COLLEGE, a college in Schenectady, N. Y., incorporated in 1795, chiefly by the efforts of General Philip Schuyler. It was named Union from its being established by the coöperation of several religious denominations. Its first president was John Blair Smith of Philadelphia, who was succeeded in 1799 by Jonathan Edwards, the younger; but its great prosperity and usefulness were secured under the presidency of Rev. Eliphalet Nott, from 1804 until his death in 1866. By his zeal, enterprise, and large benefactions, it was endowed and furnished with spacious buildings, a large library, and extensive cabinets of natural history. Dr. Nott was succeeded by Dr. Laurens P Hickok, the distinguished metaphysician. In 1869, Dr. Aiken of Princeton was called to the presidency. He resigned in 1871, when Dr. Eliphalet N. Potter, son of Bishop Alonzo Potter, and grandson of Dr. Nott, was made president. Under his administration the institution increased in funds and students. In its general aims it has been greatly enlarged by a connection with the Law and Medical Colleges at Albany, and, together with them, bears the name of Union University, of which the president of Union College is the chancellor. President Potter resigned in 1884, and Hon. J. S. Landon was appointed president *ad interim*. Harrison Edward Webster, LL.D., was elected president in 1888.

UNIONTOWN, a borough, the county-seat of Fayette county, Pa. It manufactures cement and woolen goods. Population in 1890, 6,358.

UNITED LABOR PARTY, a political organization which grew out of the Central Labor Union in New York city. This union was established in 1881–82. In 1886 it appointed a committee to prepare a plan of political action. On Sept. 23, a city convention was held, at which 176 labor organizations were represented. It nominated Henry George as mayor and adopted his doctrine of nationalizing all the land in the United States. In the mayoralty contest George was defeated, Abram S. Hewitt being elected.

The state convention of the United Labor Party at Syracuse, N. Y., nominated George for secretary of state, and also resolved in favor of many measures of particular importance to laboring men, as fewer hours of work, free schools, etc. In the election of November, 1887, George was again defeated. In October, 1888, the party nominated James J. Coogan for mayor of New York city. He obtained a much smaller vote than George ever did. This sudden dwindling in numbers showed that the United Labor Party has no real bond of coherence, and that it cannot maintain its existence as a factor in city or state politics.

UNITED STATES OF AMERICA.

For general article on the United States see Britannica, Vol. XXIII, pp. 729-830. The article is so elaborate and comprehensive—covering the history, constitution and government, geography, topography, productions and statistics down to 1888—that in these Revisions and Additions, it is required that such supplementary matter shall be given as may be needed to bring the record down to the latest possible date, and also to furnish such epitomized historic, political, and statistical information as may be found most convenient and helpful.

TERRITORY OF UNITED STATES IN 1776.

An examination of the map of the United States in the year 1776 shows the boundaries of tracts of territory as follows:

At the northeast, but south of the river St. Lawrence, Massachusetts begins with the former Sagadahoc Territory and Province of Maine, continues over its present area to New York, while, westward of Pennsylvania, broadening from the latitude of its present southern boundary to that of Lake Winnipiseogee in New Hampshire, it reaches a western limit on the Mississippi River.

New York has its present area, and north of Massachusetts has a boundary on New Hampshire which extends between New York and the northeastern spur of Massachusetts.

Rhode Island appears as on the maps of to-day.

Connecticut has its present area, while beyond Pennsylvania it extends to the Mississippi River.

Pennsylvania has no corner, as now, between New York and Lake Erie.

New Jersey, Delaware, and Maryland, present forms familiar to modern maps.

Virginia reaches to the Mississippi River, and northward to the western territory of Connecticut.

North Carolina and Georgia in full width, and South Carolina in a narrow belt, enfold the land to the common Western River.

On the south of Georgia peninsula, East Florida tends westward to the river Appalachicola, and West Florida asserts a disputed northern limit at the parallel of the mouth of the Yazoo River in the west land of Georgia.

Quebec, reaching southward over the southern trapping-grounds of the Hudson's Bay Company and over the western lands of Massachusetts, Connecticut, and Virginia, claims to cover the whole territory between the Ohio and Mississippi rivers and the great lakes.

Between the Mississippi River and the Stony Mountains lies Louisiana, a Spanish dependency.

Beyond, to the Pacific, stretches the vast expanse of the older Spanish America.

At the extreme northwest there points toward the opposing continent a peninsula whose forbidding coast has been hitherto but a few times visited by European navigators.

ORIGINAL PUBLIC LAND OF THE UNITED STATES.

The Confederation asserted jurisdiction over all of that portion of the present territory of the United States east of the Mississippi River, from the present British possessions on the north, to Florida on the south. The concessions from the States to the Confederation, divided this region into two distinctive portions: one along the coast, whose soil was so vested in the 13 States in severalty, another, inland, whose soil and exclusive jurisdiction were possessed by the Confederacy.

These States and Federal domains were separated by an irregular line along the present western boundaries of the States of New York, Pennsylvania, West Virginia, North Carolina, and Georgia. Westward of this line, and separated into two parcels by the territory of the present State of Kentucky, lay the original *public domain* of the young Confederation, comprising 406,952 square miles, while the aggregate area of the 13 *States* was but 420,802 square miles.

ORIGINAL TERRITORIAL GOVERNMENT.

Plans for the erection of governments on this domain early engaged the attention of the Congress of the Confederacy. Coincident with the cession by Virginia, Jefferson, its delegate in Congress, anticipating prompt cessions from the remaining States, reported from a committee a plan of government for the whole public territory. This plan required seventeen new States, each covering about two degrees of latitude, arranged in two tiers separated by meridians, each tier containing eight States, the 17th State to be east of the eastern tier and between the Ohio River and the western boundary of Pennsylvania.

The famous proviso was included in this report, and read as follows: "After the year 1800 there shall be neither slavery nor involuntary servitude in any of the said States other than in the punishment of crimes whereof the party shall be duly convicted."

When the proviso was put to vote three States were unrepresented; three, Maryland, Virginia, and South Carolina, voted *nay*; North Carolina was divided; the four New England States, with New York and Pennsylvania, voted *aye*. Failing to receive the additional vote necessary to complete a majority, the proviso was stricken out of the report, and the report thus amended was adopted. This ordinance was in no instance applied in the erection of a government.

Again (July 13, 1787), soon after the region northwest of the Ohio River had been transferred to the Confederation by the cessions of New York, Virginia, Massachusetts, and Connecticut, another ordinance was enacted, erecting "the territory northwest of the Ohio River." To this ordinance were appended six articles, the last of which provided for the future formation, on the land within the territory, of "not less than three nor more than five States," as follows: the western State between the Mississippi, Ohio, and Wabash Rivers and a north line from Port Vincent, on the latter river, to British territory; the middle State between the last recited line, the Ohio River, and a north line from the mouth of the Great Miami to the border line; the eastern State, between the last described line, the Ohio River, the State of Pennsylvania, and the national boundary.

Authority was reserved to create two States in that part of the territory north of the latitudinal parallel of the southern extremity of Lake Michigan. It will be noted that the meridianal boundaries between those projecting States, which were plotted on the river Ohio, now separate the States of Illinois, Indiana, and Ohio, while the northern part of the original territory has included the entire States of Michigan and Wisconsin and furnished part of the territory of the State of Minnesota.

Article VI, of the Ordinance of 1787, was as follows:

"*There shall be neither slavery nor involuntary servitude in the said territory otherwise than in punishment of crimes whereof the party shall have been duly convicted: Provided, always, that any person escaping into the same, from whom labor or service is lawfully claimed in any one of the original States, such fugitive may be lawfully reclaimed and conveyed to the person claiming his or her labor or service, as aforesaid.*"

This inhibition of slavery, save that it was immediate, is in the very terms of the defeated proviso in the first, or Jeffersonian project.

At the submission of this ordinance to vote eight States were represented in Congress, and all voted for the measure. The passage of the article was possibly secured by the appendix of the proviso respecting the return of fugitives from slavery, and by the tacit understanding that slavery would be permitted in the public domain south of the Ohio River.

ORIGINAL AREA OF THE UNITED STATES.

Meanwhile, and prior to the last two of the cessions by the States, the independence of the States forming the Confederacy had been recognized by Great Britain in the Provisional Treaty of Peace signed at Paris, Nov. 30, 1782, and in the definite Treaty of Peace between Great Britain and the United States, concluded at Paris, Sept. 3, 1783. By the second article of the treaty the boundaries of the territory of the United States were declared.

In substance, they ran from the mouth of the St. Croix River to its head and thence due north, from the source of the St. Croix River, to the Highlands; along the said Highlands which divide those rivers that empty themselves in the river St. Lawrence from those which fall into the Atlantic Ocean, to the northwesternmost head of the Connecticut River, and down that river to and westward along the 45th parallel to and along the middle of the Ontario, Erie, Huron, Superior, and Long Lakes, and their water connections, "to the most northwestern point of the Lake of the Woods, and thence, on a due west course, to the river Mississippi;" thence, down the middle of that river to and along the 31st parallel, to and along the middle of the river Appalachicola to its junction with the Flint River, and thence straight to the head of and down the River St. Mary's to the Atlantic Ocean, and included all islands within 20 leagues of the Atlantic coast.

The western and southern boundaries of this original area of the United States were confirmed by treaty with Spain, the contiguous owner, Oct. 27, 1795. The northern line was the subject of protracted and difficult negotiations with Great Britain. The Treaty of London, Nov. 19, 1794, included provisions for determining the river St. Croix and its source and the source of the Mississippi River.

By treaty of Ghent, Dec. 24, 1814, three Commissions were authorized: one to settle the title to islands off the coast of Maine; another to determine the boundary from the source of the river St. Croix to the river St. Lawrence; and a third to lay the line from the river St. Lawrence to the western point of Lake Huron, and also, as a separate duty, thence to the most northwestern water of the Lake of the woods.

The first Commission, Nov. 24, 1807, awarded Moose, Dudley, and Frederick Islands to the United States, and all other islands in Passamaquoddy Bay, and also the Isle of Grand Menan, to Great Britain.

The third Commission defined their portion of the boundry line in their decision dated at Utica, New York, June 18, 1822.

The second Commission failed to agree, and, after repeated attempts, all disputes affecting this boundary of the Treaty of 1783 were adjusted by the Webster-Ashburton Treaty, of Washington, August 9, 1842, where may be found designated the present line from the Atlantic Ocean to the St. Lawrence River, and from the western terminus of the work of the Utica Commission to the westernmost water of the Lake of the Woods, and thence, confirming the Treaty of Oct. 20, 1818, due south to the 49th parallel.

It will be seen that the United States commenced its career as an acknowledged government with the landed area which it now possesses east of the Mississippi River and north of the State of Florida and, westward of that State, north of the 31st parallel, being an extent of 827,844 square miles.

CESSION BY FOREIGN POWERS TO THE UNITED STATES.

The French Cession.—Spain having held during 37 years the Province of Louisiana, which she had received (1763) from France, receded it Oct. 1, 1890, to France, and France, April 30, 1803, ceded it to the United States.

After this accession negotiations with Great Britain were begun to determine its northern boundary. In 1807 an agreement was reached, but not formally perfected, and, the war of 1812 intervening, the settlement of the boundary was deferred to Oct. 20, 1818, when, by convention, it was extended from the northwestern point of the Lake of the Woods to and along the 49th parallel to the Stony (Rocky) Mountains. The line was extended no farther westward, among other reasons, in order that no offense might be given to Spain, which asserted title by discovery to the whole Pacific slope of the continent. Yet it was agreed, to prevent collisions, and without prejudice to the claims of the parties or of outside powers, that any country claimed by either party to the convention should be free to both parties during ten years.

The part of the eastern boundary of this cession, on the Mississippi River as far south as the 31st parallel and its southeastern boundary on the Gulf of Mexico, were undisputed. But the remainder of the eastern and the whole of the western boundary was in controversy between the United States and Spain, and the western limit at the north, as asserted by France and maintained by the United States and Spain.

The western limit at the north, as asserted by France and maintained by the United States, was the Pacific Ocean. Spain, however, claimed title, by prior discovery on the northwestern coast, as far eastward as the Rocky Mountains; and held that, as against such discovery, the title of France rested solely on discovery and exploration of the Mississippi River, covered no more than the basin drained by that river and its tributaries, and consequently ended westerly at the Rocky Mountains.

At the southwest the United States maintained an extent of the French cession, including the country east of the Rio Grande. But Spain having long kept a line of garrisons in that region, held the French territory to have been bounded by the Sabine River.

These conflicting demands were settled by treaty at Washington, Feb. 22, 1819. By this authority the border line between Spanish possessions in the southwest and the territory of the United States ran from the Gulf of Mexico up the western bank of the Sabine River to the 31st parallel of north latitude, thence north to and along the Red River, to and along the 23d meridian (100th Greenwich), to and along the southern bank of the Arkansas River to its source, and thence due north to and along the 42d degree of north latitude to the Pacific Ocean. This line in this discussion will be regarded as having been the southwestern boundary of the Province of Louisiana.

On the east the Treaty of 1763 had confined the French cession to the Mississippi River as far south as the 31st parallel, whence eastward various boundaries have been asserted.*

Under the construction of the cession adopted by the United States, the Province of Louisiana is now covered by those portions of the States of Alabama and Mississippi which lie south of the 31st parallel by the entire States of Louisiana, Arkansas, Missouri, Iowa, Nebraska, and Oregon, and by that part of the State of Minnesota west of the Mississippi River, and all that part of the State of Kansas on the north of the Arkansas River and east of the 23d meridian (100th Greenwich); by the Dakotas, Washington, Idaho, and Montana, the part of Colorado east of the Rocky Mountains and north of the Arkansas River, by that part of Wyoming north of the 42d parallel and east of the meridian of the source of the River Arkansas, and by what is known as the Indian Country.

This accession of area for which the United States paid, in principal and interest, more than $23,500,000, added (adopting the United States view of the cession) 1,171,931 square miles to the public domain, extended the United States from ocean to ocean, and completed its possession of the central river and basin of the continent.

The Spanish Cession.—The next addition to the area of the United States was contributed by Spain. At the time of the conclusion of the definitive treaty of peace between the United States and Great Britain (Sept. 3, 1783), Great Britain ceded to Spain the Provinces of East and West Florida without definition of their boundaries. Hence arose two opponent constructions of the treaty, affecting the Province of West Florida. Great Britain held the northern boundary of the province which she ceded to be the 31st parallel from the Appalachicola to the Mississippi River, and by a simultaneous treaty acknowledged the territory north of that parallel to belong to the United States, which government also adhered to a boundary on the 31st parallel.

In opposition, Spain claimed that, by the treaty, the province of West Florida was ceded, and that on the day of the treaty the province remained as extended May 15, 1767, by Great Britain, including the same rivers as bounded the original province and northward from the 31st parallel to that of the mouth of the Yazoo River. This country Spain took into possession and held until, by authority of joint resolution of Congress, Jan. 15, 1811, and acts of the same date and of March 3, 1811, passed in secret session and first published in 1818, the United States took it into possession.

On Feb. 22, 1819, the controversy was ended by the treaty of Washington, whereby Spain ceded to the United States its provinces of East and West Florida. In accordance with the construction maintained by the United States respecting the southeastern limit of the French cession and the northern limit of the Spanish cession, the latter added the territory of the present State of Florida, 59,268 square miles, to the area of the United States at a cost of nearly six and one-half millions of dollars. By the same treaty Spain agreed to that line between her western American possessions and the United States which has herein been adopted as the southwestern boundary of the French cession, and ceded to the United States all her claims to any territory east or north of that line.

After this cession by Spain, Great Britain and the United States had only their own rights to consider in the settlement of the northwestern boundary. Hitherto the line had rested on the 49th parallel of north latitude at the Rocky Mountains. By article 1, of the treaty of 1846, it was stipulated that the boundary should be extended from the Rocky Mountains westward along the same (49th) parallel "to the middle of the channel which separates the continent from Vancouver's Land, and thence southerly through the middle of said channel and of Fuca's Strait to the Pacific Ocean." The British government claimed that the "channel" of this article of the treaty is the so-called Straits of Rosario. The United States maintained it to be the Canal de Haro. The question was submitted to the arbitrament of William I, Emperor of Germany, who gave decision Oct. 21, 1872, in favor of the Canal de Haro. Thus it required nearly ninety years for the national boundary at the North to traverse the continent.

The Texan Annexation.—The next expansion of the limits of the United States was southwestward. The United Mexican States, having achieved their independence of Spain, under the treaty at Cordova, Feb. 24, 1821, by treaty of Mexico, Jan. 12, 1828, ratified that boundary with the United States of America which had been acknowledged (1819) by Spain, when possessed of their territory.

Subsequently the people of "Texas and Coahuila," one of the United States of Mexico, revolted from the authority of that republic, and in convention, March 2, 1836, declared the independent Republic of Texas. By an act of the legislature of that Republic, passed Dec. 19, 1836, its boundaries were declared to be on the north and east of the old line settled (1819) by the United States and Spain, and on the south and west from the mouth of the river Sabine and three leagues from the coast to the mouth of and up the Rio Grande to its source, and thence due north to the 42d parallel of north latitude. By joint resolution of March 3, 1837, the United States of America acknowledged the independence of the Republic of Texas; by joint resolution of Dec. 29, 1845, the republic, with the limits just now recited, was declared to be one of the United States of America. This was an annexation of 376,163 square miles of territory, making the total area of the United States 2,435,176 square miles.

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*The United States construed the cession of France (1803) to include all the region between the 31st parallel and the Gulf of Mexico, and between the Mississippi River, and the Perdido River, now the western boundary of the State of Florida.

The ground of this construction seems to have been the original Province of Louisiana extended eastward to the Perdido, and that if France, as its cession to Spain, had not actual possession, it yet had a possessory right reaching to the Perdido, which it ceded to Spain, (1763), which Spain receded to France (1800), and which France (1803), ceded to the United States. On the other hand Spain asserted that Louisiana had its boundary at the southeast as expressed in the Treaty of 1763 between Great Britain and France, namely, "The River Iberville and Lake Maurepas and Pontchartrain," the waters skirting the so-called "Island of New Orleans" westerly and southerly from the river Mississippi to the Gulf of Mexico, and that the successive transfers had carried that province with that eastern boundary into the possession of the United States. Under this construction of the cession of 1803 it embraced, east of the Mississippi, only the small "Island of New Orleans."

The Mexican Cessions.—The old Spanish provinces of Texas and Coahuila were separated by the river Nueces. At the institution of the Mexican Republic these provinces were united as the State of "Texas and of Coahuila." The river Nueces was, however, still regarded as the future boundary between the probable separate States of Texas and Coahuila as contemplated by the Constitution of the United Mexican States.

On the annexation of the Republic of Texas to the United States of America, Mexico insisted that Texas only—and not Coahuila—had revolted, and consequently that its proper western boundary lay on the river Nueces.

On the contrary, the Texan Republic has asserted a wider revolt and the western boundary on the Rio Grande. The United States annexed Texas as bounded on the west by the Rio Grande, and maintained that boundary.

The ensuing war was concluded by a treaty (Feb. 2, 1848), wherein the United States of Mexico ceded to the United States of America all claims to the area asserted by the former Republic of Texas, and to the vast tract of land *west* of the Rio Grande, and of a meridian from its source to the 42d parallel of north latitude *south* of that parallel, *east* of the Pacific Ocean, and *north* of the present boundary of the United States, excepting the Mesilla Valley south of the river Gila.

The latter territory, known as "The Gadsden* Purchase," was ceded by Mexico, Dec. 30, 1853.

The money consideration passing from the United States for the first Mexican cession was $15,000,000, and for the second cession, $10,000,000. The first cession (exclusive of the "Texan annexation") added 545,783 square miles, and the second cession, 45,535 square miles, to the area of the United States, and increased it to an aggregate of 3,026,494 square miles.

The Russian Cession.—Russia, by treaty of March 30, 1867, ratified June 20, 1867, for consideration of $7,200,000, ceded her territory in America, which has been named Alaska.†

Alaska is separated from the main territory of the United States by that western part of the British possessions which lies between the parallels of 54 degrees 40 minutes and 49 degrees north latitude, its southernmost point being nearly four hundred miles distant from the northern boundary of Washington. Its area is estimated at 577,390 square miles.

TERRITORIAL CESSIONS BY THE SEVERAL STATES.

When the Confederation was formed by the original thirteen colonies the cessions of their territory (shown on the map, and authorized by the articles of agreement) were not immediately made. Congress in an address, dated April 18, 1783, and later by resolution, dated April 29, 1784, urged that they be made speedily, as a source of common revenue and for the promotion of harmony between the States. The following is a chronological historic outline of the dates when the States severally acceded to the request of Congress:

New York authorized a cession in Feb. 1780, and executed it March 1, 1781. It was renewed by deed, April 19, 1785. The claims ceded were titles acquired by treaties with the six Nations of Indians, and covered the whole territory from the lower of the Great Lakes southward across the valley of the river Ohio as far as the Cumberland Mountains. Oct. 29, 1782, the cession was accepted by the United States.

Virginia offered to cede, by Act of Jan. 2, 1781; Congress, by Act of Sept. 13, 1783, agreed to accept the cession as offered. Thereupon Virginia, by Act of Nov. 20, 1783, authorized its delegates in Congress to complete the transfer, which was done by deed, March 1, 1784. The deed conveyed all the title and claims of the State of Virginia to territory northwest of the Ohio River. Virginia, by virtue of conquest of her militia, asserted titles as far north as Lake Erie and Michigan, but due recognition of the ancient charter boundary of the Colony of Connecticut places the northern limit of the cession on the 41st parallel of north latitude, and permits it to comprise only those parts of the States of Ohio, Indiana, and Illinois situated south of that parallel.

Massachusetts, Nov. 13, 1784, authorized a cession by her delegates in Congress; April 18, 1785, Congress agreed to accept the cession, and April 19, 1785, it was executed. It included all title of the State of Massachusetts to territory west of the present western boundary of the State of New York, and covered the land from the State of Pennsylvania to the Mississippi River, and giving the full extent of the first charter of the colony between the latitude of the southern boundary of the western extremity of the present State of Massachusetts and the latitude of a league north of the inflow of Lake Winnipiseogee in the State of New Hampshire.

Connecticut, Oct. 10, 1780, having offered to cede with restrictions which were unsatisfactory to the United States, on the second Thursday of May, 1786, again authorized a cession; May 26, 1786, Congress expressed readiness to accept the cession as proposed, and Sept. 14, 1786, the cession was accomplished by the execution of a deed and its acceptance by Congress. This cession embraced the soil and jurisdiction of the territory east of the river Mississippi, between the latitudinal parallels of 41 degrees and 42 degrees 2 minutes, and west of a meridian one hundred and twenty miles west of the present western limit of the State of Pennsylvania. Connecticut, by Act of Oct., 1797, authorized the release to the United States of jurisdiction over the land between the eastern boundary of her former cession and the present western boundary of the State of Pennsylvania. This transfer was consumated May 30, 1800. The State retained the right of soil in the same territory, which lying in the present State of Ohio between 41 degrees and 42 degrees 2 minutes, and reaching from the western boundary of the State of Pennsylvania westward one hundred and twenty miles, has ever since been known as "The Western Reserve of Connecticut." In 1792 the State conveyed five hundred thousand acres in the western part of this reserve to certain of its citizens as compensation for their property destroyed by fire and pillage during the Revolution. Sept. 9, 1795, the State alienated the remainder of this reserve for $1,200,000. This sum was appropriated as a fund whose annual interest is pledged to the support of schools.

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* So called after Gen. James Gadsden, United States Minister to Mexico.

† On the east this cession has limit on the line which by treaty between Great Britain and Russia (1825) separated their territory. It begins at the southernmost point of Prince of Wales Island, which is on the parallel of 54 degrees 40 minutes, runs northward along Portland Channel to the junction of the 56th parallel of north latitude with the continent, and thence along the summits of the mountains parallel to the coast to and along the 141st meridian to the Arctic Ocean. But where the crest of the mountains skirting the coast from the specified parallel to the meridian is more than ten marine leagues from the ocean, there the boundary is a line not more than ten marine leagues from the coast and parallel to its windings. The remainder of the boundary of this Russian cession originated in the treaty by which the cession was made. It commences in the Arctic Ocean on the 64th meridian of west longitude (141st Greenwich), descends Bering Straits midway between the Islands of Krusenstern and Radmanov to 65 degrees 35 minutes (142 degrees 30 minutes Greenwich), just south of the nearest points of Asia and America, continues between the Island of St. Lawrence and Cape Chonkotski to the 95th meridian (172d Greenwich), thence midway between Attou and Copper Islands to 193 degrees (167 east longitude from Greenwich), and thence coastwise to include the Aleutian Isles.

South Carolina, August 19, 1787, by her delegates in Congress, authorized by a previous Act of the State Legislature, executed a deed of cession which the United States accepted by Act of April 2, 1790. The deed conveyed the area of the present State of Tennessee.

North Carolina, by Act of Dec. 22, 1789, authorized a cession which was accepted April 2, 1790. The deed conveyed the area of the present State of Tennessee.

Georgia, by articles of agreement, dated April 24, 1802, ceded to the United States her claims to the whole territory between her western boundary and the Mississippi River; while the United States at the same time ceded to Georgia all of that portion of South Carolina cession lying eastward of the western boundary of Georgia. This cession conveyed all the land now in the States of Alabama and Mississippi, except the portion along the northern boundaries which was included in the South Carolina cession.

The agreement included, among others, provisions for: 1st, payment, out of proceeds from the sale of the land in the cession, of $1,250,000 to the State of Georgia as a reimbursement of its expenses in relation to the territory ceded; 2nd, the appropriation of 500,000 acres, or the proceeds of at most that quantity of land, to satisfy the claims against the lands of the cession; and 3d, extinguishment of the Indian title to specified parts of the cession. It resulted that the United States, in addition to the cession to Georgia, paid not far from $3,000,000 for this cession from Georgia.

DECLARATION OF INDEPENDENCE.

The following is the full text of the world-renowned *Declaration of Independence*, adopted by the Continental Congress, in session in Independence Hall, Philadelphia, Pa., July 4, 1776. The resolution in favor of Independence was adopted July 2, 1776. It was then placed in the hands of a committee, of whom Thomas Jefferson was chairman, who duly formulated and engrossed the document which was finally read, unanimously approved, and adopted on July 4, 1776:

IN CONGRESS, July 4, 1776.

The Unanimous Declaration of the Thirteen United States of America.

When, in the course of human events, it becomes necessary for one people to dissolve the political bands which have connected them with another, and to assume among the powers of the earth the separate and equal station to which the laws of nature and of nature's God entitle them, a decent respect to the opinions of mankind requires that they should declare the causes which impel them to the separation.

We hold these truths to be self-evident—that all men are created equal; that they are endowed by their Creator with certain unalienable rights; that among these are life, liberty, and the pursuit of happiness. That to secure these rights, governments are instituted among men, deriving their just powers from the consent of the governed; that when any form of government becomes destructive to these ends, it is the right of the people to alter or to abolish it, and its institute a new government, laying its foundation on such principles, and organizing its powers in such form, as to them shall seem most likely to effect their safety and happiness. Prudence, indeed, will dictate that governments long established should not be changed for light and transient causes; and accordingly, all experience hath shown that mankind are more disposed to suffer, while evils are sufferable, than to right themselves by abolishing the forms to which they are accustomed. But when a long train of abuses and usurpations, pursuing invariably the same object, evinces a design to reduce them under absolute despotism, it is their right, it is their duty, to throw off such government, and to provide new guards for their future security. Such has been the patient sufferance of these colonies, and such is now the necessity which constrains them to alter their former systems of government. The history of the present king of Great Britain is a history of repeated injuries and usurpations, all having in direct object the establishment of an absolute tyranny over these States. To prove this, let facts be submitted to a candid world.

He has refused his assent to laws, the most wholesome and necessary for the public good.

He has forbidden his governors to pass laws of immediate and pressing importance, unless suspended in their operation till his assent should be obtained; and, when so suspended, he has utterly neglected to attend to them.

He has refused to pass other laws, for the accommodation of large districts of people, unless those people would relinquish the right of representation in the legislature—a right inestimable to them, and formidable to tyrants only.

He has called together legislative bodies at places unusual, uncomfortable, and distant from the depository of their public records, for the sole purpose of fatiguing them into compliance with his measures.

He has dissolved representative houses repeatedly, for opposing, with manly firmness, his invasions on the rights of the people.

He has refused, for a long time after such dissolutions, to cause others to be elected; whereby the legislative powers, incapable of annihilation, have returned to the people at large, for their exercise; the state remaining, in the mean time, exposed to all the danger of invasion from without and convulsions within.

He has endeavored to prevent the population of these States; for that purpose obstructing the laws of naturalization of foreigners; refusing to pass others to encourage their migration hither, and raising the conditions of new appropriations of lands.

He has obstructed the administration of justice by refusing his assent to laws for establishing judiciary power.

He has made judges depend on his will alone for the tenure of their offices, and the amount and payment of their salaries.

He has erected a multitude of new offices, and sent hither swarms of officers to harass our people and eat out their substance.

He has kept among us in times of peace standing armies without the consent of our legislature.

He has affected to render the military independent of, and superior to, the civil power.

He has combined with others to subject us to a jurisdiction foreign to our constitution and unacknowledged by our laws; giving his assent to their acts of pretended legislation.

For quartering large bodies of armed troops among us:

For protecting them, by a mock trial, from punishment for any murders which they should commit on the inhabitants of these States:

For cutting off our trade with all parts of the world:

For imposing taxes on us without our consent:

For depriving us, in many cases, of the benefits of trial by jury:

For transporting us beyond the seas, to be tried for pretended offenses:

For abolishing the free system of English laws in a neighboring province, establishing therein an arbitrary government, and enlarging its boundaries, so as to render it at once an example and fit instrument for introducing the same absolute rule into these colonies:

For taking away our charters, abolishing our most valuable laws, and altering fundamentally the powers of our governments:

For suspending our own legislatures, and declaring themselves invested with power to legislate for us in all cases whatsoever.

He has abdicated government here by declaring us out of his protection, and waging war against us.

He has plundered our seas, ravaged our coasts, burnt our towns, and destroyed the lives of our people.

He is at this time transporting large armies of foreign mercenaries to complete the work of death, desolation, and tyranny, already begun, with circumstances of cruelty and perfidy scarcely paralleled in the most barbarous ages, and totally unworthy the head of a civilized nation.

He has constrained our fellow-citizens, taken captive on the high seas, to bear arms against their country, to become the executioners of their friends and brethren, or to fall themselves by their hands.

He has excited domestic insurrections among us, and has endeavered to bring on the inhabitants of our frontiers the merciless Indian savages, whose known rule of warfare is an undistinguished destruction of all ages, sexes, and conditions.

In every stage of these oppressions we have petitioned for redress in the most humble terms; our repeated petitions have been answered only by repeated injury. A prince whose character is thus marked by every act which may define a tyrant, is unfit to be the ruler of a free people.

Nor have we been wanting in attention to our British brethren. We have warned them, from time to time, of attempts, made by their legislature, to extend an unwarrantable jurisdiction over us. We have reminded them of the circumstances of our emigration and settlement here We have appealed to their native justice and magnanimity, and we have conjured them by the ties of our common kindred to disavow these usurpations, which would inevitably interrupt our connections and correspondence. They, too, have been deaf to the voice of justice and consanguinity. We must, therefore, acquiesce in the necessity which denounces our separation, and hold them, as we hold the rest of mankind—enemies in war—in peace, friends.

We, therefore, the representatives of the United States of America, in general congress assembled, appealing to the Supreme Judge of the world for the rectitude of our intentions; Do, in the name and by the authority of the good people of these colonies, solemnly publish and declare, that these United Colonies are, and of right ought to be, free and independent states. That they are absolved from all allegiance to the British crown, and that all political connection between them and the State of Great Britain is, and ought to be, totally dissolved; and that, as free and independent states, they have full power to levy war, conclude peace, contract alliances, establish commerce, and to do all other acts and things which independent states may of right do. And for the support of this declaration, with a firm reliance on the protection of Divine Providence, we mutually pledge to each other our lives, our fortunes, and our sacred honor.

Massachusetts Bay.

John Hancock,
Samuel Adams,
John Adams,
Robert Treat Payne,
Elbridge Gerry.

Rhode Island.

Stephen Hopkins,
William Ellery.

Connecticut.

Roger Sherman,
Samuel Huntington,
William Williams,
Oliver Wolcott.

New York.

William Floyd,
Philip Livingston,
Francis Lewis,
Lewis Morris.

New Jersey.

Richard Stockton,
John Witherspoon,
Francis Hopkinson,
John Hart,
Abraham Clark.

Pennsylvania.

Robert Morris,
Benjamin Rush,
Benjamin Franklin,
John Morton,
George Clymer,
James Smith,
George Taylor,
James Wilson,
George Ross.

New Hampshire.

Josiah Bartlett,
William Whipple.
Matthew Thornton.

Delaware.

Cæsar Rodney,
George Read,
Thomas M'Kean.

Maryland.

Samuel Chase,
William Paca,
Thomas Stone,
Charles Carroll, of Carrollton.

Virginia.

George Wythe,
Richard Henry Lee,
Thomas Jefferson,
Benjamin Harrison,
Thomas Nelson, jun.,
Francis Lightfoot Lee,
Carter Braxton.

North Carolina.

William Hooper,
Joseph Hughes,
John Penn.

South Carolina.

Edward Rutledge,
Thomas Heyward, jun.,
Thomas Lynch, jun.,
Arthur Middleton.

Georgia.

Button Gwinnet,
Lyman Hall.
George Walton.

GOVERNMENTAL RECOGNITION OF THE INDEPENDENCE OF THE UNITED STATES.

France acknowledged the Independence of the American Colonies Feb. 6, 1778, and signed a treaty of Alliance and Commerce with the American Embassy. The alliance clause was regarded and treated by England as a declaration of war by France, and the two nations immediately began to prepare for hostilities.

Holland.—Great Britain declared war against Holland, Dec. 20, 1780, on learning that Holland was engaged in negotiating a commercial treaty with the colonies. Holland recognized the independence of the colonies, April 19, 1782.

Great Britain.—In the early part of 1782 several earnest attempts were made by the British parliament to terminate the war against the colonies, but the king and ministry persisted in their efforts toward subjugation. On March 4, the commons resolved, "That all who advise the king to continue the war shall be regarded as public enemies." The administration of Lord North came to an end March 20, and a strong peace party succeded The summer of 1782 was largely spent in correspondence and negotiations. Preliminary peace articles were signed at Paris, Nov. 30, by Richard Oswald, on the part of Great Britain, and by John Adams, Benjamin Franklin, John Jay, and Henry Laurens on the part of the United States.

Congress proclaimed cessation of hostilities, April 11, 1783, and ratified the preliminary treaty with Great Britain, April 15. The Congressional proclamation was read to the army, April 19.

The last international act in the revolution was consummated Sept. 23, when a definitive treaty was signed by David Hartly, on the part of Great Britain, and by Benjamin Franklin, John Adams, and John Jay, on the part of the United States. The treaty fully conceded the independence of the American States, secured boundaries extending north to the great lakes and west of the Mississippi, restored the two Floridas to Spain, and accorded the Americans an unlimited right of fishing on the banks of Newfoundland.

During the war, Great Britain sent 112,584 troops for land-service and over 22,000 seamen to America, and the Colonists had 230,000 Continental soldiers and 56,000 militia under arms.

By a general order of Congress the army was disbanded, Nov. 3, a small force being retained at West Point, N. Y., under command of General Knox, until the organization of a peace establishment.

The British army evacuated New York City Nov. 25; General Knox moved his troops down from West Point and halted in the Bowery, and as the British marched to Whitehall he followed and took possession of Fort George, the artillery on the Battery saluting the United States flag, and the citizens giving Governor Clinton and the principal civil officers of the State who accompanied General Knox an enthusiastic reception.

Washington summoned his officers to meet him at his quarters, corner of Pearl and Broad Streets, New York, Dec. 4, and then amid copious tears and prolonged sobs, he took an affectionate farewell of each. The ceremony over, he proceeded direct to Annapolis, Md., where Congress was in session and returned to it, Dec. 23, the commission it gave him over eight years before. He rendered an account of his expenses as Commander-in-Chief, amounting to about $74,480, but declined to receive any compensation for his services, and sought the retirement of his farm.

ARTICLES OF CONFEDERATION.

In the history of the United States there have been three differently constituted Congresses: "The Continental Congress." "The Congress of the Confederation," and "The Congress of the United States." The Congress of the Confederation represented the States under the compact, or Constitution, known as "The Articles of Confederation," the full text of which was as follows:

Articles of Confederation and perpetual Union between the States of New Hampshire, Massachusetts Bay, Rhode Island and Providence Plantations, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, and Georgia.

ARTICLE 1. The style of this confederacy shall be "The United States of America."

ART. 2. Each State retains its sovereignty, freedom, and independence, and every power, jurisdiction, and right, which is not by this confederation expressly delegated to the United States in Congress assembled.

ART. 3. The said States hereby severally enter into a firm league of friendship with each other for their common defense, the security of their liberties, and their mutual and general welfare; binding themselves to assist each other against all force offered to, or attacks made upon them, or any of them, on account of religion, sovereignty, trade, or any other pretense whatever.

ART. 4. The better to secure and perpetuate mutual friendship and intercourse among the people of the different States in this Union, the free inhabitants of each of these States, paupers, vagabonds, and fugitives from justice excepted, shall be entitled to all privileges and immunities of free citizens in the several States; and the people of each State shall have free ingress and regress to and from any other State, and shall enjoy therein all the privileges of trade and commerce, subject to the same duties, impositions, and restrictions, as the inhabitants thereof respectively; provided that such restrictions shall not extend so far as to prevent the removal of property imported into any State to any other State, of which the owner is an inhabitant; provided also, that no imposition, duties, or restriction shall be laid by any State on the property of the United States or either of them.

If any person guilty of or charged with treason, felony, or other high misdemeanor, in any State, shall flee from justice and be found in any of the United States, he shall, upon demand of the Governor or Executive power of the State from which he fled, be delivered up and removed to the State having jurisdiction of his offense.

Full faith and credit shall be given in each of these States to the records, acts, and judicial proceedings of the courts and magistrates of every other State.

ART. 5. For the more convenient management of the general interests of the United States, delegates shall be annually appointed in such manner as the Legislature of each State shall direct, to meet in Congress on the first Monday in November in every year, with a power reserved to each State to recall its delegates, or any of them, at any time within the year, and to send others in their stead for the remainder of the year

No State shall be represented in Congress by less than two, nor by more than seven members; and no person shall be capable of being a delegate for more than three years in any term of six years; nor shall any person, being a delegate, be capable of holding any office under the United States, for which he, or another for his benefit, receives any salary, fees, or emoluments of any kind.

Each State shall maintain its own delegates in a meeting of the States, and while they act as members of the committee of the States.

In determining questions in the United States in Congress assembled, each State shall have one vote.

Freedom of speech and debate in Congress shall not be impeached or questioned in any court or place out of Congress; and the members of Congress shall be protected in their persons from arrests and imprisonments during the time of their going to and from and attendance on Congress, except for treason, felony, or breach of the peace.

ART. 6. No State, without the consent of the United States in Congress assembled, shall send any embassy to, or receive any embassy from, or enter into any conference, agreement, alliance or treaty, with any king, prince, or state; nor shall any person holding any office of profit or trust under the United States, or any of them, accept of any present, emolument, office, or title of any kind whatever, from any king, prince or foreign state; nor shall the United States in Congress assembled, or any of them, grant any title of nobility.

No two or more States shall enter into any treaty, confederation, or alliance whatever, between them, without the consent of the United States in Congress assembled, specifying accurately the purposes for which the same is to be entered into, and how long it shall continue.

No State shall lay any imposts or duties which may interfere with any stipulations in treaties entered into by the United States in Congress assembled, with any king, prince, or state, in pursuance of any treaties already proposed by Congress to the courts of France and Spain.

No vessel of war shall be kept up in time of peace by any State, except such number only as shall be deemed necessary by the United States in Congress assembled for the defense of such State or its trade: nor shall any body of forces be kept up by any State in time of peace except such number only, as in the judgment of the United States in Congress assembled, shall be deemed requisite to garrison the forts necessary for the defense of such State; but every State shall always keep up a well-regulated and diciplined militia, sufficiently armed and accoutred, and shall provide and have constantly ready for use, in public stores, a due number of field-pieces and tents, and a proper quantity of arms, ammunition, and camp equipage.

No State shall engage in any war without the consent of the United States in Congress assembled, unless such State be actually invaded by enemies, or shall have received certain advice of a resolution being formed by some nation of Indians to invade such State, and the danger is so imminent as not to admit of a delay till the United States in Congress assembled can be consulted; nor shall any State grant commissions to any ships or vessels of war, nor letters of marque or reprisal, except it be after a declaration of war by the United States in Congress assembled, and then only against the kingdom or state, and the subjects thereof, against which war has been so declared, and under such regulations as shall be established by the United States in Congress assembled, unless such State be infested by pirates, in which case vessels of war may be fitted out for that occasion, and kept so long as the danger shall continue, or until the United States in Congress assembled shall determine otherwise.

ART. 7. When land forces are raised by any State for the common defense, all officers of or under the rank of colonel, shall be appointed by the legislature of each State respectively, by whom such forces shall be raised, or in such manner as such State shall direct, and all vacancies shall be filled up by the State which first made the appointment

ART. 8. All charges of war, and all other expenses that shall be incurred for the common defense or general welfare, and allowed by the United States in Congress assembled, shall be defrayed out of a common treasury, which shall be supplied by the several States in proportion to the value of all land within each State granted to or surveyed for any person, as such land and the buildings and improvements thereon shall be estimated according to such mode as the United States in Congress assembled shall from time to time direct and appoint.

The taxes for paying that proportion shall be laid and levied by the authority and direction of the legislatures of the several States, within the time agreed upon by the United States in Congress assembled.

ART. 9. The United States in Congress assembled shall have the sole and exclusive right and power of determining on peace and war, except in the cases mentioned in the sixth article—of sending and receiving ambassadors—entering into treaties and alliances; provided, that no treaty of commerce shall be made whereby the legislative power of the respective States shall be restrained from imposing such imposts and duties on foreigners as their own people are subjected to, or from prohibiting the exportation or importation of any species of goods or commodities whatsoever—of establishing rules for deciding in all cases what captures on land or water shall be legal, and in what manner prizes taken by land or naval forces in the service of the United States shall be divided or appropriated—of granting letters of marque and reprisal in times of peace—appointing courts for the trial of piracies and fellonies committed on the high seas, and establishing courts for receiving and determining finally appeals in all cases of captures; provided that no member of Congress shall be appointed a judge of any of the said courts.

The United States in Congress assembled shall also be the last resort on appeal in all disputes and differences now subsisting or that hereafter may arise between two or more States concerning boundary, jurisdiction, or any other cause whatever; which authority shall always be exercised in the manner following: whenever the legislative or executive authority or lawful agent of any State in controversy with another shall present a petition to Congress, stating the matter in question, and paying for a hearing, notice thereof shall be given by order of Congress to the legislative or executive authority of the other State in controversy, and a day assigned for the appearance of the parties, by their lawful agents, who shall then be directed to appoint by joint consent commissioners or judges to constitute a court for hearing and determining the matter in question; but if they cannot agree, Congress shall name three persons out of each of the United States, and from the list of such persons each party shall alternatively strike out one, the petitioners beginning, until the number shall be reduced to thirteen; and from that number not less than seven nor more than nine names, as Congress shall direct, shall, in the presence of Congress, be drawn out by lot; and the persons whose names shall be so drawn, or any five of them, shall be commissioners or judges, to hear and finally determine the controversy, so always as a major part of the judges, who shall hear the cause, shall agree in the determination; and if either party shall neglect to attend at the day appointed, without showing reasons which Congress shall judge sufficient, or being present shall refuse to strike, the Congress shall proceed to nominate three persons out of each State, and the secretary of Congress shall strike in behalf of such party absent or refusing; and the judgement and sentence of the court, to be appointed in the manner before prescribed, shall be final and conclusive; and if any of the parties shall refuse to submit to the authority of such court, or to appear, or defend their claim or cause, the court shall, nevertheless, proceed to pronounce sentence or judgment, which shall, in like manner, be final and decisive, the judgment or sentence and other proceedings being in either case transmitted to Congress, and lodged among the acts of Congress for the security of the parties concerned; provided, that every commissioner, before he sits in judgment, shall take an oath, to be administered by one of the judges of the supreme or superior court of the State, where the cause shall be tried, "well and truly to hear and determine the matter in question, according to the best of his judgment, without favor, affection, or hope of reward;" provided, also, that no State shall be deprived of territory for the benefit of the United States.

All controversies concerning the private right of soil, claimed under different grants of two or more States, whose jurisdiction as they may respect such lands and the States which passed such grants are adjusted, the said grants or either of them being at the same time claimed to have originated antecedent to such settlement of jurisdiction, shall, on the petition of either party to the Congress of the United States, be finally determined, as near as may be, in the same manner as is before prescribed for deciding disputes respecting territorial jurisdiction between different States.

The United States in Congress assembled shall also have the sole and executive right and power of regulating the alloy and value of coin struck by their own authority, or by that of the respective States—fixing the standard of weights and measures throughout the United States—regulating the trade and managing all affairs with the Indians not members of any of the States; provided that the legislative right of any State within its own limits be not infringed or violated—establishing and regulating post-offices from one State to another throughout all the United States, and exacting such postage on the papers passing through the same, as may be requisite to defray the expenses of the said office—appointing all officers of the land forces in the service of the United States excepting regimental officers—appointing all the officers of the naval forces, and commissioning all officers whatever in the service of the United States—making rules for the government and regulation of the said land and naval forces, and directing their operations.

The United States in Congress assembled shall have authority to appoint a committee to sit in the recess of Congress, to be denominated "a committee of the States," and to consist of one delegate from each State; and to appoint such other committees and civil officers as may be necessary for managing the general affairs of the United States, under their direction—to appoint one of their number to preside, provided that no person be allowed to serve in the office of president more than one year in any term of three years—to ascertain the necessary sums of money to be raised for the service of the United States, and to appropriate and apply the same for defraying the public expenses—to borrow money or emit bills on the credit of the United States, transmitting every half year to the respective States an account of the sums of money so borrowed or emitted—to build and equip a navy—to agree upon the number of land forces, and to make requisitions from each State for its quota, in proportion to the number of white inhabitants in such State; which requisition shall be binding, and thereupon the legislature of each State shall appoint the regimental officers, raise the men, and clothe, arm, and equip them, in a soldier-like manner, at the expense of the United States; and the officers and men so clothed, armed, and equipped, shall march to the place appointed, and within the time agreed on by the United States in Congress assembled: but if the United States in Congress assembled shall, on consideration of circumstances, judge proper that any State should not raise men, or should raise a smaller number than its quota, and that any other State should raise a greater number of men than the quota thereof, such extra number shall be raised, officered, clothed, armed, and equipped, in the same manner as the quota of such State, unless the legislature of such State shall judge that such extra number cannot safely be spared out of the same; in which case they shall raise, officer, clothe, arm, and equip as many of such extra number as they judge can be safely spared And the officers and men so clothed, armed, and equipped, shall march to the place appointed, and within the time agreed on by the United States in Congress assembled.

The United States in Congress assembled shall never engage in war, nor grant letters of marque and reprisal in time of peace, nor enter into any treaties or alliances, nor coin money, nor regulate the value thereof, nor ascertain the sums and expenses necessary for the defense and welfare of the United States or any of them, nor emit bills, nor borrow money on the credit of the United States, nor appropriate money, nor agree upon the number of vessels-of-war to be built or purchased, or the number of land or sea forces to be raised, nor appoint a commander-in-chief of the army and navy, unless nine States assent to the same; nor shall a question on any other point, except for adjourning from day to day, be determined, unless by the votes of a majority of the United States in Congress assembled.

The Congress of the United States shall have power to adjourn to any time within the year, and to any place within the United States, so that no period of adjournment be for a longer duration than the space of six months; and shall publish the journal of their proceedings monthly, except such parts thereof relating to treaties, alliances, or military operations, as in their judgment require secrecy; and the yeas and nays of the delegates of each State on any question shall be entered on the journal, when it is desired by any delegate; and the delegates of a State, or any of them, at his or their request, shall be furnished with a transcript of the said journal, except such parts as are above excepted, to lay before the legislatures of the several States.

ART. 10. The committee of the States, or any nine of them, shall be authorized to execute, in the recess of Congress, such of the powers of Congress as the United States in Congress assembled, by the consent of nine States, shall from time to time think expedient to vest them with; provided that no power be delegated to the said committe, for the exercise of which, by the articles of confederation, the voice of nine States in the Congress of the United States assembled is requisite.

ART. 11. Canada, acceding to this confederation, and joining in the measures of the United States, shall be admitted into, and entitled to all the advantages of, this Union, but no other colony shall be admitted into the same unless such admission be agreed to by nine States.

ART. 12. All bills of credit emitted, moneys borrowed, and debts contracted by or under the authority of Congress, before the assembling of the United States, in pursuance of the present confederation, shall be deemed and considered as a charge against the United States, for payment and satisfaction whereof the said United States and the public faith are hereby solemnly pledged.

ART. 13. Every State shall abide by the decision of the United States, in Congress assembled, on all questions which, by this confederation, are submitted to them. And the articles of this confederation shall be inviolably observed by every State, and the Union shall be perpetual; nor shall any alteration at any time hereafter be made in any of them, unless such alteration be agreed to in a Congress of the United States, and be afterwards confirmed by the legislature of every State.

And whereas it has pleased the great Governor of the world to incline the hearts of the legislatures we respectively represent in Congress, to approve of and to authorize us to ratify the said articles of confederation and perpetual union; *know ye*, that we, the undersigned delegates, by virtue of the power and authority to us given for that purpose, do, by these presents, in the name and in behalf of our respective constituents, fully and entirely ratify and confirm each and every of the said articles of confederation and perpetual union, and all and singular the matters and things therein contained; and we do further solemnly pledge and engage the faith of our respective constituents, that they shall abide by the determinations of the United States in Congress assembled, on all questions which, by the said confederation, are submitted to them; and that the articles thereof shall be inviolably observed by the States we respectively represent; and that the Union be perpetual.

In witness whereof, we have hereunto set our hands, in Congress. Done at Philadelphia, in the State of Pennsylvania, the ninth day of July, in the year of our Lord one thousand seven hundred and seventy-eight, and in the third year of the independence of America.

New Hampshire.

Josiah Bartlett,
John Wentworth, Jr.

Massachusetts Bay.

John Hancock,
Samuel Adams,
Elbridge Gerry,
Francis Dana,
James Lovell,
Samuel Hilton.

Rhode Island.

William Ellery,
Henry Marchant,
John Collins.

Connecticut.

Roger Sherman,
Samuel Huntington,
Oliver Wolcott,
Titus Hosmer,
Andrew Adams.

New York.

James Duane,
Francis Lewis,
William Duer,
Gouverneur Morris.

Pennsylvania.

Robert Morris,
Daniel Roberbeau,
Jonathan Bayard Smith,
William Klingan,
Joseph Reed.

New Jersey.

John Witherspoon,
Nath. Scudder.

Delaware.

Thomas McKean,
John Dickinson,
Nicholas Van Dyke.

Maryland.

John Hanson,
Daniel Carroll.

Virginia.

Richard Henry Lee,
John Banister,
Thomas Adams,
John Harvie,
Francis Lightfoot Lee.

North Carolina.

John Penn,
Cornelius Harnett,
John Williams.

South Carolina.

Henry Laurens,
William Henry Drayton,
John Matthews,
Richard Hutson,
Thomas Heyward, Jr.

Georgia.

George Walton,
Edward Telfair,
Edward Langworthy.

EARLIEST CONGRESS OF THE UNITED STATES.

First Continental Congress, 1774.—In May, 1774, the Sons of Liberty of New York, first proposed a *General Congress of the American Colonies*. They forwarded this proposition through Connecticut to Boston, and through Philadelphia to every colony in the South. On June 17, the Legislature of Massachusetts appointed the first day of September, 1774, as the time, and Philadelphia as the place for holding the Continental Congress. Samuel Adams, John Adams, Thomas Cushing, and Robert Treat Paine were chosen delegates. One colony after another elected deputies soon afterward. On Monday, Sept. 5, the members of the Congress moved in a body into a plain but spacious hall offered by the carpenters of Philadelphia. Peyton Randolph, late speaker of the assembly of Virginia, was unanimously chosen chairman. The body named itself "The Congress," and its chairman "The President." Eleven colonies represented; Georgia and North Carolina had no delegates there at first. There were 55 members present, each colony having sent as many as it pleased.

It was resolved that each colony should have one vote, and that the doors should be kept shut during the time of business. The members bound themselves by their honor to keep the proceedings secret.

On the nomination of John Adams, Jacob Duché, an Episcopal clergyman, was chosen chaplain. In the middle of September North Carolina sent its delegates to Congress.

On October 8, 1774, this Congress resolved: "We approve the opposition of the inhabitants of the Massachusetts Bay to the execution of the late acts of parliament; and if the same shall be attempted to be carried into execution *by force*, in such case, all America *ought* to support them in their opposition." This measure hardened George the III. to listen to no terms; he was bent on enforcing the obnoxious acts in Massachusetts, and extending them to Connecticut and Rhode Island.

On October 10, Congress declared "that every person who should accept or act under any commission or authority denied from the regulating act of parliament, changing the form of government and violating the charter of Massachusetts, ought to be held in detestation."

In October Congress resolved unanimously, "from the first day of December, 1774, not to import any merchandise from Great Britain and Ireland." All the members bound themselves to this measure by an association. They further covenanted: "We will neither import, nor purchase any slave imported after the first day of December next, after which time we will wholly discontinue the slave trade, and will neither be concerned in it ourselves nor will we hire out our vessels, nor sell our commodities or manufactures to those who are concerned in it."

This first American Congress brought forth another measure, which was without an example: It *recognized the political authority of the people.* It addressed *the people* of the provinces from Nova Scotia to Florida, *the people* of Canada, *the people* of Great Britain; and laid its grievances before *the people,* while it refused to petition parliament. On October 26, 1774, this Congress adjourned, after it had embodied its decision in a petition to the king. This petition was very conciliatory, asking for nothing but peace, liberty and safety.

Second Continental Congress.—On May 10, 1775, the Second Continental Congress met at Philadelphia. John Hancock presided. All the thirteen colonies were now represented. Blood had been shed at Lexington and Concord, Mass., and Ticonderoga, N. Y., the key of the gateway to Canada, was on the same day taken from the British by the "Green Mountain Boys" under Ethan Allen. The representatives met as a Congress of War, in the name of a united people struggling for independence. This Congress was a revolutionary body. But, instead of establishing a centralized government, it relied on the colonial governments for executive acts. This Congress appointed Ward, Charles Lee, Schuyler, and Putnam as major-generals, and Gates as adjutant-general. It adopted the forces around Boston as the "American Continental Army," and formulated rules and articles of war for it. It chose George Washington as general-in-chief, June 17, 1775. The battle of Bunker Hill took place on the same day. At that time Congress began to issue bills of credit or "Continental currency." These bills soon began to depreciate, in spite of being declared legal tender. By successive issues of such bills, however, Congress contrived to maintain the army for some years.

In July, 1775, it adopted the last petition to the king, beseeching him to consider the complaints of the colonists, and to repeal the acts which they had found intolerable. Instead of an answer the king called, by proclamation, "on all good subjects to give information of such persons who were aiding and abetting the American rebellion." He sent 25,000 men to America under General Howe. British ships cannonaded Gloucester, Bristol, Falmouth, and other defenseless American seacoast towns. Gen. Washington raised on Jan. 1, 1776, the distinctive standard of the thirteen united American colonies.

In November, 1775, Congress appointed Franklin, Jay, and three other delegates a committee "to maintain intercourse with friends of the colonies in Great Britain, Ireland, and elsewhere." At the same time (Nov. 25) Congress ordered that British war vessels or transports should be open to capture. On March 26, 1776, it declared all British vessels lawful prize. On April 6, it opened all American ports to the vessels of all other nations than Great Britain. In June, 1776, Congress appointed a committee, consisting of Thomas Jefferson, of Virginia, John Adams, of Massachusetts, Benjamin Franklin, of Pennsylvania, Roger Sherman, of Connecticut, and Robert R. Livingston, of New York, to draw up a resolution of independence. The result was the Declaration of Independence, which see. The date of its adoption is the date of the legal existence of the United States. On Dec. 12, 1776, the Second Continental Congress adjourned.

Third Continental Congress.—This Congress met at Baltimore, Dec. 20, 1776, and lasted until the articles of "Confederation" went into operation March 1, 1781. On Nov. 15, 1777, it adopted a resolution favoring a federal government. On December 16, of the same year the United States were recognized by France, and on the 6th day of February, 1778, Benj. Franklin succeeded in concluding a treaty of alliance with France.

Confederated Congress.—On the second day of March, 1781, the "Congress of the Confederation" assembled. On the same day the federal government was accepted by the delegates from all the States. The treaty of peace with Great Britain was signed at Paris on Sept. 3, 1782, and ratified by Congress on Jan. 4, 1784. John Adams was sent as the first American embassador to Great Britain and was received by the king on June 1, 1785. A new federal constitution was signed by a convention of States on Sept. 17, 1787, and the same was ratified by the people on May 23, 1728. On March 4, 1789, the first Congress of the United States of America assembled, and on April 30 of the same year G. Washington was inaugurated as the first President.

EARLY TREATIES WITH THE UNITED STATES.

Great Britain, 1795.—Great popular indignation in the United States against England, because of her persistent refusal to negotiate a commercial treaty with this country, began to be reflected in congressional legislation in 1794. Mr. Madison on January 4, introduced resolutions in the House, declaring it expedient to increase the duties on the tonnage of vessels of nations which had no commercial treaties with the United States, and on their manufactures of leather, metals, wool, cotton, hemp, flax, and silk, and to reduce the tonnage duties on vessels of nations having such treaties; and to increase the duty on importations from the West Indies in foreign vessels from the ports from which Americans were excluded. The following is the further historic record: "A notable debate is had on the resolutions, but the House comes to no decision. A report, made in response to a resolution declaring that a naval force adequate to the protection of the commerce of the United States against the Algerine corsairs ought to be provided, is taken up Feb. 5, and a bill providing for the construction of 6 frigates, 4 of 44 guns, and 2 of 36 each, is passed by both Houses and signed by the President. Mr. Sedgwick proposes, March 12, to raise a military force of 15,000 men and to authorize the President to lay an embargo on foreign vessels for 40 days; his resolutions are lost, but the subject is again brought up, 26, when a substitute is adopted laying an embargo for 30 days on all vessels in the ports of the United States bound to any foreign place. A bill is also passed for fortifying certain ports and harbors. Mr. Smith declares that provisions ought to be made for the indemnification of all citizens of the United States, whose vessels or cargoes have been seized and confiscated by any of the belligerent powers, upon which Mr. Dayton moves a resolution for the sequestration of all debts due from American citizens to British subjects, and to compel their payment into the treasury as a fund for the proposed indemnification. Mr. Clark introduces a more stringent resolution, April 7, to prohibit all commercial intercourse with Great Britain, so far as respects the products of Great Britain and Ireland, until her government shall make compensation for injuries sustained by citizens of the United States from British armed vessels, and until the western posts are vacated. The House strikes out the western-posts clause and passes the resolution, but the Senate defeats it by the casting vote of the Vice-President."

While Congress was thus fanning the war flame the President determined on an effort at negotiation, and, April 16, nominated Chief Justice Jay as Envoy Extraordinary of the United States to Great Britain. He was instructed to labor for restitution for spoliations of American commerce, the fullfilment of the treaty of peace, and, if successful in this for a treaty of commerce. Mr. Jay embarked on his mission May 13, 1794.

The President received, March 7, a copy of a treaty of amity, commerce, and navigation, concluded by Chief Justice Jay and Lord Granville, Nov. 19, he submitted it to the Senate in special session, June 8, after violent debates it was ratified by a vote of 20 to 10 (June 24). The treaty secured indemnity to American Merchants for the seizure of their property by British vessels, and pledged a surrender of the western posts by June 1, 1796.

Indian Tribes.—About 1,100 chiefs and notable warriors, of the western Indian tribes met United States Commissioners at Greenville, Aug. 8, 1795, and signed a treaty of peace, ceding a large tract of land to the United States.

Algiers.—A treaty of peace was signed between the United States and Algiers, Sept. 5, 1795, by which all American captives were released from imprisonment upon the payment of an annual tribute to the Dey.

Spain.—The long pending disputes between the United States and Spain were settled by treaty signed Oct. 27, 1795, in which Spain conceded the claims of the United States in the matter of. the Florida boundary and the right to the free navigation of the Mississippi River. Compensation was to be made to American citizens for property illegally seized by Spanish cruisers.

France.—In February, 1796, the French minister of foreign affairs informed the United States Minister, James Monroe, that the French Directory considered the alliance between the United States and France ended by the Jay treaty; that the French minister to the United States was to be recalled; and that a special envoy was to be sent to make the announcement. A few days later, Mr. Monroe was served with a long list of complaints preferred by the French government against the United States. The President recalled Mr. Monroe, Sept. 9, appointing Charles C. Pinckney, of South Carolina, in his place: their letters were presented Dec. 9. Two days afterward, Mr. Monroe was informed by the French minister of foreign affairs that the Directory would no longer recognize a minister from the United States until after a reparation of the grievances demanded of the American government.

In 1797 the hitherto friendly relations of the United States with France were interrupted. The treaty negotiated by Jay between the United States and England had given offense to France. The French Directory issued decrees against American commerce, on the alleged ground of a violation by the United States of her neutral stand between England and France. Ships flying the American flag were captured by French cruisers, and condemned, in alleged violation of treaty provisions and international law. Gerry, Marshall, and Pinckney were sent to France as special envoys to remonstrate and negotiate a new treaty.

In 1798 the troubles between the two countries were still unadjusted. The dispatches from the special envoys of the United States were made public and indicated that Talleyrand, the French prime minister, refused to treat with them until a bribe had been tendered to the French Directory. The names of the three agents of Talleyrand who attempted to secure the bribe were designated in the despatches as X. Y. L. The publication of these despatches produced great excitement, and were quickly followed by the return of two of the special envoys, without having negotiated any settlement of difficulties. The country was aroused to a high pitch of resentment against France, and Congress voted appropriations for increasing the Navy and Army. During the greater part of this year, although there had been no formal declaration of war between the countries, France and the United States maintained a small naval warfare against each other in the waters around the West Indies; vessels were captured and their crews taken prisoners. Hostilities ceased toward the end of the year. Congress passed an Act suspending all commercial relations with France.

In 1799, Napoleon Bonaparte, who had overthrown the French Directory, offered satisfactory terms to the United States, and peace ensued.

In 1803 the United States purchased from France the Territory of Lousiana, paying therefor the sum of $15,000,000. This treaty bore date April 30. The territory thus acquired included that now embraced in several western States, and extended as far north as to the present Canadian boundary.

Tripoli.—On June 3, 1805, a treaty of peace was concluded between Tripoli and the United States.

Great Britain.—In 1807 Great Britain began the offensive search of United States vessels and seizing persons and goods suspected of being contraband of her wars with other nations. During that year the British frigate *Leopard* stopped the United States frigate *Chesapeake* at sea, and took from her several sailors. The United States passed, December 21st, the Embargo Act, forbidding any vessel from the United States from entering a foreign port.

In 1809 Congress removed the embargo from affecting all countries except Great Britain. June 18th, 1812, war was declared against that country.

In 1814 Great Britain offered, January 6th, to treat for peace, and commissioners of peace were appointed on both sides. The naval warfare between the two countries, however, continued until December 24th, 1814, when a treaty of peace was signed between Great Britain and the United States at Ghent, Belgium.

CONVENTION FOR ADOPTING THE CONSTITUTION OF THE UNITED STATES.

In May, 1785, a committee of the Federal Congress in session in New York, made a report recommending an alteration of the Articles of Confederation, but no action was taken on it, and it was left to the State legislature to take the initiative in this matter.

In January, 1786, the Virginia legislature passed a resolution providing for the appointment of "five commissioners who, or any three of them," should meet such commissioners as should be appointed by other States of the Union, at a time and place to be agreed upon, to take into consideration the following topics:

"The trade of the United States."

"A uniform system in commercial regulations; and report to the several States such plan of action as they might consider best for adoption by the Confederated Congress. The commissioners, after correspondence, appointed the 1st Monday in September as the time, and Annapolis, Md., as the place of meeting.

At the meeting in Annapolis only five States were represented, namely, Virginia, Delaware, New York, New Jersey and Pennsylvania, the commissioners appointed by Massachusetts, New Hampshire, North Carolina, and Rhode Island failed to attend. Under the circumstances of so partial a representation, the commissioners present agreed upon a report (drawn by Mr. Hamilton, of New York), expressing their unanimous conviction that it might essentially tend to advance the interests of the Union if the States by which they were respectively delegated would concur, and use their endeavors to procure the concurrence of the other States, in the appointment of commissioners to meet at Philadelphia on the second Monday of May following, to take into consideration the situation of the United States; to devise such further provisions as should appear to them necessary to render the Constitution of the Federal Government adequate to the exigencies of the Union; and to report such an act for that purpose to the United States in Congress assembled as, when agreed to by them and afterwards confirmed by the legislatures of every State, would effectually provide for the same.

Congress, on Feb. 21, 1787, adopted a resolution in favor of a convention, and the legislatures of those States which had not already done so (with the exception of Rhode Island) promptly appointed delegates.

On May 25, seven States having convened, George Washington, of Virginia, was unanimously elected President, and the consideration of the proposed constitution was commenced. On Sept. 17, 1787, the constitution as engrossed and agreed upon was signed by all the members present, except Mr. Gerry, of Massachusetts, and Messrs. Mason and Randolph, of Virginia. The president of the convention transmitted it to Congress, with a resolution stating how the proposed Federal Government should be put in operation, and an explanatory letter.

Congress, on Sept. 28, 1787, directed the Constitution so framed, with the resolutions and letter concerning the same, to "be transmitted to the several legislatures in order to be submitted to a convention of delegates chosen in each State by the people thereof, in conformity to the resolves of the convention."

On March 4, 1789, the day which had been fixed for commencing the operations of government under the new Constitution, it had been ratified by the conventions chosen in each State to consider it, as follows:

Delaware, December 7, 1787;
Pennsylvania, December 12, 1787;
New Jersey, December 18, 1787;
Georgia, January 2, 1788;
Connecticut, January 9, 1788;
Massachusetts, February 6, 1788;
Maryland, April 28, 1788;
South Carolina, May 28, 1788;
New Hampshire, June 21, 1788;
Virginia, June 26, 1788;
New York, July 26, 1788.

The other States did not ratify the new Constitution until after the meeting of the first session of the new Congress, and hence did not participate in its legislation. Of these States, North Carolina ratified the Constitution, Nov. 21, 1789; Rhode Island, May 29, 1789; and Vermont, Jan. 10, 1791.

CONSTITUTION OF THE UNITED STATES.

The following is the complete text of the Constitution of the United States, as adopted by the Federal Constitutional Convention held in Philadelphia and duly engrossed and signed, Sept. 17, 1787, and subsequently ratified by the legislatures of the several States:

WE, the people of the United States, in order to form a more perfect Union, establish Justice, insure Domestic Tranquillity, provide for the Common Defense, promote the General Welfare, and secure the Blessings of Liberty, to ourselves and our posterity, do ordain and establish this CONSTITUTION FOR THE UNITED STATES OF AMERICA.

ARTICLE I

SECTION 1. All legislative powers herein granted shall be vested in a Congress of the United States, which shall consist of a Senate and House of Representatives.

SEC. 2. The House of Representatives shall be composed of members chosen every second year by the people of the several States, and the electors in each State shall have the qualifications requisite for the electors of the most numerous branch of the State legislature.

No person shall be a representative who shall not have attained the age of twenty-five years, and been seven years a citizen of the United States, and who shall not, when elected, be an inhabitant of that State in which he shall be chosen.

[Representatives and direct taxes shall be apportioned among the several States which may be included within this Union, according to their respective numbers, which shall be determine by adding to the whole number of free persons, including those bound to service for a term of years, and excluding Indians not taxed, three-fifths of all other persons.][*] The actual enumeration shall be made within three years after the first meeting of the Congress of the United States, and within every subsequent term of ten years, in such manner as they shall by law direct. The number of representatives shall not exceed one for every thirty thousand, but each State shall have at least one Representative; and until such enumeration shall be made the State of New Hampshire shall be entitled to choose three, Massachusetts eight, Rhode Island and Providence Plantations one, Connecticut five, New York six, New Jersey four, Pennsylvania eight, Delaware one, Maryland six, Virginia ten, North Carolina five, South Carolina five, and Georgia three.

When vacancies happen in the Representation from any State, the executive authority thereof shall issue writs of election to fill such vacancies.

The House of Representatives shall choose their Speaker and other officers, and shall have the sole power of impeachment.

SEC. 3. The Senate of the United States shall be composed of two Senators from each State, chosen by the Legislature thereof, for six years; and each Senator shall have one vote.

Immediately after they shall be assembled in consequence of the first election, they shall be divided as equally as may be into three classes. The seats of the Senators of the first class shall be vacated at the expiration of the second year, of the second class at the expiration of the fourth year, and, of the third class at the expiration of the sixth year, so that one third may be chosen every second year; and if vacancies happen by resignation or otherwise, during the recess of the Legislature of any State, the Executive thereof may make temporary appointments until the next meeting of the Legislature, which shall then fill such vacancies.

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[*] The part here enclosed in brackets was afterward amended by the 2nd section of the Fourteenth Amendment.

No person shall be a Senator who shall not have attained the age of thirty years, and been nine years a citizen of the United States, and who shall not, when elected, be an inhabitant of that State for which he shall be chosen.

The Vice-President of the United States shall be President of the Senate, but shall have no vote, unless they be equally divided.

The Senate shall choose their other officers, and also a President *pro tempore*, in the absence of the Vice-President, or when he shall exercise the office of President of the United States.

The Senate shall have the sole power to try all impeachments. When sitting for that purpose, they shall be on oath or affirmation. When the President of the United States is tried, the Chief-Justice shall preside: and no person shall be convicted without the concurrence of two-thirds of the members present.

Judgment in cases of impeachment shall not extend further than to removal from office, and disqualification to hold and enjoy any office of honor, trust, or profit under the United States; but the party convicted shall nevertheless be liable and subject to indictment, trial, judgment, and punishment according to law.

SEC. 4. The times, places, and manner of holding elections for Senators and Representatives shall be prescribed in each State by the Legislatures thereof; but the Congress may at any time by law make or alter such regulations, except as to the place of choosing Senators.

The Congress shall assemble at least once in every year, and such meeting shall be on the first Monday in December, unless they shall by law appoint a different day.

SEC. 5. Each House shall be the judge of the elections, returns, and qualifications of its own members, and a majority of each shall constitute a quorum to do business; but a smaller number may adjourn from day to day, and may be authorized to compel the attendance of absent members, in such manner and under such penalties as each House may provide.

Each House may determine the rules of its proceedings, punish its members for disorderly behavior, and, with the concurrence of two-thirds, expel a member.

Each House shall keep a journal of its proceedings, and from time to time publish the same, excepting such parts as may in their judgment require secrecy; and the yeas and nays of the members of either House on any question shall, at the desire of one-fifth of those present, be entered on the journal.

Neither House, during the session of Congress, shall without the consent of the other, adjourn for more than three days, nor to any other place than that in which the two Houses shall be sitting.

SEC. 6. The Senators and Representatives shall receive a compensation for their services, to be ascertained by law and paid out of the Treasury of the United States. They shall in all cases, except treason, felony, and breach of the peace, be privileged from arrest during their attendance at the session of their respective Houses, and in going to and returning from the same; and for any speech or debate in either House, they shall not be questioned in any other place.

No Senator or Representative shall, during the time for which he was elected, be appointed to any civil office under the authority of the United States which shall have been created, or the emoluments whereof shall have been increased, during such time; and no person holding any office under the United States shall be a member of either House during his continuance in office.

SEC. 7. All bills for raising revenue shall originate in the House of Representatives; but the Senate may propose or concur with amendments as on other bills.

Every bill which shall have passed the House of Representatives and the Senate shall, before it become a law, be presented to the President of the United States; if he approve he shall sign it, but if not he shall return it, with his objections, to that House in which it shall have originated, who shall enter the objections at large on their journal and proceed to reconsider it. If after such reconsideration two thirds of the House shall agree to pass the bill, it shall be sent, together with the objections, to the other House, by which it shall likewise be reconsidered, and if approved by two-thirds of that House, it shall become a law. But in all such cases the votes of both Houses shall be determined by yeas and nays, and the names of the persons voting for and and against the bill shall be entered on the journal of each House respectively. If any bill shall not be returned by the President within ten days (Sundays excepted) after it shall have been presented to him, the same shall be a law, in like manner as if he had signed it, unless the Congress by their adjournment prevent its return, in which case it shall not be a law.

Every order, resolution, or vote to which the concurrence of the Senate and House of Representatives may be necessary (except on a question of adjournment) shall be presented to the President of the United States; and before the same shall take effect, shall be approved by him, or being disapproved by him, shall be repassed by two-thirds of the Senate and House of Representatives, according to the rules and limitations prescribed in the case of a bill.

SEC. 8. The Congress shall have power

To lay and collect taxes, duties, imposts, and excises, to pay the debts and provide for the common defense and welfare of the United States; but all duties, imposts, and excises shall be uniform throughout the United States;

To borrow money on the credit of the United States;

To regulate commerce with foreign nations, and among the several States, and with the Indian tribes;

To establish a uniform rule of naturalization, and uniform laws on the subject of bankruptcies throughout the United States;

To coin money, regulate the value thereof, and of foreign coin, and fix the standard of weights and measures;

To provide for the punishment of counterfeiting the securities and current coin of the United States;

To establish post-offices and post-roads;

To promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries;

To constitute tribunals inferior to the Supreme Court;

To define and punish piracies and felonies committed on the high seas, and offenses against the law of nations;

To declare war, to grant letters of marque and reprisal, and make rules concerning captures on land and water;

To raise and support the armies, but no appropriation of money to that use shall be for a longer term than two years;

To provide and maintain a navy;

To make rules for the government and regulation of the land and naval forces;

To provide for calling forth the militia to execute the laws of the Union, suppress insurrections, and repel invasions;

To provide for organizing, arming, and disciplining the militia, and for governing such part of them as may be employed in the service of the United States, reserving to the States respectively the appointment of the officers, and the authority of training the militia according to the discipline prescribed by Congress;

To exercise exclusive legislation in all cases whatsoever, over such district (not exceeding ten miles square) as may, by cession of particular States and the acceptance of Congress, become the seat of the Government of the United States and to exercise like authority over all places purchased by the consent of the Legislature in which the same shall be, for the erection of forts, magazines, arsenals, dock-yards, and all other needful buildings;—And,

To make all laws which shall be necessary and proper for carrying into execution the foregoing powers, and all other powers vested by this Constitution in the Government of the United States, or in any department or officer thereof.

SEC. 9. The migration or importation of such persons as any of the States now existing shall think proper to admit shall not be prohibited by the Congress prior to the year one thousand eight hundred and eight, but a tax or duty may be imposed upon such importation, not exceeding ten dollars for each person.

The privilege of the writ of habeas corpus shall not be suspended, unless when in cases of rebellion or invasion the public safety may require it.

No bill of attainder or ex post facto law shall be passed.

No capitation or other direct tax shall be laid, unless in proportion to the census or enumeration hereinbefore directed to be taken.

No tax or duty shall be laid on any article exported from any State.

No preference shall be given by any regulation of commerce or revenue to the ports of one State over those of another; nor shall vessels bound to, or from, one State, be obliged to enter, clear, or pay duties in another.

No money shall be drawn from the treasury, but in consequence of appropriations made by law; and a regular statement and account of the receipts and expenditures of all public money shall be published from time to time.

No title of nobility shall be granted by the United States; and no person holding any office of trust or profit under them, shall, without the consent of the Congress, accept of any present, emolument, office, or title, of any kind whatever, from any king, prince, or foreign State.

SEC. 10. No State shall enter into any treaty, alliance, or confederation; grant letters of marque and reprisal; coin money, emit bills of credit; make anything but gold and silver coin a tender in payment of debts; pass any bill of attainder, ex post facto law, or law impairing the obligations of contracts; or grant any title of nobility.

No State shall, without the consent of the Congress, lay any imposts or duties on imports or exports, except what may be absolutely necessary for executing its inspection laws, and the net produce of all duties and imposts, laid by any State on imports or exports, shall be for the use of the Treasury of the United States; and all such laws shall be subject to the revision and control of the Congress.

No State shall, without the consent of Congress, lay any duty of tonnage, keep troops, or ships of war, in time of peace, enter into any agreement or compact with another State, or with a foreign power, or engage in war, unless actually invaded, or in such imminent danger as will not admit of delay.

ARTICLE II.

SECTION 1. The executive power shall be vested in a President of the United States of America. He shall hold his office during the term of four years, and, together with the Vice-President, chosen for the same term, be elected as follows:

Each State shall appoint, in such manner as the Legislature thereof may direct, a number of electors, equal to the whole number of Senators and Representatives to which the State may be entitled in the Congress; but no Senator or Representative, or person holding an office of trust or profit under the United States, shall be appointed an elector.

[The electors shall meet in their respective States and vote by ballot for two persons, of whom one at least shall not be an inhabitant of the same State with themselves. And they shall make a list of all the persons voted for, and of the number of votes for each; which list they shall sign and certify, and transmit sealed to the seat of the Government of the United States, directed to the President of the Senate. The President of the Senate shall, in presence of the Senate and House of Representatives, open all the certificates, and the votes shall then be counted. The person having the greatest number of votes shall be the President, if such number be a majority of the whole number of electors appointed; and if there be more than one who have such majority, and have an equal number of votes, then the House of Representatives shall immediately choose by ballot one of them for President; and if no person have a majority, then from the five highest on the list the said House shall in like manner choose the President. But in choosing the President the votes shall be taken by States, the representation from each State having one vote; a quorum for this purpose shall consist of a member or members from two-thirds of the States, and a majority of all the States shall be necessary to a choice. In every case, after the choice of the President, the person having the greatest number of votes of the electors shall be the Vice-President. But if there should remain two or more who have equal votes, the Senate shall choose from them by ballot the Vice-President.][*]

The Congress may determine the time of choosing the electors, and the day on which they shall give their votes; which day shall be the same throughout the United States.

No person except a natural born citizen, or a citizen of the United States at the time of the adoption of this Constitution, shall be eligible to the office of President; neither shall any person be eligible to that office who shall not have attained to the age of thirty-five years, and been fourteen years a resident within the United States.

In case of the removal of the President from office, or of his death, resignation, or inability to discharge the powers and duties of the said office, the same shall devolve on the Vice-President, and the Congress may by law provide for the case of removal, death, resignation, or inability, both of the Pesident and Vice-President, declaring what officer shall then act as President, and such officer shall act accordingly until the disability be removed, or a President shall be elected.

The President shall, at stated times, receive for his services a compensation which shall neither be increased nor diminished during the period for which he shall have been elected, and he shall not receive within that period any other emolument from the United States, or any of them.

Before he enter on the execution of his office he shall take the following oath or affirmation:

'I do solemnly swear (or affirm) that I will faithfully execute the office of President of the United States, and will, to the best of my ability, preserve, protect, and defend the Constitution of the United States."

Sec 2. The President shall be commander-in-chief of the Army, and Navy of the United States, and of the militia of the several States, when called into the active service of the United States; he may require the opinion, in writing, of the principal officer in each of the executive departments upon any subject relating to the duties of their respective offices, and he shall have power to grant reprieves and pardons for offenses against the United States, except in cases of impeachment.

He shall have power, by and with the advice and consent of the Senate, to make treaties, provided two-thirds of the Senators present concur; and he shall nominate, and by and with the advice and consent of the Senate, shall appoint embassadors, other public ministers and consuls, judges of the Supreme Court, and all other officers of the United States, whose appointments are not herein otherwise provided for, and which shall be established by law; but the Congress may by law vest the appointment of such inferior officers, as they think proper, in the President alone, in the courts of law, or in the heads of departments.

The President shall have power to fill up all vacancies that may happen during the recess of the Senate, by granting commissions which shall expire at the end of their next session.

Sec. 3. He shall from time to time give to the Congress information of the state of the Union, and recommend to their consideration such measures as he shall judge necessary and expedient; he may, on extraordinary occasions, convene both Houses, or either of them, and in case of disagreement between them with respect to the time of adjournment, he may adjourn them to such time as he shall think proper; he shall receive embassadors and other public ministers, and he shall take care that the laws be faithfully executed, and he shall commission all the officers of the United States.

Sec. 4. The President, Vice-President, and all civil officers of the United States, shall be removed from office on impeachment for, and conviction of, treason, bribery, or other high crimes and misdemeanors.

ARTICLE III.

Sec. 1. The judicial power of the United States shall be vested in one Supreme Court, and in such inferior courts as the Congress may from time to time ordain and establish. The Judges both of the Supreme and inferior courts shall hold their offices during good behavior, and shall at stated times, receive for their services a compensation which shall not be diminished during their continuance in office.

Sec. 2. The judicial power shall extend to all cases, in law and equity, arising under this Constitution, the laws of the United States, and treaties made, or which shall be made, under their authority; to all cases affecting embassadors, other public ministers, and consuls; to all cases of admiralty and maritime jurisdiction; to controversies to which the United States shall be a party; to controversies between two or more States; between a State and citizens of another State; between citizens of different States; between citizens of the same state claiming lands under grants of different States, and between a State or the citizen thereof, and foreign States, citizens, or subjects.

In all cases affecting embassadors, other public ministers, and consuls, and those in which a State shall be party, the Supreme Court shall have original jurisdiction. In all the other cases before mentioned, the Supreme Court shall have appellate jurisdiction, both as to law and fact, with such exceptions and under such regulations as the Congress shall make.

The trial of all crimes, except in cases of impeachment, shall be by jury; and such trial shall be held in the State where the said crime shall have been committed; but when not committed within any State, the trial shall be at such place or places as the Congress may by law have directed.

Sec. 3. Treason against the United States shall consist only in levying war against them, or in adhering to their enemies, giving them aid and comfort. No person shall be convicted of treason unless on the testimony of two witnesses to the same overt act, or on confession in open court.

The Congress shall have power to declare the punishment of treason, but no attainder of treason shall work corruption of blood or forfeiture except during the life of the person attainted.

ARTICLE IV.

Sec. 1. Full faith and credit shall be given in each State to the public acts, records, and judicial proceedings of every other State. And the Congress may by general laws prescribe the manner in which such acts, records, and proceedings shall be proved, and the effect thereof.

Sec. 2. The citizens of each State shall be entitled to all privileges and immunities of citizens in the several States.

A person charged in any State with treason, felony, or other crime, who shall flee from justice, and be found in another State, shall on demand of the executive authority of the State from which he fled be delivered up, to be removed to the State having jurisdiction of the crime.

No person held to service or labor in one State, under the laws therof, escaping into another shall, in consequence of any law or regulation therein, be discharged from such service or labor, but shall be delivered up on claim of the party to whom such service or labor may be due.

Sec. 3. New States may be admitted by the Congress into this Union; but no new State shall be formed or erected within the jurisdiction of any other State; nor any State formed by the junction of two or more States, or parts of States, without the consent of the Legislatures of the States concerned as well as the Congress.

The Congress shall have power to dispose of and make all needful rules and regulations respecting the territory and other property belonging to the United States; and nothing in this constitution shall be so construed as to prejudice any claim of the United States, or of any particular State.

Sec. 4. The United States shall guarantee to every State in the Union a republican form of government, and shall protect each of them against invasion, and, on application of the Legislature or of the Executive (when the Legislature cannot be convened), against domestic violence.

ARTICLE V.

The Congress, whenever two-thirds of both Houses shall deem it necessary, shall propose amendments to this Constitution, or on the application of the Legislatures of two-thirds of the several States, shall call a convention for proposing amendments to the Constitution, which, in either case, shall be valid, to all intents and purposes, as part of this Constitution, when ratified by the Legislatures of three-fourths of the several States, or by Convention in three-fourths thereof, as the one or the other mode of ratification may be proposed by the Congress; provided that no amendment which may be made prior to the year one thousand eight hundred and eight, shall in any manner affect the first and fourth clauses in the ninth section of the first article, and that no State, without its consent, shall be deprived of its equal right of suffrage in the Senate.

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[*] This clause of the Constitution has been annulled; see 12th Article of the Amendments.

ARTICLE VI.

All debts contracted and engagements entered into, before the adoption of the Constitution, shall be as valid against the United States under this Constitution as under the Confederation.

This Constitution, and the laws of the United States which shall be made in pursuance thereof; and all treaties made, or which shall be made, under the authority of the United States, shall be the supreme law of the land; and the Judges in every State shall be bound thereby, anything in the Constitution or laws in any State to the contrary notwithstanding.

The Senators and Representatives before mentioned, and the members of the several State Legislatures, and all executive and judicial officers, both of the United States and of the several States, shall be bound, by oath or affirmation, to support this Constitution; but no religious test shall ever be required as a qualification to any office or public trust under the United States.

ARTICLE VII.

The ratification of the Convention of nine States shall be sufficient for the establishment of this Constitution between the States so ratifying the same.

Done in Convention by the Unanimous Consent of the States present the Seventeenth Day of September, in the Year of our Lord one thousand seven hundred and Eighty-seven, and of the Independence of the United States of America the Twelfth. In Witness whereof We have hereunto subscribed our Names.

GEO. WASHINGTON,
Presidt. and Deputy from Virginia.

New Hampshire.
John Langdon,
Nicholas Gilman.

Massachusetts.
Nathaniel Gorman,
Rufus King.

Connecticut.
Wm. Saml. Johnson,
Roger Sherman.

New York.
Alexander Hamilton.

New Jersey.
Wil: Livingstone,
David Brearley,
Wm. Paterson,
Jona. Dayton.

Pennsylvania.
B. Franklin,
Robt. Morris,
Tho: Fitzsimons,
James Wilson,
Thomas Mifflin,
Geo: Clymer,
Jared Ingersoll,
Gouv: Morris.

Delaware.
Geo: Read,
John Dickinson,
Jaco: Broom,
Gunning Bedford, Jun'r.
Richard Bassett.

Maryland.
James M'Henry,
Danl. Carroll,
Dan: of St. Thos. Jenifer.

Virginia.
John Blair,
James Madison, Jr.

North Carolina.
Wm. Blount,
Hu. Williamson,
Rich'd Dobbs Spaight.

South Carolina.
J. Rutledge,
Charles Pinckney,
Charles Cotesworth Pinckney,
Pierce Butler.

Georgia.
William Few,
Abr. Baldwin.

Attest: WILLIAM JACKSON, *Secretary.*

FIRST TEN AMENDMENTS—1791.

ARTICLE I.

Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof; or abridging the freedom of speech or of the press; or the right of the people peaceably to assemble, and to petition the Government for a redress of grievances.

ARTICLE II.

A well-regulated militia being necessary to the security of a free State, the right of the people to keep and bear arms shall not be infringed.

ARTICLE III.

No soldier shall in time of peace be quartered in any house without the consent of the owner, nor in time of war, but in a manner to be prescribed by law.

ARTICLE IV.

The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no warrants shall issue but upon probable cause, supported by oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.

ARTICLE V.

No person shall be held to answer for a capital or otherwise infamous crime, unless on a presentment or indictment of a Grand Jury, except in cases arising in the land or naval forces, or in the militia when in actual service in time of war or public danger; nor shall any person be subject for the same offense to be twice put in jeopardy of life or limb; nor shall he be compelled in any criminal case to be a witness against himself nor be deprived of life, liberty, or property, without due process of law; nor shall private property be taken for public use without just compensation.

ARTICLE VI.

In all criminal prosecutions the accused shall enjoy the right to a speedy and public trial, by an impartial jury of the State and district wherein the crime shall have been committed, which district shall have previously been ascertained by law, and to be informed of the nature and cause of the accusation; to be confronted with the witnesses against him; to have compulsory process for obtaining witnesses in his favor, and to have the assistance of counsel for his defense.

ARTICLE VII.

In suits at common law, where the value in controversy shall exceed twenty dollars, the right of trial by jury shall be preserved, and no fact tried by a jury shall be otherwise re-examined in any court of the United States than according to the rules of the common law.

ARTICLE VIII.

Excessive bail shall not be required, nor excessive fines be imposed, nor cruel nor unusual punishments inflicted.

ARTICLE IX.

The enumeration, in the Constitution, of certain rights shall not be construed to deny or disparage others retained by the people.

ARTICLE X.

The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people.

ELEVENTH AMENDMENT—1798.

ARTICLE XI.

The judicial power of the United States shall not be construed to extend to any suit in law or equity, commenced or prosecuted against one of the United States by citizens of another State, or by citizens or subjects of any foreign State.

TWELFTH AMENDMENT—1804.

ARTICLE XII.

The Electors shall meet in their respective States and vote by ballot for President and Vice-President, one of whom, at least, shall not be an inhabitant of the same state with themselves. They shall name in their ballots the person voted for as President and in distinct ballots the person voted for as Vice-President, and they shall make distinct lists of all persons voted for as President, and of all persons voted for as Vice-President, and of the number of votes for each, which lists they shall sign and certify, and transmit sealed to the seat of the Government of the United States, directed to the President of the Senate;—The President of the Senate shall, in presence of the Senate and House of Representatives, open all the certificates and the votes shall then be counted;—The person having the greatest number of votes for President shall be the President, if such number be a majority of the whole number of Electors appointed, and if no such person have such majority, then from the persons having the highest numbers not exceeding three on the list of those voted for as President, the House of Representatives shall choose immediately, by ballot, the President. But in choosing the President, the votes shall be taken by States, the representation from each State having one vote; a quorum for this purpose shall consist of a member or members from two thirds of the States, and a majority of all the States shall be necessary to a choice. And if the House of Representatives shall not choose a President, whenever the right of choice shall devolve upon them, before the fourth day of March next following, then the Vice-President shall act as President, as in case of the death or other constitutional disability of the President. The person having the greatest number of votes as Vice-President shall be Vice President if such number be a majority of the whole number of Electors appointed, and if no person have a majority, then from the two highest numbers on the list, the Senate shall choose the Vice-President; a quorum for the purpose shall consist of two thirds of the whole number of Senators, and a majority of the whole number shall be necessary to a choice. But no person constitutionally ineligible to the office of President shall be eligible to that of Vice-President of the United States.

THIRTEENTH AMENDMENT—1865.

ARTICLE XIII.

SECTION 1. Neither slavery nor involuntary servitude, except as a punishment for crime, whereof the party shall have been duly convicted, shall exist within the United States, or any place subject to their jurisdiction.

SEC. 2. Congress shall have power to enforce this article by appropriate legislation.

FOURTEENTH AMENDMENT—1868.

ARTICLE XIV.

SECTION 1. All persons born or naturalized in the United States, and subject to the jurisdiction thereof, are citizens of the United States and of the State in which they reside. No State shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States; nor shall any State deprive any person of life, liberty, or property without due process of law, nor deny to any person within its jurisdiction the equal protection of the laws.

SEC. 2. Representatives shall be apportioned among the several States according to their respective numbers, counting the whole number of persons in each State, including Indians not taxed. But when the right to vote at any election for the choice of Electors for President and Vice-President of the United States, representatives in Congress, the executive and judicial officers of a State, or the members of the Legislature thereof, is denied to any of the male inhabitants of such State, being twenty-one years of age, and citizens of the United States, or in any way abridged, except for participation in rebellion or other crime, the basis of representation therein shall be reduced in the proportion which the number of such male citizens shall bear to the whole number of male citizens twenty-one years of age in such State.

SEC. 3. No person shall be a Senator or Representative in Congress, or Elector of President or Vice-President, or hold any office, civil or military, under the United States, or under any State, who, having previously taken an oath as a member of Congress, or as an officer of the United States, or as a member of any State Legislature, or as an executive or judicial officer of any State, to support the Constitution of the United States, shall have engaged in insurrection or rebellion against the same, or given aid or comfort to the enemies thereof. But Congress may, by a vote of two thirds of each House, remove such disability.

SEC. 4. The validity of the public debt of the United States, authorized by law, including debts incurred by payment of pensions and bounties for services in suppressing insurrection or rebellion shall not be questioned. But neither the United States nor any other State shall assume or pay any debt or obligation incurred in aid of insurrection or rebellion against the United States, or any claim for the loss or emancipation of any slave, but all such debts, obligations, and claims shall be held illegal and void.

SEC. 5. That Congress shall have power to enforce, by appropriate legislation, the provisions of this article.

FIFTEENTH AMENDMENT—1870.

ARTICLE XV.

SECTION 1. The right of citizens of the United States to vote shall not be denied or abridged by the United States, or by any State, on account of race, color, or previous condition of servitude.

SEC. 2. Congress shall have power to enforce this article by appropriate legislation.

RATIFICATION OF THE CONSTITUTION AND AMENDMENTS.

The Constitution was adopted by a Convention of the States held in Philadelphia, Pa., Sept. 17, 1787; and it was subsequently adopted by the several State Legislatures at the dates and in the order following:

Delaware, December 7, 1787.
Pennsylvania, December 12, 1787.
New Jersey, December 18, 1787.
Georgia, January 2, 1788.
Connecticut, January 9, 1788.
Massachusetts, February 6, 1788.
Maryland, April 28, 1788.
South Carolina, May 23, 1788.
New Hampshire, June 21, 1788.
Virginia, June 26, 1788.
New York, July 26, 1788.
North Carolina, November 21, 1789.
Rhode Island, May 29, 1790.

The State of Vermont, by convention, ratified the Constitution, January 10, 1791, and was, by an act of Congress of February 18, 1791, "received and admitted into this Union as a new and entire member of the United States of America."

Ratification of First Ten Amendments.

The first ten amendments (with two others which were not adopted by the requisite number of States—see Constitution) were submitted to the State Legislatures by a resolution of Congress which was adopted by that body at its first session, Sept. 25, 1789, and was ratified by the several Legislatures as follows:

New Jersey, November 20, 1789.
Maryland, December 19, 1789.
North Carolina, December 22, 1789.
South Carolina, January 19, 1790.
New Hampshire, January 25, 1790.
Delaware, January 28, 1790.
Pennsylvania, March 10, 1790.
New York, March 27, 1790.
Rhode Island, June 15, 1790.
Vermont, November 3, 1791.
Virginia, December 15, 1791.

The acts of the State Legislatures ratifying the Amendments were transmitted by the Governors to the President of the United States, and by him communicated to Congress. The Legislatures of Massachusetts and Connecticut, do not appear by the record to have ratified them.

The Eleventh Amendment.—The eleventh article of amendment was submitted to the State Legislatives by a resolution of Congress passed March 5, 1791, at the first session of the 3d Congress; and Jan. 8, 1798, at the second session of the 5th Congress, it was declared by the President, in a message to the two Houses of Congress, to have been adopted by the Legislature of three-fourths of the States, there being at that time sixteen States in the Union.

The Twelfth Amendment.—The twelfth article was submitted to the Legislatures of the several States, there being then seventeen States, by a resolution of Congress passed Dec. 12, 1803, at the first session of the 8th Congress; and was ratified by the Legislatures of three-fourths of the States, in 1804, according to a proclamation of the Secretary of State, dated, Sep. 25, 1804.

The Thirteenth Amendment.—The thirteenth article was submitted to the Legislatures of the several States, there being then thirty-six States, by a resolution of Congress passed Feb. 1, 1865, at the second session of the 38th Congress, and was ratified, according to a proclamation of the Secretary of State, dated Dec. 18, 1865, by the Legislatures of the following States:

Illinois, February 1, 1865.
Rhode Island, February 2, 1865.
Michigan, February 2, 1865.
Maryland, February 3, 1865.
New York, February 3, 1865.
West Virginia, February 3, 1865.
Maine, February 7, 1865.
Kansas, February 7, 1865.
Massachusetts, February 8, 1865.
Pennsylvania, February 8, 1865.
Virginia, February 9, 1865.
Ohio, February 10, 1865.
Missouri, February 10, 1865.
Indiana, February 16, 1865.
Nevada, February 16, 1865.
Lousiana, February 17, 1865.
Minnesota, February 23, 1865.
Wisconsin, March 1, 1665.
Vermont, March 9, 1865.
Tennessee, April 7, 1865.
Arkansas, April 20, 1865.
Connecticut, May 5, 1865.
New Hampshire, July 1, 1865.
South Carolina, November 13, 1865.
Alabama, December 2, 1865.
North Carolina, December 4, 1865.
Georgia, December 9, 1865.

The following States not enumerated in the proclamation of the Secretary of State also ratified this amendment:

Oregon, December 11, 1865.
California, December 20, 1865.
Florida, December 28, 1865.

New Jersey, January 23, 1866.
Iowa, January 24, 1866.
Texas, February 18, 1870.

The Fourteenth Amendment.—The Fourteenth Article of Amendment to the Constitution was submitted to these State Legislatures by a Congressional resolution passed by the 39th Congress, June 16, 1866. The Secretary of State issued a proclamation, dated July 28, 1868, declaring that the proposed Fourteenth Amendment had been ratified, in the manner hereafter mentioned, by the legislatures of thirty of the thirty-six States, namely:

Connecticut, June, 30, 1866.
New Hampshire, July 7, 1866.
Tennessee, July 19, 1866.
New Jersey, September 11, 1866 (and the legislature of the same State passed a resolution in April, 1868 to withdraw its consent to it).
Oregon, September 18, 1866.
Vermont, November 9, 1866.
Georgia rejected it, November 13, 1866, and ratified it July 21, 1868.
North Carolina rejected it December 4, 1866, and ratified it July 4, 1868.
South Carolina rejected it December 20, 1866, and ratified it July 9, 1868.
New York ratified it January 10, 1867.
Ohio ratified it January 11, 1867 (and the legislature of the same State passed a resolution in January, 1868, to withdraw its consent to it).
Illinois ratified it January 15, 1867.
West Virginia, January 16, 1867.
Kansas, January 18, 1867.
Maine, January 19, 1867.
Nevada, January 22, 1867.
Missouri, January 26, 1867.
Indiana, January 29, 1867.
Minnesota, February 1, 1867.
Rhode Island, February 7, 1867.
Wisconsin, February 13, 1867.
Pennsylvania, February 13, 1867.
Michigan, February 15, 1867.
Massachusetts, March 20, 1867.
Nebraska, June 15, 1867.
Iowa, April 3, 1868.
Arkansas, April 6, 1868.
Florida, June 9, 1868.
Louisiana, July 9, 1868.
Alabama, July 13, 1868.
Georgia again ratified the amendment February 2, 1870.
Texas rejected it November 1, 1866, and ratified it February 18, 1870.
Virginia rejected it January 19, 1867, and ratified it October 8, 1869.

The amendment was rejected by Kentucky, January 10, 1867; by Delaware, February 8, 1867; by Maryland, March 23, 1867; and was not afterward ratified by either State.

The Fifteenth Amendment.—The fifteenth article was submitted to the Legislatures of the several States, there being then thirty-seven States, by a resolution of Congress passed February 27, 1869, at the first session of the 41st Congress; and was ratified according to a proclamation of the Secrtary of State dated March 30, 1870, by the Legislatures of the following States:

Nevada, March 1, 1869.
West Virginia, March 3, 1869.
North Carolina, March 5, 1869.
Louisiana, March 5, 1869.
Illinois, March 5, 1869.
Michigan, March 8, 1869.
Wisconsin, March 9, 1869.
Massachusetts, March 12, 1869.
Maine, March 12, 1869.
South Carolina, March 16, 1869.
Pensylvania, March 26, 1869.
Arkansas, March 30, 1869.
*New York, April, 14, 1869.
Indiana, May 14, 1869.
Connecticut, May 19, 1869.
Florida, June 15, 1869.
New Hampshire, July 7, 1869.
Virginia, October 8, 1869.
Vermont, October 21, 1869.
Alabama, November 24, 1869.
Missouri, January 10, 1870.
Mississippi, January 15—17, 1870.
*Ohio, January 27, 1870.
Georgia, February 2, 1870.
Iowa, February 3, 1870.
Nebraska, February 17, 1870.
Texas, February 18, 1870.
Rhode Island, January 18, 1870.
Kansas, January 18—19, 1870.
Minnesota, February 19, 1870.
†New Jersey ratified this amendment February 21, 1871. Subsequent to the proclamation of the Secretary of State.

California, Delaware, Kentucky, Maryland and Tennessee rejected this amendment.

RELATION OF THE PRESIDENT OF THE UNITED STATES TO NATIONAL LEGISLATION.

The Constitution enacts that the President shall from time to time give to Congress information of the State of the Union, and recommend to their consideration such measures as he shall deem necessary and expedient; he may, on extraordinary occasions, convene both houses, or either of them, and in case of disagreement between them with respect to the time of adjournment he may adjourn them to such time as he shall judge proper.

"Every bill which shall have passed the House of Representatives and the Senate shall, before it becomes a law, be presented to the President of the United States; if he approve, he shall sign it; but if not, he shall return it with his objections to that house in which it shall have originated. * * * * If any bill shall not be returned by the President within ten days (Sundays excepted) after it shall have been presented to him, the same shall be a law, in like manner as if he had signed it, unless the Congress, by their adjournment, prevents its return, in which case it shall not be a law." There is a similar provision in regard to "every order, resolution, or vote to which the concurrence of the Senate and House of Representatives may be necessary (except on a question of adjournment.)"

Where a House bill is allowed to become a law by the failure of the President to return it, it is usual for him to notify the House of that fact; and so also where he approves a bill, giving also the date of approval.

Where the President is prevented by adjournment from returning a bill with his objections, it is usual for him at the next session to communicate to the house where it originated his reasons for not approving it.

Art. 12, Amendments to the Constitution, requires that the certificate of electoral votes in the respective States for President and Vice-President shall be opened by the President of the Senate in the presence of the Senate and House of Representatives, and the vote shall then be counted.

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*New York withdrew her consent to the ratification January 5, 1870.

*Ohio had previously rejected the Amendment, May 4, 1869.

†New Jersey had previously rejected the Amendment.

Congress shall be in session on the second Wednesday in February succeeding every meeting of the electors, and the certificates, or so many of them as have been received, shall then be opened, the votes counted, and the persons to fill the offices of President and Vice-President ascertained and declared agreeable to the Constitution.

It is further provided by the *12th Article of Amendments to Const.*, that if no person have a majority of the electoral votes for President, "then, from the persons having the highest numbers, not exceeding three, on the list of those voted for as President, the House of Representatives shall choose immediately, by ballot, the President. But in choosing the President the votes shall be taken by States, the representation from each State having one vote; a quorum for this purpose shall consist of a member or members from two-thirds of the States, and a majority of all the States shall be necessary to a choice. And if the House of Representatives shall not choose a President, whenever the right of choice shall devolve upon them, before the fourth day of March next following, then the Vice-President shall act as President, as in the case of the death or other constitutional disability of the President."

In anticipation of the choice of President devolving upon it, the House of Representatives of the second session, Eighteenth Congress, adopted a set of rules for its government in said election.

PROVISION FOR CONDUCTING THE PRESIDENTIAL ADMINISTRATION IN CASE OF THE DEATH OF THE PRESIDENT AND VICE-PRESIDENT.

The act of Congress entitled "An act to provide for the performance of the duties of the office of President in case of the removal, death, resignation, or inability both of the President and Vice-President," approved January 19, 1886 (1st sess. 49th Congress), Statutes, vol. 24 page 1, enacts:

That in case of removal, death, resignation, or inability of both the President and Vice-President of the United States, the Secretary of State, or if there be none, or in case of his removal, death, resignation, or inability, then the Secretary of the Treasury, or if there be none, or in case of his removal, death, resignation, or inability, then the Secretary of War, or if there be none, or in case of his removal, death, resignation, or inability, then the Attorney-General, or if there be none, or in case of his removal, death, resignation, or inability, then the Postmaster-General, or if there be none, or in case of his removal, death, resignation or inability, then the Secretary of the Navy, or if there be none, or in case of his removal, death, resignation, or inability, then the Secretary of the Interior, shall act as President until the disability of the President or Vice-President is removed or a President shall be elected: *Provided*, That whenever the powers and duties of the office of President of the United States shall devolve upon any of the persons named herein, if Congress be not then in session, or if it would not meet in accordance with law within twenty days thereafter it shall be the duty of the person upon whom said powers and duties shall devolve to issue a proclamation convening Congress in extraordinary session giving twenty days notice of the time of meeting.

SEC. 2. That the preceding section shall only be held to describe and apply to such offices as shall have been appointed by the advice and consent of the Senate to the offices therein named, and such as are eligible to the office of President under the Constitution, and not under impeachment by the House of Representatives of the United States at the time the powers and duties of the office shall devolve upon them respectively.

SEC. 3. That sections 146, 147, 149, and 150 of the Revised Statutes are hereby repealed.

PRESIDENTIAL CABINET ADMINISTRATIONS.

The following is a full list of the Presidential Administrations of the United States from the date of the adoption of the Constitution to Jan. 1, 1892.

First Administration.

President: George Washington, of Virginia.

Vice-President: John Adams, of Massachusetts.

Secretaries of State: Thomas Jefferson, of Virginia Sept. 26, 1789; Edmund Randolph, of Virginia, Jan. 2, 1794; Timothy Pickering, of Massachusetts, Dec. 18, 1795.

Secretaries of the Treasury: Alexander Hamilton, of New York, Sept. 11, 1789; Oliver Wolcott, of Connecticut, Feb. 3, 1795.

Secretaries of War: Henry Knox, of Massachusetts, Sept. 12, 1789; Timothy Pickering, of Massachusetts, Jan. 2, 1795; James McHenry, of Maryland, Jan. 27, 1796.

Secretaries of the Navy. No navy department was organized during Washington's administration.

Postmasters-general: Samuel Osgood, of Massachusetts, Sept. 26, 1789; Timothy Pickering, of Massachusetts, Nov. 7, 1794; Joseph Habersham, of Georgia, Feb. 25, 1795.

Attorneys-general: Edmund Randolph, of Virginia, Sept. 26, 1789; William Bradford, of Pennsylvania, Jan. 27, 1794; Charles Lee, of Virginia, Dec. 10, 1795.

Second Administration—1797 to 1801.

President: John Adams, of Massachusetts.

Vice-President: Thomas Jefferson, of Virginia.

Secretaries of State: Timothy Pickering, continued in office; John Marshall, of Virginia, May 13, 1800.

Secretaries of the Treasury: Oliver Wolcott, continued in office; Samuel Dexter, of Massachusetts, Dec. 31, 1800.

Secretaries of War: James McHenry, continued in office; Samuel Dexter, of Massachusetts, May 13, 1800; Roger Griswold, of Connecticut, Feb. 3, 1801.

Secretaries of the Navy: George Cabot, of Massachusetts, May 3, 1798, declined; Benjamin Stoddert, of Maryland, May 21, 1798.

Postmaster-general: Joseph Habersham, continued in office.

Attorney-general: Charles Lee, continued in office.

Third Administration—1801 to 1809.

President: Thomas Jefferson, of Virginia.

Vice-Presidents: Aaron Burr, of New York, from 1801 to 1805; George Clinton, of New York, from March 4, 1805.

Secretary of State: James Madison, of Virginia, March 5, 1801.

Secretaries of the Treasury: Samuel Dexter, continued in office; Albert Gallatin, of Pennsylvania, Jan. 26, 1802.

Secretary of War: Henry Dearborn, of Massachusetts, March 5, 1801.

Secretaries of the Navy: Benjamin Stoddert, continued in office; Robert Smith, of Maryland, Jan. 26, 1802; Jacob Crowninshield, of Massachusetts, March 2, 1805.

Postmasters-general: Joseph Habersham, continued in office; Gideon Granger, of Connecticut, Jan. 26, 1802.

Attorneys-general: Levi Lincoln, of Massachusetts, March 5, 1801; Robert Smith, of Maryland, March 3, 1805; John Breckinridge, of Kentucky, Jan. 17, 1806; Cæsar A. Rodney, of Delaware, Jan. 20, 1807.

Fourth Administration—1809 to 1817.

President: James Madison, of Virginia.

Vice-Presidents: George Clinton, of New York, died April 20, 1812; Elbridge Gerry, of Massachusetts, March 4, 1813—died Nov. 23, 1813.

Secretaries of State: Robert Smith, of Maryland, March 6, 1809; James Monroe, of Virginia, April 2, 1811.

Secretaries of the Treasury: Albert Gallatin, continued in office; George W. Campbell, of Tennessee, Feb. 9, 1814; Alexander J. Dallas, of Pennsylvania, Oct. 6, 1814.

Secretaries of War: William Eustis, of Massachusetts, March 7, 1809; John Armstrong, of New York, Jan. 13, 1813; James Monroe, of Virginia, Sept. 27, 1814, acting secretary; William H. Crawford, of Georgia, March 3, 1815.

Secretaries of the Navy: Paul Hamilton, of South Carolina, March 7, 1890; William Jones, of Pennsylvania, Jan. 12, 1818; Benjamin W. Crowninshield, of Massachusetts, Dec. 17, 1814.

Postmaster-general: Gideon Granger, continued in office; Return J. Meigs, of Ohio, March 17, 1814.

Attorney-general: Cæsar A. Rodney, continued in office; William Pinckney, of Maryland; Dec. 11, 1811; Richard Rush, of Pennsylvania, Feb. 10, 1814.

Fifth Administration—1817 to 1825.

President: James Monroe, of Virginia.

Vice-President: Daniel D. Tompkins, of New York.

Secretary of State: John Quincy Adams, of Massachusetts, March 5, 1817.

Secretary of the Treasury: William H. Crawford, of Georgia, March 5, 1817.

Secretaries of War: Isaac Shelby, of Kentucky, March 5, 1817, declined the appointment; George Graham, of West Virginia, April 7, 1871; John C. Calhoun, of South Carolina, Oct. 8, 1817.

Secretaries of the Navy: Benjamin W. Crowninshield, continued in office; Smith Thompson, of New York, Nov. 9, 1818; John Rogers, of Massachusetts, Sept. 1, 1823; Samuel L. Southard, of New Jersey, Sept. 16, 1823.

Postmaster-general: Return J. Meigs, continued in office; John McLean, of Ohio, June 26, 1823.

Attorneys-general: Richard Rush, continued in office; William Wirt, of Virginia, Nov. 13, 1817.

Sixth Administration—1825 to 1829.

President: John Quincy Adams, of Massachusetts.

Vice-President: John C. Calhoun, of South Carolina.

Secretary of State: Henry Clay, of Kentucky, March 7, 1825.

Secretary of the Treasury: Richard Rush, of Pennsylvania, March 7, 1825.

Secretaries of War: James Barbour, of Virginia, March 7, 1825; Peter B. Porter, of New York, May 26, 1828.

Secretary of the Navy: Samuel L. Southard, continued in office.

Postmaster-general: John McLean, continued in office.

Attorney-general: William Wirt, continued in office.

Seventh Administration—1829 to 1837.

President: Andrew Jackson, of Tennessee.

Vice-Presidents: John C. Calhoun, of South Carolina—resigned Dec. 28, 1832; Martin Van Buren, of New York, March 4, 1833.

Secretaries of State: Martin Van Buren, of New York, March 6, 1829; Edward Livingston, of Louisiana, May 24, 1831; Louis McLane, of Delaware, March 29, 1833; John Forsyth, of Georgia, June 27, 1834.

Secretaries of the Treasury: Samuel D. Ingham, of Pennsylvania, March 6, 1829; Louis McLane, of Delaware, Aug. 8, 1831; William J. Duane, of Pennsylvania, May 29, 1833; Roger B. Taney, of Maryland, Sept. 23, 1833—not confirmed by the Senate; Levi Woodbury, of New Hampshire, June 27, 1834.

Secretaries of War: John H. Heaton, of Tennessee, March 9, 1829; Lewis Cass, of Michigan, Aug. 1, 1831—resigned Nov. 1836.

Secretaries of the Navy: John Branch, of North Carolina, March 9, 1829; Levi Woodbury, of New Hampshire, May 23, 1831; Mahlon Dickerson, of New Jersey, June 30, 1834.

Postmaster-general: William T. Barry, of Kentucky, March 9, 1829. Previous to this date the postmaster-general had not been recognized as a member of the president's cabinet. Amos Kendall, of Kentucky, May 1, 1835.

Attorneys-general: John McPherson Berrien, of Georgia, March 9, 1829; Roger B. Taney, of Maryland, Dec. 27, 1831; Benjamin F. Butler, of New York, June 24, 1834.

Eighth Administration—1837 to 1841.

President: Martin Van Buren, of New York.

Vice-President: Richard M. Johnson, of Kentucky.

Secretary of State: John Forsyth, continued in office.

Secretary of the Treasury: Levi Woodbury, continued in office.

Secretary of War: Joel R. Poinsett, of South Carolina, March 7, 1837.

Secretaries of the Navy: Mahlon Dickerson, continued in office; James K. Paulding, of New York, June 20, 1838.

Postmasters-general: Amos Kendall, continued in office; John M. Niles, of Connecticut, May 18, 1840.

Attorneys-general: Benjamin F. Butler, continued in office; Felix Grundy, of Tennessee, July 7, 1838; Henry D. Gilpin, of Pennsylvania, Jan. 10, 1840.

Ninth Administration—1841 to 1845.

President: William Henry Harrison, of Ohio. Died April 4, 1841, when John Tyler, the Vice-President, became President.

Vice-President: John Tyler, of Virginia.

Secretaries of State: Daniel Webster, of Massachusetts, March 5, 1841—resigned May 8, 1843; Hugh S. Legaré, of South Carolina, May 9, 1843, died June 20, 1843; Abel P. Upshur, of Virginia, July 24, 1843—killed by the bursting of a cannon, Feb. 28, 1844; John Nelson, of Maryland (acting secretary), Feb. 29, 1844; John C. Calhoun, of South Carolina, March 6, 1844.

Secretaries of the Treasury: Thomas Ewing, of Ohio, March 5, 1841—resigned Sept. 11, 1841; Walter Forward, of Pensylvania, Sept. 13, 1841—resigned March 1, 1843; Caleb Cushing, of Massachusetts, rejected by the Senate; John C. Spencer, of New York, March 3, 1843; George M. Bibb of Kentucky, June 15, 1844.

Secretaries of War: John Bell, of Tennessee, March 5, 1841—resigned Sept. 11, 1841; John McLean, of Ohio, Sept. 13, 1841, declined; John C. Spencer, of New York, Oct. 12, 1841; James M. Porter, of Pennsylvania, March 8, 1843, rejected by the Senate; William Williams, of Pensylvania, Feb. 15, 1844.

Secretaries of the Navy: George E. Badger, of North Carolina, March 5, 1841—resigned Sept. 11, 1841; Abel P. Upshur, of Virginia, Sept. 13, 1841; David Henshaw, of Massachusetts, July 24, 1843, rejected by the Senate; Thomas W. Gilmer, of Virginia, Feb. 15, 1844—died Feb. 28, 1844; John Y. Mason, of Virginia, March 14, 1844.

Postmasters-general: Francis Granger, of New York, March 6, 1841—resigned Sept. 12, 1841; Charles A. Wickliffe, of Kentucky, Sept. 13, 1841.

Attorneys-general: John J. Crittenden, of Kentucky, March 5, 1841—resigned Sept. 11, 1841; Hugh S. Legaré, of South Carolina, Sept. 13, 1841; John Nelson, of Maryland, July 1, 1843.

Tenth Administration—1845 to 1849.

President: James K. Polk, of Tennessee.

Vice-President: George M. Dallas, of Pennsylvania.

Secretary of State: James Buchanan, of Pennsylvania, March 5, 1845.

Secretary of the Treasury: Robert J. Walker, of Mississippi, March 5, 1845.

Secretary of War: William L. Marcy, of New York, March 5, 1845.

Secretaries of the Navy: George Bancroft, of Massachusetts, March 10, 1845; John Y. Mason, of Virginia, Sept. 9, 1846.

Postmaster-general: Cave Johnson, of Tennessee, March 5, 1845.

Attorneys-general: John Y. Mason, of Virginia, March 5, 1845; Nathan Clifford, of Maine, Oct. 17, 1846; Isaac Toucey, of Connecticut, June 21, 1848.

Eleventh Administration—1849 to 1853.

President: Zachary Taylor, of Louisiana. Died July 9, 1850, and was succeeded by the Vice-President.

Vice-President: Millard Fillmore, of New York.

Secretaries of State: John M. Clayton, of Delaware, March 7, 1849—resigned July 10, 1850; Daniel Webster, of Massachusetts, July 20, 1850—died Oct. 24, 1852; Edward Everett, of Massachusetts, Dec. 9, 1852.

Secretaries of the Treasury: William M. Meredith, of Pennsylvania, March 7, 1849—resigned July 10, 1850; Thomas Corwin, of Ohio, July 20, 1850.

Secretaries of War: George W. Crawford, of Georgia, March 7, 1849—resigned July 10, 1850; William A Graham, of North Carolina, July 20, 1850—resigned July 15, 1852; John P. Kennedy, of Maryland, July 22, 1852.

Secretaries of the Interior (a new office): Thomas Ewing, of Ohio, March 7, 1849—resigned July 10, 1850; James A. Pearce, of Maryland, July 20, 1850; T. McKennon, of Pennsylvania, Aug. 15, 1850, and died soon afterwards; Alexander H. H. Stuart, of Virginia, Sept. 12, 1850.

Postmasters-general: Jacob Collamer, of Vermont, March 7, 1849—resigned July 10, 1850; N. K. Hall, of New York, July 20, 1850—resigned Aug. 1852; Samuel D. Hubbard, of Connecticut, Aug. 31, 1852.

Attorneys-general: Reverdy Johnson, of Maryland, March 7, 1848—resigned July 10, 1850; John J. Crittenden, of Kentucky, July 20, 1850.

Twelfth Administration—1853 to 1857.

President: Franklin Pierce, of New Hampshire.

Vice-President: William R. King, of Alabama. Died April 18, 1853.

Secretary of State: William L. Marcy. of New York. March 5, 1853.

Secretary of the Treasury: James Guthrie, of Kentucky, March 5, 1853.

Secretary of War: Jefferson Davis, of Mississippi, March 5, 1853.

Secretary of the Navy: James C. Dobbin, of North Carolina, March 5, 1853.

Secretary of the Interior: Robert McClellan, of Michigan, March 5, 1853.

Postmaster-general: James Campbell, of Pennsylvania, March 5, 1853.

Attorney-general: Caleb Cushing, of Massachusetts, March 5, 1853.

Thirteenth Administration—1857 to 1861.

President: James Buchanan, of Pennsylvania.

Vice-President: John C. Breckenridge, of Kentucky.

Secretaries of State: Lewis Cass, of Michigan, March 6, 1857—resigned Dec. 14, 1860. Jeremiah S. Black, of Pennsylvania, succeeded him.

Secretaries of the Treasury: Howell Cobb, of Georgia, March 6, 1857—resigned Dec. 10, 1860; Philip F. Thomas, of Maryland—resigned Jan. 11, 1861; John A. Dix, of New York.

Secretaries of War: John B. Floyd, of Virginia, March 6, 1857—resigned Dec. 29, 1860; Joseph Holt, of Kentucky, Dec. 30, 1860.

Secretary of the Navy: Isaac Toucey, of Connecticut, March 6, 1857.

Secretary of the Interior: Jacob Thompson, of Mississippi, March 6, 1857—resigned Jan. 8, 1861.

Postmasters-general: Aaron V. Brown, of Tennesee, March 6, 1857—died March 8, 1859; Joseph Holt, of Kentucky, July, 1859; Horatio King, of Maine, Feb. 12, 1861.

Attorneys-general: Jeremiah S. Black, of Pennsylvania, March 6, 1857; Edwin M. Stanton, of Ohio, Dec. 1860.

Fourteenth Administration—1861 to 1869.

Presidents: Abraham Lincoln, of Illinois, died April 15, 1865. Andrew Johnson, of Tennesee, succeeded Abraham Lincoln, April 15, 1865.

Vice-Presidents: Hannibal Hamlin, of Maine; Andrew Johnson, of Tennessee, March 4, 1865—died July 31, 1875.

Secretary of State: William H. Seward, of New York, March, 1861.

Secretary of the Treasury: Salmon P. Chase, of Ohio, March, 1861; William P. Fessenden, of Maine, Sept., 1864; Hugh McCulloch, of Indiana, March, 1865.

Secretaries of War: Simon Cameron, of Pennsylvania, March, 1861; Edwin M. Stanton, of Ohio Jan., 1862.

Secretary of the Navy: Gideon Welles, of Connecticut, March, 1861.

Secretaries of the Interior: Caleb B. Smith, of Indiana, March, 1861—resigned Dec. 1862; John P. Usher, of Indiana, Jan., 1863; James Harlan, of Iowa, May, 1865; O. H. Browning, of Illinois, July, 1866.

Postmasters-general: Montgomery Blair, of Maryland, March, 1861; William Dennison, of Ohio, Oct., 1864; Alexander W. Randall, of Wisconsin, July, 1866.

Attorneys-general: Edward Bates, of Missouri, March, 1861; James Speed, of Kentucky, Dec., 1864; H. F. Stansberry, of Kentucky, July, 1866.

Fifteenth Administration—1869 to 1877.

President: Ulysses S. Grant, of Illinois.

Vice-Presidents: Schuyler Colfax, of Indiana; Henry Wilson, of Massachusetts, March 4, 1873.

Secretaries of State: Elihu B. Washburne, of Illinois, March 5, 1869; Hamilton Fish, of New York, March 11, 1869.

Secretaries of the Treasury: George S. Boutwell, of Massachusetts, March 11, 1860; William A. Richardson, of Massachusetts, March 17, 1873; Benjamin H. Bristow, of Kentucky, June 2, 1874; Lot M. Morrill, of Maine, June 21, 1876.

Secretaries of War: John A. Rawlins, of Illinois, March 11, 1869; William T. Sherman, of Ohio, Sept. 9, 1869; William W. Belknap, of Iowa, Oct. 25, 1869.

Secretaries of the Navy: Adolph E. Borie, of Pennsylvania, March 5, 1869; George M. Robeson, of New Jersey, June 25, 1869.

Secretaries of the Interior: Jacob D. Cox, of Ohio, March 5, 1869; Columbus Delano, of Ohio, Nov. 1, 1870; Zachariah Chandler, of Michigan, Oct. 19, 1875.

Postmasters-general: John A. J. Creswell, of Maryland, March 5, 1869; James W. Marshal, of Pennsylvania, July 3, 1874; Marshall Jewell, of Connecticut, Aug. 24, 1874; James N. Tyner, of Indiana, July 12, 1876.

Attorneys-general: Ebenezer R. Hoar, of Massachusetts, March 5, 1869; Amos T. Akerman, of Georgia, June 23, 1870; George H. Williams, of Oregon, Jan. 10, 1872; Edwards Pierrepont, of New York, May 15, 1875; Alphonso Taft, of Ohio, May 22, 1876.

Sixteenth Administration—1877 to 1881.

President: Rutherford B. Hayes, of Ohio.

Vice-President: William A. Wheeler, of New York.

Secretary of State: William M. Evarts, of New York, March 12, 1877.

Secretary of the Treasury: John Sherman, of Ohio, March 8, 1877.

Secretaries of War: George W. McCrary, of Iowa, March 12, 1877; Alexander Ramsey, of Minnesota, Dec. 10, 1879.

Secretaries of the Navy: Richard W. Thompson, of Indiana, March 12, 1877; Nathan Goff. Jr., of West Virginia, Jan. 6, 1881.

Secretary of the Interior: Carl Schurz, of Missouri, March 12, 1877.

Postmasters-general: David M. Key, of Tennessee, March 12, 1877; Horace Maynard, of Tennessee, June 2, 1880.

Attorney-general: Charles Devens, of Massachusetts, March 12, 1877.

Seventeenth Administration—1881.

President: James A. Garfield, of Ohio—died Sept. 19, 1881, when Vice-President Chester A. Arthur, of New York, became president.

Vice-President: Chester A. Arthur, of New York, succeeded to the presidency Sept. 19, 1881.

Secretaries of State: James G. Blaine, of Maine, March 5, 1881; F. T. Frelinghuysen, of New Jersey, Dec. 12, 1881.

Secretaries of the Treasury: William Windom, of Minnesota, March 5, 1881; Charles J. Folger, of New York, Oct. 27, 1881.

Secretary of War: Robert T. Lincoln, of Illinois, March 5, 1881.

Secretary of the Navy: William H. Hunt, of Louisiana, March 5, 1881.

Secretary of the Interior: Samuel J. Kirkwood, of Iowa, March 5, 1881.

Postmasters-general: Thomas L. James, of New York, March 5, 1881; Timothy O. Howe, of Wisconsin, Dec. 20, 1881.

Attorneys-general: Wayne McVeagh, of Pennsylvania, March 5, 1881; Benjamin Harris Brewster, of Pennsylvania, Dec. 16, 1881.

Eighteenth Administration—1885 to 1889.

President: Grover Cleveland, of New York.

Vice-President: Thomas A. Hendricks, of Indiana.

Secretary of State: Thomas F. Bayard, of Delaware, March 5, 1885.

Secretary of the Treasury: Charles S. Fairchild, of New York, March 5, 1885.

Secretary of War: William C. Endicott, of Massachusetts, March 5, 1885.

Secretary of the Navy: William C. Whitney, of New York, March 5, 1885.

Secretary of the Interior: Lucius Q. C. Lamar, of Wisconsin, March 5, 1885.

Postmaster-General: William F. Vilas, of Wisconsin, March 5, 1885.

Attorney-General: Augustus H. Garland, of Arkansas, March 5, 1885.

Nineteenth Administration—1889 to 1893.

President: Benjamin Harrison, of Indiana.

Vice-President: Levi P. Morton, of New York.

Secretary of State: James G. Blaine, of Maine.

Secretary of the Treasury: William Windom, of Minnesota, died Jan. 29, 1891;* John N. Foster, of Ohio.

Secretary of War: Redfield Proctor, of Vermont.

Secretary of the Navy; Benjamin F. Tracy, of New York.

Secretary of the Interior: John W. Noble, of Indiana.

Postmaster-General: John Wanamaker, of Pennsylvania.

Attorney-General: William H. H. Miller, of Indiana.

Sec'y of Agriculture: Jeremiah M. Rusk, of Illinois.

FORMATION OF STATES AND TERRITORIES.

Alabama—From territory ceded to United States by South Carolina and Georgia. Admitted Dec. 14, 1819.

Arkansas—From territory ceded by France. Admitted June 15, 1836.

California—From territory ceded by Mexico. Admitted Sept. 9, 1850.

Colorado—From portion of territory ceded by France and Mexico. Admitted Aug. 1, 1876.

Columbia, District of—From territory ceded by Maryland and Virginia. Established as seat of government July 16, 1790. Alexandria retroceded July 1846.

Connecticut—One of the thirteen original States. Ratified Constitution Jan. 9, 1788.

Delaware—One of the thirteen original States. Ratified Constitution Dec. 7, 1787.

Florida—From territory ceded by Spain. Admitted March 3, 1845.

Georgia—One of the thirteen original States. Ratified Constitution Jan. 2, 1788.

Idaho—From Territory of Idaho. Admitted July 3, 1890.

Illinois—Out of territory ceded by Virginia. Admitted Dec. 3, 1818.

Indiana—From territory ceded by Virginia. Admitted Dec. 11, 1816.

Iowa—From part of Wisconsin Territory. Admitted Dec. 28, 1846.

Kansas—Composed of territory ceded by France and the State of Texas. Admitted Jan. 29, 1861.

Kentucky—From the territory of Virginia. Admitted June 1, 1792.

Louisiana—From territory ceded by France. Admitted April 8, 1812.

Maine—Out of part of territory of Massachusetts. Admitted March 15, 1820.

Maryland—One of the thirteen original States. Ratified Constitution April 28, 1788.

Massachusetts—One of the thirteen original States. Ratified Constitution Feb. 6, 1788.

Michigan—From territory ceded by Virginia. Admitted Jan. 26, 1837.

Minnesota—From territory ceded by France. Admitted May 11, 1858.

Mississippi—From territory ceded by Georgia and South Carolina. Admitted Dec. 10, 1817.

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* Secretary Windom immediately after closing a lengthy and very able speech at a banquet of the New York Chamber of Commerce, suddenly expired Jan. 29, 1891, aged 63.

Missouri—From territory ceded by France. Admitted Aug. 10, 1821.

Montana—Territory of Montana. Admitted Nov. 8, 1889.

Nebraska—From territory ceded by France. Admitted March 1, 1867.

Nevada—From territory obtained from Mexico. Admitted Oct. 31, 1864.

New Hampshire—One of the thirteen original States. Ratified Constitution June 21, 1788.

New Jersey—One of the thirteen original States. Ratified Constitution Dec. 18, 1787.

New York—One of the thirteen original States. Ratified Constitution July 26, 1788.

North Carolina—One of the thirteen original States. Ratified Constitution Nov. 21, 1789.

North Dakota—From Territory of Dakota. Admitted Nov. 2, 1889.

Ohio—Out of territory ceded by Virginia. Admitted Nov. 29, 1802.

Oregon—From territory included in treaty with France, 1803, and Spain, 1819, and Great Britain, 1846. Admitted Feb. 14, 1859.

Pennsylvania—One of the thirteen original States. Ratified Constitution Dec. 12, 1787.

Rhode Island—One of the thirteen original States. Ratified Constitution May 29, 1790.

South Carolina—One of the thirteen original States. Ratified Constitution May 23, 1788.

South Dakota—From Territory of Dakota. Admitted Nov. 2, 1889.

Tennessee—Out of territory ceded by North Carolina. Admitted June, 1796.

Texas—Independent republic. Admitted Dec. 29, 1845.

Vermont—From part of the territory of New York. Admitted March 4, 1791.

Virginia—One of the thirteen original States. Ratified Constitution June 26, 1788.

Washington—From Territory of Washington. Admitted Nov. 11, 1889.

West Virginia—Formed out of a portion of the State of Virginia. Admitted Dec. 31, 1862.

Wisconsin—From part of the territory of Michigan. Admitted May 20, 1848.

Wyoming—From Territory of Wyoming. Admitted July 10, 1890.

Arizona
New Mexico
Oklahoma
Utah

The Territorial governments, when established by Congress and organized, send Delegates (one for each Territory) to the House of Representatives, who are present at its deliberations, with a right of moving amendments and debating, but not of voting.

APPORTIONMENTS OF CONGRESSIONAL REPRESENTATIONS.

The Constitution (Sec. 2, of Fourteenth Amendment) provides that "Representatives shall be apportioned among the several States according to their respective numbers, counting the whole number of persons in each State, excluding Indians not taxed." This provision amended the first paragraph of clause 3, Section 2, of Article 1 of the original Constitution. Congress, under authority of the quoted clause of the Constitution passed the Census Act of March 1, 1790; the Act of Feb. 25, 1791, providing that Kentucky and Vermont should have two Representatives each until the next apportionment; and the Act of April 14, 1792—this last being the first Apportionment Act passed under the Census of 1790. This Act fixed the total number of Representatives at 105, distributed as shown in the 2d column of the table. The subsequent apportionment Acts under several successive Censuses bore dates and made provision as to ratios of representation and numbers of Representatives as follows:

Second Census (1800).—Act of Jan. 14, 1802, ratio 1 to 33,000; number of Representatives, 141.

Third Census (1810).—Act of Dec. 21, 1811; ratio of representation, 1 to 35,000; number of Representatives, 181.

Forth Census (1820).—Act of March 7, 1822; ratio of representation, 1 to 40,000; number of Representatives, 212.

Fifth Census (1830).—Act of May 22, 1832; ratio of representation, 1 to 47,700; number of Representatives, 212.

Sixth Census (1840).—Act of June 25, 1842; ratio of representation, 1 to 70,680; and "1 additional member for each State having a fraction greater than one moiety of said ratio;" number of Representatives, 223. Under the following named Supplement Acts, additional Representatives were assigned until after the next Census and Apportionment as follows; namely: Act of May 29, 1842, 3 for Wisconsin; Act of Dec. 29, 1845, 2 for Texas; Act of Aug. 4, 1846, 2 for Iowa; and Act of Sept. 9, 1850, 2 for California.

Seventh Census (1850).—Under the Census Act of May 23, 1850, the House was to be composed of 233 members to be apportioned among the States as follows, viz:

> SEC. 25. *And be it further enacted*, That so soon as the next and each subsequent enumeration of the inhabitants of the several States, directed by the Constitution of the United States to be taken, shall be completed and returned to the office of the Department of the Interior, it shall be the duty of the Secretary of the Interior to ascertain the aggregate representative population of the United States, by adding to the whole number of free persons in all the States, including those bound to service for a number of years, and excluding Indians not taxed, three-fifths of all other persons, which aggregate population he shall divide by the number two hundred and thirty-three, and the product of such division, rejecting any fraction of a unit, if any such happen to remain, shall be the ratio or rule of apportionment of Representatives among the several States under such enumeration; and the said Secretary of the Department of the Interior shall then proceed, in the same manner, to ascertain the representative population of each State, and to divide the whole number of the representative population of each State by the ratio already determined by him, as above directed, and the product of this last division shall be the number of Representatives apportioned to such State under the then last enumeration; *Provided*, That the loss in the number of members caused by the fractions remaining in the several States on the division of the population thereof shall be compensated for by assigning to so many States having the largest fractions one additional member each for its fraction as may be necessary to make the whole number of Representatives two hundred and thirty-three: *And provided also*, That, if, after the apportionment of the Representatives under the next or any subsequent census, a new State or States shall be admitted into the Union, the Representative or Representatives assigned to such new State or States shall be in addition to the number of Representatives hereinabove limited, which excess of Representatives over two hundred and thirty-three shall only continue until the next succeeding census.

The ratio of representation under this census was fixed at 1 to 93,420; and under following Acts two additional Representatives were assigned as follows, namely: Under Act of Feb. 26, 1857, one for Minnesota, and under Act of Feb. 14, 1859, one for Oregon.

Eighth Census (1860).—Act of March 4, 1862, fixed the number of members of the House after March 3, 1863, at 241, the eight additional members being assigned one each to Pennsylvania, Ohio, Kentucky, Illinois, Iowa, Minnesota, Vermont, and Rhode Island. The ratio of Representatives was fixed at 1 to 127,381.

Ninth Census (1870).—Act of Feb. 2, 1872, provided that after March 3, 1873, the House should be composed of 293 members. The remainder of the Act was as follows:

> SECTION 2. That in each State entitled under this law to more than one Representative, the number to which said

States shall be entitled in the Forty-third, and each subsequent Congress, shall be elected by districts composed of contiguous territory, and containing as nearly as practicable an equal number of inhabitants, and equal in number to the number of Representatives to which said States may be entitled in Congress, no one district electing more than one Representative: *Provided*, That in the election of Representatives to the Forty-third Congress in any State which by this law is given an increased number of Representatives; The additional Representative or Representatives allowed to such State may be elected by the State at large and the other Representatives to which the State is entitled by the districts as now prescribed by law in said State, unless the Legislature of said State shall otherwise provide before the time fixed by law for the election of Representatives therein.

Sec. 3. That the Tuesday next after the first Monday in November, in the year 1876, is hereby fixed and established as the day, in each of the States and territories of the United States, for election of Representatives and Delegates to the Forty-ninth Congress; and the Tuesday next after the first Monday in November, in every second year thereafter, is hereby fixed and established as the day for the election, in each of said States and Territories, of Representatives and Delegates to the Congress commencing on the fourth day of March next thereafter.

Sec. 4. That if, upon trial, there shall be a failure to elect a Representative or Delegate in Congress in any State, District, or Territory, upon the day hereby fixed and established for such election, or if, after any such election, a vacancy shall occur in any such State, District, or Territory, from death, resignation, or otherwise, an election shall be held to fill any vacancy caused by such failure, resignation, death, or otherwise, at such time as is or may be provided by law for filling vacancies in the State or Territory in which the same may occur.

Sec. 5. That no State shall be hereafter admitted to the Union without having the necessary population to entitle it to at least one Representative according to the ratio of representation fixed on this bill.

Sec. 6. That should any State, after the passage of this act, deny or abridge the right of any of the male inhabitants of such State, being twenty-one years of age, and citizens of the United States, to vote at any election named in the amendments to the Constitution, article fourteen, section two, except for participation in the rebellion or other crime, the number of Representatives apportioned in this act to such State shall be reduced in the proportion which the number of such male citizens shall have to the whole number of male citizens twenty-one years of age in such State.

Under this Census the ratio of Representatives was 1 to 181,425.

By the act of May 30, 1872, entitled "An act supplemental to an act entitled 'An act for the apportionment of Representatives to Congress among the several States according to the Ninth Census,'" the representation in the House of Representatives was further increased as follows, viz:

That from and after the third day of March, eighteen hundred and seventy-three, the following States shall be entitled to one Representative each in the Congress of the United States in addition to the number apportioned to such States by the act entitled "An act for the apportionment of Representatives to Congress among the several States according to the Ninth Census," approved February second, eighteen hundred and seventy-two, to wit: New Hampshire, Vermont, New York, Pennsylvania, Indiana, Tennessee, Louisiana, Alabama, and Florida, and be elected by separate districts, as in said act directed: *Provided*, That in the election of Representatives to the Forty-third Congress only, in any State which by this law is given an increased number of Representatives, the additional representative allowed to such State may be elected by the State at large, unless the legislature of said State shall otherwise provide before the time fixed by law for the election of Representatives therein.

Tenth Census (1880).—The act of Feb. 25, 1882, enacted as follows:

Section 1. That after March 3, 1883, the House of Representatives shall be composed of 325 members, to be apportioned as follows: [See in table under column 1880, next page.]

Sec. 2. That whenever a new State is admitted to the Union, the Representative or Representatives assigned to it shall be in addition to the number 325.

Sec. 3. That in each State entitled under this apportionment the number to which such State may be entitled in the forty-eighth and each subsequent Congress shall be elected by districts composed of contiguous territory, and containing as nearly as practicable an equal number of inhabitants, and equal in number to the Representatives to which such State may be entitled in Congress, no one district electing more than one Representative: *Provided*, That unless the Legislature of such State shall otherwise provide before the election of such representatives shall take place as provided by law, where no change shall be hereby made in the representation of a State, the Representatives thereof to the forty-eighth Congress shall be elected therein as now provided by law. If the number as hereby provided for shall be larger than it was before this change, then the additional Representative or Representatives allowed to said State under this apportionment may be elected by the State at large, and the other Representatives to which the State is entitled by the districts as now prescribed by law in said State; and if the number hereby provided for shall in any State be less than it was before the change hereby made, then the whole number to such State hereby provided for shall be elected at large, unless the Legislatures of said States have provided or shall otherwise provide before the time fixed by law for the next election of Representatives therein.

All acts and parts of acts inconsistent herewith are hereby repealed.

The ratio of representation under the Tenth Census was 1 to 151,912.

The act of February 22, 1889, providing for the admission of the States of Montana, North Dakota, South Dakota, and Washington, increased the representation in the House to three hundred and thirty members, which was further increased by the acts of July 3 and 10, 1890, admitting the States of Idaho and Wyoming, to three hundred thirty-two members.

Eleventh Census (1890).—The Act of Congress fixing the ratio of representation for ensuing Quadrennium at 1 to 173,901; the total number of Representatives at 356; and the number of Representatives for the States severally shown in the last column of the Table of Assignments to the several States.

ELECTION AND RIGHTS OF TERRITORIAL DELEGATES TO CONGRESS.

Every Territory shall have the right to send a Delegate to the House of Representatives of the United States, to serve during each Congress, who shall be elected by the voters in the Territory qualified to elect members of the legislative assembly thereof. The person having the greatest number of votes shall be declared by the governor duly elected, and a certificate shall be given accordingly. Every such Delegate shall have a seat in the House of Representatives, with the right of debating, but not of voting.

The first election of a delegate in any Territory for which a temporary government is hereafter provided by Congress shall be held at the time and places and in the manner the governor of such Territory may direct, after at least sixty days' notice, to be given by proclamation; but at all subsequent elections therein, as well as at all elections for a Delegate in organized Territories, such time, places, and manner of holding the election shall be prescribed by the law of each Territory.

The Speaker shall appoint from among the Delegates one additional member on each of the following committees, viz.: Coinage, Weights and Measures; Agriculture; Military Affairs; Post-Offices and Post-Roads; Public Lands; Indian Affairs; Territories; Private Land Claims, and Mines and Mining; and they shall possess in their respective committees the same powers and privileges as in the House, and may make any motion except to reconsider.—Rule XII.

In the organization of the House, the names of Delegates are called over after those of members, and before taking their seats the same oath or affirmation is administered as in the case of members.

The right of a Delegate to submit a resolution is recognized by Rule XII, and it is also competent for him to submit any motion which a member may make, except the motion to reconsider, which is dependent on the right to vote.

NUMBER OF REPRESENTATIVES IN CONGRESS ASSIGNED TO STATES AND TERRITORIES.

The following table shows the number of Representatives to Congress assigned to each of the United States previous to 1790, and from 1790 to 1890:

States and Territories.	Before census.	1790.	1800.	1810	1820.	1830.	1840.	1850.	1860.	1870.	1880.	1890.
Alabama	...	...	...	*1	3	5	7	7	6	8	8	9
Arkansas	...	...	...	...	...	*1	1	2	3	4	5	6
California	...	...	...	...	...	...	*2	2	3	4	6	7
Colorado	...	...	...	...	...	...	...	...	...	*1	1	2
Columbia, District of	...	...	...	...	...	...	...	...	...	...	...	...
Connecticut	5	7	7	7	6	6	4	4	4	4	4	4
Delaware	1	1	1	2	1	1	1	1	1	1	1	1
Florida	...	...	...	...	...	...	*1	1	1	2	2	2
Georgia	3	2	4	6	7	9	8	8	7	9	10	11
Idaho	...	...	...	...	...	...	...	...	...	...	*1	1
Illinois	...	...	...	*1	1	3	7	9	14	19	20	22
Indiana	...	...	...	*1	3	7	10	11	11	13	13	13
Iowa	...	...	...	...	...	...	*2	2	6	9	11	11
Kansas	...	...	...	...	...	...	...	...	*1	3	7	8
Kentucky	...	*2	6	10	12	13	10	10	9	10	11	11
Louisiana	...	...	...	*1	3	3	4	4	5	6	6	6
Maine	...	...	...	7	7	8	7	6	5	5	4	4
Maryland	6	8	9	9	9	8	6	6	5	6	6	6
Massachusetts	8	14	17	20	13	12	10	11	10	11	12	13
Michigan	...	...	...	...	...	*1	3	4	6	9	11	12
Minnesota	...	...	...	...	...	...	...	*2	2	3	5	7
Mississippi	...	...	...	*1	1	2	4	5	5	6	7	7
Missouri	...	...	...	...	*1	2	5	7	9	13	14	15
Montana	...	...	...	...	...	...	...	...	...	...	*1	1
Nebraska	...	...	...	...	...	...	...	...	*1	1	3	6
Nevada	...	...	...	...	...	...	...	...	*1	1	1	1
New Hampshire	3	4	5	6	6	5	4	3	3	3	2	2
New Jersey	4	5	6	6	6	6	5	5	5	6	7	8
New York	6	10	17	27	34	40	34	33	31	33	34	34
North Carolina	5	10	12	13	13	13	9	8	7	8	9	9
North Dakota	...	...	...	...	...	...	...	...	...	...	*1	1
Ohio	...	...	*1	6	14	19	21	21	19	20	21	21
Oregon	...	...	...	...	...	...	...	*1	1	1	1	2
Pennsylvania	8	13	18	23	26	28	24	25	24	27	28	30
Rhode Island	1	2	2	2	2	2	2	2	2	2	2	2
South Carolina	5	6	8	9	9	9	7	6	4	5	7	7
South Dakota	...	...	...	...	...	...	...	...	...	...	*2	2
Tennessee	...	*1	3	6	9	13	11	10	8	10	10	10
Texas	...	...	...	...	...	...	*2	2	4	6	11	13
Vermont	...	*2	4	6	5	5	4	3	3	3	2	2
Virginia	10	19	22	23	22	12	15	13	11	9	10	10
Washington	...	...	...	...	...	...	...	...	...	...	*1	2
West Virginia	...	...	...	...	...	...	...	...	*3	3	4	4
Wisconsin	...	...	...	...	...	...	*2	3	6	8	9	10
Wyoming	...	...	...	...	...	...	...	...	...	...	1	1
*Arizona	...	...	...	...	...	...	...	...	...	...	...	...
†New Mexico	...	...	...	...	...	...	...	...	...	...	...	...
‡Oklahoma	...	...	...	...	...	...	...	...	...	...	...	...
‡Utah	...	...	...	...	...	...	...	...	...	...	...	...

* Admitted into the Union after the apportionment under which they are here arranged was made, but before the succeeding census.

† Previous to March 3, 1820, Maine formed part of Massachusetts, and was called *The District of Maine*, and its representatives were numbered with those of Massachusetts. By compact between Maine and Massachusetts, Maine became a separate and independent State, and by an act of Congress of March 3, 1820, was admitted into the Union as such—the admission to take place on the 15th of the same month. On April 7, 1820, Maine was declared entitled to seven Representatives, to be taken from those of Massachusetts.

‡ Territory.—Not yet admitted to full representation in House.

NOTE.—Ratios of representation: 1790 and 1800, 1 to 33,000; 1810, 35,000; 1820, 40,000; 1830, 47,700; 1840, 70,680; 1850, 93,420; 1860, 127,000; 1870, 131,425; 1880, 151,912; 1890, 1 to 173,912.

STATE CONSTITUTIONS AND STATE GOVERNMENTS.

By the constitutions of all the States except New York, Pennsylvania, Ohio, Wisconsin, Kansas, and Delaware, the powers of government are divided into three distinct departments—the legislative, executive, and judicial.

There is in each State and Territory a legislature. In twenty it is called the *General Assembly;* in Oregon and all the Territories, the *Legislative Assembly;* and in New Hampshire and Massachusetts, the *General Court*, consisting of a senate (in the Territories a council) and a house of representatives, called in New York, Wisconsin, California, Nevada, and Florida the *Assembly;* in Maryland, Virginia, West Virginia, the *House of Delegates*, and in New Jersey the *General Assembly.*

In all the States there is a governor, who is the executive authority, and there is also generally a lieutenant-governor. But when there is no lieutenant-governor the president of the senate succeeds if the governor dies or becomes incapable. His powers are similar to those of the President of the United States. The following are some of the qualifications required in the various States:

No person, in eleven States, can be a governor unless he is a citizen of the United States; in three, he must have been so for two years; in five, for five years; in Florida, nine years; in four, ten years; in one, twelve years; in Georgia, fifteen years, and in New Jersey and Mississippi, twenty years. He must also have been resident for periods varying from one year to ten.

In some States the governor must not be less than twenty-five years of age, in most thirty years, and in two (Kentucky and Missouri), thirty-five.

In Delaware he is not eligible a second time *for office.* In Tennessee he is not eligible for more than six years in any term of eight. So in Oregon, for not more than eight years in any period of twelve years; in Indiana, for not more than four years in any term of eight.

By the constitutions of seven States, the governor is not eligible for reëlection for any two successive terms, unless the office devolved upon him. In Georgia he is not eligible for four years after the second term.

In Massachusetts, he must be possessed of a freehold estate, in his own right, of the value of $5,000. He is elected directly by the people, and, not like the President, through a college of electors. His term of office varies from four years in sixteen States to three years in three States, two years in eighteen States, and a year in two States (Massachusetts and Rhode Island).

Both the senate and the house are in all States elected at the general election day, and vacancies in either house are generally filled in the same way by special election; but in New Hampshire and Maine vacancies are so filled by election only in the house; a vacancy in the senate is filled by joint ballot of the legislatures; so in Massachusetts vacancies in the Senate are filled by special election, upon the order of a majority of the senators elected.

A senator, by the constitution of most States, is elected for four years; in New Jersey for three years, in several for two years, and in two (Massachusetts and Rhode Island) for one year.

Half the senators are in many States elected at each general election, the other half holding over; but in two, one-third are elected at each general election, the others keeping their seats.

Representatives are usually elected for two years, but in Louisiana they are elected for four years, and in Massachusetts, Rhode Island, New York and New Jersey their tenure of office is only for one year. As a rule no person can be a State senator who is not a citizen of the United States, and in Maine he must have been thus qualified for four years.

Residence in the State is also required for terms varying from one year in eight States to four years in five, six years in one (Kentucky), and seven years in one (New Hampshire), besides which he must have been usually resident in the senatorial district for which he is a candidate for various periods ranging from one year to three months, and in Illinois and Louisiana for two years.

To be eligible as a State senator a candidate must have paid a State and county tax within one year of election. By the constitution of Delaware no person can be a senator who is not possessed of a freehold estate of 200 acres, of a personal or mixed estate of the value of $5,000.

By the constitutions of fourteen States, no person can be a representative in the lower house of the State legislature who is not a citizen of the United States, and in Maine he must have been so for five years. And in many he must have been resident in the State for a certain period, varying from one year in seven of the States to five years in two (Illinois and Louisiana). In nine of the States he must also be a qualified elector of the State, and in nearly, if not quite all, he must have been resident in the district for which he is chosen for a period varying from sixty days in Iowa to two years in Illinois and Louisiana.

In thirteen States a representative loses his seat if he ceases to reside in the district, and in six he must be a qualified elector in such district.

In fourteen States a candidate must be twenty-one years of age at the time of his election, in three, twenty-four (Delaware, Kentucky, and Missouri), and in Colorado twenty-five.

In Massachusetts the constitution forbids any property qualification for the State Legislature or council.

The following persons are disqualified from sitting in the State legislature:

In Nebraska any person interested in a contract with or an unadjusted claim against the State.

In Delaware, any person concerned in any army or navy contract.

In West Virginia, any salaried officer of a railroad.

In Kansas and Georgia, every person convicted of embezzlement of the public funds.

In Delaware, every person who has served as a State treasurer, before his accounts have been settled and discharged.

In Georgia, any person who has not paid his legal taxes.

In West Virginia and South Carolina, any person who has been convicted of bribery, perjury, or other infamous crime, or who has not accounted for public money intrusted to him.

In most States provision is made by the constitution that members of the legislature shall receive compensation. In several it cannot be increased or diminished during the term for which they are elected, and in two (Missouri and Texas) it cannot be altered at all by the legislature at any time, the amount being fixed by the constitution.

In fourteen States no member of Congress is eligible for the State legislature.

Members of the legislature are, by the constitutions of most of the States, required to make oath to support the National and the State (if in a State) constitutions, and in one (Arkansas) to support the Union, and in five that they have not bribed anybody, and in four that they will not accept a bribe for giving or withholding a vote, or for doing any duty relating to their office, and in three (Kentucky, Texas, and Nevada) that they have not been concerned in a duel.

The mode of election is in twelve States by ballot; but in Kentucky all election by the people must be *viva voce*, except that dumb persons may vote by ballot. By the constitution of nearly all, the person having the highest number (in a plurality) of votes is declared duly elected; but in Rhode Island, in all elections held by the people, a majority of votes cast is necessary to a choice. (Kentucky now has the Australian ballot.)

By the constitution of Illinois (each district voting for three representatives) each voter may cast as many votes for each candidate as there are State representatives to be elected, or may distribute his votes among the candidates as he sees fit.

In nearly all the States and Territories election day is fixed by the constitution or statutes for the first Tuesday after the first Monday in November; (1) biennially in the even years in twenty-one States; (2) biennially in the odd years in three States; (3) annually in nine States; the remainder vary as to their day.

The right of suffrage is given to every male citizen of the United States aged twenty-one or who has declared his intention of becoming a citizen.

Under the head of "Qualifications of Voters" will be found a table giving the requirements of the constitutions of the several States in respect to suffrage. It is believed to be substantially accurate, but will be verified before republication in the next edition, and additional matter given.

By the constitution of all the States, exept Nebraska and Oregon, an impeachment is first made by the House of Representatives, and is tried by the Senate sitting as a court under oath, except in New York, when it is tried by the Senate and the judges of the court of appeals.

Two-thirds of the Senators *elected* must, in fifteen States, concur for conviction; and in nineteen, two-thirds of the Senators *present*. In New Hampshire, Massachusetts, Alabama, and Mississippi a vote of a quorum is sufficient; but in Nebraska the impeachment is first made by the Legislature in joint convention upon resolution in either house, and a majority of elected members must concur; and it is then tried by the judges of the Supreme court.

The effect of impeachment is, by the constitutions of all but Maryland and Oregon, merely to remove from office, and in all the States, except five, to disqualify the person impeached from holding any other State appointment.

A person impeached, whether convicted or not on the impeachment, is nevertheless liable, by the constitutions of all the States, except Indiana and Maryland, to indictment, trial, and punishment according to law.

By the constitutions of thirty-two States either house may (8) expel any of its members by a vote of two-thirds of the elected members, and in Vermont, by a majority vote of a quorum. But in twenty-five States no member can be expelled a second time for the same cause, nor in Vermont, Michigan, or Arizona for any cause known to his constituents before his election.

In Michigan and Arizona the reason for expulsion must be entered in the journal, with the names of the members voting.

In Pennsylvania, Arkansas, Colorado, and Alabama a member expelled for corruption is not thereafter eligible for either house.

Each house has in thirty of the States power to punish its members for disorderly conduct; and in many, either house may punish any person, not a member, for disorderly or contemptuous conduct, such punishment not to extend beyond the final adjournment of the session, and in others, by different terms of imprisonment, varying from thirty days to twenty-four hours.

The constitutions of all the States provide that each house shall be the judge of the qualifications, elections, and returns of its members.

In most cases it is provided that each house shall choose its own officers, except in certain cases the president of the senate, which place is filled (1) in eighteen States by the lieutenant-governor, (2) in Rhode Island by the governor or lieutenant-governor or the secretary of state. In all other States it is enacted that each house shall determine the rules of its own proceedings.

By the constitutions of nearly all of the States a majority of elected members in either house constitutes a quorum, but in five two-thirds are necessary. In New Hampshire a majority is a quorum in the house, but when less than two-thirds are present a two-thirds vote is necessary to any act or proceeding, and in the senate thirteen are necessary to a quorum, and when less than sixteen are present a vote of ten is necessary, and in Massachusetts sixteen members constitute a quorum in the senate and one hundred in the house. But a smaller number than a quorum may, in thirty-two States, adjourn from day to day and compel the attendance of absent members. Freedom of speech is guaranteed by the constitutions of most of the States, as well as freedom from arrest in all cases except treason, felony, and breach of the peace during the session of the legislature, and in going and returning. In Michigan, Wisconsin, California, and Arizona the privilege from arrest (except as above) lasts during the whole of the time that they are members of the legislature.

In most of the legislatures it is provided by the constitutions that the proceedings shall be open to the public, except on such occasions as may, in the opinion of the house, require secrecy.

The regular session of the legislature is in one State (Rhode Island) twice a year; in Massachusetts, New York, New Jersey, and South Carolina, once a year; and in others every two years, in the even or the odd year as the case may be.

There are, however, often adjourned sessions held in the intervening year, except in Pennsylvania, where they are prohibited. The length of the session is limited in many of the States, thus: In Indiana the limit is sixty-one days; in Colorado and Georgia, forty days; in six States and two Territories, sixty days; in Maryland, ninety days; in Alabama, thirty days; West Virginia, forty-five days.

Extra sessions on extraordinary occasions may be convened by the governor, but no such extraordinary session can be called in the Territories without the approval of the President of the United States. In Virginia an extra session is convened on the application of two-thirds of the members; in West Virginia, on application of three-fifths of the elected members, except on extraordinary occasions.

In West Virginia, Kentucky, and Georgia the ordinary session may be continued by a two-thirds vote, and in Virginia the session may be continued for thirty days beyond the time limited, upon the concurrence of three-fifths of the members.

By the constitutions of all the States, neither house can adjourn without the consent of the other for more than three or two days (as the case may be).

In most States, if the two houses disagree with respect to the time of adjournment, the governor may adjourn the legislature to such time as he thinks proper, with certain limitations, such as not beyond the first day of the regular session in fifteen States; for not more than ninety days in New Hampshire, Massachusetts, and Delaware, and not exceeding four months in Pennsylvania, and Kentucky; no limit being given in Vermont and Georgia.

Amendments to the constitution of a State may be proposed by the State legislature for confirmation by the people of the State (except in Kentucky and New Hampshire), or the citizens may be asked to decide on the advisability of holding a convention for the revision of the constitution. If a convention is decided upon, the amendments made by it are referred for ratification or rejection to the vote of the people.

Length of Congressional Sessions.

As stated elsewhere the Congressional *terms* are for two full years beginning at noon, March 4, of each alternate year; the Congressional *sessions* generally begin on the first Monday in December of each year, and continue until formal adjournment, which cannot be later than noon of March 4, of each second year. The following table gives the numbers of the several Congresses, and the number and dates of the sessions during each Congressional term.

Congress.		Time of Session.
1st	1st Session	From March 4, 1789, to Sept. 29, 1789
	2d	From January 4, 1790, to August 12, 1790
	3d	From December 6, 1790, to March 3, 1791
2d	1st	From October 24, 1791, to May 8, 1792
	2d	From November 5, 1792, to March 2, 1793
3d	1st	From December 2, 1793, to June 9, 1794
	2d	From November 3, 1794, to March 3, 1795
4th	1st	From December 7, 1795, to June 1, 1796
	2d	From December 5, 1796, to March 3, 1797
5th	1st	From May 15, 1797, to July 10, 1797
	2d	From November 13, 1797, to July 16, 1798
	3d	From December 3, 1798, to March 3, 1799
6th	1st	From December 2, 1799, to May 14, 1800
	2d	From November 17, 1800, to March 3, 1801
7th	1st	From December 7, 1801, to May 3, 1802
	2d	From December 6, 1802, to March 3, 1803
8th	1st	From October 17, 1803, to March 27, 1804
	2d	From November 5, 1804, to March 3, 1805
9th	1st	From December 2, 1805, to April 21, 1806
	2d	From December 1, 1806, to March 3, 1807
10th	1st	From October 26, 1807, to April 25, 1808
	2d	From November 7, 1808, to March 3, 1809
11th	1st	From May 22, 1809, to June 28, 1809
	2d	From November 27, 1809, to May 1, 1810
	3d	From December 3, 1810, to March 3, 1811
12th	1st	From November 4, 1811, to July 6, 1812
	2d	From November 2, 1812, to March 3, 1813
13th	1st	From May 24, 1813, to August 2, 1813
	2d	From December 6, 1813, to April 18, 1814
	3d	From September 19, 1814, to March 3, 1815
14th	1st	From December 4, 1815, to April 30, 1816
	2d	From December 2, 1816, to March 3, 1817
15th	1st	From December 1, 1817, to April 20, 1818
	2d	From November 16, 1818, to March 3, 1819
16th	1st	From December 6, 1819, to May 15, 1820
	2d	From November 13, 1820, to March 3, 1821
17th	1st	From December 3, 1821, to May 8, 1822
	2d	From December 2, 1822, to March 3, 1823
18th	1st	From December 1, 1823, to May 27, 1824
	2d	From December 6, 1824, to March 3, 1825
19th	1st	From December 5, 1825, to May 22, 1826
	2d	From December 4, 1826, to March 3, 1827
20th	1st	From December 3, 1827, to May 26, 1828
	2d	From December 1, 1828, to March 3, 1829
21st	1st	From December 7, 1829, to May 31, 1830
	2d	From December 6, 1830, to March 3, 1831
22d	1st	From December 5, 1831, to July 16, 1832
	2d	From December 3, 1832, to March 3, 1833
23d	1st	From December 2, 1833, to June 30, 1834
	2d	From December 1, 1834, to March 3, 1835
24th	1st	From December 7, 1835, to July 4, 1836
	2d	From December 5, 1836, to March 3, 1837
25th	1st	From September 4, 1837, to Oct. 16, 1837
	2d	From December 4, 1837, to July 9, 1838
	3d	From December 3, 1838, to March 3, 1839
26th	1st	From December 2, 1839, to July 21, 1840
	2d	From December 7, 1840, to March 3, 1841
27th	1st	From May 31, 1841, to Sept. 13, 1841
	2d	From December 6, 1841, to August 31, 1842
	3d	From December 5, 1842, to March 3, 1843
28th	1st	From December 4, 1843, to June 17, 1844
	2d	From December 2, 1844, to March 3, 1845
29th	1st	From December 1, 1845, to August 10, 1846
	2d	From December 7, 1846, to March 3, 1847
30th	1st	From December 6, 1847, to August 14, 1848
	2d	From December 4, 1848, to March 3, 1849
31st	1st	From December 3, 1849, to Sept. 30, 1850
	2d	From December 2, 1850, to March 3, 1851
32d	1st	From December 1, 1851, to August 31, 1852
	2d	From December 6, 1852, to March 3, 1853

Congress.		Time of Session.
33d	1st	From December 5, 1853, to August 7, 1854
	2d	From December 4, 1854, to March 3, 1855
34th	1st	From December 3, 1855, to August 18, 1856
	2d	From August 21, 1856, to August 30, 1856
	3d	From December 1, 1856, to March 3, 1857
35th	1st	From December 7, 1857, to June 14, 1858
	2d	From December 6, 1858, to March 3, 1859
36th	1st	From December 5, 1859, to June 25, 1860
	2d	From December 3, 1860, to March 2, 1861
37th	1st	From July 4, 1861, to August 6, 1861
	2d	From December 2, 1861, to July 17, 1862
	3d	From December 1, 1862, to March 3, 1863
38th	1st	From December 7, 1863, to July 4, 1864
	2d	From December 5, 1864, to March 3, 1865
39th	1st	From December 4, 1865, to July 28, 1866
	2d	From December 3, 1866, to March 2, 1867
40th	1st	From March 4, 1867, to March 30, 1867
	1st	From July 3, 1867, to July 20, 1867
	1st	From November 21, 1867, to Dec. 2, 1867
	2d	From December 2, 1867, to July 27, 1868
	3d	From December 7, 1868, to March 3, 1869
41st	1st	From March 4, 1869, to April 23, 1869
	2d	From December 6, 1869, to July 15, 1870
	3d	From December 5, 1870, to March 3, 1871
42d	1st	From March 4, 1871, to April 20, 1871
	2d	From December 4, 1871, to June 10, 1872
	3d	From December 2, 1872, to March 3, 1873
43d	1st	From December 1, 1873, to June 23, 1874
	2d	From December 7, 1874, to March 3, 1875
44th	1st	From December 6, 1875, to August 15, 1876
	2d	From December 4, 1876, to March 3, 1877
45th	1st	From October 15, 1877, to Dec. 3, 1877
	2d	From December 3, 1877, to June 20, 1878
	3d	From December 2, 1878, to March 3, 1879
46th	1st	From March 18, 1879, to July 1, 1879
	2d	From December 1, 1879, to June 16, 1880
	3d	From December 6, 1880, to March 3, 1881
47th	1st	From December 5, 1881, to August 8, 1882
	2d	From December 4, 1882, to March 3, 1883
48th	1st	From December 3, 1883, to July 3, 1884
	2d	From December 1, 1884, to March 3, 1885
49th	1st	From December 7, 1885, to August 6, 1886
	2d	From December 6, 1886, to March 3, 1887
50th	1st	From December 5, 1887, to Oct. 20, 1888
	2d	From December 3, 1888, to March 3, 1889
51st	1st	From December 2, 1889, to Oct. 1, 1890
	2d	From December 1, 1890, to March 3, 1891
52d	1st	From December 7, 1891, to March 3, 1892
	2d	From December 5, 1892, to March 3, 1893

NOTE.—To determine the years covered by a given Congress, double the number of the Congress, and add the product to 1798; the result will be the year in which the Congress closed. Thus, the 85th Congress — 70 + 1789 = 1859, that being the year which terminated the 35th Congress, on the 4th of March. To find the number of a Congress sitting in any given year, subtract 1789 from the year; if the result is an even number, half that number will give the Congress, of which the year in question will be the closing year. If the result is an odd number, add one to it, and half the result will give the Congress, of which the year in question will be the first year.

EXTRA CONGRESSIONAL SESSIONS.

The Congressional *term* is for two years beginning at noon on March 4 every *odd* year, and terminating at noon on March 4, of the next odd year. The general elections for members of the House of Representatives take place the first Tuesday after the first Monday in November of *even* years severally preceding the opening of the Congressional term. In case of vacancies, however, the election may occur at other dates but in all cases the *term* closes at noon of March 4, of the *odd* years.

The *sessions* of Congress open on the first Monday of December in every year unless they are by law specially appointed for a different date. In the foregoing list of dates for the several Congresses, the dates of the "extra sessions" are not specifically given. For greater convenience of reference they are properly classified in the following tables showing the dates when convened, the number of the *Congress* in which they took place, with the number of the session in that Congress, and the date of the passage of the act providing for the holding of the extra session."

The first table shows the list of the "extra sessions" called by Congress itself:

When convened.	Congress.	Session.	Date of passage of act.
March 4, 1789	1st	First	*1788, Sept., 13
1st Monday in Jan., 1790	1st	Second	1789, Sept. 29
4th Monday in Oct., 1791	2nd	First	1791, Mar. 2
1st Monday in Nov., 1792	2nd	Second	1792, May 5
1st Monday in Nov., 1794	3rd	Second	1794, May 30
1st Monday in Nov., 1797	5th	First	1797, Mar. 3
Changed to 2d Monday in Nov. 1797.	5th	Second	†1797, July 1
3d Monday in Nov., 1800	6th	Second	1800, May 13
1st Monday in Nov., 1803	8th	First	1803, Mar. 3
1st Monday in Nov., 1804	8th	Second	1804, Mar. 26
1st Monday in Nov., 1808	10th	Second	1808, Apr. 22
4th Monday in May, 1809	11th	First	1809, Jan. 30
4th Monday in Nov., 1809	11th	Second	1809, June 24
1st Monday in Nov., 1812	12th	Second	1812, July 6
4th Monday in May, 1813	13th	First	1813, Feb. 27
1st Monday in Dec., 1813	13th	Second	1813, July 27
Last Monday in Oct., 1814	13th	Third	1814, Apr. 18
3d Monday in Nov., 1818	15th	Second	1818, Apr. 18
2d Monday in Nov., 1820	16th	Second	1820, May 13
March 4, 1867	40th	First	‡1867, Jan. 22
March 4, 1869	41st	First	‡1867, Jan. 22
March 4, 1871	42nd	First	‡1866, Jan. 22

*The First Session of the First Congress was convened in accordance with the following resolution of the Continental Congress, adopted Sept. 13, 1788, namely:

"*Resolved, etc.*, That the first Wednesday in January next be the day for appointing electors in the several States which before the said day shall have ratified the said Constitution; that the first Wednesday in February next be the day for the electors to assemble in their several states and vote for a President; and that the first Wednesday in March next be the time, and the present seat of Congress the place, for commencing proceedings under the said Constitution.

†Repealed the act of March 3rd, 1797.

‡The act of Jan. 22, 1867, provided that in addition to the regular times of meeting of Congress, there shall be a meeting of the Congress of the United States, and of each succeeding Congress thereafter, at 12 o'clock meridian, on the fourth day of March, the day on which the term begins for which the Congress is elected. That act was repealed by the act of April 20, 1871. (17 Statutes 12.)

List of Extra Sessions of Congress Convened by the President.

The President * * may, on extraordinary occasions, convene both Houses or either of them.

Session.		When convened.	Cause.
Congress.	Session.		
V	First	May 15, 1797	Suspension of diplomatic relations with France.
VIII	First	Oct. 17, 1803	Cessions of Louisana by Spain to France.
X	First	Oct. 26, 1807	Relations with Great Britain.
XII	First	Nov. 4, 1811	Relations with Great Britain.
XIII	Third	Sept. 19, 1814	War with Great Britain.
XXV	First	Sept. 4, 1837	Suspension of specie payments.
XXVII	First	May 31, 1841	Condition of finances and revenue.
XXXIV	Second	Aug. 21, 1856	Failure of previous session to make appropriations for Army.
XXXVII	First	July 4, 1861	Insurrection in certain Southern States.
XLV	First	Oct. 15, 1877	Failure of previous session to make appropriations for Army.
XLVI	First	Mar. 18, 1879	Failure of previous session to make appropriation for legislative, executive and judicial and Army expenses.

List of Special Sessions of the Senate from 1789 to 1889, Called by the President.

No.	Commencement.	Termination.	Days.
1	March 4, 1791	March 4, 1791	1
2	March 4, 1793	March 4, 1793	1
3	June 8, 1795	June 26, 1795	19
4	March 4, 1797	March 4, 1797	1
5	July 17, 1798	July 19, 1798	3
6	March 4, 1801	March 5, 1801	2
7	March 4, 1809	March 7, 1809	4
8	March 4, 1817	March 6, 1817	3
9	March 4, 1825	March 9, 1825	6
10	March 4, 1829	March 17, 1829	14
11	March 4, 1837	March 10, 1837	7
12	March 4, 1841	March 15, 1841	12
13	March 4, 1845	March 19, 1845	17
14	March 5, 1849	March 23, 1849	19
15	March 4, 1851	March 13, 1851	10
16	March 4, 1853	April 11, 1853	38
17	March 4, 1857	March 14, 1857	11
18	June 15, 1858	June 16, 1858	2
19	March 4, 1859	March 10, 1859	7
20	June 26, 1860	June 28, 1860	3
21	March 4, 1861	March 28, 1861	25
22	March 4, 1863	March 14, 1863	11
23	March 4, 1865	March 11, 1865	8
24	April 1, 1867	April 20, 1867	20
25	April 12, 1869	April 22, 1869	11
26	May 10, 1871	May 27, 1871	18
27	March 4, 1873	March 26, 1873	23
28	March 5, 1875	March 24, 1875	20
29	March 5, 1877	March 17, 1877	13
30	March 4, 1881	May 20, 1881	78
31	October 10, 1881	October 29, 1881	20
32	March 4, 1885	April 2, 1885	30
33	March 4, 1889	April 2, 1889	30

ADMISSION TO THE FLOOR OF THE HOUSE OF REPRESENTATIVES.

The following is the rule of the House prevailing in 1891, with regard to the admission of persons to the floor occupied by the members of Congress:

RULE XXXIV.—The persons hereinafter named, and none other, shall be admitted to the hall of the House or rooms leading thereto, viz: The President and Vice-President of the United States and their private secretaries, Judges of the Supreme Court, Members of Congress and Members elect, contestants in election cases during the pendency of their cases in the House, the Secretary and Sergeant-at-Arms of the Senate, heads of Departments, Foreign Ministers, Governors of States, the Architect of the Capital, the Librarian of Congress and his assistant in charge of the Law Library, such persons as have, by name, received the thanks of Congress, ex-Members of the House of Representatives who are not interested in any claim or directly in any bill pending before Congress, and clerks of committees when business from their committees is under consideration; and it shall not be in order for the Speaker to entertain a request for the suspension of this rule or to present from the chair the request of any member for unanimous consent.

The first rule for the admission within the hall of other than members was adopted Jan. 7, 1802, and was confined to "*Senators*, officers of the General and State Governments, foreign ministers and such persons as members might introduce." Jan. 11, 1802, an attempt was made to amend so as to exclude persons "introduced by members," which failed. Nov. 8, 1804, a proposition was made to confine the privilege to *Senators*, which also failed. Dec. 17, 1805, *officers of State governments* were excluded. Feb. 1, 1808, a proposition was made to admit ex-members of Congress and the judges of the Supreme Court. After a good deal of debate it was rejected. Feb. 11, 1809, the rule was enlarged so as to admit judicial officers of the United States, as also ex-membersof Congress. Feb. 25, 1814, those who had been heads of Departments were admitted. Feb. 10, 1815, officers who had received the thanks of Congress were included; Jan. 12. 1816, the Navy commissioners; Feb. 21, 1816, governors of States and Territories; and on March 13, 1822, the President's secretary. Jan. 26, 1833, the rule was further enlarged by admitting "*such persons as the Speaker or a member might introduce*," and Dec. 10, 1883, the House, by a vote almost unanimous, rescinded that amendment. Dec. 23, 1857, soon after removing into the new hall in the south wing of the Capitol extension, the privilege of admission was restricted to "members of the Senate, their secretary, heads of Departments, President's private secretary, the governor for the time being of any State, and judges of the Supreme Court of the United States." March 19, 1860, it was adopted in its present form, excepting the last clause, a proposition to admit ex-members having been rejected. The last clause, adopted March 2, 1865, was intended to prevent persons not entitled to the privilege of the hall from occupying the cloak and other adjoining rooms. Jan. 29, 1878, the House adopted the following resolution, by yeas 155, to nays 92, viz: "*Resolved*, That the rule in regard to the admission of persons to the privileges of the floor be enforced, and the Speaker is requested to discontinue the practice of issuing passes, which has been indulged in by common consent."

In the revision of the rules in the second session 46th Congress, the words "contestants in election cases during the presidency of their cases in the House" were added, so as to authorize the then existing practice, and in the first session of the 48th Congress the word "Congress" was striken and the words "House of Representatives" inserted, so as to restrict the privilege of the floor to ex-members of the House of Representatives.

VETO POWER OF THE PRESIDENT, AND THE SUBSEQUENT CONGRESSIONAL LEGISLATURE RELATING THERETO.

When a bill, having passed both houses, shall be presented to the President of the United States, "if he approve he shall sign it, but if not he shall return it, with his objections, to that house in which it shall have originated, who shall enter the objections at large on their Journal and proceed to reconsider it. If, after such reconsideration, two-thirds of that house shall agree to pass the bill, it shall be sent, together with the objections, to the other house, by which it shall likewise be reconsidered, and if approved by two-thirds of that house it shall become a law. But in all such cases the votes of both houses shall be determined by yeas and nays, and the names of the persons voting for and against the bill shall be entered on the Journal of each house, respectively. If any bill shall not be returned by the President within ten days (Sundays excepted) after it shall have been presented to him, the same shall be a law, in like manner as if he had signed it, unless the Congress by their adjournment prevent its return, in which case it shall not be a law."

A similar provision is made in the case of orders, resolutions, or votes presented to the President for his approval.

Whenever a bill is returned to the House with the objections of the President, it is usual to have the message containing his objections immediately read, and for the House to proceed to the reconsideration of the bill; or to postpone its consideration for a future day; but not where less than a quorum is present. A veto message and a bill may be referred, or the message alone, and the bill may be laid on the table.

The main question in the consideration of a vetoed bill is, "Will the House on reconsideration agree to pass the bill?"

The "*two-thirds*" by which a vetoed bill must be approved before it can become a law with the signature of the President, has been construed, in both houses to mean "*two-thirds of the members present*.

A motion to proceed to the consideration of a vetoed bill with the objections of the President, is a privileged question under the Constitution.

A vote on the passage of a vetoed bill cannot be reconsidered. A motion to discharge a committee from the further consideration of a veto message, is a privileged question.

Whenever a bill, order, resolution, or vote is returned by the President with his objections, and on being reconsidered is passed by two-thirds of each of the two houses of Congress, and thereby becomes a law, or takes effect, it shall be received by the Secretary of State from the President of the Senate, or the Speaker of the House of Representatives, in whichsoever house it shall last have been approved, and he shall carefully preserve the originals.

When the President does not approve a bill, and is prevented, by the adjournment of Congress from returning it with his objections, it is usual for him to inform the house in which the bill originated, at the next session, of his reasons for not approving it.

Qualifications of Voters in the Several States.

Under the Constitution of the United States "all persons born or naturalized in the United States, and subject to the jurisdiction thereof are citizens of the United States and of the States wherein they reside;" and "no State shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States; nor shall any State deprive any person of life, liberty, or property without due process of law, nor deny to any person within its jurisdiction the equal protection of the law." In all the States except Wyoming, the right of suffrage is limited to male citizens twenty-one years of age, with the further exception that in Colorado, Massachusetts, and a few other States women are permitted to vote at school district elections. There is a great lack of uniformity in the suffrage laws of the several States, as the following will show:*

Alabama.—The voter must be a citizen, or have declared his intention to become a citizen; must have been in the State one year, in the county three months, and in the voting precinct one month. Indians, idiots, and men convicted of crime cannot vote.

Arkansas.—Citizens, or those who have declared their intention to become such, except Indians, idiots, and criminals, may vote after a residence of one year in the State, six months in the county, and one month in the voting precinct. Registration is prohibited, as being a bar to suffrage.

California.—Only actual citizens can vote, after having been one year in the State, ninety days in the county, and thirty days in the voting precinct. Registration is required by law; and Chinese, Indians, idiots, and convicts are excluded.

Colorado.—Citizens, or those who have declared their intention to become such, may vote after a residence of six months in the State, persons in prison only being excluded. Registration is required by the constitution.

Connecticut.—Actual citizens, except those unable to read, and convicts, can vote after a residence of one year in the State and six months in the county and voting precinct. Registration is required by law.

Delaware.—Actual county taxpayers, except convicts, the insane, paupers and idiots, may vote after a residence of one year in the State and one month in the county.

Florida.—Citizens of the United States, or those who have declared their intention to become such, except betters on elections, duelists, idiots, the insane, and criminals, can vote after a residence of one year in the State and six months in the county. Registration is required by the constitution.

Georgia.—Actual citizens, except nontaxpayers, criminals, idiots, and the insane, can vote after a residence of one year in the State and six months in the county.

Idaho.—Every male citizen of the United States twenty-one years old, who has resided in the State for six months and in the county where he offers to vote thirty days next preceding the day of election, is a qualified elector, except those under guardianship, idiotic or insane persons, or persons convicted of felony, embezzlement of public funds, bartering or offering to barter his vote, or of an infamous crime. Bigamists and polygamists are also excluded.

Illinois.—Actual citizens, except convicts, may vote after a residence of one year in the State and ninety days in the county and thirty days in the voting precinct. Registration is required by law.

Indiana.—Citizens or those who have declared their intention so to become, except fraudulent voters and bribers, may vote after a residence of six months in the State, sixty days in the county, and thirty days in the voting precinct.

Iowa.—Actual citizens, except criminals, idiots, and the insane may vote after a residence of six months in the State and sixty days in the county. Registration is required by law.

Kansas.—Citizens, or those who have declared their intention to become so, except rebels, convicts, idiots, and the insane, can vote after a residence of six months in the State and thirty days in the voting precinct. Registration is required in cities only.

Kentucky.—Under the State law free white male citizens, except convicts can vote after a residence of two years in the State, one year in the county, and sixty days in the voting precinct; but the exclusion of colored citizens being in conflict with the Federal Constitution, the law limiting the suffrage to white citizens is of no effect.

Louisiana.—Citizens, or those who have declared their intention to become such, except criminals, idiots, and the insane, can vote after a residence of one year in the State, six months in the county, and thirty days in the voting precinct.

Maine.—Actual citizens, except paupers and Indians not taxed, map vote after a residence of three months in the State. Registration is required.

Maryland.—Actual citizens, except criminals, those guilty of bribery, and the insane, can vote after a residence of one year in the State and six months in the county. Registration is required.

Massachusetts.—Citizens, except paupers, illiterates, nontaxpayers, and persons under guardians, can vote after a residence of one year in the State and six months in the voting precinct. Registration is required.

Michigan.—Citizens, or those who have declared their intention of becoming such, except duelists, can vote after a residence of three months in the State and ten days in the voting precinct. Registration is required.

Minnesota.—Citizens, or those who have declared their intention to become so, except convicts, lunatics and idiots, can vote after a residence of four months in the State and ten days in the voting precinct. Registration is required.

Missouri.—Citizens, or those who have declared their intention to become so, except United States soldiers, paupers, criminals, and lunatics, can vote after a residence of one year in the State and sixty days in the county. Registration is required in cities only.

Mississippi.—Actual citizens, except criminals, idiots, and lunatics, can vote after a residence of six months in the State and one month in the county. Registration is required.

Montana.—Every male citizen of the United States twenty-one years or over, who shall have resided in the State one year immediately preceding the election at which he offers to vote, and in the town, county, or precinct such time as may be prescribed by law, shall be a qualified elector, except idiots or insane persons. Women shall have the right to vote at any school district election.

Nebraska.—Citizens, or those who have declared their intention of becoming so, except United States soldiers, convicts, and idiots, can vote after a residence of six months in the State. Registration is required.

Nevada.—Citizens, or those who have declared their intention so to become, except criminals, idiots, and lunatics, can vote after a residence of six months in the State and thirty days in the county. Registration is required.

New Hampshire—Actual citizens, except paupers, can vote after a residence of six months in the town. Registration is required.

New Jersey.—Actual citizens, except criminals, paupers, lunatics, and idiots, can vote after a residence of one year in the State and five months in the county. Registration is required in cities of 10,000 inhabitants and over.

New York.—Actual citizens, except convicts, and election betters and bribers, may vote after a residence of one year in the State, four months in the county, and thirty days in the voting precinct. Registration is required in cities of 10,000 inhabitants or over.

North Carolina.—Actual citizens, except convicts, can vote after a residence of twelve months in the State and ninety days in the county. Registration is required.

North Dakota.—Every male person of twenty-one years or upward who have resided in the State one year, in the county six months, and in the precinct ninety days next preceeding any election, shall be deemed qualified electors; citizens of the United States, persons of foreign birth who have declared their intention of becoming citizens, and Indians who have severed their tribal relations. No person who is under guardianship, *non compos mentis*, or insane, nor any person convicted of treason or felony.

Ohio.—Actual citizens, except idiots and lunatics, can vote after a residence of one year in the State, thirty days in the county, and single men after being twenty days in the voting precinct.

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*Transferred in full text from the Manual and Digest of the House of Representatives, Jan. 1, 1891.

OREGON.—Citizens, or those who have declared their intention of becoming so, except Chinamen, United States soldiers, convicts, lunatics, and idiots, may vote after a residence of six months in the State.

PENNSYLVANIA.—Actual citizens, except non-taxpayers and political bribers, can vote after a residence of one year in the State and two months in the voting precinct. Registration is required.

RHODE ISLAND.—Actual taxpaying citizens, who possess property to the value of $134, can vote after a residence of one year in the State and six months in the towns. Registration is required.

SOUTH CAROLINA.—Actual citizens, except United States soldiers, duelists, paupers, criminals, lunatics, and idiots may vote after a residence of one year in the State and sixty days in the county. Registration is required.

SOUTH DAKOTA.—Citizens of the United States of the age of twenty-one years and upward, or those who have declared their intention of becoming citizens, and who have resided in the State six months, in the county thirty days, and in election precinct ten days next preceding any election are qualified voters.

TENNESSEE.—Actual citizens, except non-payers of poll tax, may vote after a residence of twelve months in the State and six months in the county.

TEXAS.—Citizens, or those who have declared their intention of becoming so, except United States soldiers, criminals, idiots, lunatics, and paupers, can vote after a residence of one year in the State and six months in the county and voting precinct Registration is prohibited by the constitution.

VERMONT—Actual citizens, except bribers, can vote after a residence of one year in the State. Registration is required.

VIRGINIA.—Actual citizens, except United States soldiers, non-payers of capitation tax, duelists, convicts, idiots, and lunatics, can vote after a residence of twelve months in the State and three months in towns. Registration is required.

WASHINGTON.—All male persons of the age of twenty-one or over, citizens of the United States, who have lived in the State one year, and the county ninety days, and in the city, town, ward, or precinct thirty days immediately preceeding the election at which they offer to vote, shall be entitled to vote, except Indians not taxed, idiots, insane persons, and persons convicted of infamous crimes (unless restored to their civil rights).

WEST VIRGINIA.—Actual citizens, except convicts, paupers, and lunatics, can vote after a residence of one year in the State and six months in the county. Registration is prohibited by the constitution.

WISCONSIN.—Citizens, or those who have declared their intention of becoming so, except duelists, bribers, betters, convicts, lunatics, and idiots, may vote after a residence of one year in the State.

WYOMING.—Suffrage not to be denied or abridged on account of sex. Every citizen of the United States twenty-one years of age and upward who has resided in the State one year and in the county wherein such residence is located sixty days next preceeding any election, shall be entitled to vote at such election, except idiots, insane persons, and persons convicted of infamous crimes, and also such persons as shall not be able to read the constitution of the State.

CHAPLAINS OF THE UNITED STATES SENATE AND HOUSE OF REPRESENTATIVES.

The Chaplains of the Senate and House of Representatives are elected by a *viva voce* vote at the commencement of each Congress, their official terms to continue "until their successors are chosen" and their salaries to be $1,500 per year.

The practice which had prevailed for several years, of the election by each house of a chaplain, who should open their daily sessions with prayer, alternating weekly between the House and Senate, was suspended during the 35th Congress. At the first session of that Congress a resolution was adopted by the House, which directed "that the daily sessions of that body be opened by prayer, and requesting the ministers of the gospel in this city (Washington) to attend and alternately perform this solemn duty." The clergymen of Washington generally responded to this request, and for the remainder of the Congress performed the duty of chaplains.

At the first session of the 36th Congress the old practice of the election of a chaplain by each house was revived, and it was at that time decided that a proposition to proceed to such election presented a question of privilege.

Until the revision of the rules in the 2d session of the 46th Congress, there was no *Rule* relating to the election of chaplain.

SUPREME COURT OF THE UNITED STATES.

The United States Supreme Court is composed of a Chief Justice and eight Associate Justices, appointed by the President of the United States subject to the approval of the United States Senate. The Associate Judges have precedence according to the dates of their commissions, or, when the commissions of two or more of them bear the same date, according to their ages. In each case of a vacancy in the office of Chief Justice, or of his inability to perform the duties and powers of his office, those duties shall devolve upon the Associate Justice who is first in precedence until such disability is removed, or, another Chief Justice is appointed and duly qualified.

The salary of the Chief Justice is $10,500 per annum, and of each Associate Justice $10,000.

The Chief Justices besides their duties in annual sessions of the Supreme Court in Washington, have assigned to them each his own judicial circuit, these circuits having in addition, their own circuit judges.

The following is a complete list of the Justices of the United States Supreme Court, the names of the Chief Justices are in *italics*.

Names.	Service.		Born	Died.
	Term.	Years		
John Jay, N. Y.	1789–1795	6	1745	1829
John Rutledge, S. C.	1789–1791	2	1739	1800
William Cushing, Mass.	1789–1810	21	1733	1810
James Wilson, Pa.	1789–1798	9	1742	1798
John Blair, Va.	1789–1796	7	1732	1800
Robert H. Harrison, Md.	1789–1790	1	1745	1790
James Iredell, N. C.	1790–1799	9	1751	1799
Thomas Johnson, Md.	1791–1793	2	1732	1819
William Paterson, N. J.	1793–1806	13	1745	1806
John Rutledge, S. C.	1795–1795	..	1739	1800
Samuel Chase, Md.	1796–1811	15	1741	1811
Oliver Ellsworth, Conn.	1796–1800	5	1745	1807
Bushrod Washington, Va.	1798–1829	31	1762	1829
Alfred Moore, N. C.	1799–1804	5	1755	1810
John Marshall, Va.	1801–1835	34	1755	1835
William Johnson, S. C.	1804–1834	30	1771	1834
Brockholst Livingston, N. Y.	1806–1823	17	1757	1823
Thomas Todd, Ky.	1807–1826	19	1765	1826
Joseph Story, Mass.	1811–1845	34	1779	1845
Gabriel Duval, Md.	1811–1836	25	1752	1844
Smith Thompson, N. Y.	1823–1843	20	1767	1843
Robert Trimble, Ky.	1826–1828	2	1777	1828
John McLean, Ohio	1829–1861	32	1785	1861
Henry Baldwin, Pa.	1830–1844	16	1779	1844
James M. Wayne, Ga.	1835–1867	32	1790	1867
Roger B. Taney, Md.	1836–1864	28	1777	1864
Philip P. Barbour, Va.	1836–1841	5	1783	1841
John Catron, Tenn.	1837–1865	28	1786	1865
John McKinley, Ala.	1837–1852	16	1780	1852
Peter V. Daniel, Va.	1841–1860	19	1785	1860
Samuel Nelson, N. Y.	1845–1872	27	1792	1873
Levi Woodbury, N. H.	1845–1851	6	1789	1851
Robert C. Grier, Pa.	1846–1870	23	1794	1870
Benj. R. Curtis, Mass.	1851–1857	6	1809	1874
John A. Campbell, Ala.	1853–1861	8	1811	1889
Nathan Clifford, Maine	1858–1881	23	1803	1881
Noah H. Swayne, Ohio	1861–1881	20	1804	1884
Samuel F. Miller, Iowa	1862–1890	28	1816	1890
David Davis, Ill.	1862–1877	15	1815	1886
Stephen J. Field, Cal.	1863–	..	1816	....
Salmon P. Chase, Ohio	1864–1873	9	1808	1873
William Strong, Pa.	1870–1880	10	1808	....
Joseph P. Bradley, N. J.	1870–	..	1813	....
Ward Hunt, N. Y.	1872–1882	10	1811	1886
Morrison R. Waite, Ohio.	1874–1888	14	1816	1888
John M. Harlan, Ky.	1877–	..	1833	....
William B. Woods, Ga.	1880–1887	7	1824	1887
Stanley Mathews, Ohio	1881–1889	8	1824	1889
Horace Gray, Mass.	1881–	..	1828	....
Samuel Blatchford, N. Y.	1882–	..	1820	....
Lucius Q. C. Lamar, Miss.	1888–	..	1825	....
Melville W. Fuller, Ill.	1888–	..	1833	....
David J. Brewer, Kan.	1889–	..	1837	....
Henry B. Brown, Mich.	1890–	..	1836	....

Each separate State has its own judicial system for which see Britannica *in loc.*

NUMBER OF SESSIONS, TERMS OF OFFICE, LIMIT OF SESSIONS, SALARIES OF GOVERNORS, ETC., IN THE SEVERAL STATES AND TERRITORIES.

States.	Sessions	Month and Day.	Limit of sessions.	No. of Senators.	No. of Rep's.	Term of Senators	Term of Rep's.	Salary.
Alabama	Biennial	Tu. aft. 2 Mon. Nov	50 days	33	100	4	2	$4 a day and 10c. mileage.
Arkansas	Biennial	2d Mon. Jan	60 days	32	92	4	2	$6 a day.
California	Biennial	1st Mon. aft. Jan. 1	60 days	40	80	4	2	$8 a day and 10 cents mileage and $25.
Colorado	Biennial	Wed. aft. 1 Mon. Jan	90 days.	26	49	4	2	$7 a day and 15c. mileage.
Connecticut	Annual	Wed. aft. 1 Mon. Jan	None	24	249	2	2	$300 and mileage.
Delaware	Biennial	1st Tue. Jan	None	9	20	4	2	$3 a day and mileage.
Florida	Biennial		60 days	32	70	4	2	$6 a day and 10c. mileage.
Georgia	Biennial	1st Wed. Nov	40 days*	44	175	2	2	$4 a day and mileage.
Idaho	Biennial	2d Mon. Dec	60 days	12	24	2	2	$4 a day and 20c. mileage.
Illinois	Biennial	Wed. aft. 1 Mon. Jan	None.	51	153	4	2	$5 a day and 10 cents mileage and $50.
Indiana	Biennial	Thur. aft. 1 Mon. Jan	60 days.	50	100	4	2	$6 a day and mileage.
Iowa	Biennial	2d Mon. Jan	None.	50	100	4	2	$550 a year.
Kansas	Biennial	2d Tu. Jan	50 days	40	125	4	2	$3 a day and 15c mileage.
Kentucky	Biennial	Last Wed. Dec	60 days*	38	100	4	2	$5 a day and 15c. mileage.
Louisiana	Biennial	2d Mon. May	60 days	36	98	4	4	$4 a day and mileage
Maine	Biennial	1st Wed. Jan	None.	31	151	2	2	$150 and 20c. mileage.
Maryland	Biennial	1st Wed. Jan	90 days.	26	117	4	2	$5 a day and mileage.
Massachusetts	Annual.	1st Wed. Jan	None.	40	240	1	1	$750 a year and 20c. mileage
Michigan	Biennial	1st Wed. Jan	None.	32	100	2	2	$3 a day and 10c. mileage.
Minnesota	Biennial	Tu. aft. 1 Mon. Jan	60 days	63	107	4	2	$5 a day and 15c. mileage.
Mississippi	Biennial	Tu. aft. 1 Mon. Jan	None.	40	120	4	2	$400 a year.
Missouri	Biennial	Wed. aft. Jan. 1	70 days.	34	140	4	2	$5 a day and mileage and $30.
Montana	Biennial	2d Mon. Jan	60 days	12	24	2	2	$4 a day and 20c. mileage.
Nebraska	Biennial	1st Tu. Jan	40 days	33	100	2	2	$3 a day and 10 cents mileage.
Nevada	Biennial	1st Mon. Jan	60 days.	20	40	4	2	$8 a day and 40c. mileage.
N. Hampshire	Biennial	1st Wed. in Jan	None.	24	321	2	2	$250 and mileage.
New Jersey	Annual	2d Tu. in Jan	None	21	60	3	1	$500 a year.
New York	Annual	1st Tu. Jan	None	32	128	2	1	$1,500 a year and 10c. mileage.
North Carolina	Biennial	Wed. aft. 1 Mon. Jan	60 days	50	120	2	2	$4 a day and 10c. mileage,
North Dakota	Biennial	2d Tu. Jan	60 days.	24	48	2	2	$4 a day and 20c. mileage.
Ohio †	Biennial	1st Mon. Jan	None.	37	110	2	2	$600 a year and 12c. mile.
Oregon	Biennial	2d Mon. Jan	40 days.	30	60	4	2	$3 a day and 15c. mileage.
Pennsylvania	Biennial	1st Tu. Jan	None.	50	204	4	2	$1,500 a year and 5 cents mileage.
Rhode Island ‡	Annual	Last Tu. May	None.	36	72	1	1	$1 a day and 8c. mileage.
South Carolina	Annual	4th Tu. Nov	None.	35	124	4	2	$5 a day and 10c. mileage.
South Dakota	Biennial	2d Tu. Jan	60 days	24	48	2	2	$4 a day and 20c. mileage.
Tennessee	Biennial	1st Mon. Jan	75 days.	33	99	2	2	$4 a day and 16c. mileage.
Texas	Biennial	2d Tu. Jan	90 days	31	106	4	2	$5 a day and mileage.
Vermont	Biennial	1st Wed. Oct	None.	30	240	2	2	$3 a day.
Virginia	Biennial	1st Wed. Dec	90 days||	40	100	4	2	$540 a year.
Washington	Biennial	2d Mon. Jan	60 days	12	24	2	2	$4 a day and 20c. mileage.
West Virginia	Biennial	2d Wed. Jan	45 days||	26	65	4	2	$4 a day and 10c. mileage.
Wisconsin	Biennial	1st Mon. Jan	None.	33	100	4	2	$500 a year and 10 cents mileage.
Wyoming	Biennial	2d Tu. Jan	60 days	12	24	2	2	$4 a day and 20c. mileage
TERRITORIES.								
Arizona	Biennial	1st Mon. Jan	60 days.	12	24	2	2	$4 a day and 20 cents mileage.
New Mexico	Biennial	Last Mon. Dec	60 days.	12	24	2	2	
Oklahoma								
Utah	Biennial	2d Mon. Jan	60 days	12	24	2	2	

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* Unless extended by special vote.

† In Ohio and a few other States, where the legislative sessions are biennial, the legislature holds "adjourned sessions," practically amounting to annual meetings.

‡ The Rhode Island legislature is required to meet annually the last Tuesday in May, at Newport, and an adjourned session to be holden annually at Providence.

|| Unless extended by special vote.

PRESIDENTIAL ELECTION IN THE UNITED STATES.

Year of Election.	Number of States.	Total Elect. Vote.	Political Party.	*Presidents. Candidates.	Vote. States.	Vote. Popular.	Vote. Electoral.	*Vice-Presidents. Candidates.	Elect. Votes.
1789	†10	73		G. Washington			69		
				John Adams					34
				John Jay					9
				R. H. Harrison					6
				John Rutledge					6
				John Hancock					4
				Geo. Clinton					3
				S. Huntington					2
				John Milton					2
				Jas. Armstrong					1
				Benj. Lincoln					1
				Edw. Telfair					1
				Vacancies			4		4
1792	15	135	F	G. Washington			132		
			F	John Adams					77
			A-F	Geo. Clinton					50
				Thos. Jefferson					4
				Aaron Burr					1
				Vacancies			3		3
1796	16	138	F	John Adams			71		
			A-F	Thos. Jefferson					68
			F	Thos. Pinckney					59
			F	Aaron Burr					30
				Samuel Adams					15
				O. Ellsworth					11
				Geo. Clinton					7
				John Jay					5
				James Iredell					3
				G. Washington					2
				John Henry					2
				S. Johnston					2
				C. C. Pinckney					1
1800	16	138	A-F	Thos. Jefferson			73		
			A-F	Aaron Burr					73
			F	John Adams					65
			F	C. C. Pinckney					64
			....	**John Jay**					1
1804	17	176	A-F	Thos. Jefferson	15		162	Clinton	162
			F	C. C. Pinckney	2		14	King	14
1808	17	176	A-F	Jas. Madison	12		122	Clinton	113
			....	**C. C. Pinckney**	5		47	King	47
			....	**Geo. Clinton**			6	Langdon	9
							....	**Madison**	3
								Monroe	3
				Vacancy			1		1
1812	18	218	A-F	Jas. Madison	11		128	Gerry	131
			F	DeW. Clinton	7		89	Ingersoll	86
			....	**Vacancy**			1		1
1816	19	221	A-F	James Monroe	16		183	Tompkins	183
			F	Rufus King	3		34	Howard	22
								Ross, etc.	16
1820	24	235	A-F	**James Monroe**	24	....	231	**Tompkins**	218
			F	Jno. Q. Adams			1	Stockton	8
								Rodney	4
								Harper	1
								Rush	1
				Vacancies			3		3
1824	24	261	A-F	A. Jackson	11	155,872	99	Calhoun	182
			C	Jno. Q. Adams	8	105,321	84	Sanford	30
			A-F	W. H. Crawford	4	44,282	41	Macon	24
			A-F	**Henry Clay**	3	46,587	37	Jackson	13
								Van Buren	9
								Clay	2
				Vacancy					1
1828	24	261	D	A. Jackson	15	647,231	178	Calhoun	171
			N R	Jno. Q. Adams	9	509,097	83	Rush	83
								Smith	7
1832	24	288	D	A. Jackson	16	687,502	219	Van Buren	189
			N R	Henry Clay	7	530,189	49	**Sergeant**	49
				John Floyd	1	33,108	11	Lee	11
			A-M	William Wirt	1		7	Ellmaker	7
								Wilkins	30
				Vacancies			2		2
1836	26	294	D	M. Van Buren	15	761,549	170	**Johnson****	147
			W	W. H. Harrison	7		73	Granger	77
			W	Hugh L. White	2	736,656	26	Tyler	47
			W	Dan. Webster	1		14	Smith	23
			W	W. P. Mangum	1		11		
1840	26	294	W	**W. H. Harrison**	19	1,275,017	234	Tyler	234
			D	M. Van Buren	7	1,128,702	60	Johnson	48
			L	Jas. G. Birney		7,059			
								Tazewell	11
								Polk	1
1844	26	275	D	James K. Polk	15	1,337,243	170	Dallas	170
			W	Henry Clay	11	1,299,068	105	Frelingh's'n	105
			L	Jas. G. Birney		62,300			
1848	30	290	W	Zachary Taylor	15	1,360,101	163	Fillmore	163
			D	Lewis Cass	15	1,220,544	127	Butler	127
			F. S.	M. Van Buren		291,263		Adams	
1852	31	296	D	Franklin Pierce	27	1,601,474	254	King	254
			W	Winfield Scott	4	1,386,578	42	Graham	42
			F. D.	**John P. Hale**	..	156,149	...	**Julian**	
1856	31	296	D	Jas. Buchanan	19	1,838,169	174	Breckinr'ge	174
			R	J. C. Fremont	11	1,341,264	114	Dayton	114
			A	**M. Fillmore**	1	874,534	8	**Donelson**	8
1860	33	303	R	Ab'm Lincoln	17	1,866,352	180	Hamlin	180
			D	J. C. Breckinr'ge	11	845,763	72	Lane	72
			C. U.	John Bell	3	589,581	39	**Everett**	39
			I. D.	S. A. Douglas	2	1,375,157	12	Johnson	12
1864	**36	314	R	Ab'm Lincoln	22	2,216,067	212	Johnson	212
			D	G. B. McClellan	3	1,808,725	21	Pendleton	21
				Vacancies	11		81		81
1868	37	317	R	**Ulysses S. Grant**	26	3,015,071	214	**Colfax**	214
			D	**H. Seymour**	8	2,709,613	80	Blair	80
				Vacancies	3		23		23
1872	37	366	R	Ulysses S. Grant	31	3,597,070	286	Wilson	286
			D. & L.	Horace Greeley	6	2,834,079	...	**Brown**	47
			D	**Charles O'Conor**		29,408		Julian	5
			T	James Black		5,608		Colquitt	5
			......	**T. A. Hendricks**			42	**Palmer**	3
			......	**B. Gratz Brown**			18	Bramlette	3
			......	**C. J. Jenkins**			2	Groesbeck	1
				David Davis			1	Machen	1
								Banks	1
				Not counted			17		14
1876	38	369	R	R. B. Hayes	21	4,033,950	185	Wheeler	185
			D	S. J. Tilden	17	4,284,885	184	Hendricks	184
			G	Peter Cooper	..	81,740			
			P	G. Clay Smith		9,522			
				Scattering		2,636	...	.....	
1880	38	369	R	J. A. Garfield	19	4,454,416	214	Arthur	214
			D	**W. S. Hancock**	19	4,444,952	155	English	155
			G	J. B. Weaver		308,578		Chambers	
				Scattering		12,576			
1884	38	401	D	G. Cleveland	20	4,874,986	219	Hendricks	219
			R	**Jas. G. Blaine**	18	4,851,981	182	**Logan**	182
			P. P	**Benj. F. Butler**	..	175,370	...	**West**	
			P	John P. St. John		150,369		Daniels	
1888	38	401	R	Benj. Harrison		5,438,672	233	Morton	233
			D	G. Cleveland		5,534,882	168	Thurman	168
			P	Clinton B. Fisk		244,087		Brooks	..
			U. L.	**A. J. Streeter**		146,839		**Cunningh'm**	...

F., stands for *Federalist*; R., *Republican*; O., *Opposition*; C., *Coalition*; D., *Democratic*; N. R., *National Republican*; A.-M., *Anti-Mason*; W., *Whig*; L., *Liberty*; F. S., *Free Soil*; F. D., *Free Democrat*; C. U., *Constitutional Union*; I. D., *Independent Democrat*; D. & L., *Democratic and Liberal*; T., *Temperance*; G., *Greenback*; P., *Prohibition*; A., *American*; P. P., *People's Party*; U. L., *United Labor*.

*** Previous to the election of 1804 each elector voted for two candidates for President; the one receiving the highest number of votes, if a majority, was declared elected President; and the next highest Vice-President.**

† Three States out of thirteen did not vote, viz.: New York, which had not passed an electoral law; and North Carolina and Rhode Island, which had not adopted the Constitution.

‡ There having been a tie vote, the choice devolved upon the House of Representatives, which selected Jefferson.

§ No choice having been made by the Electoral College, the choice devolved upon the House of Representatives, which selected Adams on first ballot.

**** No candidate having received a majority of the votes of the Electoral College, the Senate elected R. M. Johnson Vice-President, who received 33 votes; Francis Granger received 16.**

SPEAKERS OF THE HOUSE OF REPRESENTATIVES.

The following is a complete list of the Speakers of the House of Representatives from the organization of the 1st Congress until the close of the 51st Congress, in 1891, giving the State which the Speaker represented, and the length of time of his services as Speaker. The names of the Speakers *pro tem* are *not included.*

Name.	State.	Cong'ss.	Term of Service.
F. A Muhlenberg	Pa	1st	Apr. 1, 1789, to Mar. 3, 1791
Jonathan Trumbull	Conn	2d	Oct. 24, '91, to Mar. 2, '93
F. A. Muhlenberg	Pa	3d	Dec. 2, '93, to Mar. 3, '95
Jonathan Dayton	N. J.	4th	Dec. 7, '95, to Mar. 3, '97
" "	"	5th	May 15, '97, to July 16, '98
Geo. Dent	Md	5th	Dec. 3, '98, to Mar. 3, '99
Theodore Sedgwick	Mass	6th	Dec. 2, '99, to Mar. 3, 1801
Nathaniel Macon	N. C.	7th	Dec. 7, 1801, to Mar. 3, '03
" "	"	8th	Oct. 17, '03, to Mar. 3, '05
" "	"	9th	Dec. 2, '05, to Mar. 3, '07
Joseph B. Varnum	Mass	10th	Oct. 26, '07, to Mar. 3, '09
" "	"	11th	May 22, '09, to Mar. 3, '11
Henry Clay[*]	Ky	12th	Nov. 4, '11, to Mar. 3, '13
" "	"	13th	May 24, '13, to Jan. 19, '14
Langdon Cheves	S. C.	13th	Jan. 19, '14, to Mar. 3, '15
Henry Clay[†]	Ky	14th	Dec. 4, '15, to Mar. 3, '17
" "	"	15th	Dec. 1, '17, to Mar. 3, '19
" "	"	16th	Dec. 6, '19, to May 15, '20
John W. Taylor	N. Y.	16th	Nov. 15, '20, to Mar. 3, '21
Philip P. Barbour	Va	17th	Dec. 4, '21, to Mar. 3, '23
Henry Clay	Ky	18th	Dec. 1, '23, to Mar. 3, '25
John W. Taylor	N. Y.	19th	Dec. 5, '25, to Mar. 3, '27
Andrew Stevenson[‡]	Va	20th	Dec. 3, '27, to Mar. 3, '29
" "	"	21st	Dec. 7, '29, to Mar. 3, '31
" "	"	22d	Dec. 5, '31, to Mar. 3, '33
" "	"	23d	Dec. 2, '33, to June 2, '34
John Bell	Tenn.	23d	June 2, '34, to Mar. 3, '35
James K. Polk	"	24th	Dec. 7, '35, to Mar. 3, '37
" "	"	25th	Sept. 5, '37, to Mar. 3, '39
Robt. M. T. Hunter	Va	26th	Dec. 16, '39, to Mar. 3, '41
John White	Ky	27th	May 31, '41, to Mar. 3, '43
John W. Jones	Va	28th	Dec. 4, '43, to Mar. 3, '45
John W. Davis	Ind	29th	Dec. 1, '45, to Mar. 3, '47
Robert C. Winthrop	Mass	30th	Dec. 6, '47, to Mar. 3, '49
Howell Cobb	Ga	31st	Dec. 22, '49, to Mar. 3, '51
Linn Boyd	Ky	32d	Dec. 1, '51, to Mar. 3, '53
" "	"	33d	Dec. 5, '53, to Mar. 3, '55
Nathaniel P. Banks	Mass	34th	Feb. 2, '56, to Mar. 3, '57
James L. Orr	S. C.	35th	Dec. 7, '57, to Mar. 3, '59
Wm. Pennington	N. J.	36th	Feb. 1, '60, to Mar. 2, '61
Galusha A. Grow	Pa	37th	July 4, '61, to Mar. 3, '63
Schuyler Colfax	Ind	38th	Dec. 7, '63, to Mar. 3, '65
" "	"	39th	Dec. 4, '65, to Mar. 2, '67
" "	"	40th	Mar. 4, '67, to Mar. 3, '69
James G. Blaine	Me	41st	Mar. 4, '69, to Mar. 3, '71
" "	"	42d	Mar. 4, '71, to Mar. 3, '73
" "	"	43d	Dec. 1, '73, to Mar. 3, '75
Michael C. Kerr	Ind	44th	Dec. 6, '75, to Aug 20, '76
Samuel S. Cox	N. Y.	44th	Feb. 17, '76, to May 12, '76
Milton Sayler	Ohio	44th	June 19, '76, to June 24, '76
Samuel J. Randall	Pa	44th	Dec. 4, '76, to Mar. 3, '77
" "	"	45th	Oct. 15, '77, to Mar. 3, '79
" "	"	46th	Mar. 18, '79, to Mar. 3, '81
J. Warren Kiefer	Ohio	47th	Dec. 5, '81, to Mar. 3, '83
John G. Carlisle	Ky	48th	Dec. 3, '83, to Mar. 3, '85
" "	"	49th	Dec. 7, '85, to Mar. 3, '87
" "	"	50th	Dec. 5, '87, to Mar. 3, '89
Thomas B. Reed	Me	51st	Dec. 2, '89, to Mar. 3, '91

[*] Resigned, Jan. 19, 1814.
[†] Resigned, Oct. 20, 1820.
[‡] Resigned, June 2, 1834.

THE UNITED STATES COURT OF CLAIMS.

The Court of Claims of the United States was established by Congressional Act of Feb. 24, 1855.

Members of Congress are not allowed to practice in the Court of Claims. The Act of Congress, approved March 3, 1887, enacted that "the Court of Claims shall have jurisdiction to hear and determine" the following matters:

First. All claims founded upon the Constitution of the United States or any law of Congress, except for pensions, or upon any regulation of any Executive Department, or upon any contract, expressed or implied, with the Government of the United States, or for damages, liquidated, or unliquidated, in cases not sounding in tort, in respect of which claims the party would be entitled to redress against the United States either in a court of law, equity, or admiralty if the United States were suable: *Provided, however,* That nothing in this section shall be construed as given to either of the courts herein mentioned jurisdiction to hear and determine claims growing out of the late civil war, and commonly known as "war claims," or to hear and determine other claims which have heretofore been rejected or reported on adversely by any court, department, or commission authorized to hear and determine the same.

Second. All set-offs, counter-claims, claims for damages, whether liquidated or unliquidated, or other demands whatsoever on the part of the Government of the United States against any claimant against the Government in said court: *Provided*, that no suit against the Government of the United States shall be allowed under this act unless the same shall have been brought within six years after the right accrued for which the claim is made.

SEC. 2. That the district courts of the United States shall have concurred jurisdiction with the Court of Claims as to all matters named in the preceeding section where the amount of the claim does not exceed one thousand dollars, and the circuit courts of the United States shall have such concurrent jurisdiction in all cases where the amount of such claim exceeds one thousand dollars and does not exceed ten thousand dollars. All causes brought and tried under the provision of this act shall be tried by the court without a jury.

SEC. 3. That whenever any person shall present his petition to the Court of Claims alleging that he is or has been indebted to the United States as an officer or agent thereof, or by virtue of any contract therewith, or that he is the guarantor, or surety, or personal representative of any officer, or agent, or contractor so indebted, or that he or the person for whom he is such surety, guarantor, or personal representative has held any office or agency under the United States, or entered into any contract therewith, under which it may be or has been claimed that an indebtedness to the United States has arisen and exists, and that he or the person he represents has applied to the proper Department of the Government requesting that the account of such office, agency, or indebtedness may be adjusted and settled, and that three years have elapsed from the date of such application and said account still remains unsettled and unadjusted, and that no suit upon the same has been brought by the United States, said court shall, due notice first being given to the head of said department and to the Attorney-General of the United States, proceed to hear the parties and to ascertain the amount, if any, due the United States on said account. The Attorney-General shall represent the United States at the hearing of said cause. The court may postpone the same from time to time whenever justice shall require. The judgment of said court or of the Supreme Court of the United States, to which an appeal shall lie, as in other cases, as to the amount due, shall be binding and conclusive upon the parties. The payment of such amount so found due by the court shall discharge such obligation. An action shall accrue to the United States against such principal, or surety, or representative to recover the amount so found due, which may be brought at any time within three years after the final judgment of said court. Unless suit shall be brought within said time, such claim and the claim on the original indebtness shall be forever barred.

SEC. 4. That the jurisdiction of the respective courts of the United States proceeding under this act, including the right of exception and appeal, shall be governed by the law now in force, in so far as the same is applicable and not inconsistent with the provisions of this act; and the course of procedure shall be in accordance with the established rules of said respective courts, and of such additions and modifications thereof as said courts may adopt.

SEC. 5 That the plaintiff in any suit brought under the provisions of the second section of this act shall file a petition, duly verified, with the clerk of the respective court having jurisdiction of the case, and in the district where the plaintiff resides. Such petition shall set forth the full name and residence of the plaintiff, the nature of his claim, and a succinct statement of the facts upon which the claim is based, the money or any other thing claimed, or the damages sought to be recovered, and praying the court for a judgment or decree upon the facts and law.

SEC. 6. That the plaintiff shall cause a copy of his petition filed under the preceding section to be served upon the district attorney of the United States in the district wherein suit is brought, and shall mail a copy of the same, by registered letter, to the Attorney-General of the United States, and shall thereupon cause to be filed with the clerk of the court wherein suit is instituted an affidavit of such service and the mailing of such letter. It shall be the duty of the district attorney upon whom service of petition is made as aforesaid to appear and defend the interests of the Government in the suit, and within sixty days after the service of the petition upon him, unless the time should be extended by order of the court made in the case, to file a plea, answer, or demurrer on the part of the Government, and to file a notice of any counter-claim, set-off, claim for damages, or other demand or defense whatsoever of the Government in the premises: *Provided*, That, should the district attorney neglect or refuse to file the plea, answer, demurrer, or defense as required, the plaintiff may proceed with the case under such rules as the court may adopt in the premises; but the plaintiff shall not have judgment or decree for his claim, or any part thereof, unless he shall establish the same by proof satisfactory to the court.

SEC. 7. That it shall be the duty of the court to cause a written opinion to be filed in the cause, setting forth the specific findings by the court of the facts therein and the conclusions of the court upon all questions of law involved in the case, and to render judgment thereon. If the suit be in equity or admiralty, the court shall proceed with the same according to the rules of such courts.

SEC. 8. That in the trial of any suit brought under any of the provisions of this act, no person shall be excluded as a witness because he is a party to or interested in said suit; and any plaintiff or party in interest may be examined as a witness on the part of the Government.

Section ten hundred and seventy-nine of the Revised Statutes is hereby repealed. The provisions of section ten hundred and eighty of the Revised Statutes shall apply to cases under this act.

SEC. 9. That the plaintiff or the United States in any suit brought under the provisions of this act, shall have the same rights of appeal or writ of error as are now reserved in the Statutes of the United States in that behalf made, and upon the conditions and limitations therein contained. The modes of procedure in claiming and perfecting an appeal or writ of error shall conform in all respects, and as near as may be, to the statutes and rules of court governing appeals and writs of error in like causes.

SEC. 10. That when the findings of facts and the law applicable thereto have been filed in any case as provided in section six of this act, and the judgment of decree is adverse to the Government, it shall be the duty of the district attorney to transmit to the Attorney-General of the United States certified copies of all the papers filed in the cause, with a transcript of the testimony taken, the written findings of the court, and his written opinion as to the same; whereupon the Attorney-General shall determine and direct whether an appeal or writ of error shall be taken or not; and when so directed the district attorney shall cause an appeal or writ of error to be perfected in accordance with the terms of the statutes and rules of practice governing the same: *Provided*, That no appeal or writ of error shall be allowed after six months from the judgment of decree in such suit. From the date of such final judgment or decree interest shall be computed thereon, at the rate of four per centum per annum, until the time when an appropriation is made for the payment of the judgment or decree.

SEC. 11. That the Attorney-General shall report to Congress, and at the beginning of each session of Congress, the suits under this act in which a final judgment or decree has been rendered, giving the date of each, and a statement of the costs taxed in each case.

SEC. 12. That when any claim or matter may be pending in any of the Executive Departments which involves controverted questions of fact or law, the head of such Department, with the consent of the claimant, may transmit the same, with the vouchers, papers, proofs and documents pertaining thereto, to said Court of Claims, and the same shall be there proceeded in under such rules as the court may adopt. When the facts and conclusions of law shall have been found, the court shall reports its findings to the Department by which it was transmitted.

SEC. 13. That in every case which shall come before the Court of Claims, or is now pending therein, under the provisions of an act entitled "An act to afford assistance and relief to Congress and the Executive Departments in the investigation of claims and demands against the Government," approved March third, eighteen hundred and eighty-three, if it shall appear to the satisfaction of the court, upon the facts established, that it has jurisdiction to render judgment or decree thereon under existing laws or under the provisions of this act it shall proceed to do so, giving to either party such further opportunity for hearing as in its judgment justice shall require, and report its proceedings therein to either house of Congress or to the Department by which the same was referred to said court.

SEC. 14. That whenever any bill, except for a pension, shall be pending in either house of Congress providing for the payment of a claim against the United States, legal or equitable, or for a grant, gift, or bounty to any person, the house in which such bill is pending may refer the same to the Court of Claims, who shall proceed with the same in accordance with the provisions of the act approved March third, eighteen hundred and eighty-three, entitled "An act to afford assistance and relief to Congress and the Executive Departments in the investigation of claims and demands against the Government," and report to such house the facts in the case and the amount, where the same can be liquidated, including any facts bearing upon the question whether there has been delay or laches in presenting such claim or applying for such grant, gift, or bounty, and any facts bearing upon the question whether the bar of any statute of limitation should be removed or which shall be claimed to excuse the claimant for not having resorted to any established legal remedy.

SEC. 15. If the Government of the United States shall put in issue the right of the plaintiff to recover the court may, in its discretion, allow costs to the prevailing party from the time of joining such issue. Such costs, however, shall include only what is actually incurred for witnesses, and for summoning the same, and fees paid to the clerk of the court.

SEC. 16. That all laws and parts of laws inconsistent with this act are hereby repealed.

THE CAPITAL OF THE UNITED STATES.

As stated elsewhere, the first Continental Congress met in Carpenter's Hall, Philadelphia, Sept. 5, 1774. The hall was a plain edifice (still standing) and provided fairly well in respect of accommodations for a small deliberative body.

The second Continental Congress also met in Philadelphia, and adjourned Dec. 12, 1776, to Baltimore, where its third session began Dec. 20, 1776. On Nov. 1, 1784, the Confederative Congress assembled in Trenton, N. J. On Jan. 11, 1885, it assembled in New York City. The first National Congress was also held in New York, commencing March 4, 1789.

In 1789 Maryland ceded to the United States the territory now known as the District of Columbia, for its use by the Government as the National headquarters. This gift was supplemented in 1789 by the Virginia Legislature, by the cession, for the same purpose, of 40 square miles (including Alexandria), on the opposite side of the Potomac River. These two tracts, selected by President Washington, and having jointly an area of 100 square miles (10 miles square), were accepted by the Government and designated "The District of Columbia."

This selection was made by Congress in 1790 after a spirited controversy, in which the most vigorous effort was made to locate the National Capital in some other portion of the country. Indeed, the contest was only settled by a compromise in which the Northern Congressmen consented to vote for the new Capital, and the Southern members consented to vote for the Federal assumption of the debts of the two States ceding the territory.

[In 1846 Congress receded to Virginia that portion of the district which she had transferred to the Federal Government.]

The Act of Congress, locating the Federal district, passed June 28, 1790, contained the following clause: "That a district of territory, on the river Potomac, at some place between the mouths of the Eastern Branch of the Connegacheague, be, and the same is hereby accepted for the permanent seat for the Government of the United States."

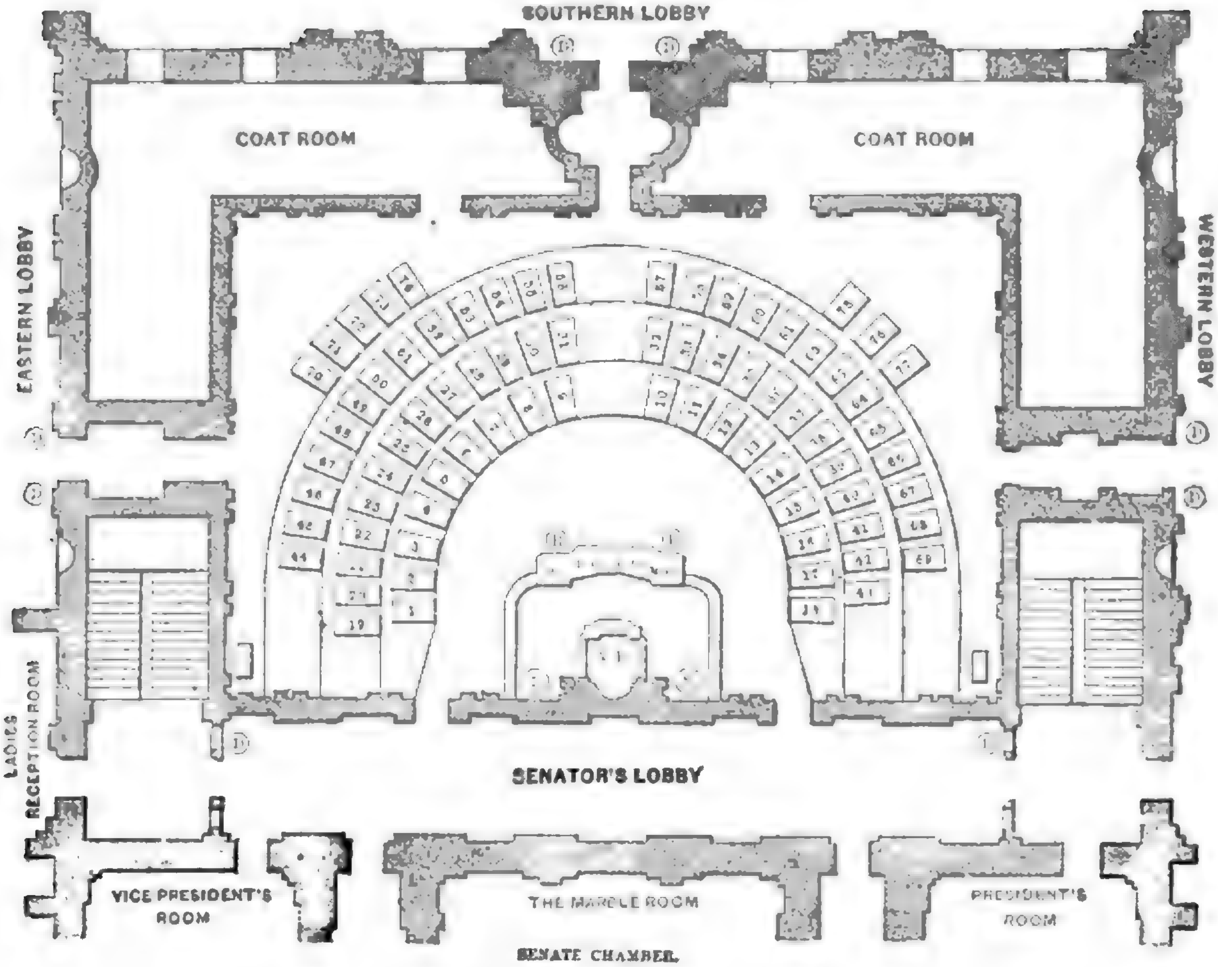
The same act provided also that Congress should meet in Philadelphia until the first Monday in November, 1800, when the Government should be removed to the District of Columbia.

In 1791, under Washington's supervision, the National Capital was planned and laid out on its present site. The President desired it to be called Federal City, but on Sept. 9 of that year, it was named Washington.

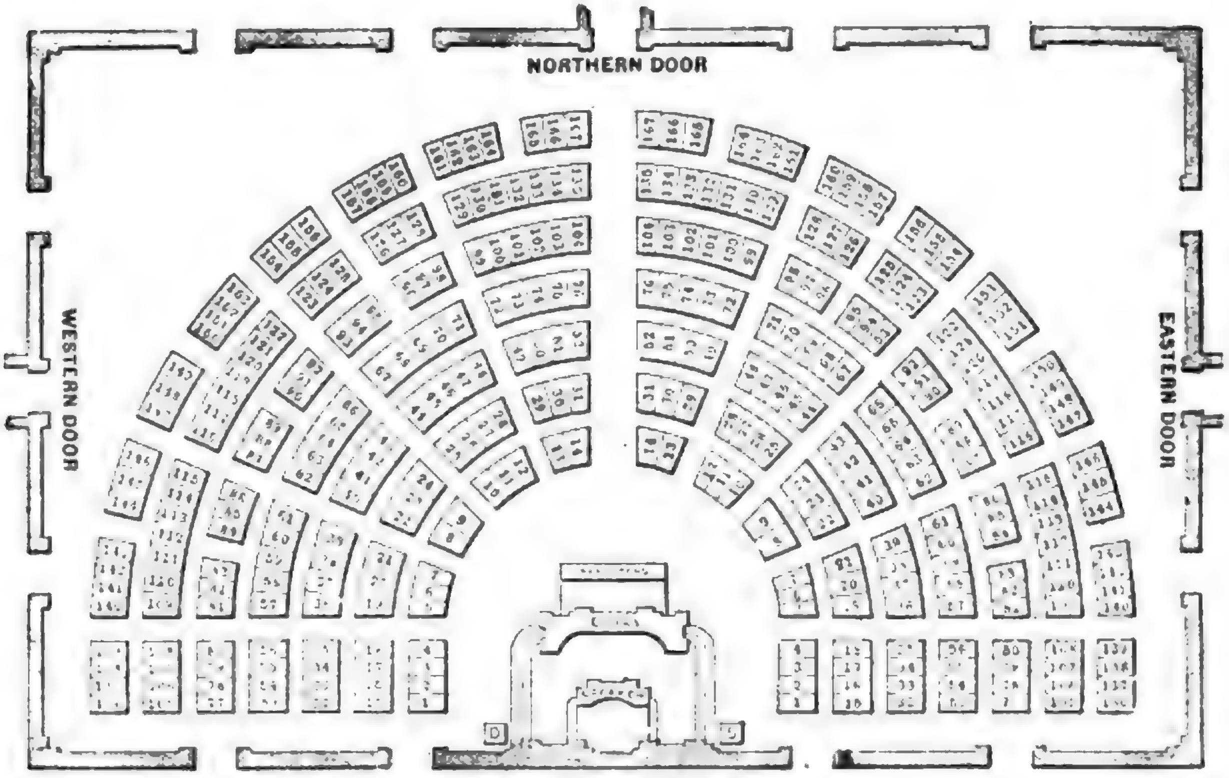
On Sept. 18, 1793, President Washington laid the cornerstone of the Capitol building with Masonic ceremonies.

In 1800 the seat of Government was transferred to Washington. The north wing of the Capitol only was completed, but it was fitted up for both Houses. The President's residence was completed externally. The city of Washington at that date was described as having "one good tavern and very few houses in any one place, most of them being very small huts, and the War Office and Treasury Building burned down."

A bill for a monument to President Washington passed the House of Representatives in 1800, but after being amended in the Senate, was postponed. Fifty years later it was commenced by funds raised by private subscriptions.


SOUTHERN LOBBY
COAT ROOM
COAT ROOM
EASTERN LOBBY
WESTERN LOBBY
LADIES RECEPTION ROOM
SENATOR'S LOBBY
VICE PRESIDENT'S ROOM
THE MARBLE ROOM
PRESIDENT'S ROOM

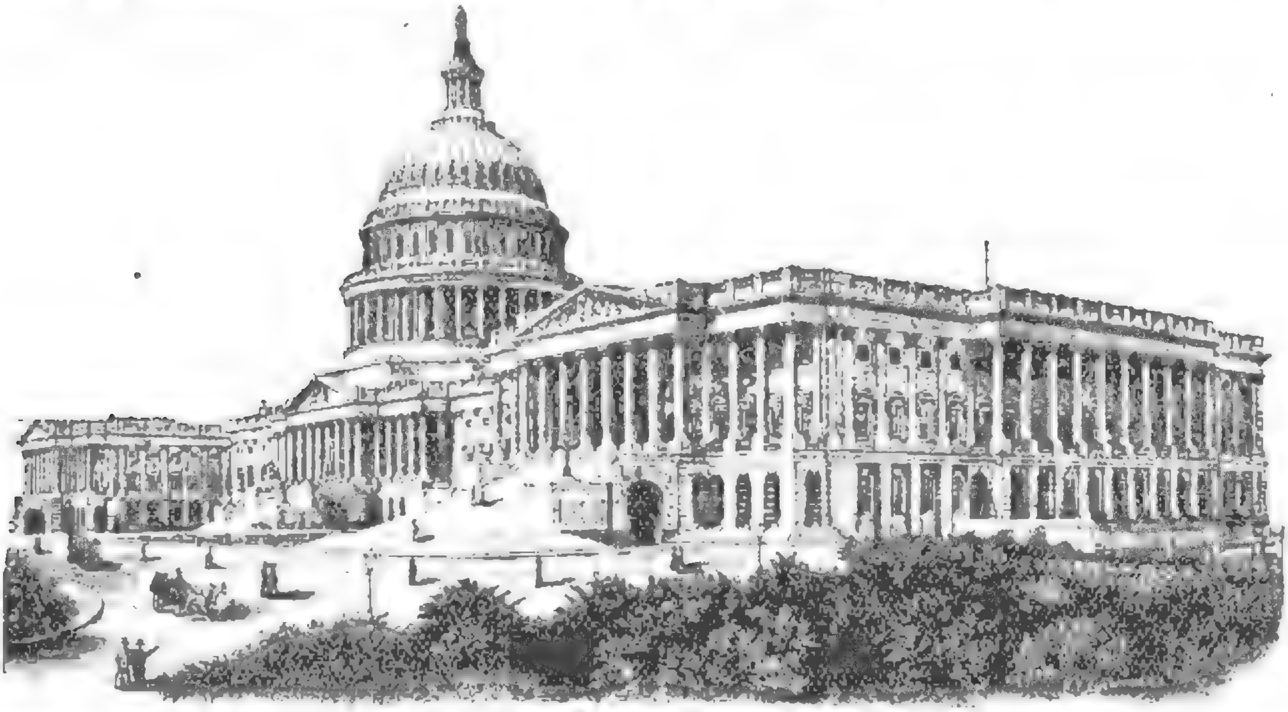
SENATE CHAMBER.


NORTHERN DOOR
WESTERN DOOR
EASTERN DOOR

HOUSE OF REPRESENTATIVES.

The Capitol Building.—The Capitol fronts the east, and stands on a plateau ninety feet above the level of the Potomac, in latitude 38° 53′ 20.4″ north and longitude 77° 00′ 35.7″ west from Greenwich.

The southeast corner-stone of the original building was laid on Sept. 18, 1793, by President Washington, aided by the Freemasons of Maryland. It was constructed of sandstone, painted white, from an island in Aquia Creek, Virginia, under the direction of Stephen H. Hallett, James Hoban, George Hadfield, and afterward of B. H. Latrobe, architects. The north wing was finished in 1800 and the south wing in 1811, a wooden passage-way connecting them. On August 24, 1814, the interior of both wings was destroyed by British incendiaries, but they were immediately rebuilt. In 1818 the central portion of the building was commenced under the architectural superintendence of Charles Bulfinch, and the original building was finally completed in 1827. Its cost, including the grading of the grounds, alterations and repairs, up to 1827, was $2,433,844.13.



THE NATIONAL CAPITOL.

The corner-stone to the extensions of the Capitol was laid on July 4, 1851, by President Fillmore, Daniel Webster officiating as orator of the day. Thomas U. Walter was architect, and subsequently Edward Clark, under whose direction the work was completed in November, 1867. The material used for the extensions is white marble from the quarries at Lee, Mass., with white marble columns from the quarries at Cockeysville, Md.

The dome of the original central building was constructed of wood, but was removed in 1856 to be replaced by the present stupendous structure of cast iron, which was completed in 1865. The entire weight of iron used is 8,909,200 pounds.

The main building is 352 feet 4 inches long in front and 121 feet 6 inches deep, with a portico 160 feet wide, of 24 columns on the east and a projection of 83 feet on the west, embracing a recessed portico of 10 coupled columns. The extensions are placed at the north and south ends of the main building, with connecting corridors 44 feet long by 56 feet wide, flanked by columns. Each extension is 142 feet 8 inches in front, by 238 feet 10 inches deep, with porticos of 22 columns each on their eastern fronts, and with porticos of 10 columns on their ends and on their western fronts. The entire length of the building is 751 feet 4 inches, and the greatest depth, including porticos and steps, is 324 feet. The area covered by the entire building is 153,112 square feet.

The dome is crowned by a bronze statue of Freedom, modeled by Crawford, which is 19 feet 6 inches high, and weighs 14,985 pounds. The height of the dome above the base-line of the east front is 287 feet 11 inches; the height from the top of the balustrade of the building is 217 feet 11 inches; and the greatest diameter at the base is 135 feet 5 inches.

The rotunda is 95 feet 6 inches in diameter, and its height from the floor to the top of the canopy is 180 feet 3 inches.

The Senate Chamber is 112 feet in length, by 82 feet in width, and thirty feet in height. Its galleries will accommodate 1,000 persons.

The Representatives' Hall is 130 feet in length, by 93 feet in width, and 30 feet in height.

The Supreme Court room was occupied by the Senate until December, 1859, the court having previously occupied the room beneath, now used as a law library.

[The Library of Congress was burned by the British in 1814, and was partially destroyed by an accidental fire in 1851. The present center hall was finished in 1853, and the wing halls were finished in 1867. The Library of Congress occupies the entire western projection of the central Capitol building. The original Library was commenced in 1800, but was destroyed with the Capitol in 1814, during the war with England. It was afterward replenished by the purchase of the library belonging to ex-President Jefferson, by Congress, embracing about 7,000 volumes. In 1851 it contained 55,000 volumes, and by an accidental fire in that year the whole collection was destroyed, except 20,000 volumes. It was rebuilt in 1852, when $75,000 was appropriated in one sum to replenish the collection. The library is recruited by regular appropriations made by Congress, which average about $11,000 per annum; also by additions received by copyright, by exchanges, and from the Smithsonian Institution.] A new edifice of ample dimensions, and of beautiful architectural design, is now in process of erection near the Capitol, into which the Congressional Library will be early transferred.

The basement story of the Capitol contains 73 rooms, of which 24 are in the "House Wing," 26 in the "Main Wing," and 23 in the "Senate Wing." Many of the rooms are designated severally for the use of the various committees.

The principal story of the Capitol contains 48 rooms. Of these 17 are in the "House Wing," and include the hall of the House of Representatives; the "Main Wing" has 12 chief rooms, including the "Old Hall of Representatives," now used as a "Statuary Hall" (to which each State has been invited to contribute 2 statues of its most distinguished citizens); the "Congressional Library" (subdivided into various departments); the "Supreme Court-room," and the "Rotunda."

The "Senate Wing" contains 19 chief rooms, including the "Senate Chamber," the "President's Room," "Vice-President's Room," etc., etc.

The attic story embraces 42 rooms, designated chiefly for committees, documents, and as "lobbies."

The diagrams on page 1556 furnish a clear view of the two chief legislative halls.

EXPORTS TO AND IMPORTS FROM VARIOUS COUNTRIES.

The following table shows for the year 1889-90 the values of the exports of domestic merchandise to and the imports from the following countries, according to the United States returns:—

Country.	Home Exports to 1889-90.	Imports from 1889-90.
Great Britain and Ireland	$444,459,009	$186,488,956
Germany	84,315,215	98,837,683
France	49,013,004	77,672,311
British North America	38,544,454	39,396,980
Belgium	26,140,377	9,395,489
Netherlands	22,487,588	17,029,233
Spain	12,736,273	5,288,587
Italy	13,974,249	20,330,051
Russia	10,661,581	3,409,879
British Australasia	11,168,081	4,277,676
Cuba	12,669,509	53,801,591
Mexico	12,666,108	22,690,915
British West Indies	8,074,433	14,865,018
Brazil	11,902,496	59,318,756
Argentine Republic	6,322,627	5,401,697
Colombia	2,522,351	3,575,258
Portugal	3,891,780	1,418,309
China	2,943,790	16,260,471
Hayti	4,101,464	2,421,221
Japan	5,227,186	21,103,324
Central, America	5,104,275	8,052,444
British East Indies	4,555,256	20,804,319
Hong Kong	4,434,641	969,745
Africa	3,778,076	1,501,058
Hawaii	4,606,900	12,313,908
Venezuela	3,984,290	10,966,765
Denmark	5,037,290	258,508
Chili	3,219,465	3,183,249
Dutch East Indies	1,799,306	5,791,250
Guianas	2,439,184	4,918,736
Uruguay	3,210,112	1,754,908
Austria-Hungary	945,703	9,331,378
Turkey in Europe, Asia, and Africa	176,986	4,622,779
Philippine Islands	122,276	11,592,626
Switzerland	22,170	14,441,960

NATIONAL DEBT OF THE UNITED STATES.

The official statement of the Public Debt of the United States showed the following summaries on the morning of November 1, 1891:

Interest-bearing Debt	$585,026,720 00
Debt on which interest had ceased	6,209,230 26
Debt-bearing interest	389,074,025 85
Total Debt	$980,309,976 11
Cash in Treasury	$740,530,258 68
Demand Liabilities	600,858,338 64
Net Balance in Treasury	$139,671,920 04

The cash in Treasury consisted of gold, $263,774,741.81; silver, $410,116,967.91; paper currency and certificates, $45,763,786.76; other deposits, $20,874,762.12; total, $740,530,258.68.

The Demand Liabilities was for gold, silver, and currency certificates, treasury notes, fund for redemption of National Bank notes, outstanding checks, balance of disbursing offices and agencies, etc.

Deducting the net balance in Treasury, $139,671,920.04, from the total debt ($980,309,976.11) leaves the net debt Nov. 1, 1891, at $840,638,056.07.

ASSESSED VALUATION OF PROPERTY IN THE UNITED STATES.

The assessed valuation of real and personal property in the several States and Territories for 1880 and 1890, together with the increase of the assessed valuation during the last decade, is shown in the following table:

States and Territories.	Total assessed valuation.		Increase of assessed valuation.
	1880.	1890.	
Total	$16,902,993,543	$24,249,589,804	$7,346,596,261
Alabama	122,867,228	197,080,441	74,213,213
Arizona	9,270,214	21,434,767	12,164,553
Arkansas	86,409,364	†172,408,497	85,999,133
California	584,578,036	1,071,102,327	486,524,291
Colorado	74,471,693	188,911,325	114,439,632
Connecticut	327,177,385	358,913,906	31,736,521
Delaware	59,951,643	†74,134,401	14,182,758
District of Columbia	99,401,787	153,307,541	53,905,754
Florida	30,938,309	76,926,938	45,988,629
Georgia	239,472,599	377,366,784	137,894,185
Idaho	6,440,876	25,581,305	19,140,429
Illinois	‡786,616,394	‡727,416,252	§59,200,142
Indiana	727,815,131	782,872,126	55,056,995
Iowa	398,671,251	†478,318,248	79,646,997
Kansas	160,891,689	290,593,711	129,702,022
Kentucky	350,563,971	512,615,506	162,051,535
Louisiana	160,162,439	234,320,780	74,158,341
Maine	235,978,716	309,129,101	73,150,385
Maryland	497,307,675	482,184,824	§15,122,851
Massachusetts	1,584,756,802	2,154,134,626	569,377,824
Michigan	517,666,359	¶945,450,000	427,783,641
Minnesota	258,028,687	588,531,743	330,503,056
Mississippi	110,628,129	†157,518,906	46,890,777
Missouri	532,795,801	786,343,753	253,547,952
Montana	18,609,802	106,392,892	87,783,090
Nebraska	90,585,782	184,770,305	94,184,523
Nevada	29,291,459	24,663,385	§4,628,074
New Hampshire	164,755,181	252,722,016	87,966,835
New Jersey	572,518,361	688,309,187	115,790,826
New Mexico	11,363,406	†46,041,010	34,677,604
New York	2,651,940,006	3,775,325,938	1,123,385,932
North Carolina	156,100,202	212,697,287	56,597,085
North Dakota	8,786,572	78,394,536	69,607,964
Ohio	1,534,360,508	1,778,138,457	243,777,949
*Oklahoma	....	....	....
Oregon	52,522,084	166,025,731	113,503,647
Pennsylvania	1,683,459,016	2,592,841,032	909,382,016
Rhode Island	252,536,673	321,764,503	69,227,830
South Carolina	133,560,135	132,182,638	§1,377,497
South Dakota	11,534,958	131,592,587	120,057,629
Tennessee	211,778,538	347,510,103	135,731,565
Texas	320,364,515	695,842,320	375,477,805
Utah	24,775,279	104,758,750	79,983,471
Vermont	86,806,775	161,551,328	74,744,553
Virginia	308,455,135	362,422,741	53,967,606
Washington	23,810,693	†124,795,449	100,984,756
West Virginia	139,622,705	169,927,587	30,304,882
Wisconsin	438,971,751	592,890,719	153,918,968
Wyoming	43,621,829	†31,431,195	17,809,666

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*The assessed valuation of Oklahoma not being given, the population of that territory is omitted in calculating the assessed valuation per capita for 1890 of the United States.

†Annual report of 1889.

‡The state board of equalization declares that in 1880 the assessed value was 50 per cent. and in 1890 only 25 per cent. of the true value, hence the reduction.

§Decrease.

¶Assessment of 1886: assessment made every 5 years.

UNITED STATES CENSUS.

The act of Congress providing for taking the eleventh (1890) and subsequent censuses was approved by President Cleveland March 1, 1888. It provided that the census should be taken June 1, 1890, and on successive days, and create the office of Superintendent of the Census with an annual salary of $6,000. Subsequently Robert P. Porter, of New York, was appointed Superintendent by President Harrison, and later a list of professional experts was selected and charged with supervising severally the various departments of the work. Their names appear in their reports embraced in the several volumes included in the General Census Report.

The work of enumerating and tabulating the people and preparing the numerous reports for the press requires many months, and at this writing (October, 1891,) has been reported to the public only in part. The first volume, it is expected, will give all the data as to population by States, counties and towns, nativity, color, etc.; volume two, health and physical condition, vital and mortality statistics; volume three, public schools, illiteracy, pauperism and crime, and churches and religious denominations; volume four, trades and professions; volume five, survivors of the late war; volume six, wealth, taxation, public indebtedness, and estimated values of property; volume seven, indebtedness of business corporations and individuals, including mortgage indebtedness; volume eight, agricultural statistics; volume nine, manufactures; volume ten, mines and mining; volume eleven, fish and fisheries; volume twelve, transportation, railways, navigation, telegraphs and telephones; volume thirteen, insurance.

PRODUCTION OF GOLD AND SILVER IN UNITED STATES.

The total production of gold and silver in the country was as follows during each of the years from 1885 to 1889:—

Year.	Gold.	Silver.	Total.
1885	$31,081,000	$51,600,000	$83,401,000
1886	35,000,000	51,000,000	86,000,000
1887	33,100,000	53,441,300	86,541,300
1888	33,175,000	59,195,000	92,370,000
1889	32,800,000	64,646,464	97,446,464

The precious metals are raised mainly in California for gold; and Colorado, Arizona, Utah, Nevada, and Montana for silver. The total value of gold deposited at the mints and assay offices from 1793 to 1887 is estimated at $1,334,609,150, and the silver at $423,655,811.

In 1889-90 gold (domestic product) to the value of $49,228,823, and weighing 32,430,151 standard ounces, were deposited.

For other mining and mineral statistics see the several topics in these Revisions and Additions.

IMPORTS AND EXPORTS OF MERCHANDISE.

The following table shows the total values of imports and exports of merchandise for the years named severally ending June 30:—

Years.	Imports of Merchandise.	Exports of Merchandise.
1879	$445,777,775	$698,340,790
1886	635,436,136	665,964,529
1887	692,319,768	703,022,923
1888	723,957,114	683,862,104
1889	745,131,652	730,282,609
1890	789,222,228	845,293,828

IMPORTS AND EXPORTS OF GOLD AND SILVER.

The following table gives the total value of gold and silver bullion and specie imported into the United States, and the value of that exported, being the product of the States, in the years ended June 30, 1879 and 1886-90:—

Year.	Imports of Species.	Exports of Domestic and Foreign Species.
1879	$20,296,000	$24,997,441
1886	38,593,656	72,463,410
1887	60,170,792	35,997,691
1888	59,337,986	46,414,183
1889	28,963,073	96,641,533
1890	33,976,326	52,148,490

POPULATION OF THE UNITED STATES IN 1890 AND 1880 BY STATES AND GROUPS OF STATES.

States and Territories.	1890.	1880.	Number.	Percentage.
The United States	62,480,540	50,155,783	12,324,757	24.57
North Atlantic divis'n	17,364,429	14,507,407	2,857,022	19.69
Maine	660,261	648,936	11,325	1.75
New Hampshire	375,827	346,991	28,836	8.31
Vermont	332,205	332,286	*81	*0.02
Massachusetts	2,233,407	1,783,085	450,322	25.26
Rhode Island	345,343	276,531	68,812	24.88
Connecticut	745,861	622,700	123,161	19.78
New York	5,981,934	5,082,871	899,063	17.69
New Jersey	1,441,017	1,131,116	309,901	27.40
Pennsylvania	5,248,574	4,282,891	965,683	22.55
South Atlantic divis'n	8,836,750	7,597,197	1,239,553	16.32
Delaware	167,871	146,608	21,263	14.50
Maryland	1,040,431	934,943	105,488	11.28
District of Columbia	229,796	177,624	52,172	29.37
Virginia	1,648,911	1,512,565	136,346	9.01
West Virginia	760,448	618,457	141,991	22.96
North Carolina	1,617,340	1,399,750	217,590	15.54
South Carolina	1,147,161	995,577	151,584	15.23
Georgia	1,834,366	1,542,180	292,186	18.96
Florida	390,435	269,493	120,942	44.88
North Central division	22,322,151	17,364,111	4,958,040	28.55
Ohio	3,666,719	3,198,062	468,657	14.65
Indiana	2,189,030	1,978,301	210,729	10.65
Illinois	3,818,536	3,077,871	740,665	24.06
Michigan	2,089,792	1,636,937	452,855	27.66
Wisconsin	1,683,697	1,315,497	368,200	27.99
Minnesota	1,300,017	780,773	519,244	66.50
Iowa	1,906,729	1,624,615	282,114	17.36
Missouri	2,677,080	2,168,380	508,700	23.46
North Dakota	182,425	36,909	145,516	394.26
South Dakota	327,848	98,268	229,580	233.63
Nebraska	1,056,793	452,402	604,391	133.60
Kansas	1,423,485	996,096	427,389	42.91
South Central division	10,948,253	8,919,371	2,028,882	22.75
Kentucky	1,855,436	1,648,690	206,746	12.54
Tennessee	1,763,723	1,542,359	221,364	14.35
Alabama	1,508,073	1,262,505	245,568	19.45
Mississippi	1,284,887	1,131,597	153,290	13.55
Louisiana	1,116,828	939,946	176,882	18.82
Texas	2,232,220	1,591,749	640,471	40.24
Indian Territory†	.....	.....	.....	.....
Oklahoma	161,701	.....	61,701	.....
Arkansas	1,125,385	802,525	322,860	40.23
Western division	3,008,948	1,767,697	1,241,251	70.22
Montana	131,769	39,159	92,610	236.50
Wyoming	60,589	20,789	39,800	191.45
Colorado	410,975	194,327	216,648	111.49
New Mexico	144,862	119,565	25,297	21.16
Arizona	59,691	40,440	19,251	47.60
Utah	206,498	143,963	62,535	43.44
Nevada	44,327	62,266	*17,939	*28.81
Idaho	84,229	32,610	51,619	158.29
Alaska§	.....	.....	.....	.....
Washington	349,516	75,116	274,400	365.30
Oregon	312,490	174,768	137,722	78.80
California	1,204,002	864,694	339,308	39.24

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* Decrease.

† The number of white persons in the Indian Territory is not included in this table, as the census of Indians and other persons on Indian reservations, which was made a subject of special investigation by law, has not yet been completed.

‡ Including 5,237 persons in Greer county (in Indian Territory) claimed by Texas.

§ The number of white persons in Alaska is not included in this table, as the census of Alaska, which was made a subject of special investigation by law, has not yet been completed.

INDUSTRIES AND OCCUPATIONS.

MANUFACTURING AND MECHANICAL INDUSTRIES.

	Establishments.	Capital.	Hands.	Wages.	Materials.	Products.
Agricultural Implements	1,943	$62,109,668	39,580	$15,359,610	31,531,170	68,640,486
Boots and Shoes	18,329	58,973,665	143,296	53,821,164	128,565,798	217,088,627
Brick and Tile	5,631	27,673,678	66,355	13,443,532	9,744,834	32,833,587
Carpets	195	21,468,587	20,371	6,835,218	18,984,877	31,792,802
Chemicals	1,349	85,394,211	29,520	11,840,704	77,471,836	117,377,324
Coke	149	5,545,058	3,142	1,198,654	2,996,441	5,359,489
Cotton Manufactures	756	208,280,346	172,544	42,040,510	102,206,347	192,090,110
Flour and Grist-mill products	24,338	177,361,878	58,408	17,422,316	441,545,225	505,185,712
Glass	211	19,844,699	24,177	9,144,100	8,028,621	21,154,571
Hosiery and Knit Goods.	359	15,749,591	28,885	6,701,475	15,210,951	29,167,227
Iron and Steel (aggregate)	1,005	230,971,884	140,978	55,476,785	191,271,150	296,557,685
Bessemer and Open-Hearth	36	20,975,939	10,835	4,930,349	36,826,928	55,806,210
Leather	5,424	77,100,574	34,865	14,049,556	145,255,716	184,089,663
Lumber (sawed)	25,708	181,186,122	147,956	31,845,971	146,155,385	233,268,729
Musical Instruments	129	11,446,765	11,250	7,008,794	8,351,227	19,254,739
Paper	692	46,241,202	24,422	8,525,355	33,951,297	55,109,914
Patent Medicines	563	10,620,880	4,025	1,651,596	6,704,729	14,682,494
Printing and Publishing	3,467	62,983,704	58,478	30,531,657	32,460,395	90,789,341
Sash, Door, and Blinds	1,288	20,457,670	21,896	8,540,930	20,790,919	36,621,325
Sewing Machines	106	12,501,830	9,553	4,686,099	4,829,106	13,863,188
Ship-building	2,188	20,979,874	21,345	12,713,813	19,736,358	36,800,327
Silk	382	19,125,213	31,337	9,146,705	22,467,701	41,033,045
Slaughtering and Meat-packing	872	49,419,213	27,297	10,508,530	267,738,902	303,562,413
Tobacco	7,674	89,995,292	87,577	25,051,457	65,384,407	118,670,166
Woolen Goods*	1,990	96,095,564	86,504	25,836,392	100,845,611	160,606,721
Worsted Goods	76	20,374,043	18,803	5,683,027	22,013,628	33,549,942

* Exclusive of carpets, felt goods, gloves and mittens, hosiery and knit goods, mixed textiles, wool hats, and worsted goods.

OCCUPATIONS OF THE PEOPLE.

From the Official Returns of the Tenth Census, 1880.

ENGAGED IN AGRICULTURE.

	1870.	1880
Agricultural laborers	2,885,996	3,323,876
Apiarists	136	1,016
Dairymen, dairywomen	3,550	8,948
Farm overseers	3,609	3,106
Farmers and planters	2,977,711	4,225,945
Florists	1,085	4,550
Gardeners, nursery, and vine growers	32,547	51,482
Stock-drovers	3,181	3,449
Stock-herders	5,590	21,098
Stock-raisers	6,588	16,528
Turpentine farmers and laborers	2,478	7,450
Others in agriculture		45
Total	5,922,471	7,670,493

PROFESSIONAL AND PERSONAL SERVICES.

	1870.	1880.
Actors	2,053	4,812
Architects	2,017	3,375
Artists, teachers of art	4,071	9,104
Auctioneers	2,266	2,331
Authors, lecturers and literary persons	846	1,131
Barbers, hair-dressers	24,794	44,851
Billiard and bowling saloon keepers	1,230	1,543
Boarding, lodging-house keepers	12,785	19,058
Chemists, assayists, metallurgists	608	1,960
Clergymen	43,874	64,698
Clerks and copyists	6,138	25,167
in gov't offices	8,672	16,840
in hotels, restaurants	5,243	10,916
Collectors, claim agents	693	4,213
Dentists	8,505	12,314
Designers, draughtsmen	934	2,820
Domestic servants	975,734	1,075,653
Employés of char. inst.	848	2,396
of government	14,407	31,401
of hotels, restaurants	24,138	77,413
Engineers (civil)	7,374	8,261
Hostlers	17,586	31,097
Hotel keepers	26,394	32,453
Hunters, trappers, guides and scouts	1,111	1,912
Janitors	1,769	6,763
Journalists	5,286	12,308
Laborers (not specified)	1,032,853	1,859,223
Launderers, laundresses	60,906	121,942
Lawyers	40,736	64,137
Livery-stable keepers	8,504	14,218
Messengers	8,717	18,985
Midwives	1,186	2,118
Musicians (professional)	16,010	30,477
Nurses	10,976	13,483
Officers, Army and Navy	2,286	2,090
Officials of government	44,743	67,061
Physicians and surgeons	62,445	85,671
Restaurant keepers	35,185	13,074
Sextons	1,151	2,449
Showmen, showwomen	1,177	2,604
Soldiers and sailors	23,338	24,161
Teachers and scientists	128,160	227,710
Veterinary surgeons	1,166	2,130
Watchmen (private and detectives)	....	13,394
Whitewashers	2,837	3,346
Other professions	....	4,570
Total	2,684,793	4,074,238

MANUFACTURING AND MINING.

	1870.	1880.
Ag'l implem't makers	3,811	4,891
Apprentices to trades	15,992	44,170
Artificial-flower makers	1,169	3,329
Bag-makers	866	1,408
Bakers	27,680	41,309
Basket makers	5,237	5,654
Blacksmiths	141,774	172,726
Bleachers, dyers, scourers	4,901	8,212
Bl'nd, do'r, sash makers	5,155	4,946
Bootmakers	2,101	2,063
Bone and ivory workers	208	1,888
Bookbinders, finishers	9,104	13,882
Boot and shoemakers	171,127	194,079
Bottlers, min. wat. m'k's	....	2,081
Box-factory operators	6,080	15,762
Brass founders, workers	4,694	11,568
Brewers and maltsters	11,246	16,927
Brick and tile makers	26,070	36,052
Bridge b'ld'rs, con'trs	1,029	2,587
Brit., Jap. ware makers	1,092	1,375
Broom, brush makers	5,816	8,470
Builders, contractors	7,511	10,804
Butchers	44,354	76,241
Butter fact'y operatives	1,272	4,872
Cabinet makers	42,835	50,654
Candle, soap, tal. mk'rs	1,942	2,253
Car-makers	2,228	1,708
Carpenters and joiners	344,596	373,143
Carpet-makers	15,669	17,068
Carriage and wagon mkrs	42,464	49,881
Charcoal and lime burs.	3,834	5,851
Cheese makers	3,534	4,570
Chemical w'ks employés	....	2,928
Cigar-makers	28,286	56,599
Clerks and book-keepers in manuf. houses	5,861	10,114
Clock and watch makers	1,779	13,820
Confectioners	8,219	13,692
Coopers	41,789	49,138
Copper-workers	3,122	2,342
Corset makers	....	4,690
Cotton-mill operatives	111,606	169,771
Distillers and rectifiers	2,874	3,245
Employés (not specified)	20,242	34,796
Engineers and firemen	34,233	79,625
Engravers	4,226	4,377
Fertilizer establishment operatives	316	1,383
File mak'rs, cut'rs, grin'rs	1,418	1,838
Fishermen, oystermen	27,549	41,352
Flax dressers	1,046	1,894
Fur-workers	1,191	1,580
Galloon, gimp and tassel makers	569	2,235
Gas-works employés	2,086	4,693
Gilders	1,534	1,763
Glass-works operat'ves	9,518	17,934
Glove-makers	2,329	4,511
Gold and silver workers	18,508	28,405
Gun and locksmiths	8,184	10,572
Hair cleaners, dressers	1,026	1,965
Harness and saddle mkrs	32,817	39,960
Hat and cap makers	12,625	16,860
Hosiery and knitting mill operatives	3,653	12,194
Iron and steel works and shop operatives	86,203	114,589
Lace makers	....	1,708
Lead and wire works	....	2,106
Leather case and pocket-book makers	....	1,342
Leather curriers, dressers finishers and tanners	30,078	29,842
Lumbermen, raftsmen.	17,752	30,651
Machinists	54,755	101,130
Manufacturers	42,877	44,019
Marble and stone cutters	25,831	32,842
Masons, brick and stone.	89,710	102,473
Meat and fruit preserving employés	770	2,800

Meat packers, curers and picklers	1,164	3,436
Mechanics (not specified)	16,514	7,858
Mill and factory operatives (not specified)	41,619	80,836
Millers	41,582	53,440
Milliners, dress-makers and seamstresses	92,084	285,401
Miners	152,107	234,228
Mirror, pic. frame m'k'rs	970	2,503
Nail makers		5,808
Officials mfg. and mining companies	9,720	8,198
Oil, mill, and refinery operatives	1,747	3,929
Oil-well operators and laborers	8,803	7,240
Organ makers	667	2,437
Painters and varnishers	85,123	128,556
Paper hangers	2,490	5,013
Paper mill operatives	12,469	21,430
Pattern makers	3,970	5,822
Photographers, etc	7,558	9,990
Piano forte makers and tuners	2,535	5,413
Plasterers	23,577	22,083
Plumbers and gas-fitters	11,143	19,383
Potters	5,069	7,233
Printers, litho., stereo	41,073	72,726
Print-work operatives	3,738	5,419
Pub. of books, maps, etc.	1,577	2,781
Pump-makers	1,672	1,366
Quarrymen	18,589	15,169
Quartz, stamp-mill lab'rs	617	1,449
Rag-pickers	436	2,306
Railroad build., cont'rs	1,292	1,206
Roofers and slaters	2,750	4,036
Rope, cordage makers	2,675	3,514
Rubber-factory oper	3,886	6,350
Sail and awning makers	2,309	2,950
Salt-makers	1,721	1,431
Saw, planing-mill oper	47,298	77,050
Sawyers	6,939	5,195
Scale and rule makers	416	1,027
Screw-makers	780	1,361
Sewing machine fac. op.	3,881	2,725
Sewing machine oper's	3,042	7,505
Shingle and lath makers	3,788	5,160
Ship carpenters, calkers, riggers and smiths	21,074	17,452
Shirt, cuff, collar makers	4,080	11,823
Silk-mill operatives	3,256	18,071
Starch makers	220	1,385
Stave and headi'g mak'rs	1,858	4,061
Steam-boiler makers	6,958	12,771
Stove, furnace and grate makers	1,543	3,311
Straw-workers	2,029	4,229
Sugar-makers, refiners	1,600	2,327
Tailors and tailoresses	161,820	133,756
Thread-mill operatives		3,259
Tinners, and tinware makers	30,524	42,818
Tobacco-factory oper.	11,985	20,146
Tool, cutlery makers	5,351	13,749
Trunk and valise makers	2,017	3,013
Umbrella and parasol makers	1,439	1,967
Upholsterers	5,736	10,448
Wheelwrights	20,942	15,592
Wire-makers and work'rs	1,834	7,170
Woodchoppers	8,238	12,731
Wood-turners, carvers, wooden-ware makers	7,947	12,964
Woolen-mill operatives	58,836	88,010
Others in mfg., mechanical and mining indus.	8,270	13,542
Total manuf. and mining	2,707,421	3,837,112

TRADE AND TRANSPORTATION.

	1870	1880.
Agents	10,449	18,523
Bankers and brokers	10,631	15,180
Boatmen and watermen	21,332	20,968
Brokers (commercial)		4,193
Canalmen	7,338	4,329
Clerks in stores	254,359	353,444
Clerks and book-keepers in banks	7,103	10,227
Clerks and book-keepers in express companies	767	1,856
Clerks and book-keepers in insurance offices	1,568	2,830
Clerks and book-keepers in railroad offices	7,374	12,331
Commercial travelers	7,262	28,158
Draymen, hackmen, teamsters, etc	120,756	177,586
Employés and officials of trading and transportation companies	4,152	9,702
Employés of banks (not clerks)	424	1,070
and officials of express compan's (not clerks)	8,629	13,004
of insur. compan's (not clerks)	11,611	13,116
in warehouses	....	5,022
of railroad companies (not clerks)	154,027	236,058
Hucksters and peddlers	34,337	53,491
Milkmen and m. women	3,726	9,242
Newspaper criers and carriers	2,002	3,374
Officials and employés of trading and transportation companies	976	9,702
Officials of banks	2,738	4,421
Officials of insur. comp	762	1,771
Officials of railroad comp	1,902	2,069
Officials and employés of St. R'y companies	5,191	11,925
Officials and employés of telegraph companies	8,579	22,809
Officials and employés of telephone companies	....	1,197
Packers	1,894	4,176
Pilots	3,649	3,770
Porters, lab's, in stores, warehouses	3,513	32,193
Sailors	56,663	60,070
Salesmen, saleswomen	14,203	72,279
Saloon-k'rs, bar-tenders	14,362	68,461
Shippers and freighters	3,567	5,166
Steamboat men, women	7,975	12,365
Stewards, stewardesses	1,245	22,808
Toll gate, bridge keep'rs	2,268	2,308
Traders and dealers (not specified)	101,271	112,842
Traders in ag. implem'ts	1,089	1,909
in books, stationery	3,392	4,982
in boots, shoes	7,019	9,998
in cabinet ware	4,087	7,119
in cigars, tobacco	8,284	11,866
in clothing	7,595	10,073
in coal, wood	6,636	10,871
in cotton, wool	1,701	2,494
in crockery, china, glass, stoneware	1,765	2,373
in drugs and medicines	17,369	27,704
in dry and fancy goods	40,958	45,831
in gold, silverware, jewelry	6,786	2,305
in groceries	74,410	101,849
in hats, caps	3,375	4,809
in ice	1,464	2,854
in iron, tin, copper wares	9,008	15,076
in junk	...	3,574
in leather, hides, skins	2,361	2,382
in liquors and wines	11,178	15,500
in live stock	7,723	12,596
in lumber	9,440	11,263
in marble, stone, slate	....	1,405
in music and musical instruments	848	1,906
in newspapers, periodicals	1,455	2,729
in oils, paints, turpentine	986	1,940
in paper, paper stock	...	1,862
in produce, provisions	19,337	35,129
in real estate	8,023	11,253
in sewing machines	3,152	6,577
Undertakers	1,996	5,118
Weighers, gaugers, measurers	926	3,302
Others in trade and transportation	....	177
Total trade and transp	1,191,238	1,810,256

SUMMARY OF OCCUPATIONS BY STATES.

States and Territories.	Agriculture.	Professional Services.	Trades and Transportation.	Mfg. and Mech. trades, and Mining.
Alabama	380,630	72,211	16,953	22,996
Arizona	3,425	8,210	3,252	7,574
Arkansas	216,655	23,406	9,233	11,528
California	79,396	121,435	57,392	118,292
Colorado	13,630	24,813	15,491	47,408
Connecticut	44,026	51,296	29,920	116,091
Dakota	28,508	14,016	6,219	9,501
Delaware	17,849	17,646	4,967	14,148
Dist. Columbia	1,164	39,975	9,848	15,287
Florida	56,731	17,923	6,446	8,436
Georgia	432,204	104,259	25,222	36,167
Idaho	3,858	3,861	1,327	6,532
Illinois	436,471	229,467	128,372	205,570
Indiana	331,240	137,281	56,482	110,227
Iowa	303,557	103,932	50,872	69,941
Kansas	206,080	53,507	26,370	36,319
Kentucky	320,571	104,239	35,568	61,481
Louisiana	205,306	96,111	29,120	30,681
Maine	82,130	47,411	29,790	72,962
Maryland	90,927	98,264	49,234	85,237
Massachusetts	64,973	170,160	115,576	370,295
Michigan	240,319	143,249	54,723	130,913
Minnesota	131,535	59,452	24,349	31,789
Mississippi	339,938	49,448	12,975	13,115
Missouri	355,297	146,588	79,300	109,771
Montana	4,513	6,954	2,766	8,022
Nebraska	90,507	28,706	15,106	18,225
Nevada	4,180	10,573	4,149	13,231
New Hampshire	44,490	28,206	11,735	58,167
New Jersey	50,214	110,722	66,582	160,561
New Mexico	11,139	19,042	3,264	4,577
New York	377,460	537,897	330,119	620,869
North Carolina	360,937	69,321	15,956	33,963
Ohio	397,495	250,371	104,315	242,294
Oregon	27,101	16,645	6,149	17,458
Pennsylvania	301,112	446,713	179,965	528,277
Rhode Island	10,645	24,657	15,217	66,160
South Carolina	294,602	64,246	13,556	19,698
Tennessee	294,153	94,107	23,628	36,082
Texas	359,317	97,561	34,909	30,346
Utah	14,550	11,144	4,149	10,219
Vermont	55,251	28,174	8,945	26,214
Virginia	254,099	146,564	30,418	63,060
Washington	12,781	6,940	3,405	7,296
West Virginia	107,578	31,680	10,653	26,288
Wisconsin	195,901	97,491	37,530	86,510
Wyoming	1,639	4,011	1,545	1,689
U. S.—Total, 1880	7,670,493	4,074,238	1,810,256	3,837,112
Total, 1870	5,922,471	2,684,793	1,191,238	2,707,421
Increase in 10 yrs.	1,748,022	1,389,445	619,018	1,129,691
" per ct. "	29.51	51.75	51.96	41.79

RELATIVE RANK OF STATES AND TERRITORIES IN RESPECT OF POPULATION.

The subjoined lists show the relative order of rank of the forty-four states and of four territories in 1890; also the order and rank of the states and territories in 1880. Indian Territory and Alaska are not included. The District of Columbia is included in both lists:

	1890.		1880.
1	New York.	1	New York.
2	Pennsylvania.	2	Pennsylvania.
3	Illinois.	3	Ohio.
4	Ohio.	4	Illinois.
5	Missouri.	5	Missouri.
6	Massachusetts.	6	Indiana.
7	Texas.	7	Massachusetts.
8	Indiana.	8	Kentucky.
9	Michigan.	9	Michigan.
10	Iowa.	10	Iowa.
11	Kentucky.	11	Texas.
12	Georgia.	12	Tennessee.
13	Tennessee.	13	Georgia.
14	Wisconsin.	14	Virginia.
15	Virginia.	15	North Carolina.
16	North Carolina.	16	Wisconsin.
17	Alabama.	17	Alabama.
18	New Jersey.	18	Mississippi.
19	Kansas.	19	New Jersey.
20	Minnesota.	20	Kansas.
21	Mississippi.	21	South Carolina.
22	California.	22	Louisana.
23	South Carolina.	23	Maryland.
24	Arkansas.	24	California.
25	Louisiana.	25	Arkansas.
26	Nebraska.	26	Minnesota.
27	Maryland.	27	Maine.
28	West Virginia.	28	Connecticut.
29	Connecticut.	29	West Virginia.
30	Maine.	30	Nebraska.
31	Colorado.	31	New Hampshire.
32	Florida.	32	Vermont.
33	New Hampshire.	33	Rhode Island.
34	Washington.	34	Florida.
35	Rhode Island.	35	Colorado.
36	Vermont.	36	District of Columbia.
37	South Dakota.	37	Oregon.
38	Oregon.	38	Delaware.
39	District Columbia.	39	Utah (Ter.).
40	Utah (Ter.).	40	Dakota (Ter.).
41	North Dakota.	41	New Mexico (Ter.).
42	Delaware.	42	Washington (Ter.).
43	New Mexico (Ter.).	43	Nevada.
44	Montana.	44	Arizona (Ter.).
45	Idaho.	45	Montana (Ter.).
46	Oklahoma (Ter.).	46	Idaho (Ter.).
47	Wyoming.	47	Wyoming (Ter.).
48	Arizona (Ter.).		
49	Nevada.		

It will be seen that, as in 1880, New York still led the list in 1890, and was followed by Pennsylvania. Ohio and Illinois had exchanged places. Of the other changes in the list the most marked were those of Texas, which had risen from No. 11 to No. 7; Kentucky, which dropped from 8 to 11; Minnesota, which had risen from 26 to 20; Nebraska, which had risen from 30 to 26; Maryland, which dropped from 23 to 27; Colorado, which had risen from 35 to 31; Vermont, which had dropped from 32 to 36; Washington, which had risen from 42 to 34; Delaware, which had dropped from 38 to 42; Nevada, which had dropped from 43 to 49, and Arizona, which had dropped from 44 to 48.

CENTER OF POPULATION* OF THE UNITED STATES.

The center of population is the center of gravity of the population of the country, each individual being assumed to have the same weight. The method of determination used, in order that the result might be comparable with that obtained in 1880, was in brief as follows:

The population of the country was first distributed by "square degrees," as the area included between consecutive parallels and meridians has been designated. A point was then assumed tentatively as the center, and corrections in latitude and longitude to this tentavive position were computed. In this case the center was assumed to be at the intersection of the parallel of 39° with the meridian of 86° west of Greenwich. The population of each square degree was assumed to be located at the center of that square degree, except in cases where it was manifest that this assumption would be untrue, as, for instance, where a part of the square degree was occupied by the sea or other large body of water, or where it contained a city of considerable magnitude which was situated "off center." In these cases the position of the population of the square degree was estimated as nearly as possible. The distance of each such center of population of a square degree, whether assumed to be at the center of the square degree or at a distance from the center, from the assumed parallel, and from the assumed meridian, were then computed. The population of each square degree was then multiplied by its distance from the assumed parallel of latitude, and the sum of the products, or moments, north and south of that parallel made up. Their difference, divided by the total population of the country, gave a correction to the latitude. In a similar manner the east and west moments were made up, and from them a correction in longitude was obtained.

In 1790 the center of population was at 39° 16.5' north latitude and 76° 11.2' west longitude, which a comparison of the best maps available would seem to place about twenty-three miles east of Baltimore. During the decade of 1790 to 1800 it appears to have moved almost due west to a point about eighteen miles west of the same city, being in latitude 39° 16.1' and longitude 76° 56.5'.

From 1800 to 1810 it moved westward and slightly southward to a point about forty miles northwest by west from Washington, being in latitude 39° 11.5' and longitude 77° 37.2'. The southward movement during this decade appears to have been due to the annexation of the territory of Louisiana, which contained quite extensive settlements.

From 1810 to 1820 it moved westward and again slightly southward to a point about sixteen miles north of Woodstock, Virginia, being in latitude 39° 5.7' and longitude 78° 33'. This second southward movement appears to have been due to the extension of settlement in Mississippi, Alabama and eastern Georgia.

From 1820 to 1830 it moved still westward and southward to a point about nineteen miles southwest of Moorefield, in the present State of West Virginia, being in latitude 38° 57.9' and longitude 79° 16.9'. This is the most decided southward movement that it has made during any decade. It appears to have been due in part to the addition of Florida to our territory and in part to the great extension of settlements in Louisiana, Mississippi, and Arkansas, or generally, it may be said, in the southwest.

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* Furnished by Henry Gannett to the Census Department, Washington, D. C., Feb. 18, 1891.

POSITION OF THE CENTER OF POPULATION.

Years.	North latitude.	West longitude.	Approximate locations by important towns.	Westward movement during preceding decade.
1790	39° 16.5′	76° 11.2′	23 miles east of Baltimore, Maryland	
1800	39 16.1	76 56.5	18 miles west of Baltimore, Maryland	41 miles.
1810	[illegible] 11.5	77 37.2	40 miles northwest by west of Washington, District of Columbia	36 do.
1820	[illegible] 5.7	78 33.0	16 miles north of Woodstock, Virginia	50 do.
1830	38 57.9	79 16.9	19 miles west-southwest of Moorefield, West Virginia	39 do.
1840	[illegible] 2.0	80 18.0	16 miles south of Clarksburg, West Virginia	55 do.
1850	38 59.0	81 19.0	23 miles southeast of Parkersburg, West Virginia	55 do.
1860	39 0.4	82 48.8	20 miles south of Chillicothe, Ohio	81 do.
1870	39 12.0	83 35.7	48 miles east by north of Cincinnati, Ohio	42 do.
1880	39 4.1	84 39.7	8 miles west by south of Cincinnati, Ohio	58 do.
1890	39 11.9	85 32.9	20 miles east of Columbus, Indiana	48 do.

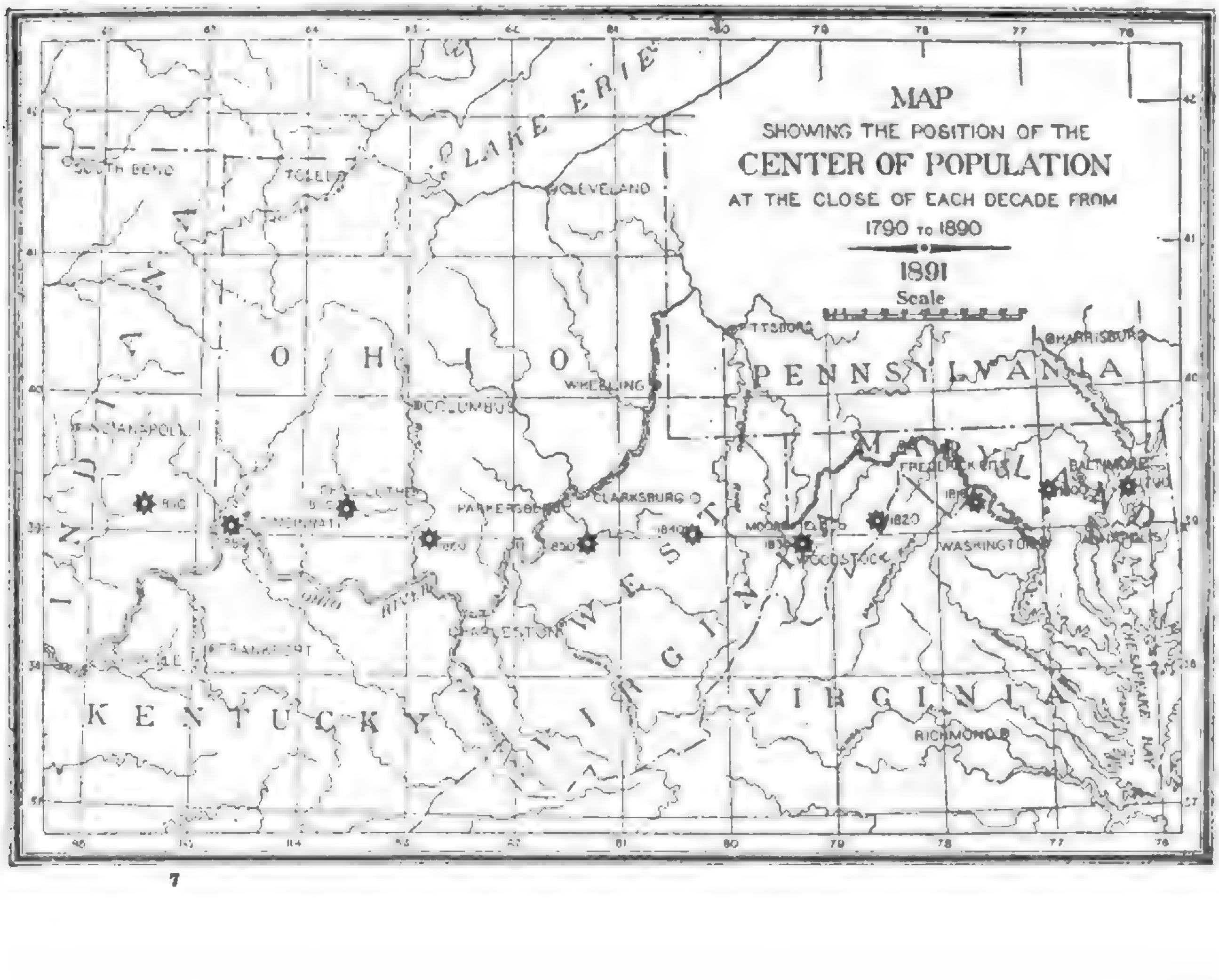
From 1830 to 1840 it moved still further westward, but slightly changed its direction northward, reaching a point sixteen miles south of Clarksburg, West Virginia, being in latitude 39° 2′ and longitude 80° 18′. During this decade settlement had made decided advances in the prairie states and in the southern portions of Michigan and Wisconsin, the balance of increase settlement evidently being in favor of the northwest.

From 1840 to 1850 it moved westward and slightly southward again, reaching a point about twenty-three miles southeast of Parkersburg, West Virginia, in latitude 38° 59′ and longitude 81° 19′, the change of direction southward being largely due to the annexation of Texas.

From 1850 to 1860 it moved westward and slightly northward, reaching a point twenty miles south of Chillicothe, Ohio, this being in latitude 39° 0.4′, longitude 82° 48.8′.

From 1860 to 1870 it moved westward and sharply northward, reaching a point about forty-eight miles east by north of Cincinnati, Ohio, in latitude 39° 12′, longitude 83° 35.7′. This northward movement was due in part to waste and destruction in the South consequent upon the civil war, and in part probably to the fact that the census of 1870 was defective in its enumeration of the Southern people, especially of the newly-enfranchised colored population.

In 1880 the center of population had returned southward to nearly the same latitude which it had in 1860, being in latitude 39° 4.1′, longitude 84° 39.7′ This southward movement was due only in part to an imperfect enumeration at the South in


MAP
SHOWING THE POSITION OF THE
CENTER OF POPULATION
AT THE CLOSE OF EACH DECADE FROM
1790 TO 1890
1891
Scale
LAKE ERIE
SOUTH BEND
TOLEDO
CLEVELAND
INDIANA
OHIO
INDIANAPOLIS
COLUMBUS
WHEELING
PITTSBURG
HARRISBURG
PENNSYLVANIA
MARYLAND
FREDERICK CITY
BALTIMORE
WASHINGTON
CHILLICOTHE
CINCINNATI
PARKERSBURG
CLARKSBURG
MOOREFIELD
WOODSTOCK
1890
1880
1870
1860
1850
1840
1830
1820
1810
1800
1790
OHIO RIVER
CHARLESTON
FRANKFORT
WEST VIRGINIA
VIRGINIA
KENTUCKY
RICHMOND
CHESAPEAKE BAY

1870. During the decade between 1870 and 1880 the Southern States made a large positive increase, both from natural growth and from immigration southward.

During the past decade the center of population has moved northward into practically the same latitude which it occupied in 1870. It has moved westward 58′ 13″, or forty-eight miles, being less by ten miles than its movement during the preceding decade, six miles greater than the movement between 1860 and 1870, and slightly less than the average westward movement since the first census, its present position being in latitude 39° 11′ 56″ and longitude 85° 32′ 53″. The most salient point of its progress during the past decade is the northing which has been made, which is doubtless due to the great development in the cities of the Northwest and in the State of Washington, and in no small degree to the increase of population in New England.

The center of the area of the United States excluding Alaska is in Northern Kansas, in approximate latitude 39° 55′ and approximate longitude 98° 50′. The center of population is therefore about three-fourths of a degree south and more than seventeen degrees east to the center of area.

The table and map, on page 1563, show the movement of the center of population since 1790.

White and Colored Population of the South.

The Southern States, in which comparisons are usually made between the white and colored population, embrace seventeen states and the District of Columbia. The abnormal increase of the colored population in what is known as the "Black Belt" during the decade ending in 1880 led to the popular belief that the negroes were increasing at a much greater rate than the white population. This error was a natural one, and arose from the difficulty of ascertaining how much of the increase shown by the Tenth Census was real, and how much was due to the omissions of the census of 1870. The census reports of the Southern States and of the District of Columbia, by decades for the last half century, are given in the subjoined table:

Years.	Population.		Number of colored to 100,000 white.	Per cent. of increase.	
	White.	Colored.		White.	Colored.
1790	1,271,488	680,884	54,258	....	....
1800	1,702,980	918,336	53,925	33 94	33.11
1810	2,208,785	1,272,119	57,594	29 70	38.52
1820	2,831,560	1,653,240	58,186	28 20	29.96
1830	3,660,758	2,187,545	59,757	29 28	32.32
1840	4,632,530	2,701,901	58,325	26 55	23.51
1850	6,222,418	3,442,238	55,320	34 32	27.40
1860	8,203,852	4,216,241	51,393	31 84	32.49
1870	9,812,732	4,555,990	46,429	19 61	8.06
1880	13,530,408	6,142,360	45,397	37 89	34.82
1890	16,868,205	6,996,166	41,475	24 67	13.90

It will be seen that in 1890, there were in the states under discussion 6,996,166 colored inhabitants, and in 1880, 6,142,360. The colored element increased during the decade at the rate of 13.90 per cent. The white population of these states in 1890 numbered 16,868,205, and in 1880, 13,530,408. They increased during the decade at the rate of 24.67 per cent, or nearly twice as rapidly as the colored element. In 1880 the proportion of white to persons of color in these states was in the relation of 100,000 to 45,397. In 1890 the proportion of the latter class had diminished, being then as 100,000 to 41,475. During the last decade the colored race has not held its own against the white in a region where the climate and conditions are, of all those which the country affords, the best suited to its development.

Referring again to this table, it is seen that in but three decades, that is, from 1800 to 1830, during a part of which time the slave trade was in progress, has the colored race increased more rapidly than the white. Since 1830 the white people have steadily increased at a more rapid rate than the colored. This increase has not been effected by the aid of immigration, for with the exception of Kansas and Missouri these states have received comparatively few immigrants either from foreign countries or from the Northern States.

Similarly the proportion of the colored inhabitants to the white increased somewhat between 1800 and 1830, but since that time it has steadily diminished. In 1830, when this proportion was at its maximum, there were nearly six colored inhabitants to ten white, but this proportion has been reduced to a trifle more than four at the present date, or by nearly one-third of its amount.

The Census Department states that the deficiencies of the Ninth Census are so apparent in this table that any extended reference to them is wholly unnecessary.

Of the total colored population in 1890 there were 2,581 Chinese, 100 Japanese, and 8,207 ("civilized" and counted) Indians, leaving of the African race 6,996,166.

Population of the State of California by Race.

In 1890 a special count by race was made by the United States Census Office, for the State of California in order to separate the Chinese and Indians from the rest of the population, as required by the laws of that State, for the purposes of State apportionment. The results of this special count showed that, for the State as a whole, the white population had increased from 767,181 in 1880, to 1,111,558 in 1890, an increase of 344,377, or 44.89 per cent. The colored population in the State showed an increase during the decade of 5,419, or 90.05 per cent, while there had been a decrease in the Chinese of 3,451, or 4.59 per cent. The whole number of Indians in the State was less in 1890 than in 1880 by 3,922, or a decrease of 24.10 per cent. The number of Japanese in 1890, as compared with 1880, was large, although relatively small as compared with the whole population. The number of Japanese returned in 1890 was 1,099, as against 86 in 1880. The total population of the State for 1890 was 1,208,130, as compared with 864,694 for 1880, the increase being 343,436, and the per cent of increase 39.72.

Population With Reference to Mean Annual Temperature.

In the following table from census reports of 1890 (furnished by Henry Gannett, of Washington, D. C., from data contributed by Gen. A. W. Greely and other officers of the U. S. Weather Bureau) the 1st column shows the degrees of temperature; the 2d, 3d, and 4th columns a distribution of population in accordance with the isothermal lines, subject to the supposition that the entire population of the country was at each date 100,000 persons, or, in other words, these columns show the percentage of the population which was at the date designated living between the various isothermal lines, the computation being carried out to the thousandth of 1 per cent. The 5th and 6th columns show the change in the number from census to census under the same assumption that the entire population

POPULATION WITH REFERENCE TO MEAN ANNUAL TEMPERATURE.

Degrees of Temperature.	Number in 100,000 Inhabitants.			Change in Number 100,000.		Number in 100,000 Above Each Group.			Density of Population.			Increase in Density of Population.	
	1890.	1880.	1870.	1880-'90.	1870-'80.	1890.	1880.	1870	1890	1880.	1870.	1880-'90	1870-'80.
Below 40	1,653	1,155	919	498	236	1,653	1,155	919	4,699	2,635	1,612	2,064	1,023
40 to 45	8,180	7,413	7,119	767	294	9,833	8,568	8,038	12,515	9,105	6,722	3,410	2,383
45 to 50	27,423	27,324	28,986	99	—1,662	37,256	35,892	37,024	28,610	22,866	18,650	5,744	4,216
50 to 55	31,583	32,396	33,182	—813	—786	68,839	68,288	70,206	31,024	25,545	20,113	5,479	5,432
55 to 60	13,775	14,230	13,723	—455	507	82,614	82,518	83,929	22,780	18,888	14,005	3,892	4,883
60 to 65	9,865	9,982	9,152	—117	830	92,479	92,500	93,081	17,893	14,532	10,240	3,361	4,292
65 to 70	6,279	6,262	5,662	17	600	98,758	98,762	98,743	14,161	11,234	7,881	2,927	3,452
70 to 75	1,210	1,216	1,242	—6	—26	99,968	99,978	99,985	7,493	6,015	4,702	1,478	1,293
Above 75	32	22	15	10	7	100,000	100,000	100,000	3,597	2,009	1,034	1,588	975

was 100,000. The 7th, 8th, and 9th columns show the number of inhabitants, the total population being assumed at 100,000, living under temperate conditions below each of the several groups. The 10th, 11th, and 12th columns show the density of population, *i. e.*, the number of inhabitants per square mile in each of the several groups, while the last two columns show the increase in density.

A glance at above table will show that in 1870, 1880, and 1890 more than half the population was living under a temperature between 45 and 55 degrees, and that between 45 and 60 degrees were found from 70 to 75 per cent of the inhabitants. Only a trifle over one per cent were living where the temperature was greater than 70 degrees, while in the region whose mean annual temperature was above 75 degrees the number of inhabitants was trifling. The number of inhabitants to the square mile not only expresses the density of popluation, but also gives a comparative measure of the absolute number and the increase in absolute number. The greatest density is and has been since 1870, where the temperature ranges from 50 to 55 degrees. From this as a maximum it diminishes rapidly both with an increase and decrease of temperature. The most rapid proportional increase in population has taken place at the two extremes, where it has trebled during the twenty years intervening between 1870 and 1890, while in the same time it has increased but about 50 per cent in the most densely-settled group.

The average annual temperature of the territory of the United States, excluding Alaska from consideration, is 53 degrees. The average annual temperature under which the people of the country live, taking into account the density of settlement, is practically the same.

DISTRIBUTION OF POPULATION IN ACCORDANCE WITH TOPOGRAPHIC FEATURES.

The following table based on an exceedingly instructive subdivision of the territory of the United States into areas differing in the character of their surface, their products, and their climate, and classifying the population in accordance therewith, has been condensed from a department of the Census of 1890 prepared by Henry Gannett, Geographer and Agent of the Census Department. The classification covers the population of the official census of 1890, 1880, and 1870.

Regions.	Population in Thousands.			Density of Population per sq. mile in 1890.
	1890.	1880.	1870.	
Coast swamps	1,809	1,569	1,284	31.5
Atlantic plain	8,784	711.3	5,546	74'4
Piedmont region	7.858	6,660	5,168	60.5
New England hills	2,290	2.171	1,905	40.7
Appalachian Mountain region	2,849	2.346	1,959	49.6
Cumberland - Allegheny plateau.	5,749	4.787	3,940	59.8
Interior timber region	11.292	9,891	7.976	44.3
Lake region	3,578	2,507	1,722	25.1
Ozark Mountain region	1,041	784	473	22.8
Alluvial region of the Mississippi.	885	683	460	28.6
Prairie region	13,048	9.777	6,715	28.3
Great Plains	737	[illegible]	73	1.4
North Rocky mountains	153	60	290	1.1
South Rocky mountains	247	192	78	2.1
Plateau region	110	81	29	0.7
Basin region	408	252	149	1.4
Columbian mesas	210	91	[illegible]	1.9
Sierra Nevada	146	136	111	4.9
Pacific valley	135	248	166	9.1
Cascade range	179	54	30	5.5
Coast ranges	810	552	328	14.3

Topographical Description.—Coast Swamps.

These swamps are found along the South Atlantic and Gulf coasts, extending inland to varying distances, in some places as much as a hundred miles. They have the greater breadth in North Carolina and Louisiana, but border the coast nearly all the way from southeast Virginia to the mouth of the Rio Grande, Texas. Upon the Atlantic coast the surface of these swamps, while exceedingly level, has ample slope for drainage, and accordingly as the land becomes valuable their borders are being drained and converted into farms. In the Carolinas a considerable area of them is utilized for rice plantations. In the main they are well timbered, principally with cypress and juniper, among which is a luxuriant growth of cane. The population of this region is mainly of the colored race, the climate being very unhealthy for the white race.

Atlantic Plain.

The Atlantic plain comprises the strip of land lying between the Coast swamps and the fall line throughout the Atlantic States south of New York and the Gulf States as far as the Mississippi River. It is characterized by a level surface, a low elevation, scarcely reaching two hundred feet above the sea, is underlaid by recent sedimentary rocks, and except where they have been removed by the hands of man is covered with pine forests.

Piedmont Region.

This region comprises a strip of country extending from Main to Alabama, lying between the fall line on the east and the Blue Ridge on the west. It is underlaid by metamorphic rocks and forested with a mixed growth of broad and narrow leaf trees. The lower portion is comparatively level, being broken only by the beds of streams, but in the neighborhood of the Blue Ridge and throughout New England it is hilly.

New England Hills.

This name has been applied to the hill country in the upper part of New England, including all of the upper part of Maine, the White Mountains of New Hampshire, the Green Mountains of Vermont, and the Adirondacks of New York, all of which is a broken, mountainous country, ranging in elevation from one to six thousand feet, and covered with forests.

Appalachian Mountain Region.

This region includes the Blue Ridge and the Appalachian valley lying immediately north and west of it, and extends from New Jersey to Alabama and Georgia. The Blue Ridge, consisting of a single range throughout Pennsylvania, Maryland, and Virginia, expands in North Carolina into a very complex mass of mountains, and there reaches its maximum elevation, namely, 6,700 feet. The Appalachian valley is drained in New Jersey and Pennsylvania by the Delaware and Susquehanna rivers, in Virginia by the Potomac, the James, and Kanawha rivers, and in Tennessee mainly by the Tennessee River. It is traversed by numerous ranges, some of them assuming the dignity of seperate mountain ranges, and all of them running closely parallel to one another and to the general direction of the valley.

Cumberland-Allegheny Plateau.

Rising from the northwest border of the Appalachian valley is an escarpment extending more or less continuously from northeastern Pennsylvania down through Maryland, Virginia, and Tennessee into Alabama. From the summit of this escarpment a plateau stretches with a general northwestern slope. This plateau is everywhere deeply scored by streams with a general northwesterly direction. These streams have cut the plateau into a mass of very irregular ridges and gorges, making it one of the most intricate mountain regions on the globe. The entire region is densely covered with forests, the hand of man having removed but a very small part of them.

Interior Timbered Region.

This region comprises southern Ohio and Indiana, the western half of Kentucky and Tennessee, and the northeastern part of Mississippi, together with small areas in adjoining states. It possesses no characteristic features beyond the fact that except in the settled regions it is covered with forests.

Lake Region.

A narrow strip of country bordering on the Great Lakes has been segregated under this name. It includes small parts of New York, Pennsylvania, and Ohio, and most of Michigan, Wisconsin, and northern Minnesota. Owing to the proximity of large bodies of water this region has many of the characteristics of a coast climate. The atmosphere being moist, the winters are abnormally warm and the summers abnormally cool. This region contains great pine forests, which are still serving as a main source of supply of that timber.

Ozark Mountain Region.

This region is located in northwest Arkansas, southwest Missouri, and the eastern part of Indian territory. In Arkansas it is made up of a succession of narrow ranges 2,000 to 3,000 feet high having a generally east and west trend, separated by somewhat broad valleys. Further to the northeast, in Missouri, the hills become merely a confused mass, without order or system.

Alluvial Region of the Mississippi.

This region extends in a rapidly widening strip from Cairo, at the mouth of the Ohio, to the coast swamps in Louisiana, into which it merges without any sharp line of demarcation. It includes parts of the states of Missouri, Arkansas, Mississippi, and Louisiana, besides a trifling area in Kentucky and Tennessee. Much the larger portion of it is marshy, and is below the level of the waters in the rivers. The dry land lies mainly along the immediate banks of the streams, having been formed by deposition from overflows. With the exception of the cultivated land this region is entirely covered with forests. The soil is of the highest degree of fertility, but the climate is hostile to the white race, and by far the larger proportion of its inhabitants are of the colored race.

Prairie Region.

This region comprises a small portion of western Indiana, most of Illinois and Iowa, southern Wisconsin and Minnesota, northern Missouri, eastern Dakota, Kansas, and Nebraska, and extends in a broad belt down through the Indian territory and Texas.

On the east it merges by insensible degrees into the forest-clad regions, and on the west by equally insensible degrees into the Great Plains. It is a region of transition from the one to the other. Its climate is such that without protection forests can not thrive. Before the advent of man various unfavorable conditions, among which forest fires were the most prominent, prevented the growth of forests in this region.

Its surface is level or slightly undulating, and was, in its natural state, covered with luxuriant grasses, but timber growth was scarce, and was confined almost entirely to the bluffs and the borders of streams. With the protection afforded by man the growth of forests has increased in this region, until now it presents a landscape, diversified by a tree growth, whose extent is constantly increasing. It is the granary of the country.

Great Plains.

Merging with the prairie region by insensible degrees are the Great Plains, extending from approximate longitude 99° to the foot of the Rocky Mountains, and from the Canadian border to the Rio Grande. It is a region devoid of timber, except in the narrowest strips along certain streams, but sparsely covered with bunch grass, changing in the more arid regions to sage, artemisia, cactus, and yucca. Its surface is a monotonous, billowy expanse, broken only here and there by lines of cliffs and buttes.

Throughout this region the rainfall is insufficient for the needs of agriculture, and irrigation is necessary for the cultivation of the soil. The supply of water in the flowing streams is sufficient to irrigate only a small part of the land, and the extent to which settlement is possible will in the future become therefore a question of the abundance of water and not of land.

Cordilleran Region.

The Cordilleran region is naturally subdivided into districts, which differ from one another in certain features and have other features in common. Except in the extreme northwest, in Washington, Western Oregon, and Northwest California, the climate is arid and the rainfall is insufficient for agriculture. This aridity of climate and deficency of rainfall increase southward and reach a maximum in Southern Nevada, California, and Arizona. The prevalence of forests accompanies the rainfall. Upon the northwest coast and inland as far as the Cascade range in Oregon and Washington the country is densely covered with forests of great trees. This forest belt extends inland through Northern Washington and Idaho into the mountainous region of Montana, and thence southeastward, accompanying the mountain ranges into the Yellowstone Park. Elsewhere no forests are found except upon the mountains, and in the more arid regions of the south even the mountains are bare to their summits. The valleys produce only the vegetation characteristic of an arid region. Where the rainfall is abundant bunch grass is found, but as the rainfall diminishes and the dryness of the atmosphere increases, the vegetation of the valleys changes to artemisia, cactus, yucca, and other desert plants.

Rocky Mountain Region.

This region, including the easternmost portion of the Cordilleran system, comprising Western Montana, Eastern Idaho, Western Wyoming, Central Colorado and New Mexico, with a little of Texas, is composed of a series of ranges separated by valleys of greater or less breadth, trending parallel to one another a little west of north and east of south. It is naturally subdivided into two parts. The northern part extends from Canada southeastward into Central Wyoming; thence for a distance of a hundred miles or thereabouts the mountain ranges disappear, leaving in their place only broad plateaus. The ranges reappear in Southern Wyoming and extend thence southward. In the northern part the mountains range from nine to thirteen thousand or more feet in altitude, rising from a base of four or five thousand feet. In the southern part the base is much higher, rising in Colorado to six or eight thousand feet, with high mountain valleys reaching 10,000 feet above the sea, while many of the ranges exceed 14,000 feet in altitude. Both the general level of the country and the mountain ranges diminish in altitude southward.

Plateau Region.

This region comprises most of the drainage basin of the Colorado River above the mouth of the Virgin in Southern Nevada. It is a region of great plateaus, whose surfaces are level or slightly inclined, and which terminate with great lines of cliffs, in some cases thousands of feet in height. From the mountains which border this range on the east, north and west, these plateaus descend by a succession of gigantic steps from an elevation of twelve thousand feet down to one or two thousand feet above the sea. Every stream is in a cañon, and as the rainfall is light and spasmodic a great majority of these cañons are dry during the greater part of the year. In many regions these cañons are so abundant as to have reduced the plateau to a mere skeleton, or the process of erosion may have gone still further, so that nothing is left of the upper plateau but fragments in the form of mesas and buttes.

The higher plateaus in the neighborhood of the mountains are green and forested from the abundant rainfall. The lower plateaus, on the other hand, have only the sparsest vegetation or are absolutely sterile.

Basin Region.

In the interior of the Cordilleran region is an area comprising practically all of Nevada, Western Utah, part of Eastern California, and Southern Oregon, which has no drainage to the sea. It is a closed basin. The only discharge of its waters is by sinking into the thirsty soil or by evaporation into the thirsty atmosphere. This is the most desert part of the country, with the exception of the course of the lower Colorado and Gila rivers. The rainfall is scanty even upon the mountains; so scanty, indeed, that there are but two or three running streams of any magnitude within it. Its surface is diversified by many ranges of mountains having a general parallel trend, rising from flat valleys filled with alluvium. These ranges divide the basin into numerous minor basins, in each of which water collects and sinks. In the eastern part the largest basin is that known as the Great Salt Lake, into which several small streams flow from the Wasatch Mountains. In the western part the principal basin is that of the Humboldt River. The elevation of the floor of the basin ranges from 6,000 feet near its middle line, downward, reaching in Death Valley, in Eastern California, an elevation of 200 feet below the level of the sea.

Columbian Mesas.

The drainage basin of the Snake River, in Idaho, Oregon, and Washington, together with a part of the basin of the Columbia, in the latter state, has been in great part covered by eruptions of basalt, which, bursting out of the soil at various points, has spread over the country, forming a table-land.

Sierra Nevada.

Separating the Great Basin from the California valley, in eastern California, is a broad, heavy forest-covered range of mountains with long slopes to the west and an abrupt ascent to the east.

Pacific Valley.

West of the Cascade range and the Sierra Nevada and stretching from Puget sound to southern California is a valley drained in Oregon by the Willamette and in California by the Sacramento and San Joaquin rivers. In its southern part, south of the latitude of the Bay of San Francisco, the climate is such that irrigation is necessary, while north of it the rainfall is sufficient, and in Oregon and Washington is more than sufficient for the farmer's needs. Where the rainfall is insufficient this valley is treeless, but farther north, and especially in Oregon and Washington, it is covered with dense forests.

Cascade Range.

Stretching northward in line with the Sierra Nevada, but distinguished sharply from it by the character of its formation, is the Cascade range. It is a series of extinct volcanoes, rising from a high plateau of volcanic rock. This range is densely forested.

Coast Ranges.

Separating this valley from the Pacific is a succession of ranges trending parallel with the coast and known as the Coast ranges. In southern California the valleys among these ranges are of the highest degree of fertility and produce grapes and tropical fruits in profusion. Farther north the country is but little settled or even explored.

DISTRIBUTION OF POPULATION WITH REFERENCE TO MEAN ANNUAL RAINFALL.

In 1890 Mr. Gannett obtained (from reports furnished chiefly through the Weather Bureau from nearly 2,000 stations) data from which he platted upon a map of the United States the curves of mean annual rainfall, at intervals of ten inches, sketched in accordance with their indications, and supplemented by his knowledge of the relief of the country and its known influence upon rainfall. From the map thus prepared the counties falling between the different curves of mean annual rainfall were drawn off in lists. In cases where the county was cut in parts by a curve, due weight was given in the partition of the county to any inequality in distribution of population. The population was then distributed by counties in accordance with the lists. The result is shown in the table below.

In this table the first column shows the grades, expressed in inches of rainfall; the second, third, and fourth columns, the number of inhabitants found in each grade in 1890, 1880, and 1870, assuming that the total population at each of the above periods was one hundred thousand, or, in other words, the percentage of the population in each of these grades at the periods under consideration, carrying the figures out to the thousandth of 1 per cent; the fifth and sixth columns show the increase or decrease in number; the seventh, eighth, and ninth columns show the number of inhabitants in each one hundred thousand above each grade, and therefore are cumulative columns; the tenth, eleventh, and twelfth columns show the density of population in each grade in 1890, 1880, and 1870, and the last two columns show the increase in population per square mile.

It will be noticed that the main body of the population of the country inhabits the region in which the annual rainfall is between 30 and 50 inches, three-fourths of the inhabitants or thereabouts being found there. On either side, as the rainfall increases or diminishes, the population diminishes rapidly. It will be seen further that the arid region of the west, where the rainfall is less than 20 inches—a region which comprises two-fifths of the entire area of the country—contains at present less than 3 per cent of the population.

The greatest density of population is in the area enjoying from 40 to 50 inches of annual rainfall, the average of this region being 59 inhabitants to the square mile. Next to that is the area having from 30 to 40 inches, where the density is 43.1. The density of population has increased rapidly in these regions. It is apparent, however, that the most rapid increase, as expressed by density of population, is where the rainfall ranges from 20 to 30 inches; that is in the eastern portion of the Great Plains ranging from Texas to the Dakotas where the density has increased in twenty years from 1.6 to 8.1.

The average annual rainfall upon the surface of the United States, as deduced from the map previously mentioned, is 29.6 inches. The average annual rainfall with relation to the population, deduced by giving weight to each area of country in proportion to the number of its inhabitants, was in 1870, 42.5 inches; in 1880 it had diminished to 42 inches, and in 1890 to 41.4 inches, the diminution being caused mainly by the settlement of the Great Plains and the arid regions of the west.

DISTRIBUTION OF POPULATION IN ACCORDANCE WITH MEAN RELATIVE HUMIDITY OF ATMOSPHERE.

On the coast of Oregon and Washington, the atmosphere is more highly charged with moisture than elsewhere within our territory. The high mountain regions of the Appalachian and to a considerable extent those of the Rocky mountain ranges also have a moist atmosphere. The moisture is less in the Piedmont region east of the Appalachians and in the upper Mississippi valley. Passing across the prairie and the great plains, the amount of moisture in the atmosphere diminishes still more, while the minimum is reached in the Great Basin, in Utah, Nevada, southern Arizona, and southeastern California. In a general way, the amount of moisture in the atmosphere increases and decreases with the rainfall, but this is not always the case. The upper lake region, with an atmosphere as moist as that of Washington city, has a much smaller rainfall. The coast of

Inches of Rainfall.	Number in 100,000 Inhabitants.			Change in Number in 100,000 Inhabitants.		Number in 100,000 Above Each Grade.			Population per square mile.			Increase in Population per square mile.	
	1890.	1880.	1870.	1880-'90.	1870-'80.	1890.	1880.	1870.	1890.	1880.	1870.	1890-'90.	1870-'80.
Below 10	300	276	192	+22	+86	300	276	192	0.8	0.6	0.3	0.2	0.3
10 to 20	2,612	1,385	949	+1.227	+436	2,910	1,663	1,142	1.8	0.8	0.4	1.0	0.4
20 to 30	6,038	4,343	1,909	+1,695	+2,434	8,948	6,006	3,060	8.1	4.7	1.6	3.4	[illegible]
30 to 40	34,107	34,969	36,644	−862	−1,678	43,056	40,975	39,695	43.1	35.5	28.6	7.6	[illegible]
40 to 50	39,459	40,984	42,719	−1,525	−1,735	82,515	81,959	82,414	59.0	49.2	39.4	9.8	[illegible]
50 to 60	16,164	16,734	16,212	−570	+532	98,679	98,693	98,626	25.1	20.9	15.5	4.2	5.4
60 to 70	1,274	1,271	1,358	+3	−87	99,958	99,965	99,979	18.1	14.5	11.9	3.6	2.6
Above 70	55	35	17	−30	+18	100,000	100,000	100,000	4.1	2.1	0.8	2.0	1.3

southern California, with a deficient rainfall, has as moist an atmosphere as the Atlantic coast.

In the following table the first column defines the classes of population grouped by percentages of saturation of the atmosphere in the sections in which the people reside; the second gives the number of inhabitants in each class expressed in round thousands; the third, the percentage of increase during the last decade; the fourth, the percentage of total population; the fifth, the density of population, or the population per square mile in each class.

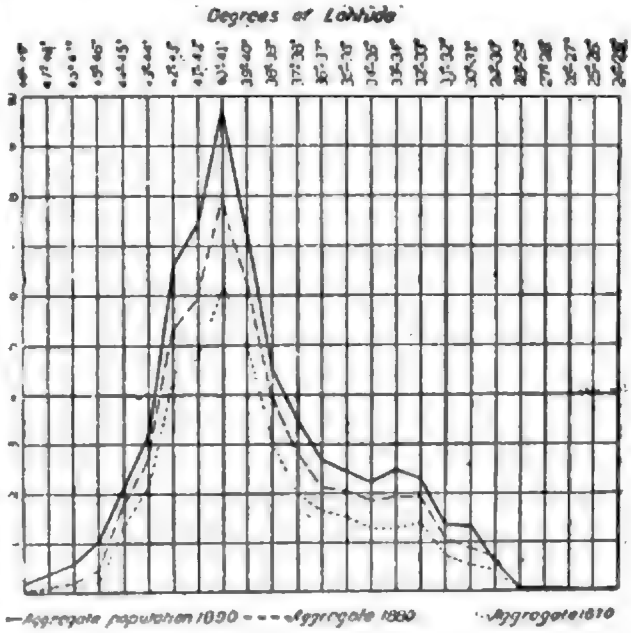
Class.	Pop. in Class.	Per Cent. of Increase.	Per Cent. of Total Population.	Density.
Below 50...	2,309,000	341.10	0.49	1.14
50 to 55.....	433,000	114.36	0.69	1.44
55 to 60	291,000	117.16	0.46	1.35
60 to 65	868,000	97.72	1.39	2.89
65 to 70	22,969,000	19.14	36.68	31.46
70 to 75	34,067,000	24.28	54.40	40.07
75 to 80.....	3,341,000	39.03	5.34	14.21
Above 80...	344,000	72.00	0.55	5.55

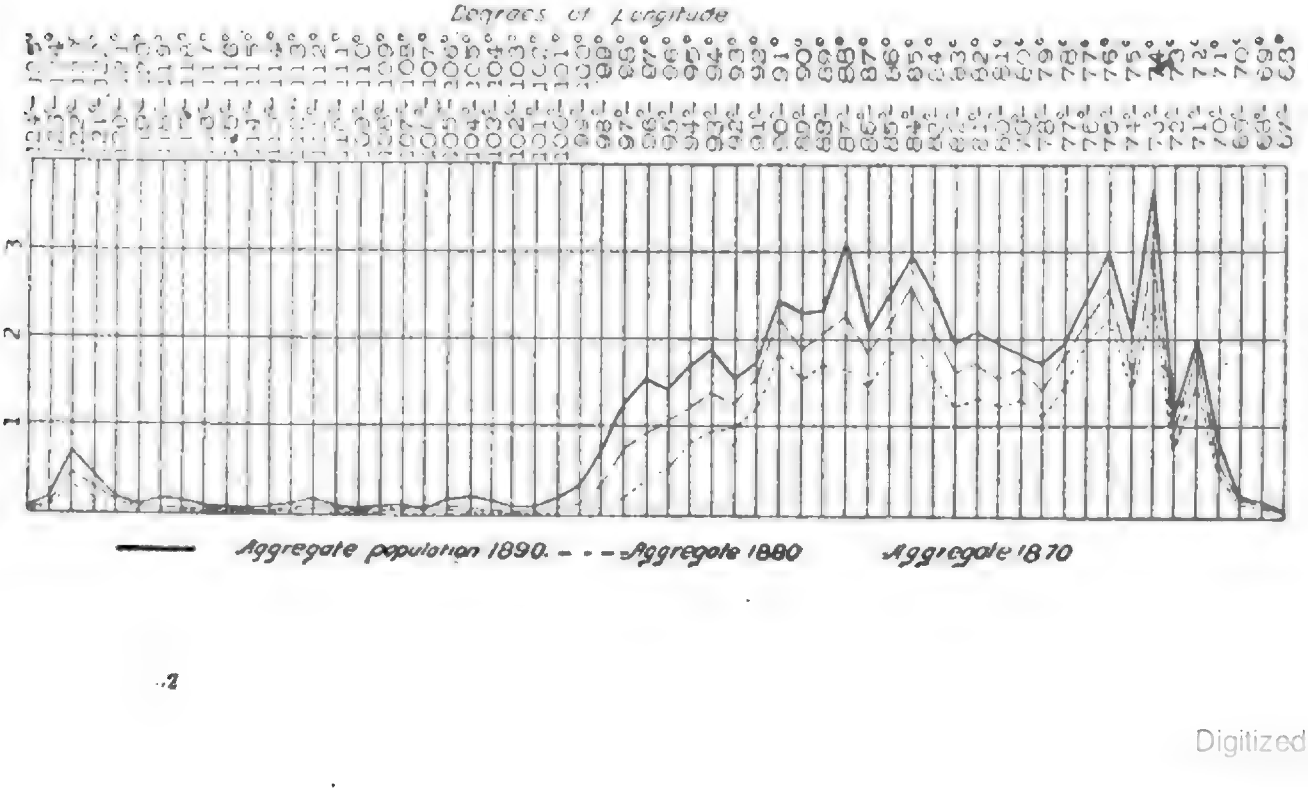
A glance at this table shows that nearly all the population breathe an atmosphere containing 65 to 75 per cent. of its full capacity of moisture; that is, the atmosphere is from two-thirds to three-fourths saturated. In 1890, 57,036,000 out of 62,622,250 were found in this region. The number of inhabitants living in a drier atmosphere was at the date of the census comparatively trifling, numbering in 1890 less than two millions. In the moister atmosphere were found larger numbers scattered along the Gulf coast and the shores of Washington and Oregon.

DISTRIBUTION OF POPULATION IN RESPECT OF LATITUDE AND LONGITUDE.

The following diagrams show the distribution of population of the United States with respect of latitude and longitude at the dates severally of the last three censuses. They were prepared for the report of the census of 1890 by Henry Gannett, Geographer and Special Agent of the Census Department.

Naturally the greater density of population in a square degree is governed by the location of the larger cities. Thus the two square degrees between latitudes 40° and 41° and longitudes 73° and 75°, comprising New York, Brooklyn, Jersey City, and other large cities, contain 3,653,000 inhabitants. The square degree between latitudes 42° and 43° and longitudes 71° and 72°, comprising Boston and its suburbs, has 1,238,000 inhabitants; that between latitudes 39° and 40° and longitudes 75° and 76°, in which is most of Philadelphia, has 1,414,000, while that between latitudes 41° and 42° and longitudes 87° and 88°, in which is situated most of Chicago, contains 950,000 people.





AREA AND POPULATION OF DRAINAGE BASINS OF THE UNITED STATES.

The following table was prepared by Henry Gannett, Geographer and Special Agent of the Census Department:

Drainage Basins.	Approximate area in square miles.	Population 1890.	Population per square mile.
Atlantic Ocean	2,178,210	60,220,763	27 6
New England coast	61,830	4,486,813	72.6
Saint John river	7,890	53,381	6.8
Penobscot river	8,934	113,179	12 7
Kennebec river	10,102	236,553	23 4
Merrimac river	4,864	616,594	126 8
Connecticut river	11,269	782,216	69.4
Housatonic river	1,933	251 701	130 2
Middle Atlantic coast	83,020	11,482,411	138 3
Hudson river	13,366	1,094,126	81 9
Delaware river	12,012	2,561,113	218.2
Susquehanna river	27,655	1,965,184	71.1
Potomac river	14,479	870,135	60.1
South Atlantic coast	132,040	4,248,466	32.2
James river	9,684	495,910	51 2
Cape Fear river	8,310	239,399	28.8
Neuse river	5,299	216,933	40.9
Pedee river	17,098	600,277	35.1
Roanoke river	9,237	404,281	43.8
Santee river	14,686	607,098	41.3
Savannah river	11,402	446,569	39.2
Altamaha river	14,109	473,967	33.6
Great Lakes	175,340	7,009,859	40 0
Saint Lawrence river	13,636	474,158	34 8
Lake Ontario	12,387	1,006,068	81 3
Lake Erie	17,207	2,179,269	126.7
Lake Huron	18,839	439,393	23.3
Lake Michigan	45,876	2,507,562	54.7
Lake Superior	17,830	155,271	8.7
Red river	39,577	247,518	6.3
Gulf of Mexico	1,725,980	32,903,214	19.1
Peninsula of Florida	48,900	435,003	8.9
Apalachicola river	18,918	699,718	37.0
Mobile river	43,436	1,425,649	32 8
Tombigbee river	18,896	611,338	32 4
Alabama river	23,820	784,089	32 9
Pascagoula river	8,980	129,084	14.4
Pearl river	8,670	175,698	20.3
Sabine river	20,440	172,656	8.4
Trinity river	17,960	449,718	25.0
Brazos river	59,646	512,621	8 6
Colorado river	41,220	183,524	4.5
Nueces river	18,944	41,533	2.2
San Antonio river	16,352	169,847	10.4
Rio Grande	128,793	156,150	1.2
Mississippi river	1,240,089	27,411,522	22.1
Yazoo river	12,794	415,406	32.5
Illinois river	29,013	1,867,935	64.4
Rock river	9,792	532,117	54 3
Wisconsin river	12,280	259,778	21.2
Chippewa river	8,892	141,520	15.9
Saint Croix river	7,576	92,854	12 3
Minnesota river	16,000	327,852	20.5
Cedar river	12,492	393,021	31 5
Des Moines river	14,752	425,128	28 9
Ohio river	201,720	10,986,777	54 5
Tennessee river	43,897	1,384,733	31 5
Cumberland river	18,573	720,012	38 8
Kentucky river	7,425	291,022	39 2
Green river	9,065	358,804	39.6
Licking river	3,658	221,478	60.5
Kanawha river	16,590	331,795	20 1
Monongahela river	7,625	495,636	65.0
Allegheny river	11,137	970,869	84 9
Miami river	5,400	469,596	87 0
Scioto river	6,480	444,124	68 5
Muskingum river	7,740	541,378	69 9
Wabash river	33,725	1,915,790	56 8
Big Sandy river	4,050	190,298	47 0
Missouri river	527,155	4,590,561	8.7
Big Sioux river	7,890	119,387	15 1
Yellowstone river	69,683	21,574	0 3
Platte river	90,011	647,104	7 2
Kansas river	59,256	985,524	16 6
Osage river	15,444	508,291	32 9
Arkansas river	185,671	1,771,312	9 5
Cimarron river	17,360	55,620	3 2
Canadian river	42,710	54,766	1 3
White river	27,925	338,306	12.1
Red river of Loui'ana	89,970	955,757	10 6
Washita	19,158	360,566	18.8
Saint Francis river	7,884	162,897	20 7
Great Basin	228,150	256,130	1.1
Great Salt Lake	32,400	156,150	4.8
Humboldt river	32,148	38,119	1.2
Pacific Ocean	619,240	2,145,357	3 5
Colorado river	225,049	208,643	0.9
Green river	47,222	27,494	0 6
Grand river	26,472	47,349	1.8
Little Colorado river	29,258	3,821	0 1
Gila river	68,623	45,917	0.7
Sacramento river	58,824	378,462	6 4
San Joaquin river	29,952	134,206	4.5
Klamath river	14,660	18,199	1.2
Columbia river	216,537	393,415	1 8
Willamette river	11,700	129,782	11.1
Snake river	103,835	142,091	1.4
Clark fork	63,291	46,067	0.7

The areas of the respective drainage basins were determined with care, and adjusted to suit the total area of the United States, exclusive of Alaska.

URBAN POPULATION OF THE UNITED STATES.

In the census reports of the United States the urban population has been understood as that included in cities which have each 8,000 inhabitants and over. While this limit is now recognized as too high (the 4,000 limit being generally regarded as the better one), it has been continued for the convenience of comparisons with the figures of the previous census reports.

The urban population returned in 1890 is 29.12 per cent. of the total population of the whole country. The following are the corresponding figures for the several censuses:

Census Years.	Population of the United States.	Population of cities.	Inhabitants of cities in each 100 of the total population.
1790	3,929,214	131,472	[illegible]
1800	5,308,483	210,873	3.97
1810	7,239,881	356,920	[illegible]
1820	9,633,822	475,135	4.93
1830	12,866,020	864,509	6.72
1840	17,069,453	1,453,994	8.52
1850	23,191,876	2,897,586	12.49
1860	31,443,321	5,072,256	16.13
1870	38,558,371	8,071,875	20.93
1880	50,155,783	11,318,547	22.57
1890	62,622,250	18,235,670	29.12

It will be seen that the proportion of urban population has increased gradually during the past century from 3.35 up to 29.12 per cent. or from one-thirtieth up to nearly one-third of the total population. The increase had been quite regular from the beginning up to 1880, while from 1880 to 1890 it made a leap from 22.57 up to 29.12 per cent. thus illustrating in a forcible manner the accelerated tendency of our population toward urban life. The number of cities having each a population of more than 8,000 increased from 6 in 1790 to 286 in 1880, whence it leaped to 443 in 1890.

In 1870 there were only 14 cities reporting each a population of 100,000 or over; in 1880 there were 20; and in 1890 the number had increased to 28. In 1880 New York was the only city whose population had reached a million; now there are three, namely: New York, Chicago, and Philadelphia. The list and relative rank of the cities having each a population of 100,000 in the census years of 1870, 1880, and 1890 are shown as follows:

Rank	1890.	1880.	1870.
1	New York, N. Y.	New York, N.Y.	New York, N.Y.
2	Chicago, Ill.	Philadelp'a, Pa.	Philadelp'a, Pa.
3	Philadelphia, Pa.	Brooklyn, N. Y.	Brooklyn, N. Y.
4	Brooklyn, N. Y.	Chicago, Ill.	St. Louis, Mo.
5	Saint Louis, Mo.	Boston, Mass.	Chicago, Ill.
6	Boston, Mass.	St. Louis, Mo.	Baltimore, Md.
7	Baltimore, Md.	Baltimore, Md.	Boston, Mass.
8	San Francisco, Cal.	Cincinnati, O.	Cincinnati, O.
9	Cincinnati, Ohio.	San Franc., Cal.	N. Orleans, La.
10	Cleveland, Ohio.	N. Orleans, La.	S. Francisco, Cal.
11	Buffalo, N. Y.	Cleveland, O.	Buffalo, N. Y.
12	New Orleans, La.	Pittsburg, Pa.	Washington, D.C
13	Pittsburg, Pa.	Buffalo, N. Y.	Newark, N. J.
14	Washington, D. C.	Wash'gton, D.C.	Louisville, Ky.
15	Detroit, Mich.	Newark, N. J.	
16	Milwaukee, Wis.	Louisville, Ky.	
17	Newark, N. J.	Jersey City, N.J.	
18	Minneapolis, Minn.	Detroit, Mich.	
19	Jersey City, N. J.	Milw'kee, Wis.	
20	Louisville, Ky.	Providence, R.I.	
21	Omaha, Neb.		
22	Rochester, N. Y.		
23	Saint Paul, Minn.		
24	Kansas City, Mo.		
25	Providence, R. I.		
26	Denver, Colo.		
27	Indianapolis, Ind.		
28	Alleghany City, Pa.		

List of Cities Having Each, in 1890, a Population of 8,000 or Over.

Cities and Towns.	Population.		Increase.	
	1890.	1880.	Numb'r.	Per Cent.
Adams, Mass	9,213	5,591	3,622	64.78
Adrian, Mich	8,756	7,849	907	11.56
Akron, Ohio	27,601	16,512	11,089	67.16
Alameda, Cal	11,165	5,708	5,457	95.60
Albany, N. Y.	94,923	90,758	4,165	4.59
Alexandria, Va.	14,339	13,659	680	4.98
Allegheny, Pa.	105,287	78,682	26,605	33.81
Allentown, Pa	25,228	18,063	7,165	39.67
Alpena, Mich	11,283	6,153	5,130	83.37
Alton, Ill	10,294	8,975	1,319	14.70
Altoona, Pa	30,337	19,710	10,627	53.92
Amesbury, Mass.	9,798	3,355	6,443	192.04
Amsterdam, N. Y	17,336	9,466	7,870	83.14
Anderson, Ind	10,741	4,126	6,615	160.32
Ann Arbor, Mich	9,431	8,061	1,370	17.00
Anniston, Ala.	9,876	942	8,934	948.41
Appleton, Wis.	11,869	8,005	3,864	48.27
Arkansas City, Kans.	8,347	1,012	7,335	724.80
Asheville, N. C.	10,235	2,616	7,619	291.25
Ashland, Wis.	9,956	....	....	....
Ashtabula, Ohio.	8,338	4,445	3,893	87.58
Atchison, Kans.	13,963	15,105	1,142	7.56
Athens, Ga	8,639	6,099	2,540	41.65
Atlanta, Ga	65,533	37,409	28,124	75.18
Atlantic, City, N. J.	13,055	5,477	7,578	138.36
Auburn, Me	11,250	9,555	1,695	17.74
Auburn, N. Y	25,858	21,924	3,934	17.94
Augusta, Ga.	33,300	21,891	11,409	52.12
Augusta, Me.	10,527	8,665	1,862	21.49
Aurora, Ill.	19,688	11,873	7,815	65.82
Austin, Tex.	14,476	11,013	3,463	31.44
Baltimore, Md.	434,439	332,313	102,126	30.73
Bangor, Me	19,103	16,856	2,247	13.33
Bath, Me	8,723	7,874	849	10.78
Baton Rouge, La.	10,478	7,197	3,281	45.59
Battle Creek, Mich.	13,197	7,063	6,134	86.85
Bay City, Mich.	27,839	20,693	7,146	34.53
Bayonne, N. J.	19,033	9,372	9,661	103.08
Beatrice, Neb	13,836	2,447	11,389	465.43
Beaver Falls, Pa.	9,735	5,104	4,631	90.73
Bellaire, Ohio	9,934	8,025	1,909	23.79
Belleville, Ill	15,361	10,683	4,678	43.79
Beverly, Mass	10,821	8,456	2,365	27.97
Biddeford, Me.	14,443	12,651	1,792	14.16
Binghampton, N. Y	35,005	17,317	17,688	102.14
Birmingham, Ala.	26,178	3,086	23,092	748.28
Bloomington, Ill	20,048	17,180	2,868	16.60
Boston, Mass	448,477	362,839	85,638	23.60
Braddock, Pa.	8,561	3,310	5,251	158.64
Bradford, Pa.	10,514	9,197	1,317	14.32
Bridgeport, Conn.	48,866	27,643	21,223	76.78
Bridgeton, N. J	11,424	8,722	2,702	30.98
Brockton, Mass.	27,294	13,608	13,686	100.57
Brookline, Mass.	12,103	8,057	4,046	50.22
Brooklyn, N. Y.	806,343	566,663	239,680	42.30
Brunswick, Ga.	8,459	2,891	5,568	192.60
Buffalo, N. Y.	255,664	155,134	100,530	64.80
Burlington, Iowa	22,565	19,450	3,115	16.02
Burlington, N. J.	8,222	6,090	2,132	35.01
Burlington, Vt.	14,590	11,365	3,225	28.38
Butler, Pa.	8,734	3,163	5,571	176.13
Butte, Mont	10,723	3,363	7,360	218.85
Cairo, Ill	10,324	9,011	1,313	14.57
Cambridge, Mass	70,028	52,669	17,359	32.96
Camden, N. J	58,313	41,659	16,654	39.98
Canton, Ohio	26,189	12,258	13,931	113.65
Carbondale, Pa.	10,833	7,714	3,119	40.43
Cedar Rapids, Iowa.	18,020	10,104	7,916	78.35
Charleston, S. C.	54,955	49,984	4,971	9.95
Charlotte, N. C	11,557	7,094	4,463	62.91
Chattanooga, Tenn.	29,100	12,892	16,208	125.72
Chicago, Ill	1,099,850	503,185	596,665	118.58
Chicopee, Mass.	14,050	11,286	2,764	24.49
Chillicothe, Ohio	11,288	10,938	350	3.20
Chippewa Falls, Wis.	8,670	3,982	4,688	117.73
Chelsea, Mass	27,909	21,782	6,127	28.13
Chester, Pa	20,226	14,997	5,229	34.87
Cheyenne, Wyo	11,690	3,456	8,234	238.25
Cincinnati, Ohio.	296,908	255,139	41,769	16.37
Cleveland, Ohio.	261,353	160,146	101,207	63.20
Clinton, Iowa	13,619	9,052	4,567	50.45
Clinton, Mass.	10,424	8,029	2,395	29.83
Cohoes, N. Y.	22,509	19,416	3,093	15.93
Colorado Springs, Col.	11,140	4,226	6,914	163.61
Columbia, Pa.	10,599	8,312	2,287	27.51
Columbia, S. C.	15,353	10,036	5,317	52.98
Columbus, Ga	17,303	10,123	7,180	70.93
Columbus, Ohio.	90,398	51,647	38,743	71.68
Concord, N. H.	17,004	13,843	3,161	22.83
Corning, N. Y.	8,550	4,802	3,748	78.05
Council Bluffs, Iowa.	21,474	18,063	3,411	18.88
Covington, Ky	37,371	29,720	7,651	25.74
Cranston, R. I.	8,099	5,940	2,159	36.35
Cumberland, Md.	12,729	10,693	2,036	19.04
Cumberland, R. I.	8,090	6,445	1,645	25.52
Dallas, Tex.	38,067	10,358	27,709	267.51
Danbury, Conn	16,552	11,666	4,886	41.88
Danville, Ill	11,491	7,733	3,758	48.60
Danville, Va.	10,305	7,526	2,779	36.93
Davenport, Iowa	26,872	21,831	5,041	23.09
Dayton, Ohio.	61,220	38,678	22,542	58.28
Decatur, Ill.	16,841	9,547	7,294	76.40
Delaware, Ohio.	8,224	6,894	1,330	19.29
Denison, Tex.	10,958	3,975	6,983	175.67
Denver, Colo.	106,713	35,629	71,084	199.51
Des Moines, Iowa.	50,093	22,408	27,685	123.55
Detroit, Mich.	205,876	116,340	89,536	76.96
Dover, N. H.	12,790	11,687	1,103	9.44
Dubuque, Iowa	30,311	22,254	8,057	36.20
Duluth, Minn	33,115	3,483	29,632	850.76
Dunkirk, N. Y.	9,416	7,248	2,168	29.91
Dunmore, Pa.	8,315	5,151	3,164	61.42
East Liverpool, Ohio	10,956	5,568	5,388	96.77
Easton, Pa	14,481	11,924	2,557	21.44
East Portland, Ore	10,532	2,934	7,598	258.96
East Providence, R. I.	8,422	5,056	3,366	66.57
East St. Louis, Ill.	15,169	9,185	5,984	65.15
Eau Claire, Wis	17,415	10,119	7,296	72.10
Elgin, Ill.	17,823	8,787	9,036	102.83
Elizabeth City, N. J	37,764	28,229	9,535	33.78
Elkhart, Ind	11,360	6,953	4,407	63.38

Cities and Towns.	Population.		Increase.	
	1890.	1880.	Numb'r.	Per Cent.
Elmira, N. Y.	29,708	20,541	9,167	44.63
El Paso, Tex.	10,338	736	9,602	1,304.62
Erie, Pa.	40,634	27,737	12,897	46.50
Evansville, Ind	50,756	29,280	21,476	73.35
Everett, Mass	11,068	4,159	6,909	166.12
Fall River, Mass	74,398	48,961	25,437	51.95
Findlay, Ohio	18,553	4,633	13,920	300.45
Fitchburg, Mass.	22,037	12,429	9,608	77.30
Flint, Mich	9,803	8,409	1,394	16.58
Flushing, N. Y	10,868	a6,683	4,185	62.62
Fond du Lac, Wis	12,024	13,094	b1,070	b8.17
Fort Scott, Kan	11,946	5,372	6,574	122.38
Fort Smith, Ark.	11,311	3,099	8,212	264.99
Fort Wayne, Ind	35,393	26,880	8,513	31.67
Fort Worth, Tex	23,076	6,663	16,413	246.33
Framingham, Mass	9,239	6,235	3,004	48.18
Frederick, Md	8,193	8,659	b466	b5.38
Freeport, Ill	10,189	8,516	1,673	19.65
Fresno, Cal.	10,818	1,112	9,706	872.84
Galesburg, Ill	15,264	11,437	3,827	33.46
Galveston, Tex.	29,084	22,248	6,836	30.73
Gardner, Mass	8,424	4,988	3,436	68.89
Gloucester, Mass	24,651	19,329	5,322	27.53
Gloversville, N. Y	13,864	7,133	6,731	94.36
Grand Rapids, Mich	60,278	32,016	28,262	88.27
Green Bay, Wis	9,069	7,464	1,605	21.50
Greeneville, S. C	8,607	6,160	2,447	39.72
Greenwich, Conn	10,131	7,892	2,239	28.37
Hagerstown, Md	10,118	6,627	3,491	52.68
Hamilton, Ohio	17,565	12,122	5,443	44.90
Hannibal, Mo	12,857	11,074	1,783	16.10
Harrisburg, Pa	40,164	30,762	9,402	30.56
Harrison, N. J	8,338	6,898	1,440	20.88
Hartford, Conn	53,230	42,015	11,215	26.69
Hastings, Neb	13,584	2,817	10,767	382.22
Haverhill, Mass	27,412	18,472	8,940	48.40
Hazleton, Pa	11,872	6,935	4,937	71.19
Helena, Mont	13,834	3,624	10,210	281.73
Henderson, Ky	8,835	5,365	3,470	64.68
Hoboken, N. J	43,648	30,999	12,649	40.80
Holyoke, Mass	35,637	21,915	13,722	62.61
Hornellsville, N. Y	10,996	8,195	2,801	34.18
Hot Springs, Ark	8,086	3,554	4,532	127.52
Houston, Tex	27,557	16,513	11,044	66.88
Hudson, N. Y	9,970	8,670	1,300	14.99
Huntington, W. Va	10,108	3,174	6,934	218.46
Hutchinson, Kans	8,682	1,540	7,142	463.77
Hyde Park, Mass	10,193	7,088	3,105	43.81
Indianapolis, Ind	105,436	75,056	30,380	40.48
Ironton, Ohio	10,939	8,857	2,082	23.51
Iron Mountain, Mich	8,599	(c)	....	....
Ishpeming, Mich	11,197	6,039	5,158	85.41
Ithaca, N. Y	11,079	9,105	1,974	21.68
Jackson, Mich	20,798	16,105	4,693	29.14
Jackson, Tenn	10,039	5,377	4,662	86.70
Jacksonville, Fla	17,201	7,650	9,551	124.85
Jacksonville, Ill	10,740	10,927	b187	b1.71
Jamestown, N. Y	16,038	9,357	6,681	71.40
Jamesville, Wis	10,836	9,018	1,818	20.16
Jeffersonville, Ind	10,666	9,357	1,309	13.99
Jersey City, N. J	163,003	120,722	42,281	35.02
Johnston, R. I	9,778	5,765	4,013	69.61
Johnstown, Pa	21,805	8,380	13,425	160.20
Joliet, Ill	23,264	11,657	11,607	99.57
Joplin, Mo	9,943	7,038	2,905	41.28
Kalamazoo, Mich	17,853	11,937	5,916	49.56
Kankakee, Ill	9,025	5,651	3,374	59.71
Kansas City, Kans	38,316	3,200	35,116	1,097.38
Kansas City, Mo.	d132,716	55,785	76,931	137.91
Kearney, Neb.	8,074	1,782	6,292	353.09
Keokuk, Iowa	14,101	12,117	1,984	16.37
Key West, Fla	18,080	9,890	8,190	82.81
Kingston, N. Y	21,261	18,344	2,917	15.90
Knoxville, Tenn	22,535	9,693	12,842	132.49
Kokomo, Ind	8,261	4,042	4,219	104.38
La Crosse, Wis	25,090	14,505	10,585	72.97

a Estimated. b Decrease. c No population for 1880.

Cities and Towns.	Population.		Increase.	
	1890.	1880.	Numb'r.	Per Cent.
Lafayette, Ind	16,243	14,860	1,383	9.31
Lancaster, Pa	32,011	25,769	6,242	24.22
Lansing, Mich	13,102	8,319	4,783	57.49
Lansingburg, N. Y.	10,550	7,432	3,118	41.95
Laredo, Tex.	11,319	3,521	7,798	221.47
La Salle, Ill	9,855	7,847	2,008	25.59
Lawrence, Kans	9,997	8,510	1,487	17.47
Lawrence, Mass	44,654	39,151	5,503	14.06
Leadville, Colo	11,212	14,820	b3,608	b24.35
Leavenworth, Kan	19,768	16,546	3,222	19.47
Lebanon, Pa	14,664	8,778	5,886	67.05
Lewiston, Me	21,701	19,083	2,618	13.72
Lexington, Ky	21,567	16,656	4,911	29.48
Lima, Ohio	15,987	7,567	8,420	111.27
Lincoln, Neb	55,154	13,003	42,151	324.16
Lincoln, R. I	20,355	13,765	6,590	47.88
Little Falls, N. Y	8,783	6,910	1,873	27.11
Little Rock, Ark	25,874	13,138	12,736	96.94
Lockport, N. Y	16,038	13,522	2,516	18.61
Logansport, Ind	13,328	11,198	2,130	19.02
Long Island City, N.Y.	30,506	17,129	13,377	78.10
Los Angeles, Cal	50,395	11,183	39,212	350.64
Louisville, Ky	161,129	123,758	37,371	30.20
Lowell, Mass	77,696	59,475	18,221	30.64
Lynchburg, Va	19,709	15,959	3,750	23.50
Lynn, Mass	55,727	38,274	17,453	45.60
McKeesport, Pa	20,741	8,212	12,529	152.57
Macon, Iowa	22,746	12,749	9,997	78.41
Madison, Ind	8,937	8,945	b8	b0.09
Madison, Wis	13,426	10,324	3,102	30.05
Mahanoy, Pa	11,286	7,181	4,105	57.16
Malden, Mass.	23,031	12,017	11,014	91.65
Manchester, Conn	8,222	6,462	1,760	27.24
Manchester, N. H	44,126	32,630	11,496	35.23
Manchester, Va.	9,246	5,729	3,517	61.39
Manistee, Mich	12,812	6,930	5,882	84.88
Mankato, Minn	8,838	5,550	3,288	59.24
Mansfield, Ohio	13,473	9,859	3,614	36.66
Marblehead, Mass.	8,202	7,467	735	9.84
Marietta, Ohio	8,273	5,444	2,829	51.97
Marinette, Wis.	11,523	2,750	8,773	319.02
Marion, Ind.	8,769	3,182	5,587	175.58
Marion, Ohio	8,327	3,899	4,428	113.57
Marlborough, Mass	13,805	10,127	3,678	36.32
Marquette, Mich	9,093	4,690	4,403	93.88
Marshalltown, Iowa	8,914	6,240	2,674	42.85
Massillon, Ohio	10,092	6,836	3,256	47.63
Meadville, Pa.	9,520	8,860	660	7.45
Medford, Mass.	11,079	7,573	3,506	46.30
Melrose, Mass	8,519	4,560	3,959	86.82
Memphis, Tenn	64,495	33,592	30,903	92.00
Menominee, Mich	10,630	3,288	7,342	223.30
Meriden, Conn	21,652	15,540	6,112	39.33
Meridian, Miss	10,624	4,008	6,616	165.07
Michigan City, Ind	10,776	7,366	3,410	46.29
Middletown, Conn	9,013	6,826	2,187	32.04
Middletown, N. Y	11,977	8,494	3,483	41.01
Milford, Mass.	8,780	9,310	b530	b5.69
Millville, N. J.	10,002	7,660	2,342	30.57
Milwaukee, Wis	204,468	115,587	88,881	76.90
Minneapolis, Minn	164,738	46,887	117,851	251.35
Moberly, Mo.	8,215	6,070	2,145	35.34
Mobile, Ala	31,076	29,132	1,944	6.67
Moline, Ill.	12,000	7,800	4,200	53.85
Montgomery, Ala.	21,883	16,713	5,170	30.93
Mount Carmel, Ill.	8,254	2,378	5,876	247.10
Mount Vernon, N. Y	10,677	4,586	6,091	132.82
Muncie, Ind.	11,345	5,219	6,126	117.38
Muscatine, Iowa	11,454	8,295	3,159	38.08
Muskegon, Mich	22,702	11,262	11,440	101.58
Nanticoke, Pa	10,044	3,884	6,160	158.60
Nashua, N. H	19,311	13,397	5,914	44.14
Nashville, Tenn	76,168	43,350	32,818	75.70
Natchez, Miss	10,101	7,058	3,043	43.11
Natick, Mass	9,118	8,479	639	7.54
Nebraska City, Neb.	11,494	4,183	7,311	174.78

d Includes 13,048 outside the limits of Kansas City.

Cities and Towns.	Population.		Increase.	
	1890.	1880.	Numb'r.	Per Cent.
New Albany, Ind	21,059	16,423	4,636	28.23
Newark, N. J	181,830	136,508	45,322	[illegible]
Newark, Ohio	14,270	9,600	4,670	48.65
New Bedford, Mass	40,733	26,845	13,888	51.73
New Brighton, N. Y	16,423	12,679	3,744	29.53
New Britain, Conn. (b)	19,007	11,800	7,207	61.08
New Brunswick, N. J	18,603	17,166	1,437	8.47
Newburg, N. Y	23,087	18,049	5,038	27.91
Newburyport, Mass	13,947	13,538	409	3.02
Newcastle, Pa	11,600	8,418	3,182	37.80
New Haven, Conn	81,298	62,882	18,416	29.29
New London, Conn	13,757	10,537	3,220	30.56
New Orleans, La	242,039	216,090	25,949	12.01
Newport, Ky	24,918	20,433	4,485	21.95
Newport, R. I	19,457	15,693	3,764	23.99
New Rochelle, N. Y	8,318	5,276	3,042	57.66
Newton, Mass	24,379	16,995	7,384	43.45
New York, N. Y	1,515,301	1,206,299	309,002	25.62
Norfolk, Va	34,871	21,966	12,905	58.75
Norristown, Pa	19,791	13,063	6,728	51.50
North Adams, Mass	16,074	10,191	5,883	57.73
Northampton, Mass	14,990	12,172	2,818	23.15
Norwalk, Conn	17,747	13,956	3,791	27.16
Norwich, Conn	16,156	15,112	1,044	6.91
Oakland, Cal	48,682	34,555	14,127	40.88
Ogden, Utah	14,889	6,069	8,820	145.33
Ogdensburg, N. Y	11,662	10,341	1,321	12.77
Oil City, Pa	10,932	7,315	3,617	49.45
Omaha, Neb	140,452	30,518	109,934	360.23
Orange, N. J	18,844	13,207	5,637	42.68
Oshkosh, Wis	22,836	15,748	7,088	45.01
Oswego, N. Y	21,842	21,116	726	3.44
Ottawa City, Ill	9,985	7,834	2,151	27.46
Ottumwa, Iowa	14,001	9,004	4,997	55.50
Owensborough, Ky	9,837	6,231	3,606	57.87
Paducah, Ky	13,076	8,036	5,040	62.72
Paris, Texas	8,254	3,980	4,274	107.39
Parkersburg, W. Va	8,408	6,582	1,826	27.74
Passaic, N. J	13,028	6,532	6,496	99.45
Paterson, N. J	78,347	51,031	27,316	53.53
Pawtucket, R. I	27,633	19,030	8,603	45.21
Peabody, Mass	10,158	9,028	1,130	12.52
Peekskill, N. Y	9,676	6,893	2,783	40.37
Pensacola, Fla	11,750	6,845	4,905	71.66
Peoria, Ill	41,024	29,259	11,765	40.21
Perth Amboy, N. J	9,512	4,808	4,704	97.84
Petersburg, Va	22,680	21,656	1,024	4.73
Philadelphia, Pa	1,046,964	847,170	199,794	23.58
Phillipsburg, N. J	8,644	7,181	1,463	20.37
Phoenixville, Pa	8,514	6,682	1,832	27.42
Pine Bluff, Ark	9,952	3,203	6,749	210.71
Piqua, Ohio	9,090	6,031	3,059	50.72
Pittsburg, Pa	238,617	156,389	82,228	52.58
Pittsfield, Mass	17,281	13,364	3,917	29.31
Pittston, Pa	10,302	7,472	2,830	37.87
Plainfield, N. J	11,267	8,125	3,142	38.67
Plattsmouth, Neb	8,392	4,175	4,217	101.01
Plymouth, Pa	9,344	6,065	3,279	54.06
Port Huron, Mich	13,543	8,883	4,660	52.46
Port Jervis, N. Y	9,327	8,678	649	7.48
Portland, Me	36,425	33,810	2,615	7.73
Portland, Ore	46,385	17,577	28,808	163.90
Portsmouth, N. H	9,827	9,690	137	1.41
Portsmouth, Ohio	12,394	11,321	1,073	9.48
Portsmouth, Va	13,268	11,390	1,878	16.49
Pottstown, Pa	13,285	5,305	7,980	150.42
Pottsville, Pa	14,117	13,253	864	6.52
Poughkeepsie, N. Y	22,206	20,207	1,999	9.89
Providence, R. I	132,146	104,857	27,289	26.02
Pueblo, Colo	24,558	3,217	21,341	663.38
Quincy, Ill	31,494	27,268	4,226	15.50
Quincy, Mass	16,723	10,570	6,153	58.21
Racine, Wis	21,014	16,031	4,983	31.08
Raleigh, N. C	12,678	9,265	3,413	36.84
Reading, Pa	58,661	43,278	15,383	35.54
Richmond, Ind	16,608	12,742	3,866	30.34
Richmond, Va	81,388	63,600	17,788	27.97

Cities and Towns.	Population.		Increase.	
	1890.	1880.	Number.	Per Cent.
Roanoke, Va	16,159	(c)	....	....
Rochester, N. Y	133,896	89,366	44,530	49.83
Rockford, Ill	23,584	13,129	10,455	79.63
Rock Island, Ill	13,634	11,659	1,975	16.94
Rockland, Me	8,174	7,599	575	7.57
Rome, N. Y	14,991	12,194	2,797	22.94
Rutland, Vt	11,760	12,149	a389	a3.20
Sacramento, Cal	26,386	21,420	4,966	23.18
Saginaw, Mich	46,322	29,541	16,781	56.81
Saint Joseph, Mo	52,324	32,431	19,893	61.34
Saint Louis, Mo	451,770	350,518	101,252	28.89
Saint Paul, Minn	133,156	41,473	91,683	221.07
Salem, Mass	30,801	27,563	3,238	11.75
Salt Lake City, Utah	44,843	20,768	24,075	115.92
San Antonio, Tex	37,673	20,550	17,123	83.32
San Diego, Cal	16,159	2,637	13,522	512.78
Sandusky, Ohio	18,471	15,838	2,633	16.62
San Francisco, Cal	298,997	233,959	65,038	27.80
San José, Cal	18,060	12,567	5,493	43.71
Saratoga Springs, N. Y	11,975	8,421	3,554	42.20
Savannah, Ga	43,189	30,709	12,480	40.64
Schenectady, N. Y	19,902	13,655	6,247	45.75
Scranton, Pa	75,215	45,850	29,365	64.05
Seattle, Wash	42,837	3,533	39,304	1,112.48
Sedalia, Mo	14,068	9,561	4,507	47.14
Shamokin, Pa	14,403	8,184	6,219	75.99
Sheboygan, Wis	16,359	7,314	9,045	123.67
Shenandoah, Pa	15,944	10,147	5,797	57.13
Shreveport, La	11,979	8,009	3,970	49.57
Sing Sing, N. Y	9,352	6,578	2,774	42.17
Sioux City, Iowa	37,806	7,366	30,440	413.25
Sioux Falls, S. Dak	10,177	2,164	8,013	370.29
Somerville, Mass	40,152	24,933	15,219	61.04
South Bend, Ind	21,819	13,280	8,539	64.30
South Bethlehem, Pa	10,302	4,925	5,377	109.18
South Omaha, Neb	8,062	(c)	....	....
Spencer, Mass	8,747	7,466	1,281	17.16
Spokane Falls, Wash	19,922	350	19,572	5,592.00
Springfield, Ill	24,963	19,743	5,220	26.44
Springfield, Mass	44,179	33,340	10,839	32.51
Springfield, Mo	21,850	6,522	15,328	235.02
Springfield, Ohio	31,895	20,730	11,165	53.86
Stamford, Conn	15,700	11,297	4,403	38.97
Steelton, Pa	9,250	2,447	6,803	278.01
Steubenville, Ohio	13,394	12,093	1,301	10.76
Stillwater, Minn	11,260	9,055	2,205	24.35
Stockton, Cal	14,424	10,282	4,142	40.28
Streator, Ill	11,414	5,157	6,257	121.33
Superior, Wis	11,983	(c)	....	....
Syracuse, N. Y	88,143	51,792	36,351	70.19
Tacoma, Wash	36,006	1,098	34,908	3,179.23
Taunton, Mass	25,448	21,213	4,235	19.96
Terre Haute, Ind	30,217	26,042	4,175	16.03
Tiffin, Ohio	10,801	7,879	2,922	37.09
Titusville, Pa	8,073	9,046	a973	a10.76
Toledo, Ohio	81,434	50,137	31,297	62.42
Topeka, Kans	31,007	15,452	15,555	100.67
Trenton, N. J	57,458	29,910	27,548	92.10
Troy, N. Y	60,956	56,747	4,209	7.42
Union, N. J	10,643	5,849	4,794	81.96
Utica, N. Y	44,007	33,914	10,093	29.76
Vernon, Conn	8,808	6,915	1,893	27.38
Vicksburg, Miss	13,373	11,814	1,559	13.20
Vincennes, Ind	8,853	7,680	1,173	15.27
Waco, Texas	14,445	7,295	7,150	98.01
Waltham, Mass	18,707	11,712	6,995	59.73
Warwick, R. I	17,761	12,164	5,597	46.01
Washington, D. C	230,392	177,624	52,768	29.71
Waterbury, Conn	28,646	17,806	10,840	60.88
Watertown, N. Y	14,725	10,697	4,028	37.66
Watertown, Wis	8,755	7,883	872	11.06
Wausau, Wis	9,253	4,277	4,976	116.34
West Bay City, Mich	12,981	6,397	6,584	102.92
West Chester, Pa	8,028	7,046	982	13.94
Westfield, Mass	9,805	7,587	2,218	[illegible]
West Troy, N. Y	12,967	8,820	4,147	47.02
Weymouth, Mass	10,866	10,570	296	2.80

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a Decrease. *c* No population for 1880.

b Includes New Britain City, not separately returned

Cities and Towns.	Population.		Increase.	
	1890.	1880.	Number.	Per Cent.
Wheeling, W. Va.	35,013	30,737	4,276	13.91
Wichita, Kans.	23,853	4,911	18,942	385.71
Wilkesbarre, Pa.	37,718	23,339	14,379	61.61
Williamsport, Pa.	27,132	18,934	8,198	43.30
Willimantic, Conn.	8,648	6,608	2,040	30.87
Wilmington, Del.	61,431	42,478	18,953	44.62
Wilmington, N. C.	20,056	17,350	2,706	15.60
Winona, Minn.	18,208	10,208	8,000	78 37
Winston, N. C.	8,018	2,854	5,164	180.94
Woburn, Mass.	13,499	10,931	2,568	23.49
Woonsocket, R. I.	20,830	16,050	4,780	29.78
Worcester, Mass.	84,655	58,291	26,364	45.23
Yonkers, N. Y.	32,033	18,892	13,141	69.56
York, Pa.	20,793	13,940	6,853	49.16
Youngstown, Ohio.	33,220	15,435	17,785	115.23
Zanesville, Ohio.	21,009	18,113	2,896	15.99

The Superintendent of the Census of 1890 in closing his special report on the urban population, says: In defining what constitutes a city in each case the Census Office has consistently maintained the policy of including only such population as lives within the charter limits, because no other defined limits exist. In many cases, however, this does not give to the city all the population which naturally belongs to it. There may be populous suburbs, which are to all intent and purposes parts of the city, whose inhabitants transact business within the city, who are served by the same post-office, etc., but who, living without the charter limits, are not included in the city's population. Of this our greatest city, New York, is a forcible example. Within a radius of fifteen miles of the city hall on Manhattan Island the people are in effect citizens of New York, so far as their business and social interests go, although politically they live in different cities, counties and states. This body of population, the commercial metropolis of the country, contains a population considerably in excess of 3,000,000, or two-thirds that of London, which is, similarly, a congeries of municipalities. Next to London, New York and its suburbs form the largest city of the globe. Other cases are those of St. Paul and Minneapolis, whose corporate limits join one another, and Bristol, Tenn., and Bristol, Va., two corporations whose line of division follows the middle of the main street of the city, and which have a joint population of 6,229. Texarkana, Tex., and Texarkana, Ark., is a similar case. Knoxville, Tenn., has large suburbs immediately adjoining, whose population would, if added, increase it to very nearly 40,000 inhabitants.

The rate of growth of many of these cities, especially those situated west of the Mississippi River, has been amazing. Chicago has added over half a million to her inhabitants, thus more than doubling her size in ten years. Minneapolis, St. Paul, Omaha, Kansas City, and Denver have expanded to triple or quadruple their former size, while all over the west smaller cities have sprung up as if by magic.

POPULATION AND AREA OF FIFTY CITIES OF THE UNITED STATES BY SQUARE MILES AND ACRES.

In the following lists nineteen other cities would have been included had it not been for the lack of data not reported to the Census Department in time for use in the tabulated summaries prepared by that department. The missing figures except for population (for which see page 465 of these Revisions and Additions) were from Pittsburg, Pa., Jersey City, N. J., Louisville, Ky., Kansas City, Mo., Providence, R. I., Allegheny, Pa., Albany, N. Y., Columbus, O., Richmond, Va., Paterson, N. J., Scranton, Pa., Atlanta, Ga., Memphis, Tenn., Wilmington, Del., Dayton, O., Troy, N. Y., Grand Rapids, Mich., and Reading, Pa.

The total population of the fifty cities (as shown in table on opposite page) in 1890 was 10,095,370. The area in square miles, and the density of population are given for convenience of comparison.

Washington, District of Columbia, is considered as a city proper; that is, it includes the area and population inclosed within the actual municipal boundaries, and not those of the District of Columbia.

The area of New York includes the islands in the East River, (having an aggregate of 520 acres) belonging to the twelfth, ninteenth, and twenty-third wards. There being no way to separate the population of these islands from that of the city proper, the area must be included in the whole.

The area given for Fall River comprises all except portions of the 6th and 9th wards, the area of which the city engineer reported to the Census Agent had never been measured.

Of the fifty cities included in the foregoing tables, twenty-two have a population of over 100,000 each and a total of 8,737,648, or 13.95 per cent. of the total population of the United States.

The average density of population in these twenty-two cities is 10,190.03 to the square mile, or 15.92 to the acre. There are, however, enormous differences in the ratios of population to area included in the city limits of these various cities. This ratio, stated in round numbers as persons to the acre, ranges from 4 in St. Paul, 5 in Minneapolis, 9 in Omaha, 10 in New Orleans and Buffalo, 11 in Chicago and Denver, 12 in Saint Louis, to 59 in in New York, 48 in Brooklyn, 31 in Washington, and 30 in San Francisco. For the other larger cities, the figures for population per acre are, in round numbers, Baltimore, 24; Boston, 20; Cincinnati and Milwaukee, 19 each; Cleveland, Detroit, Indianapolis, and Newark, 16 each; Nashville, 14; Rochester and Philadelphia, 13 each.

These ratios, however, give no information as to the difference in density of population in the actually built-up portions, as will be seen by comparisons of the density figures for wards in some of these cities. Thus, in New York City the number of persons per acre ranges from 474 in ward ten to 3 in ward twenty-four; in Chicago, from 116 in ward sixteen to 2 in wards twenty-eight and thirty-three; in Philadelphia, from 163 in ward three to 1 in ward twenty-three; in Brooklyn, from 198 in ward sixteen to 6 in ward twenty-six; in Boston, from 204 in ward eight to 3 in ward twenty-three; in Baltimore, from 141 in ward ten to 3 in ward twenty-two; in Cincinnati, from 162 in ward thirteen to 3 in ward thirty; in Buffalo, from 60 in ward two to 1 in wards twelve and thirteen; in New Orleans from 56 in ward ten to 2 in ward nine; in Milwaukee, from 43 in ward two to 7 in wards seventeen and eighteen; in Newark, from 64 in ward fifteen to 4 in ward ten; in Minneapolis, from 38 in ward six to 1 in ward ten; in Saint Paul, from 42 in ward four to 1 in wards two and ten; in Rochester, from 59 in ward thirteen to 4 in ward fifteen.

ARMY AND NAVY OF THE UNITED STATES.

For the latest statistics of the Army and Navy see those articles in these Revisions and Additions.

Cities.	Counties.	Population.	Area.		Population to—	
			Square miles.	Acres.	Each square mile.	Each acre
New York	New York, N. Y	1,515,301	40.22	25,740.80	37,675.81	58.87
Chicago	Cook, Ill	1,099,850	160.57	102,764.80	6,849.66	10.70
Philadelphia	Philadelphia, Pa	1,046,964	129.39	82,809.60	8,091.54	12.64
Brooklyn	Kings, N. Y	806,343	26.46	16,934.40	30,474.04	47.62
Saint Louis	Missouri	451,770	61.35	39,264.00	7,368.21	11.51
Boston	Suffolk, Mass	448,477	35.28	22,579.20	12,711.93	19.86
Baltimore	Maryland	434,439	28.38	18,163.20	15,307.93	23.92
San Francisco	San Francisco, Cal	298,997	15.46	9,894.40	19,340.04	30.22
Cincinnati	Hamilton, Ohio	296,908	25.00	16,000.00	11,876.32	18.56
Cleveland	Cuyahoga, Ohio	261,353	24.88	15,923.20	10,504.54	16.41
Buffalo	Erie, N. Y	255,664	39.04	24,985.60	6,548.77	10.23
New Orleans	Orleans, La	242,039	37.09	23,737.60	6,525.72	10.20
Detroit	Wayne, Mich	205,876	20.59	13,177.60	9,998.33	15.62
Milwaukee	Milwaukee, Wis	204,468	17.00	10,880.00	12,027.53	18.79
Washington	District of Columbia	202,978	10.24	6,553.60	19,822.07	30.97
Newark	Essex, N. J	181,830	17.77	11,372.80	10,232.41	15.99
Minneapolis	Hennepin, Minn	164,738	51.67	33,068.00	3,188.27	4.98
Omaha	Douglas, Nebr	140,452	24.50	15,680.00	5,732.73	8.96
Rochester	Monroe, N. Y	133,896	15.60	9,984.00	8,583.08	13.41
Saint Paul	Ramsey, Minn	133,156	51.42	32,908.80	2,589.56	4.06
Denver	Arapahoe, Colo	106,713	15.49	9,913.60	6,889.15	10.76
Indianapolis	Marion, Ind	105,436	10.07	6,444.80	10,470.31	16.35
Worcester	Worcester, Mass	84,655	34.02	21,772.80	2,488.39	3.89
Toledo	Lucas, Ohio	81,434	19.72	12,620.80	4,129.51	6.45
New Haven	New Haven, Conn	81,298	7.56	4,838.40	10,753.70	16.80
Lowell	Middlesex, Mass	77,696	11.15	7,136.00	6,968.25	10.89
Nashville	Davidson, Tenn	76,168	8.44	5,401.60	9,024.64	14.10
Fall River	Bristol, Mass	74,398	10.95	7,008.00	6,794.34	10.62
Cambridge	Middlesex, Mass	70,028	5.83	3,731.20	12,011.66	18.77
Camden	Camden, N. J	58,313	4.34	2,777.60	13,436.18	20.99
Trenton	Mercer, N. J	57,458	3.95	2,528.00	14,546.33	22.73
Lynn	Essex, Mass	55,727	10.64	6,809.60	5,237.50	8.18
Hartford	Hartford, Conn	53,230	14.66	9,382.40	3,630.97	5.67
Evansville	Vanderburg, Ind	50,756	4.42	2,828.80	11,483.26	17.94
Los Angeles	Los Angeles, Cal	50,395	27.60	17,664.00	1,825.91	2.85
Lawrence	Essex, Mass	44,654	6.67	4,268.80	6,694.75	10.46
Hoboken	Hudson, N. J	43,648	1.47	940.80	29,692.52	46.39
Dallas	Dallas, Texas	38,067	7.68	4,915.20	4,956.64	7.74
Sioux City	Woodbury, Iowa	37,806	30.90	19,776.00	1,223.50	1.91
Portland	Cumberland, Me	36,425	2.51	1,606.40	14,511.95	22.67
Holyoke	Hampden, Mass	35,637	3.98	2,547.20	8,954.02	13.99
Binghampton	Broome, N. Y	35,005	10.04	6,425.60	3,486.55	5.45
Duluth	Saint Louis, Minn	33,115	3.23	2,067.20	10,252.32	16.02
Elmira	Chemung, N. Y	19,708	4.45	2,848.00	6,575.96	10.43
Davenport	Scott, Iowa	26,872	4.41	2,822.40	6,093.42	9.52
Canton	Stark, Ohio	26,189	6.80	4,352.00	3,851.32	6.02
Taunton	Bristol, Mass	25,448	47.40	30,336.00	536.88	0.84
La Crosse	La Crosse, Wis	25,090	8.19	5,241.60	3,063.49	4.79
Newport	Campbell, Ky	24,908	1.20	768.00	20,755.00	32.45
Rockford	Winnebago, Ill	23,584	6.37	4,076.80	3,702.35	5.78

There were in 1891 ten navy yards and stations, namely: Brooklyn, Portsmouth, Charleston, League Island, New London, Washington, Norfolk, Pensacola, Mare Island, and Port Royal. Of these Brooklyn, Portsmouth, Norfolk, Mare Island, and Port Royal are used as construction yards. At Washington there is a manufactory for the completion of heavy ordnances.

CONGRESSIONAL CEMETERY OF THE UNITED STATES.

By the Act of May 12, 1876, it is provided that "hereafter, whenever any deceased Senator or member of the House of Representatives shall be actually interred in the Congressional Cemetery, so called, it shall be the duty of the Sergeant-at-Arms of the Senate, in the case of a Senator, and of the Sergeant-at-Arms of the House of Representatives, in the case of a member of the House, to have a monument erected, of granite, with suitable inscriptions, and the cost of the same shall be a charge upon and paid out either from the contingent funds of the Senate or the House of Representatives, to whichever the deceased may have belonged, and any existing omissions of monuments or inscriptions, as aforesaid, are hereby directed and authorized to be supplied in like manner; and all laws upon the subject of monuments in the Congressional Cemetery are hereby repealed."

SEED FARMS IN THE UNITED STATES.

The production of seeds was the first time made a subject of census inquiry in 1890. The report prepared by J. H. Hale under the direction of M. Whitshed, special agent in charge of the Department of Horticulture, was made after personal application for the statistics, of seed farm proprietors and dealers throughout the United States. It showed that there were in the United States in the census year 596 farms, with a total of 169,851 acres, devoted exclusively to seed growing, of which 96,567¼ acres were reported as producing seeds. Of these, 12,905 acres were devoted to beans, 1,268 to cabbage, 919 to beets, 10,219 to cucumbers, 71 to celery, 15,004 to sweet corn, 16,322 to field corn, 4,663 to squashes, 7,971 to peas, 5,149 to muskmelons, 662 to radishes, and 4,356 to tomatoes. The 596 seed farms reported represent a total value of farms, implements, and buildings of $18,325,935.86, and employed in the census year 13,500 men and 1,541 women. 258 of these farms are in the North Atlantic division, with an average of 185 acres per farm. In the North Central division there are 157 seed farms, with an average of 555 acres per farm. The seed farms in Iowa and Nebraska average 695 acres, several being nearly 3,000 acres in extent.

SHIPPING ON THE GREAT LAKES.

The total number of vessels on the great lakes of the United States, Jan. 1, 1890, was 2,744; total gross tonnage 924,472; estimated carrying capacity, 1,254,271 tons; commercial valuation, $48,809,750.

The following table gives the classes of vessels severally, their tonnage, and their commercial value:

Classes.	No.	Tonnage.	Com'cial Value.
Steam Vessels.			
Side-wheel passenger	67	30,270	2,815,500
Propellers carrying both passengers and freight	307	143,983	10,967,900
Propellers carrying freight only	433	387,095	23,320,200
Tugs	495	25,103	2,617,800
Ferry	41	4,707	499,500
Pleasure yachts	67	2,195	831,700
Pile drivers	15	247	53,500
Sand dredges	4	398	14,000
Sand boats	1	81	5,000
Fire boats	7	631	195,000
Steam lighters	4	392	14,000
Unclassified steam vessels	58	2,964	238,000
Sail and Unrigged Vessels.			
Schooners	939	185,776	4,240,900
Lake barges	301	138,404	3,463,500
Scows	7	996	9,000
Sloops	47	1,213	25,450
Yawls	1	17	300

Of these vessels there were on Lake Superior 167; on Lakes Huron and St. Clair, 726; Lake Michigan, 1,003; Lake Erie, 664; Lake Ontario, 131, and St. Lawrence River and Lake Champlain, 92.

NURSERIES IN THE UNITED STATES.

The material from which the following summaries were made were reported direct from the nurserymen by filling up blanks sent out from the Census Office in 1890. The tabulations show that there are in the United States 4,510 nurseries, valued at $41,978,835.80 and occupying 172,806 acres of land, with an invested capital of $54,425,669.51, and giving employment to 45,657 men, 2,279 women, and 14,200 animals, using in the propagation and cultivation of trees and plants $990,606.04 worth of implements. Of the acreage in nurseries 95,025.42 were found to be used in growing trees, plants, shrubs, and vines of all ages; and the figures, based upon the best estimate of the nurserymen, make the grand total of plants and trees 3,386,855,778, of which 518,016,612 are fruit trees, 685,603,396 grapevines and small fruits, and the balance nut, deciduous, and evergreen trees, hardy shrubs, and roses. The largest acreage is devoted to the production of apple trees, viz.: 20,232.75 acres, numbering 240,570,666 young trees, giving an average of 11,890 per acre, while the plum, pear, and peach have, respectively, 7,826.5, 6,854.25, and 8,357 acres, producing 88,494,367, 77,223,402, and 49,887,894 young trees, or an average of 11,307, 11,266, and 14,861 trees to the acre.

The following shows the acreage and average number of trees or plants grown per acre, severally, and the total plants of each kind in the United States in 1890:

Trees or Plants.	Number of acres.	Average No. grown per acre.	Total number grown.
Apple	20,232¾	11,890	240,570,666
Apricot	269	11,689	3,144,466
Cherry	8,690	10,362	88,246,251
Fig	63¼	11,734	742,200
Lemon	79	6,998	552,841
Lime	6	10,688	64,125
Nectarine	50	13,054	652,679
Olive	26	12,616	328,016
Orange	607½	7,191	4,368,322
Peach	8,357	14,861	49,887,894
Pear	6,854¼	11,266	77,223,402
Plum	7,826½	11,307	88,494,367
Pomelo	14	5,764	80,700
Prune	588	12,964	7,623,000
Quince	518	11,675	6,047,650
Nut	1,376⅘	10,072	13,866,006
Deciduous	12,342	105,121	1,297,406,257
Evergreen	8,644½	95,094	822,038,234
Hardy shrubs	2,881½	15,989	46,072,380
Rose	346½	11,295	3,913,658
Grapevines	5,678	28,052	159,189,248
Strawberry	4,433	61,157	271,108,253
Raspberry	5,756⅖	15,025	86,487,491
Blackberry	4,889⅗	21,582	105,516,840
Currant	2,021	24,432	49,376,805
Gooseberry	1,009½	14,047	14,180,789
Miscellaneous fruit trees and plants	1,477	....	....

NUMBER OF NURSERIES, THEIR ACREAGE, AND CAPITAL INVESTED.

States and Territories.	Number of Nurseries.	Acres of Land.	Total Capital Invested.
The United States	4,510	172,806	$54,425,669.51
North Atlantic division:			
Maine	41	226	208,177.50
New Hampshire	5	23	14,500.00
Vermont	17	75	46,500.00
Massachusetts	140	1,891	1,773,500.00
Rhode Island	9	45	58,500.00
Connecticut	20	328	194,071.57
New York	520	24,840	12,202,844.50
New Jersey	145	5,465	1,970,503.90
Pennsylvania	311	6,506	4,210,805.50
South Atlantic division:			
Delaware	35	725	155,361.15
Maryland	50	1,443	519,400.00
District of Columbia	1	120	125,000.00
Virginia	54	1,890	922,172.58
West Virginia	22	633	126,066.40
North Carolina	32	960	231,840.00
South Carolina	3	70	4,000.00
Georgia	16	812	277,960.00
Florida	137	1,374	456,234.93
North Central division:			
Ohio	393	16,790	4,178,518.19
Indiana	223	5,464	1,056,611.91
Illinois	434	17,812	4,778,083.94
Michigan	155	3,015	869,491.10
Wisconsin	117	1,651	492,277.50
Minnesota	69	1,726	652,433.61
Iowa	183	12,049	1,591,790.73
Missouri	229	15,190	2,932,473.24
North Dakota	13	26	45,500.00
South Dakota	27	586	126,749.88
Nebraska	177	15,641	1,479,958.04
Kansas	339	11,492	1,425,792.81
South Central division:			
Kentucky	49	621	504,393.75
Tennessee	54	1,643	1,015,971.00
Alabama	15	975	455,040.00
Mississippi	15	505	79,284.00
Louisiana	24	290	170,400.00
Texas	97	4,665	1,211,900.61
Arkansas	68	767	119,800.86
Western division:			
Colorado	23	687	162,916.58
New Mexico	1	70	16,200.00
Arizona	3	82	8,500.00
Utah	17	192	83,810.00
Idaho	8	248	172,000.00
Washington	27	435	190,620.00
Oregon	26	1,576	236,658.00
California	166	11,144	4,871,930.40

Horses, Mules and Asses on Farms.

The following United States census summaries for 1890 include the number of these animals employed only on farms which contain each three acres and over, and show that in the states and territories there were on hand, June 1, 1890, 14,976,017 horses, 2,246,936 mules, and 49,109 asses; that in 1889 there were foaled 1,814,404 horses, 157,105 mules and 7,957 asses; that there were sold in the same year 1,309,557 horses, 329,995 mules, and 7,271 asses, and that there died from all causes 765,211 horses, mules, and asses during the same period.

The increase of horses from 1880 to 1890 is shown to be 44.59 per cent, as against 44.95 per cent between 1870 and 1880. The increase of mules from 1880 to 1890 was 26.66 per cent.

Of the aggregate number of horses and mules in the whole country, June 1, 1890, 86.95 per cent were horses and 13.05 per cent were mules. The North Atlantic group of states had the smallest proportion of mules, 2.41 per cent, while the South Atlantic group had the largest proportion, 32.04 per cent, as against 67.96 per cent of horses.

The census summaries by states and groups of states are as follows:

States and Territories.	Horses.	Mules.	Asses.
The United States.	14,976,017	2,246,936	49,109
North Atlantic Division.			
Maine	109,156	248	30
New Hampshire	52,458	115	8
Vermont	89,569	313	17
Massachusetts	64,618	157	39
Rhode Island	9,864	[illegible]	2
Connecticut	43,764	267	12
New York	664,430	4,386	250
New Jersey	86,925	8,166	61
Pensylvania	616,660	29,235	328
South Atlantic Division.			
Delaware	25,656	4,790	29
Maryland	130,395	14,064	97
District of Columbia	826	46	1
Virginia	242,334	87,119	[illegible]
West Virginia	154,721	7,221	[illegible]
North Carolina	131,451	99,299	712
South Carolina	59,888	86,073	283
Georgia	103,501	156,860	517
Florida	81,087	9,624	131
North Central Division.			
Ohio	880,677	18,193	366
Indiana	720,085	58,668	976
Illinois	1,335,289	106,180	1,695
Michigan	516,117	3,670	152
Wisconsin	460,740	5,406	346
Minnesota	461,509	9,315	196
Iowa	1,312,079	40,746	902
Missouri	946,191	245,102	6,441
North Dakota	130,931	8,665	44
South Dakota	250,305	7,522	119
Nebraska	626,789	45,972	540
Kansas	930,305	93,932	2,005
South Central Division.			
Kentucky	401,356	146,521	5,128
Tennessee	311,842	198,172	5,467
Alabama	121,207	133,892	908
Mississippi	155,050	155,712	1,043
Louisiana	126,777	87,589	489
Texas	1,025,876	220,596	6,836
Oklahoma	25,854	4,882	41
Arkansas	186,867	124,888	1,600
Western Division.			
Montana	144,826	[illegible]	16
Wyoming	87,403	1,185	57
Colorado	155,170	5,144	1,995
New Mexico	39,130	2,409	5,958
Arizona	15,780	637	809
Utah	64,801	1,122	432
Nevada	56,788	1,632	91
Idaho	84,135	[illegible]	36
Washington	153,770	1,312	33
Oregon	224,962	4,756	190
California	405,313	52,885	[illegible]

Production of Cotton in the United States.

The manufacture of cotton in the United States has been rapidly growing in recent years. At the census of 1880 there were found to be 756 manufactories for materials solely for cotton, with a capital of $208,280,445, the number of spindles was 10,653,435 (12,000,000 in 1882); of looms, 225,759; hands employed, 174,659; cotton consumed, 1,570,344 bales (750,343,981 lbs.), valued at $86,945,728; producing materials valued at $192,090,000.

The following are some statistics of cotton:

Year.	Production.	Imports.	Exports.	Ret'n'd for Home Consumption.
	lbs.	lbs.	lbs.	lbs.
1880	2,771,797,596	3,547,792	1,822,295,843	953,049,105
1884	2,757,544,422	7,012,492	1,863,926,466	900,637,448
1885	2,742,966,011	5,115,680	1,893,268,732	854,812,969
1886	3,182,305,659	5,072,334	2,059,314,405	1,128,063,588
1887	3,157,378,443	3,924,581	2,170,173,701	991,129,273
1888	3,430,172,391	5,497,592	2,264,324,798	1,180,345,185
1889	3,437,408,499	7,978,039	2,385,004,628	1,060,376,910

The value of cottons of domestic manufacture exported from the United States were from $4,071,882 in 1875 to $11,639,591 in 1885, and $10,212,644 in 1889.

Live Stock Ranges.

On the ranges of Texas, the Indian Territory, Colorado, the western portions of Kansas, Nebraska, Wyoming, the Dakotas, Montana, Idaho, the eastern portions of California, Oregon and Washington, Nevada, Utah, Arizona and New Mexico there were found in June 1890, 517,128 horses, 5,433 mules, 14,109 asses, or burros, 6,828,183 cattle, 6,676,902 sheep, and 17,276 swine. The sales of horses in 1889 amounted to $1,418,205; of cattle, $17,913,712; of sheep, $2,669,668, and of swine, $27,182. The total number of men reported upon ranges in care of this stock is 15,390. This industry is found to be more generally prosperous at this time than for several years previous.

Coal Product West of Mississippi River.

The following table furnishes the census summaries for 1890:

States and Territories.	Mines.	Productions.	Value.	Price at Mint.
Grand total	569	16,067,500	$24,413,262	$1 52
Trans-Mississippi Valley	440	10,051,229	1,4271,622	1 42
Dakota and Nebraska	5	30,307	46,331	1.53
Kansas	127	2,230,763	3,294,754	1.48
Indian Territory	10	752,832	1,323,806	1.76
Iowa	172	4,061,704	5,392,220	1 33
Missouri	123	2,567,823	3,478,058	1 35
Arkansas	8	279,584	395,836	1 42
Texas	4	128,216	340,617	2.66
Rocky Mountain region	98	4,836,368	7,486,004	1.55
Montana	8	363,301	881,523	2 43
Wyoming	15	1,388,947	1,748,618	1.26
Colorado	53	2,360,536	3,605,622	1 53
New Mexico	18	486,983	872,785	1 79
Utah	4	236,601	377,456	1 60
Pacific Coast	22	1,179,903	2,655,636	2 25
California and Oregon	10	186,176	451,881	2 43
Washington	12	[illegible]	2,203,755	2.22

In *North and South Dakota* the ascertained coal areas lie in the western counties, between a line running from the Turtle Mountains in the north through Burleigh County to the southern borders of the Black Hills and the western boundary line. The product is a fair grade of lignite or brown coal, suitable for heating and steam, and in some localities it is adapted for the manufacture of gas. The output in 1889 was 28,907 short tons valued at $41,431.

In *Kansas* the coal measures cover an area of about 10,000 square miles, underlying the entire eastern portion of the state. The coals are bituminous and are found to be excellent for coking, steam, gas, smelting, and domestic purposes. The coal deposits are known to extend into twenty counties, and in 1890 mining operations were carried on in Leavenworth, Franklin, Neosho, Cherokee, Bourbon, and Osage Counties. The output is rapidly increasing. The veins vary from one to five feet.

In the *Indian Territory* the only carboniferous coal west of the Mississippi River extend across the boundaries of Kansas, Missouri, and Arkansas, underlying almost the entire eastern half of that territory. The present developments of importance are along the line of the Missouri, Kansas and Texas Railway, in the Choctaw Nation Reservation, and are conducted by the Osage Coal and Mining Company at McAlester and the Atoka Mining Company at Lehigh.

The quality of the coal now being mined in this territory is excellent for steam and heating purposes, and is well suited for gas and coking. The beds from which the product is obtained range from three to five feet in thickness, and comprise the two lower veins, which are here found to be of much greater thickness and freer from bone and other impurities than in any other part of the field. Competent authorities assert that the coals now being mined in the Indian Territory are superior to any found west of the Appalachian field.

In *Iowa* nearly half the State is underlaid with coals. The northern extremity of the great coal field occupies the southern portion of the State, extending across the southeastern counties of Nebraska, thence southward through Kansas, Missouri, Arkansas, Texas, and Indian Territory. Coal is produced in twenty-six counties, and is of a quality generally well adapted for steam and heating purposes. No canal or gas coal is found in the State.

In *Missouri* coal is found in thirty-nine counties, the deposite being a part of what is known as the Fourth Field underlying portions of Nebraska, Iowa, Kansas, Missouri, Arkansas, and Indian Territory. The geological surveys of the State have not as yet clearly defined the outcroppings of the beds in the several counties, but mining operations have been conducted to a greater or less extent in the territory lying north of the Missouri River from the western boundary to the Mississippi River, and in the counties lying south of the Missouri River, between Kansas City and Jefferson City, and along the western boundary to Jasper and Dade counties. The principal developments are within Adair, Audrain, Barton, Bates, Caldwell, Callaway, Grundy, Henry, Johnson, Lafayette, Macon, Montgomery, Putnam, Randolph, Ray, and Vernon counties.

The character of the coal is semi-bituminous, and is adapted for steam and heating purposes, as well as for smithing.

In *Arkansas* the coal deposits are located in the western part of the State upon either side of the Arkansas River, extending between Forth Smith and Little Rock. Mining operations have been conducted in Sebastian, Franklin, Logan, Crawford, Johnson, and Pope counties. The coals of Arkansas are variable in quality, and are adapted for steaming, coking, and gas manufacture, and domestic purposes. Coal mining in this State may be said to have begun about the year 1870, but it did not assume commercial importance until about the year 1883.

In *Texas* the principal coal lies in the northern portion of the State, extending southwest from the Red River in Montague county, to the Colorado River. This basin is a continuation of the great Foarth or Western field, of which it forms the southern extremity. It is said to underlie the whole or portions of twenty-five counties, and embraces an area of 12,000 square miles. The only operation of importance in this field, in the year 1889 was that of the Texas and Pacific Coal Company in Erath county. The field next in importance in this State lies along the Rio Grande, underlying Webb, Dimmit, Zavalla, Uvalde, Medina, and Maverick counties, known as the Nueces coal field, and embraces about 3,700 square miles. The quality here is variable, differing materially from that of the Central field, the lower measures yielding a fair semi-bituminous product, while the upper measures are somewhat lignitic. The principal developments in this field are Santo Tomas, in Webb county, and Eagle Pass, in Maverick county.

An extended area, bounded by lines drawn from Clarksburg, in Red River county, southwesterly to the Rio Grande, and thence northeast to the Sabine River, in Sabine county, is said to contain important deposits of lignite. No developments have thus far been reported in this field, except those of the North Texas Coal and Mining Company in Raines county.

The *Rocky Mountain coal regions* are embraced in *Colorado*, *Wyoming*, *Montana*, *Utah*, and *New Mexico*. Although indications of lignite deposits have been found in Nevada, Idaho, and Arizona, no effort at development has yet been made beyond desultory prospecting. Lignite, bituminous, and anthracite coals are found in the region under consideration. The latter, however, so far as known, is confined to Gunnison and Pitkin counties, in Colorado, and the quality is said to compare favorably with the anthracite of eastern Pennsylvania. The bituminous coals comprise some excellent qualities of coking and gas coals. During the decade since the Tenth Census the development of coal mining in the states and territories named has been intelligently and vigorously prosecuted.

In *California*, although coal deposits of more or less importance have been discovered in many of the counties of the State west of the Sierras from Siskiyou, in the vicinity of Mount Shasta, in the north, to San Diego in the south, no mining operations upon a commercial scale have been prosecuted except in Amador and Contra Costa counties. Coal was discovered in the Mount Dieblo district in 1852, but productive mining was not prosecuted until after the year 1860. This district now furnishes the major portion of the product of the State. The coals of California, so far as at present known, are all lignitic in character, generally inferior to the coals of Washington and Oregon, and can not compete with the better coals supplied by sea from British Columbia and Australia.

In *Oregon* outcroppings of coal have been found in nineteen counties, both east and west of the Cascade Range, but mining operations are reported only in Coos county. These mines are located at

Marshfield, on Coos Bay, and are operated by the Oregon Coal and Navigation Company. The Coos county field is claimed to cover an area of several hundred square miles, and is a fair quality of lignite. The product is shipped mainly to San Francisco.

In *Washington* the mining of coal began in 1850-51 in the vicinity of Bellingham Bay, in the extreme northwestern part of the Territory (now a State), but operations there were discontinued in 1879, and have not been resumed. Several important coal areas have since been opened up, both on the western and eastern slopes of the Cascade Range, the most important of which are in the vicinity of Puget Sound, in King, Pierce, and Thurston counties, and in Yakima county, near the Attanam River. Outcroppings have been found in other localities, notably at Ellensburg, and in Lincoln and Spokane counties, and also in White Salmon River, in Cascade county. The coals of this State embrace lignite, semi-bituminous, and bituminous varieties, adapted for coking, gas, steam, and domestic purposes. Some specimens of a very fine grade of coal, resembling anthracite, are reported as having been taken from Cowlitz pass, in Yakima county. The total area of the coal deposits of Washington has not yet been fully determined, but there is no doubt that almost inexhaustible supplies are at hand, not only for the future demand of its own population, but sufficient to furnish a basis for profitable traffic for transportation to the entire Pacific coast.

QUICKSILVER MINES AND REDUCTION WORKS.

The quicksilver mines and reduction works of the United States were limited in 1889 to California and Oregon. In California there were three mines in Lake county, four in Napa county, and one each in Merced, San Benito Santa Clara, and Sonoma. There was also a non-productive mine in Siskiyou and another in Trinity county.

In Oregon there were three non-productive mines in Douglas county.

During the year there were 26,464 flasks, or 2,024,469 pounds, or 1,012 tons of quicksilver produced in California. About 20 flasks were produced in Oregon. This yield was much less than usual owing to litigation and other causes.

At eleven active establishments there were expended $219,622 for supplies, $626,289 for wages, and $35,490 for other expenses, embracing taxes, rent, interest, etc., making a total of $881,401, showing that 71 per cent. was paid for wages, 25 per cent. for supplies, and 4 per cent. for all other expenses. Of the amount paid for wages the office force absorbed $34,966, and there was paid to foremen, mechanics, miners, furnace hands, and laborers, $591,323. The total cost was $881,401; total market value, $1,190,500; profit, $309,099. The total capital invested in mines, buildings, machinery, etc., was estimated at $1,331,114. The sale prices averaged about $45 per flask.

STATISTICS FOR EARLIER PERIODS.—The earliest records relating to production of quicksilver in California for 1860, cinnabar having been first discovered there in 1845, and but very little quicksilver was produced prior to 1850, when active work was commenced at New Almaden. Outside of California quicksilver has been produced in two localities in the United States; in Oregon, to the extent of 2,000 flasks, and in Utah, where about 200 flasks were reported.

The production of quicksilver in the United States and in all other countries for ten years is shown by flasks in the following table:

Year.	Total of all mines, United States.	Almaden mine, Spain.	Idria mine, Austria.	Italian mines.	Total foreign mines.	Grand total, yearly.
1880	59,926	45,322	10,510	8,410	59,242	119,168
1881	60,851	41,989	11,333	8,760	60,082	120,933
1882	52,732	46,716	11,663	4,110	62,489	115,221
1883	46,725	49,177	13,152	6,065	68,394	115,119
1884	31,913	48,098	13,967	7,850	69,915	101,828
1885	32,073	45,813	13,503	6,965	66,281	98,354
1886	29,981	51,199	14,496	7,375	73,070	103,051
1887	33,760	53,276	14,676	7,075	75,027	108,787
1888	33,250	51,872	14,962	9,830	76,664	109,914
1889	26,464	49,477	15,295	10,000	74,772	101,236
Total	407,675	485,939	138,557	66,440	685,936	1,093,611

PRODUCTION OF IRON ORE IN THE UNITED STATES.

The census of 1890 showed that during the year closing Dec. 31, 1889, the production of iron ore in the United States amounted to 14,518,041 long tons, the yield being from twenty-six States and two Territories.

Michigan was by far the largest producer of iron ore in the census year 1889, a total of 5,856,169 long tons having been mined, the value of which was $15,800,521 at the mines, an average of $2.70 per ton. The tonnage from Michigan therefore represents 40.34 per cent. of the total, while the aggregate value is 47.38 per cent. of that of the entire country.

The credit of holding second rank lies between the States of Alabama and Pennsylvania, the former, from the figures collected, having apparently a slightly greater output than the latter. This uncertainty is owing to the fact that the reports obtained from two of the larger Alabama mines covered operations commencing May 1, 1889, and ending May 1, 1890, and no detailed record of the amount of ore produced and labor employed during the three months of 1890 was obtainable. The position of Pennsylvania is also affected by the refusal of one large producer to supply absolute figures, but it will be noted that in the shipments or apparent consumption of iron ores Pennsylvania takes precedence of Alabama.

Alabama is therefore placed second as a producer of iron ore, with 1,570,319 long tons, valued at $1,511,611, an average of 96 cents per ton. These figures represent 10.82 and 4.53 per cent., respectively, of the total output and value.

Pennsylvania closely follows Alabama, its output being 1,560,234 long tons, valued at $3,063,534, an average of $1.96 per ton, and 10.75 and 9.19 per cent., respectively, of the total output and value.

The other State which produced over 1,000,000 tons in the present census year was New York, which is credited with 1,247,537 long tons, valued at $3,100,216, an average of $2.49 per ton, the figures representing, respectively, 8.59 and 9.30 per cent. of the total output and value.

These four States, therefore, produced a total of 10,234,259 long tons, or 70.49 per cent. of the entire output of the iron-ore mines of the United States, while the value of the ore aggregates $23,475,882, or 70.39 per cent. of the total valuation.

The tabulated statement which follows is taken from actual returns, made to the Census Department and verified in every way possible except by individual visitations to all of the iron-ore mines. The figures of production are possibly below the actual results, for in some localities farmers gather ore at odd times and sell to blast furnaces in small lots. Wherever this amount could be obtained it is included in the table.

States and Territories.	Number of mines producing.	Amount produced. Long tons.	Total value of production.	Value per long ton.
Total	592	14,518,041	$33,351,978	$2 30
Alabama	45	1,570,319	1,511,611	0.96
Colorado	18	109,136	487,433	4.47
Connecticut, Maine and Massachusetts	7	88,251	265,901	3.01
Delaware and Maryland	14	29,380	68,240	2.32
Georgia and North Carolina	17	268,145	334,025	1.29
Idaho and Montana	7	24,072	158,974	6.60
Kentucky	4	77,457	135,559	1.75
Michigan	73	5,856,169	15,800,521	2.70
Minnesota	4	864,508	2,478,041	2.87
Missouri	8	265,718	560,931	2.11
New Jersey	24	415,510	1,341,543	3.23
New Mexico and Utah	2	36,050	70,956	1.97
New York	35	1,247,537	3,100,216	2.49
Ohio	70	254,294	532,725	2.09
Oregon and Washington	3	26,288	39,234	1.49
Pennsylvania	189	1,560,234	3,068,534	1.96
Tennessee	16	473,294	606,176	1.28
Texas	2	13,000	19,760	1.52
Virginia and West Virginia	38	511,255	935,290	1.83
Wisconsin	16	837,399	1,840,308	2.20

Limestone Quarries in the United States.

The following table shows the number of quarries and the value of products in 1889 by states and territories:

States and Territories.	Number of quarries.	Total value.
Alabama	21	$324,814
Arkansas	7	18,960
California	22	516,780
Colorado	15	138,091
Connecticut	9	131,697
Idaho	3	28,545
Illinois	104	2,190,607
Indiana	172	1,899,336
Iowa	143	530,573
Kansas	115	478,822
Kentucky	54	303,314
Maine	60	1,523,429
Maryland	30	164,860
Massachusetts	12	119,078
Michigan	8	85,352
Minnesota	72	613,217
Missouri	123	1,859,960
Montana	4	21,964
Nebraska	29	207,019
New Jersey	33	129,662
New Mexico	4	3,892
New York	157	1,708,830
Ohio	221	1,514,934
Pennsylvania	373	2,655,477
Rhode Island	2	27,625
South Carolina	2	14,520
Tennessee	11	73,028
Texas	18	217,835
Utah	2	27,508
Vermont	16	196,966
Virginia	11	122,023
Washington	8	231,987
West Virginia	8	93,856
Wisconsin	79	813,953
Other states (a)	6	77,935
Total	1,954	$19,095,179

The total value given in the above table is exclusive of that known as white marble. The latter would add $3,488,170, increasing the total to $22,582,349.

The production of limestone in the United States for the census year 1889 was as follows: For building purposes, 92,289,896 cubic feet, valued at $5,405,671; converted into lime, 18,474,668 barrels, valued at $8,217,015; stone for burning into lime, 478,082 tons, valued at $184,024; flux for furnaces, 3,894,337 tons, valued at $1,569,312; for street work, 46,491,622 cubic feet, valued at $2,383,456; for bridge, dam, and railroad work, 26,679,012 cubic feet, valued at $1,289,622; miscellaneous uses, 549,875 cubic feet, valued at $46,079, making a total value of $19,095,179. The expenditures were as follows: For wages, $10,121,985; for supplies and materials consumed, $4,227,246; other expenses of quarries, $743,483, making a total of $15,092,714. The capital invested in the industry amounted to $27,022,325; of this sum $14,771,200 was in land, $4,988,207 in buildings and fixtures, $4,541,623 in tools, implements, etc., and $2,711,295 in cash.

Surveys of Public Lands of the United States.

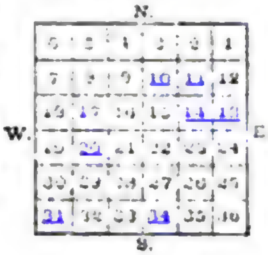
*I. Historical Note.**

After the close of the Revolutionary War, the eastern colonies surrendered to the General Government their several claims to the lands north of the Ohio, and west of Pennsylvania, as far as to the Mississippi River. Connecticut, however, retained the northeastern corner of Ohio, now called the "Connecticut," or "Western Reserve." Virginia also reserved a large tract in the southern part of the State, between the Scioto and the Miami rivers. Georgia relinquished her claim to Alabama and Mississippi. Subsequently Florida, the Louisiana Purchase, Texas, California, and Arizona were acquired either by treaty or by purchase. See Territorial Cessions of the States in these Revisions and Additions.

As early as 1785 provision was made by Congress for a uniform system of surveys of all public lands. The present system was adopted in 1786. Thomas Jefferson is generally credited with its authorship. "Lot 16" of every township was set apart for the maintenance of public schools. Since 1852, sections 16 and 36 in every township are given to the school fund. They are called *School Sections.* The surveys are not extended across Indian Reservations, nor over any lands which are not the property of the United States.

Diagram 1.

A TOWNSHIP



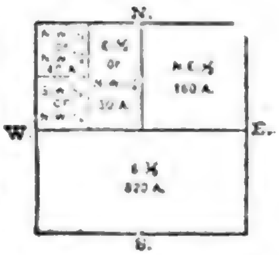
There was no system adopted in allotting the lands of the original States. Each tract was described by *metes* and *bounds*, and often in a manner so vague as to present various conflicting claims.

II. The Township and its Subdivisions.

The public lands of the United States are generally laid out in *townships* and *sections.* These townships and sections are designated by a simple and uniform system of numbering.

Diagram 2.

A SECTION.



A *township* is six miles square, and consequently contains thirty-six square miles, or 23,040 acres. Its boundaries are *meridians* on the east and west, and *parallels of latitude* on the north and south.

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*Originally and chiefly prepared for Swinton's Geography, and inserted in these Revisions and Additions, through the kindness of the American Book Exchange, New York, 1891.

A township is divided into 36 *sections*, each one mile square "as nearly as may be." A section contains 640 acres.

The sections of a township are always numbered in the order indicated by Diagram 1.

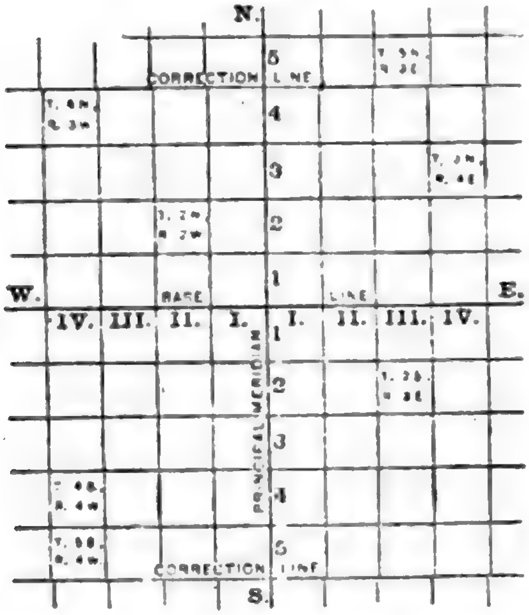
Section 1 is always in the northeast corner of the township, and the numbers run alternately west and east. Sections are divided as indicated in Diagram 2.

The government surveyors mark the corners of townships, sections, half-sections, and quarter-sections (except the corner in the center of the section) with stakes, stones, or mounds of turf, after a uniform system. In some of the later surveys eighths and sixteenths are also measured.

III. Numbering of Townships.

Townships are legally designated by numbers instead of names. All surveys begin by establishing a *true meridian*, along which the surveyors measure from some selected point, marking each half-mile point with a "quarter stake," and each mile point with a "section corner." At each six-mile point a "township corner" is marked. This line is called a *principal meridian*.

Diagram 3.



Through this selected starting-point upon the principal meridian, a true parallel of latitude is run, and measured from the meridian. The half-mile, mile, and six-mile corners are marked as upon the meridian. This is called a *base-line*.

In the later surveys, additional parallels, called *correction-lines* are measured at distances of twenty-four or thirty miles apart, and also true meridians forty-eight miles apart, called *guide meridians*. The principal meridians, guide-meridians, base-lines, and correction-lines, are *astronomical lines*. All other lines are run with chain and compass, and are subject to two errors,—one from the variation of the needle, and the other from the impossibility of making perfectly accurate measurements with the chain. The sections are never surveyed by the same surveyors that mark the townships.

Townships are numbered north and south from the base-line. A row of townships running north and south is called a range. Ranges are numbered east and west from the principal meridian.

This is illustrated by diagram 3.—Each square represents a township. Numerals on the base-line indicate ranges east and west of the principal meridian. Numerals on the principal meridian indicate townships north and south of the base-line. The southwest township on this diagram is described as "Township 5 South, of Range 4 West," or "T. 5 S., R. 4 W."

North of the *base-line* the correction-lines occur every four townships, or twenty-four miles; south of the *base-line*, every five townships, or thirty miles. This is on account of the greater convergence of the meridians as we proceed north. In a survey of Central British America, to secure equal accuracy, correction lines would need to be laid out every two or three townships.

In locating townships they are always described as north or south of the *base-line*.

Sometimes a *new base-line* is located in passing from one state to another. For instance, on the fourth *principal meridian* the south boundary line of Wisconsin forms a new base-line for surveys in that state.

To locate any given township, as, for instance, Township 16 North of Range 9 East, count eastward from the principal meridian along the base-line until the ninth range is reached; then count northward in that range until its sixteenth township is reached.

To locate a township accurately when its number and range are given, it is necessary to know from what meridian it is reckoned, and where its base-line crosses that meridian.

IV. Location of Meridians.

There are thirty meridians governing the surveys of public lands in the United States, as follows:

The *first principal meridian* divides the states of Ohio and Indiana, having for its base the Ohio River, the river being coincident with 84° 51′ of longitude west from Greenwich. This meridian governs the surveys of public lands in the State of Ohio.

The *second principal meridian* coincides with 86° 28′ of longitude west from Greenwich, starts from the confluence of the Little Blue River with the Ohio, runs north to the northern boundary of Indiana, and governs the surveys in Indiana and a portion of those in Illinois.

The *third principal meridian* starts from the mouth of the Ohio River and extends to the northern boundary of the State of Illinois, and governs the surveys in said state *east* of the meridian, with the exception of those projected from the second meridian, and the surveys on the *west* to the Illinois River. This meridian coincides with 89° 10′ 30″ of longitude west from Greenwich.

The *fourth principal meridian* begins in the middle of the channel of the mouth of the Illinois River, in latitude 38° 58′ 12″ north and longitude 90° 29′ 56″ west from Greenwich, and governs the surveys in Illinois west of the Illinois River and west of the third principal meridian lying north of the river. It also extends due north through Wisconsin and northeastern Minnesota, governing all the surveys in the former and those in the latter state lying east of the Mississippi, and the third guide meridian (west of the fifth principal meridian) north of the river.

The *fifth principal meridian* starts from the mouth of the Arkansas River, and with a common base-line running due west from the mouth of the Saint Francis River, in Arkansas, governs the surveys in Arkansas, Missouri, Iowa, Minnesota west of the Mississippi, and the third guide meridian north of the river, and in North and South Dakota east of the Missouri River. This meridian is coincident with 90° 58′ longitude west from Greenwich.

The *sixth principal meridian* coincides with longitude 97° 22′ west from Greenwich, and, with the principal base-line intersecting it on the 40th degree of north latitude, extends north to the intersection of the Missouri River and south to the 37th degree of north latitude, controlling the surveys in Kansas, Nebraska, most of North and South Dakota lying west of the Missouri River, Wyoming and Colorado, excepting the valley of the Rio Grande del Norte, in southwestern Colorado, where the surveys are projected from the New Mexico meridian.

The *Michigan meridian*, in longitude 84° 19′ 09″ west from Greenwich, with a base-line on a parallel seven miles north of Detroit, governing the surveys in Michigan.

The *Tallahassee meridian*, in longitude 84° 18′ west from Greenwich, runs due north and south from the point of intersection with the base-line at Tallahassee, and governs the surveys in Florida.

The *Saint Stephen's meridian*, longitude 88° 02' west from Greenwich, starts from Mobile, passes through Saint Stephen's, intersects the base-line on the 31st degree of north latitude, and controls the surveys of the southern district in Alabama and of the Pearl River district lying east of the river and south of township 10 north in the state of Mississippi.

The *Huntsville meridian*, longitude 86° 31' west from Greenwich, extends from the northern boundary of Alabama as a base, passes through the town of Huntsville, and governs the surveys of the northern district in Alabama.

The *Choctaw meridian*, longitude 89° 10' 30'' west from Greenwich, passes two miles west of the town of Jackson, in Mississippi, starting from the base-line twenty-nine miles south of Jackson, and terminating on the south boundary of the Chickasaw cession, controlling the surveys east and west of the meridian and north of the base.

The *Washington meridian*, longitude 91° 05' west from Greenwich, seven miles east of the town of Washington, in Mississippi, with the base-line corresponding with the 31st degree of north latitude, governs the surveys in the southwestern angle of the State.

The *The Saint Helena meridian*, 91° 05' west from Greenwich, extends from the 31st degree of north latitude, as a base, due south, and passing one mile east of Baton Rouge, controls the surveys in the Greensborough and the southeastern districts of Louisiana, both lying east of the Mississippi.

The *Louisiana meridian*, 92° 20' west from Greenwich, intersects the 31st degree north latitude at a distance of forty-eight miles west of the eastern bank of the Mississippi River, and, with the base-line coincident with the said parallel of north latitude, governs the surveys in Louisiana west of the Mississippi.

The *New Mexico meridian*, longitude 106° 52' 09'' west from Greenwich, intersects the principal base-line on the Rio Grande del Norte, about ten miles below the mouth of the Puerco River, on the parallel of 34° 19' north latitude, and governs the surveys in New Mexico, and the valley of the Rio Grande del Norte, in Colorado.

The *Great Salt Lake meridian*, longitude 111° 53' 47'' west from Greenwich, intersects the base-line at the corner of Temple Block, in Salt Lake City, Utah, on the parallel of 40° 46' 04'' north latitude, and governs the surveys of Utah.

The *Boise meridian*, longitude 116° 20' west from Greenwich, intersects the principal base between the Snake and Boise rivers, in latitude 43° 26' north. The initial monument, at the intersection of the base and meridian, is nineteen miles distant from Boise City, on a course of south 29° 30' west. The meridian governs the surveys in Idaho.

The *Mount Diablo meridian*, California, coincides with longitude 121° 54' west from Greenwich, intersects the base-line on the summit of the mountain from which it takes its name, in latitude 37° 53' north, and governs the surveys of all central and northeastern California and the entire State of Nevada.

The *San Bernardino meridian*, California, longitude 116° 56' west from Greenwich, intersects the base-line at Mount San Bernardino, latitude 34° 06' north, and governs the surveys in Southern California lying east of the meridian and that part of the surveys situated west of it which are south of the eighth standard parallel south of the Mount Diablo base-line.

The *Humbolt meridian*, longitude 121° 11' west from Greenwich, intersects the principal base-line on the summit of Mount Pierce, in latitude 40° 25' 30'' north, and controls the surveys in the northwestern corner of California lying west of the coast range of mountains and north of township 5 south of the Humbolt base.

The *Willamette meridian* is coincident with longitude 122° 44' west from Greenwich, its intersection with the base-line is on the parallel of 45° 30' north latitude, and it controls the public surveys in Oregon and Washington.

The *Montana meridian* extends north and south from the initial monument established on the summit of a limestone hill, eight hundred feet high, longitude 111° 40' 51'' west from Greenwich. The base-line runs east and west from the monument on the parallel of 45° 46' 27'' north latitude. The surveys for Montana are governed by this meridian.

The *Gila and Salt River meridian* intersects the base-line on the south side of Gila River, opposite the mouth of Salt River, in longitude 112° 15' 46'' west from Greenwich, and latitude 32° 22' 57'' north, and governs the public surveys in Arizona.

The *Indian meridian* intersects the base-line at Fort Arbuckle, Indian territory, in longitude 97° 15' 56'' west from Greenwich, latitude 34° 31' north, and governs the surveys in that territory.

The *Wind River Meridian* governs the subdivisional surveys within the Shoshone Indian Reservation, in Wyoming.

The *Uinta special base and meridian* govern the surveys of the Uinta Indian Reservation, in Utah.

The *Navajoe special base and meridian* control the surveys of the Navajoe Indian Reservation, in New Mexico and Arizona.

The *Black Hills meridian* is coincident with the west boundary of South Dakota, on the 27° of longitude west from Washington, and intersects the base-line in the parallel of 44° north latitude. It governs the surveys in the southwestern corner of South Dakota.

The *Grand River meridian* and base-line govern the subdivisional surveys for allotment to the Ute Indians, in Western Colorado.

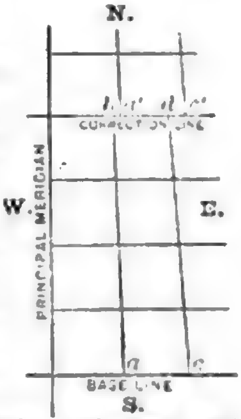
The *Cimarron meridian*, coincident with the eastern boundary of New Mexico, or 103° meridian on longitude west from Greenwich, intersects the base-line on the parallel 36° 30' north latitude (the north boundary of Texas), and governs the surveys in the strip of public lands inclosed between Kansas and Colorado on the north, the Indian territory on the east, Texas on the south, and New Mexico on the west.

V. *Convergence of Meridians.*

In consequence of the convergence of meridians, townships accurately surveyed are not perfect squares, but are longer upon the southern than upon the northern boundary.

If the township corners upon a base-line are exactly six miles apart, the townships surveyed northward grows less and less as the distance from the base-line increases, and those surveyed southward grow larger. Hence the necessity of standard parallels, or *correction-lines*, to prevent the errors from becoming so great as to destroy the value of the system.

Diagram 4.



Upon these *correction-lines* the township corners are carefully placed at distances of six miles apart.

The convergence of meridians is greater in the higher latitudes; but at latitude 42° it is about half a rod to a mile. Supposing the surveys to be perfectly accurate, and the correction-lines to be twenty-four miles apart, the convergence of the meridians will then be about twelve rods, and there will be a double set of township corners, as illustrated in the following diagram, in which the convergence of the meridians is greatly exaggerated to make it evident to the eye.

Explanation.—In consequence of the convergence of meridians, a line run due north from *a* strikes the correction-line at *b* instead of at *a*. Double township corners are consequently established at *b* and *a*, and so on, their distance apart increasing with their distance from the principal meridian.

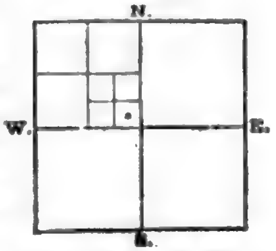
Lands are legally advertised in the following way:—

"The south-east quarter of the south-east quarter of the north-west quarter of section thirty-five in township twenty-nine north, of range seven east of the fourth principal meridian, containing ten acres more or less."

The above is often abbreviated thus:—

"The S. E. ¼ of the S. E. ¼ of the N. W. ¼ Sect. 35, T. 29 N., R. 7 E. of the 4th p. m."

Diagram 5.



Supposing the annexed drawing to represent the Section 35 described, the star (*) shows the position of the lot advertised.

The proper description is found by consulting the records of the land-offices, or the deed by which the title was originally conveyed by the government.

These records are presumed to be correct, and the only appeal from them is to the commissioner of the General Land Office, the Secretary of the Interior, and ultimately to the President of the United States.

VI. Public Land Sales and Grants.

The immense extent of land, forming part of the United States, as yet chiefly uninhabited and uncultivated, is held to be National property, at the disposal of Congress and the Executive of the Republic. The public lands of the United States which are still undisposed of lie in nineteen States and six Territories, including Alaska. The public lands are divided into two great classes. The one class have a dollar and a quarter an acre designated as the minimum price, and the other two dollars and a half an acre, the latter being the alternate sections, reserved by the United States in land grants to railroads, etc. Titles to these lands may be acquired by private entry or location under the homestead, pre-emption, and timber-culture laws; or, as to some classes, by purchase for cash. The homestead laws give the right to 160 acres of a-dollar-and-a-quarter lands, or to 80 acres of two-dollar-and-a-half lands, to any citizen or applicant for citizenship over twenty-one who will actually settle upon and cultivate the land. The title is perfected by the issue of a patent after five years of actual settlement. The only charges in the case of homestead entries are fees and commissions.

Another large class of free entries of public lands is that provided for under the Timber-Culture Acts of 1873-78. The purpose of these laws is to promote the growth of forest trees on the public lands. They give the right to any settler who has cultivated for two years as much as five acres in trees to an 80-acre homestead, or, if ten acres, to a homestead of 160 acres, and a free patent for his land is given him at the end of three years instead of five.

In the middle of 1889 there were 1,815,504,147 acres of public lands in the States and Territories, of which 981,631,984 had been surveyed. Of the total area of the United States, 1,400,000 square miles, or 896,000,000 acres, were unoccupied at the census of 1880. Upwards of 88 million acres of land are settled under the Homestead and Timber-Culture Acts. In 1889 there were 6,029,231 acres taken up under the Homestead Act, and 3,735,305 under the Timber-Culture Act.

In 1888, 5,317,906 acres were sold for cash, and the total number of acres of public lands disposed of during that year was 30,116,684, the money received being $13,547,137. Of the public lands in 1889, 369,529,600 acres were in Alaska unsurveyed. It is provided by law that two sections, or 640 acres of land, in each "township," are reserved for common schools, so that the spread of education may go together with colonization.

The power of Congress over the public territory is exclusive and universal, except so far as restrained by stipulations in the original cessions.

PRESIDENTS OF THE EARLY AMERICAN CONGRESSES.

The following is a full list of presidents of Congress up to the date of the adoption of the National Constitution, with the dates severally of their administrations:*

Peyton Randolph, of Virginia	1774–75
Henry Middleton, of South Carolina	1775–76
John Hancock, of Massachusetts	1776–77
Henry Laurens, of South Carolina	1777–78
John Jay, of New York	1778–79
Samuel Huntington, of Connecticut	1779–80
Thomas McKean, of Pennsylvania	1780–81
John Hanson, of Maryland	1781–82
Elias Boudinot, of New Jersey	1782–83
Thomas Mifflin, of Pennsylvania	1783–84
Richard Henry Lee, of Virginia	1784–86
Nathaniel Gorham, of Massachutts	1786–87
Arthur St. Clair, of Pennsylvania	1787–88
Cyrus Griffin, of Virginia	1788–89

John Hancock signed first as President of the Congress the Declaration of Independence.

Elias Boudinot signed as president the definitive treaty of peace.

Thomas Mifflin received as president Washington's commission when he resigned it in 1783; while

Richard Henry Lee presented the immortal resolution which declared the colonies to be free and independent States.

CHRONOLOGICAL HISTORIC OUTLINE OF THE UNITED STATES.

Coast of Florida discovered by Ponce de Leon	1512
California discovered by Grijalva's expedition	1535
Louisiana conquerred by De Soto	1540
Raleigh establishes first settlement in Virginia	1585
Jamestown, Virginia, founded by Lord de la Warr	1607
New Amsterdam—now New York—built by the Dutch	1614
New Jersey settled by the Dutch	1614
Settlement of New England begun by Captain Smith	1614
Landing of the pilgrims at Plymouth Rock, Dec. 25,	1620
Delaware settled by Swedes and Dutch	1614–1627
Massachusetts settled by Sir H. Rosewell	1628
Maryland settled by Lord Baltimore	1633
Connecticut settled by Lords Say and Brooke	1635
Rhode Island settled by Roger Williams	1635
Connecticut (composed then of Hartford, Windsor, and Wethersfield) adopted a liberal constitution, the first written constitution in history Jan. 1,	1639
Roger Williams organized at Providence, R. I. the first Baptist Church in America	1639
Rhode Island establishes a democratic constitution	1641
An unsuccessful "Plan" was formulated to unite all the American-English colonies into one confederacy	1644
Maryland Assembly passed an act giving complete toleration to all Christians	1649
The Connecticut Assembly prohibited the use of tobacco to persons under the age of 20	1650
New Amsterdam (New York City) was incorporated	1652
Many Quakers suffering persecution in England began to migrate to the American colonies but were persecuted in Massachusetts from this date	1657
An Indian church was organized in Natick, Mass	1660
The General Court of Massachusetts published a declaration of rights, claiming self-government, and denying the right of Appeals to England June,	1661
John Elliot published his translation of the New Testament into the Massachusetts Indian dialect	1661
The Virginia Assembly voted its members a salary of 250 pounds of tobacco each day and passed severe laws against "Quakers, Baptists, and other Dissenters"	1662
Execution for alleged witchcraft began in Connecticut	1663
New York taken by the English	1664
The first settlement in Michigan (Mission Sault de Ste Marie) established	1668

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*Kindly furnished for these Revisions and Additions by Prof. J. D. Gray, A. M., of Trenton, N. J.

South Carolina settled by the English	1669
George Fox, founder of the Quakers, visited the American Colonies	1671
Marquette and Joliet discovered and descended the Wisconsin, Des Moines, Mississippi, and other Western rivers	1673
New York surrendered to a Dutch Squadron,	July 1673
Peace concluded between England and Holland, the American colonies being ceded back to England	Feb. 1674
King Philip's war—Philip defeated and killed	1676
Pennsylvania settled by William Penn	1682
Louisiana settled by the French	1682
William Penn published a frame of government for Pennsylvania	1682
Philadelphia founded (there being "three or four little cottages")	1683
A printing press was set up in Philadelphia where there were 600 houses	1686
A French Census showed a population in French America of 11,249 persons—about one-twentieth of the population of the English American Colonies	1688
France declared war against England, lasting till 1697, greatly disturbing the Colonies	1689
A semi-official estimate showed the population of the Colonies to be about 200,000, as follows: Massachusetts including Maine and Plymouth, 44,000; New Hampshire, 6,000; Rhode Island and Providence, 6,000 Connecticut, 19,000; New York, 20,000; New Jersey, 10,000; Pennsylvania and Delaware, 12,000; Maryland, 25,000; Virginia 50,000; Carolina (to Florida), 8,000	1690
A public post is established to send letters from Philadelphia to the Potomac *eight times a year!*	1695
England and France signed articles of peace at Ryswick	Sept. 20, 1697
Lemoine D'Iberville, commissioned by Louis XIV. of France sailed with four ships and immigrants to mouth of Mississippi.	1698
Mississippi explored and settled by the French	1699
Yale College was founded at Saybrook, Conn., Nov. 11 (chartered Oct. 1701)	1700
Detroit founded by La Mothe Cadillac (with 100 French colonists)	1701
England declared war against France and Spain (the war of the Spanish succession, lasting till 1713)	1702
New York Assembly appropriated £1,500 to fortify the Narrows (Lord Cornbury embezzled it)	1703
The Boston *News-Letter*, the earliest newspaper in America, started in Boston	1704
High Church party in South Carolina disfranchised dissenters (two-thirds of the population)	1704
First Church erected in North Carolina	1705
New York succeeded in getting Lord Cornbury removed from the governorship	1708
A Colonial and English fleet captured Port Royal, Acadia, and change its name to Annapolis	1710
A committee of English Commons report that the American plantations ought to be furnished with negroes at reasonable prices	1711
An Anglo-Colonial fleet of 15 ships, 40 transports, and 10,000 men sailed from Boston to conquer Canada; 8 ships were wrecked and expedition utterly failed	1711
Indians besieged Detroit but were repulsed by the French	1712
The peace of Utrecht was signed by England, France and Spain	1713

[France ceded to Britain, Acadia, Hudson Bay and its borders, and Newfoundland, and admits Britain's supremacy in the American fisheries; the Assiento Treaty is transferred to England, which undertakes to carry to the Spanish West Indies 4,800 negroes a year for 30 years, paying on 4,000 a duty of $33.33 per head, and for all over 4,000 a duty of $16.67 a head; during the 30 years not far from 30,000 are taken from Africa by the English annually, as against 15,000 a year for the previous 20 years. The population of the English colonies was about 400,000.]

A public bank was opened in Massachusetts	1716
Georgia settled by General Oglethorp	1717
War was declared between France and Spain (lasting till 1721)	1719
The first newspaper was started in Philadelphia	1719
The South Sea and Mississippi Bubble Companies bursted and spread ruin	1720
The Boston "Courant" was started by James Franklin, a brother of Benj. Franklin	1721
The "Gazette," a weekly, was started in New York (the first paper in New York)	1725
The French built Fort Niagara	1726
Sir William Keith, ex-governor of Pennsylvania, suggested the extension of the *stamp duty* system to the American Colonies	1728
New Orleans was fortified; it numbered 4,000 French and 2,000 Negroes	1729
George Washington was born	Feb. 22, 1732
The first route was opened between New York and Philadelphia	1732
Kentucky settled by Col. Boone	1732
Stamp Act, which led to the Revolutionary War	1764
First Colonial Congress at New York	Oct. 7, 1765
Boston "Tea Party;" English cargo of tea destroyed	1773
Declaration of Rights	Nov. 4, 1774
First action between British and Americans at Lexington	April 19, 1775
George Washington appointed commander-in-chief	1775
Battle of Bunker Hill	June 17, 1775
Declaration of Independence	July 4, 1776
Flag adopted by act of Congress	June 14, 1777
United States named by Congress	Sept. 9, 1777
Washington defeated at the Brandywine,	Sept. 11, 1777
A Federal government adopted by Congress,	Nov. 15, 1777
Lafayette and other French officers join the Americans	1777
The States recognized by France	1777
The British troops evacuate Philadelphia	1778
Major André hanged as a spy	Oct. 2, 1780
Surrender of Lord Cornwallis at Yorktown,	Oct. 19, 1781
Definitive treaty of peace signed at Paris,	Sept. 3, 1783
John Adams, first American ambassador to England	1785
The cotton plant introduced into Georgia	1786
Quakers of Philadelphia emancipate their slaves	1788
United States Government organized,	March 4, 1789
George Washington, 1st President	April 30, 1789
Present departments of State established	1789
Death of Benjamin Franklin	April 17, 1790
United States bank instituted	June 17, 1791
City of Washington chosen capital	July 8, 1792
Re-election of Washington	March 4, 1793
John Adams, 2d President	March 4, 1797
Washington dies	Dec. 14, 1799
Seat of government removed from Philadelphia to Washington	1800

Thomas Jefferson, 3d President......March 4, 1801
Louisiana bought from the French........... 1803
American ports closed to British........July, 1808
Importation of slaves abolished........Jan. 1, 1807
James Madison, 4th President.......March 4, 1809
War with Great Britain — 1812-14 — begins June 18, 1812
Buffalo burned by the British............Dec., 1813
Treaty of peace signed at Ghent..... Dec. 24, 1814
James Monroe, 5th President........March 4, 1817
Center foundation of the capitol, Washington, laid ....Aug. 24, 1818
Florida ceded by the Spanish to the United States..............................Oct. 24, 1820
John Quincy Adams, 6th President........... 1825
First passenger railway—Stockton to Darlington, Eng.. 1825
Death of the two ex-Presidents Adams and Jefferson...........................July 4, 1826
Convention with Great Britain concerning indemnity for war of 1812-14.........Nov. 13, 1826
General Jackson, 7th President......March 4, 1829
Ports re-opened to British commerce...Oct. 5, 1830
Commercial panic.......................... 1832
Great fire at New York...............Dec. 16, 1835
National debt paid off........................ 1836
Martin VanBuren, 8th President.....March 4, 1837
Steamer Caroline burned by the British, Dec. 29, 1837
Telegraph perfected by Morse............... 1837
Great Western steamship arrives at New York..............................June 17, 1838
American banks suspend cash payments, Oct., 1839
Gen. Harrison, 9th President, March 4; dies April 4, 1841
John Tyler, Vice-President, becomes 10th President 1841
Resignation of all the ministers except Webster...............................Sept. 11, 1841
Sewing machines invented by Elias Howe about 1841
James Knox Polk, 11th President....March 4, 1845
War declared against the United States by Mexico...................................June 4, 1845
Gen. Taylor, 12th President, March 4, 1849; dies ....July 9, 1850
Millard Filmore, Vice-President, becomes 13th President..............................July 10, 1850
California admitted a State ....Aug. 15, 1850
Fugitive slave bill passed.............August, 1850
Henry Clay dies.....................June 29, 1851
J. F. Cooper, American novelist, dies Sept. 14, 1851
Part of the Capitol at Washington and the whole of the library of Congress destroyed by fire...............................Dec. 24, 1851
Daniel Webster dies...................Oct. 24, 1852
Commodore Perry's expedition to Japan 1852
Gen. Franklin Pierce, 14th President, March 4, 1853
Crystal Palace opens at New York....July 14, 1853
Astor library, New York, opened..... Jan. 9, 1854
Commercial treaty between Japan and United States ....March 23, 1854
Reciprocity treaty between Great Britain and the United States ....June 7, 1854
James Buchanan, 15th President....March 4, 1856
Commercial panic in New York......August, 1857
Atlantic telegraph completed.........August, 1858
Massacre at Mountain Meadows, Utah, Sept. 18, 1858
Prescott, the historian, dies...........Jan. 28, 1859
Insurrection at Harper's Ferry....... Oct. 16, 1859
Abraham Lincoln chosen as candidate for the Presidency at Chicago..............May 16, 1860
Great Eastern arrives at New York..June 23, 1860
Prince of Wales visits Washington ...Oct. 3, 1860
South Carolina secedes from the Union, Dec. 20, 1860

New York and other Northern States protest against secession.....................Jan. 4, 1861
Kansas admitted as a State............Jan. 21, 1861
Secession by Convention—Mississippi, Jan. 8; Alabama and Florida, Jan. 11; Georgia, Jan. 19; Louisiana, Jan. 26; Texas, by Legislature..Feb. 1, 1861
Morrill Tariff Bill passed.............March 2, 1861
Abraham Lincoln, 16th President....March 4, 1861
Southern Commissioners not received by the President at Washington..........March 12, 1861
Slavery abolished in District of Columbia, April 4, 1861
Treaty between Great Britain and the United States for the suppression of the slave-trade, April 7, 1861
President Lincoln proclaims the blockade of the ports of the seceding States....April 10, 1861
War begins; Major Anderson refuses to surrender Fort Sumter to the secessionists, April 11, 1861
President Lincoln calls for volunteers and informs foreign powers of his intention to maintain the Union by force of arms, May 4, 1861
Queen Victoria commands her subjects to be neutral during the war.............May 13, 1861
Commodore Farragut ascends the Mississippi, May, 1861
Neutrality announced by the French Emperor, June 10, 1861
Congress authorizes a war loan of $250,000,000, July 17, 1861
First Battle of Bull Run........ ....July. 21, 1861
McClellan assumes command of the Army of Potomac......... ....Aug. 20, 1861
McClellan commander-in-chief of Federal Army...Nov. 1, 1861
Mason and Slidell taken off the British steamer by Captain Wilkes..........Nov. 8, 1861
President Lincoln issues a proclamation confiscating the property and emancipating the slaves of all Confederates found in arms after 60 days......................July 26, 1862
Ex-President Martin Van Buren dies....July, 1862
President Lincoln proclaims freedom to the slaves ....Jan. 2, 1863
Grant's successful campaign in Tennessee, May, 1863
Made commander-in-chief...........March 8, 1864
Lincoln re-elected President............Nov., 1864
Nevada admitted to the Union................ 1864
Congress abolishes slavery.............Feb. 2, 1865
Lincoln and Johnson inaugurated...March 4, 1865
Battle of Five Forks, April 1; Lee retreats, April 2, 1865
Richmond and Petersburg evacuated by the Confederates, and occupied by Grant, April 3, 1865
Lee surrenders ....April 9, 1865
President Lincoln shot in Ford's Theater, Washington, by Wilkes Booth, April 14; dies.......................................April 15, 1865
Andrew Johnson, Vice-President, 17th President ....April 17, 1865
Confederates surrender; the war is over, April 26, 1865
Solemn fast observed for death of President Lincoln.................................June 1, 1865
Armies on both sides rapidly disbanding, June, 1865
Southern prisoners of war released on parole, July 20, 1865
National thanksgiving for peace......Nov. 2, 1865
Habeas Corpus Act restored...........Dec. 1, 1865
Eighty-five members of the Southern States excluded from Congress..............Dec., 1865

The war proclaimed at an end........April 3, 1866
General Winfield Scott dies..........May 29, 1866
Atlantic Cable completed............July 27, 1866
Impeachment of President Johnson agreed to, Jan. 7, 1867
Alaska purchased for $7,000.000........April 9, 1867
General amnesty (with exceptions) issued, July 4, 1868
Darien canal scheme approved by Congress, Jan.. 1869
Suffrage bill abolishing distinctions based on race, color, or property, passed......Feb. 21, 1869
General Grant, 18th President.......March 4, 1869
Naturalization treaty with Great Britain ratified by the Senate.................April 15, 1869
Great peace jubilee at Boston; colossal concert of 10,371 voices and 1,094 instruments conducted by P. S. Gilmore........June 15, 1869
Naturalization treaty signed.........Jan. 26, 1870
Proclamation against the Kuklux in North Carolina..........................March 5, 1871
Formation of the Yellowstone National Park authorized by Congress.... ....March, 1872
General Grant re-elected President....Nov. 5, 1872
Great discoveries in electric lighting, by Thomas A. Edison..........................1872
Insurrection of Negroes suppressed at Trenton, Tennessee; leaders hung......August, 1874
Great Centennial demonstration began at Philadelphia........................Jan. 1, 1876
Centennial Exposition opened at Philadelphia May 10, and closed.................Nov. 10, 1876
R. B. Hayes, 19th President.........March 4, 1877
Telephone invented in...................... 1877
Phonograph invented by Thomas A. Edison.. 1877
Movement against the Mormons on account of their polygamy; first conviction, fine, and imprisonment......................Oct. 20, 1878
James A. Garfield, 20th President....March 4, 1881
Was shot by Guiteau.................July 2, 1881
Died Sept. 19; was succeeded by Chester A. Arthur, Vice-President, 21st President.... 1881
Longfellow dies.....................March 24, 1882
Grover Cleveland, 22d President....March 4, 1885
Death of General Grant..............July 23, 1885
Pan-American Exposition in New Orleans, Nov. 10, 1885
Death of Vice-President Hendricks, Nov. 25, 1885
Statue of Liberty unveiled in New York Harbor ....Oct. 26, 1886
Ex-President Arthur dies ....Nov. 18, 1886
Interstate Commerce Bill becomes a law, Feb. 4, 1887
Centennial of the adoption of the Constitution celebrated in Philadelphia, Sept. 15-17, 1887
Fisheries Convention between the United States and England, signed........Feb. 15, 1888
A Blizzard paralyzes business in the Eastern States........... ....March 11-14, 1888
Benjamin Harrison inaugurated President of the United States................March 4, 1889
Oklahoma opened for settlement, April 22, 1889
Centennial of the inauguration of General Washington as first President of the United States celebrated in New York, April 28-May 1, 1889
North and South Dakota admitted to the Union ....Nov. 3, 1889
Montana admitted to the Union......Nov. 8, 1889
Washington admitted to the Union, Nov. 11, 1889
Idaho admitted to the Union ....July 3, 1890
Wyoming admitted to the Union....July 11, 1890
The McKinley Tariff Bill passed the House, May 21; passed the Senate........Sept. 30, 1890
Democrats elected majority of next Congress.................................Nov., 1890
51st Congress adjourned............March 4, 1891
International Copyright Law became operative, and President Harrison announced by proclamation that the provisions of law now extended to Belgium, France, Great Britain, and Switzerland ....July 1, 1891
Ex-Vice-President Hamlin died......July 4, 1891
Hon. James G. Blaine, Secretary of State announced reciprocity treaties with Brazil, San Domingo, and some other countries,* Oct. 14, 1891
The Attorney-General of the United States announced a Treaty of Agreement between the Governments of the United States and Great Britain, to submit to arbitration the important questions growing out of the Bering Sea and Fishery Controversies, Nov.10, 1891
Funeral of James Russell Lowell in Boston Mass..................... ....Aug. 14, 1891
Centennial of Admission of Vermont into U. S. celebrated.... ....Aug. 19, 1891
A building in Park Place New York collapsed killing 62 people...................Aug. 22, 1891
A wreck on Western North Carolina R. R. killed and wounded 50 persons......Aug. 27, 1891
News of defeat of Balmaceda Army in Chili received in U. S....................Aug. 28, 1891
German Government removed the prohibition of American pork.......... ... Sept. 3, 1891
Tennessee legislature refused abolish Convict lease system........................Sept. 5, 1891
New Chillian Government recognized by U. S. Government .... Sept. 7, 1891
Death of Balmaceda by suicide announced Sept. 19, 1891
Oklahoma's new lands opened to settlers Sept. 22, 1891
Leland Sanford Jr. University opened at Palo Alto, Cal.......................Oct. 1, 1891
Statue of General Grant unveiled at Chicago Oct. 7, 1891
Earthquake shocks at San Francisco..Oct. 14, 1891
Philip Brooks of Boston consecrated bishop of Prot. Epis. Church...............Oct. 14, 1891
Sunol lowered the world's trotting record by half a second........................Oct 18, 1891
Italian Government permitted the importation of American pork ....Oct. 21, 1891
U. S. formally demanded reparation for assault on crew of Baltimore... .....Oct. 26 1891
N. Y. Court of Appeals decided the Tilden will case in favor of the natural heirs... Oct. 27, 1891
Maverick National Bank, Boston failed Nov. 2, 1891
Riotous miners released 200 Convict-workers in Tenn..............................Nov. 2, 1891
New York Presbytery acquitted Prof Briggs of heresy...........................Nov. 4, 1891
Memorial meeting in honor of Parnell held in New York...... ....Nov. 15, 1891
Attempt made by a lunatic to assassinate Dr. John Hall of New York.........Nov. 29, 1891
Armored Cruiser New York was launched at Philadelphia........... ....Dec. 2, 1891
Norcross, a Boston lunatic endeavored to assassinate Russell Sage, N. Y.......Dec. 4, 1891

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*Brazil, some months since, entered into a treaty by which many American articles are admitted free. Flour is made free and pork is admitted at a nominal duty.

Cuba and Porto Rico have reduced the duty on flour from $5.80 a barrel to $1 (which gives us the market), besides putting nearly one hundred articles of American production on the free list.

San Domingo has made a reciprocity treaty with flour and pork upon the free list, besides a large number of other articles. Other treaties for reciprocity are in progress.

Germany without negotiating a formal treaty, has removed the prohibition on pork, and our Government, in consideration thereof, has left her sugar on the free list. This opens to us an entirely new market, and $15,000,000 to $20,000,000 of American pork will be consumed per annum where not a pound has been taken for ten years.—[Sec. Blaine's Letter.]

First Session of 52d Congress opened (Chas. C. Crisp of Georgia elected speaker) Dec. 5, 1891

Edward M. Field, New York arrested for forgery.................................Dec. 15, 1891

The Poet Whittier celebrated in Boston his 84th birthday.......................Dec. 24, 1891

A collision on Hudson River R. R. killed 14 persons...........................Dec. 24, 1891

The wheat crop for 1891 was reported by the U. S. Government figures at the enormous total of 611,780,000 bushel, nearly 100,000,000 bushels larger than any previous year, Jan. 1, 1892

Randolph Rogers. the American Sculptor died in Rome Italy aged 69..........Jan. 15, 1892

Chief Judge Ruger of New York Court of Appeals died.........................Jan. 16, 1892

Judge M. M. Knapp of New Jersey Court died while charging a grand jury....... Jan. 26, 1892

The Chillian reply to the U. S. demands was received (satisfactory)..............Jan. 27, 1892

President Harrison in a second message to Congress announces the satisfactory close of the Chillian incidents..............Jan. 28, 1892

The U. S. Supreme Court decided that the Anti-Lottery Act passed by Congress is constitutional.......................Jan. 31, 1892

North German Lloyd steamer "Eider" was wrecked............................Jan. 31, 1892

Reciprocal trade relations annouced by President Harrison as established between U. S. and British West Indies.............Feb. 5, 1892

END OF AMERICAN REVISIONS AND ADDITIONS, VOL. XXIII.

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